GS. TS Nguyễn Thị Hiền (chủ biên).

GS.TS. Nguyễn Trọng Đàn; ThS. Lê Thị Lan Chi

THE LANGUAGE OF CHEMISTRY,FOOD AND BIOLOGICAL TECHNOLOGY

IN ENGLISH

(NGÔN NGỮ TIẾNG ANH CHUYÊN NGÀNH CÔNG NGHỆ HÓA HỌC, CÔNG NGHỆ THỰC PHẨM VÀ CÔNG NGHỆ SINH HỌC)

ĐẠI HỌC BÁCH KHOA HÀ NỘI 2009

LỜI NÓI ĐẦU

Cuốn sách Tiếng Anh "***The language of Chemistry, Food and Biological Technology in English***" (TACN) được biên soạn để cung cấp những kiến thức cơ bản thuộc các chuyên ngành Hóa, Thực phẩm và Công nghệ sinh học. Cuốn sách này có thể dùng làm tài liệu cho sinh viên và các bạn đọc quan tâm đến các chuyên ngành trên. Cuốn sách được chia làm bốn phần chính theo kinh nghiệm các giáo trình tiếng Anh chuyên ngành Hóa, Thực phẩm của các trường Đại học kỹ thuật Hóa Thực phẩm Praha Tiệp Khắc, Ba Lan, Nga, Úc, Anh.

Phần 1: Các bài khóa cơ bản - gồm 60 bài khóa giới thiệu bức tranh toàn cảnh của chuyên ngành Hóa, Thực phẩm và Công nghệ sinh học. Từ các ngành Hóa đến các nguyên tố; từ kỹ thuật ngành Hóa nói chung đến việc chưng cất hoặc khái niệm tạo ra một sản phẩm cụ thể nói riêng trong các lĩnh vực khoa học về công nghệ thực phẩm và công nghệ sinh học, với các ngôn từ và kết cấu quan trọng, cách diễn đạt bằng tiếng Anh.

Phần 2: Tóm tắt ngữ pháp tiếng Anh áp dụng trong khoa học - đó là thứ ngữ pháp mang đặc thù của ngành với cách viết tắt, cách đọc các công thức hóa học, các nguyên tố hóa học, cách phát âm các từ chuyên ngành có gốc La tinh, Hy lạp.

Phần 3: Bài tập - gồm một số bài tập để luyện cách phát âm, cách đọc các từ viết tắt, công thức hóa học, các nguyên tố hóa học, số và phân số, các bài dịch Anh-Việt, Việt-Anh... và một số bài kiểm tra để người đọc tự đánh giá khả năng ngôn ngữ của mình, tăng khả năng dịch và đọc tiếng Anh chuyên ngành.

Phần 4: Từ vựng - bao gồm các từ và các cụm từ đã dùng trong các bài khóa được liệt kê theo thứ tự A, B, C. Nghĩa của từ và cụm từ là nghĩa văn cảnh của ngành khoa học có liên quan đến các bài khóa. Hệ thống phiên âm quốc tế cũng được dùng để giúp cho việc tự học và tra cứu của người đọc và độc giả có thể hiểu và đọc chính xác các từ tiếng Anh chuyên môn này.

Mỗi bài ở phần 1 có kết cấu như sau:

(i) Bài khóa giới thiệu chủ đề

(ii) Bài tập:

A- Đọc và dịch từ tiếng Anh sang tiếng Việt

B- Trả lời câu hỏi theo nội dung bài khóa

C- Dịch từ tiếng Việt sang tiếng Anh

Khi biên soạn cuốn TACN, các tác giả chú ý cung cấp ngữ liệu của ngành Hóa, Thực phẩm và Công nghệ sinh học trong những ngôn cảnh của chuyên ngành này giúp người đọc hình thành các kỹ năng đọc hiểu với các cấu trúc cơ bản nhất hay gặp trong các tài liệu khoa học. Các câu hỏi theo nội dung bài học nhằm giúp người học phát triển kỹ năng nghe nói. Các câu dịch bước đầu chuẩn bị cho người học hình thành kỹ năng viết theo văn phong khoa học của ngành. Mặc dầu cuốn sách này đã bắt đầu được biên soạn từ những năm 1980, đưa vào dạy sinh viên ngành Công nghệ lên men từ nhưng năm 1990 và cho đến nay được hoàn chỉnh dần phục vụ chính thức cho sinh viên chính quy từ năm 1997. Cuốn sách được biên soạn gồm 40 bài khóa và 20 bài đọc thêm với các chuyên ngành hẹp với mong muốn dạy cho sinh viên từ học kỳ 5 đến học kỳ 8, mỗi học kỳ 45 tiết. Cùng với mỗi bài khóa có bài luyện và ôn ngữ pháp cơ bản, như vậy sinh viên học đến năm thứ 5 chuyên ngành sẽ có thể đọc sách kỹ thuật tốt hơn nhiều.

Việc biên soạn cuốn sách này cũng không tránh khỏi khiếm khuyết,với lần in thứ nhất vào dịp 45 năm ĐHBK Hà nội và lần thứ 2 tại Nhà xuất bản KHKT và dùng giảng dạy cho các trường Đại Học và Cao đẳng có hiệu quả từ Bắc đến Nam và đến nay tác giả đã nhận được sự góp ý xây dựng của độc giả và người học .

Chúng tôi đã rút king nghiệm dậy trên 10 năm qua và có bỏ sung, sửa chữa để cuốn sách này bổ ích nhất cho Sinh viên ngành chuyên môn tương ứng học và bạn học, đọc khác quan tâm.

GS.TS. NGUYỄN THỊ HIỀN

Nguyên chủ nhiệm Bộ Môn CNSH-Thực phẩm.

Đại Học Bách Khoa Hà Nội

Hà Nội 2009

LỜI CẢM ƠN

Cuốn sách "***The language of Chemistry, Food and Biological Technology in English***" được biên soạn dành cho sinh viên ngành Hóa học - Thực phẩm – CN Sinh học, các độc giả ở Việt Nam có quan tâm đến ngành học này cùng các ngành khác có liên quan.

Tập thể tác giả: GS.TS. Nguyễn Thị Hiền, GS. Nguyễn Trọng Đàn, Ths. Lê Thị Lan Chi (thư ký) xin chân thành cảm ơn sự giúp đỡ của:

- Ban giám hiệu trường Đại học bách khoa Hà Nội
- Ban chủ nhiệm khoa Công nghệ Hóa học - Thực phẩm - Sinh học trường Đại học bách khoa Hà Nội
- Bộ môn Công nghệ Sinh học thực phẩm trường Đại học bách khoa Hà Nội
- Đặc biệt cám ơn GS. Nguyễn Trọng Đàn - Trưởng khoa tiếng Anh trường đại học ngoại thương Hà Nội, GS.TS. Lưu Duẩn - ĐHBK Hồ Chí Minh và GS.TS. Nguyễn Trọng Cẩn - ĐH Thủy sản Nha Trang đã tạo điều kiện cho chủ biên biên soạn phần chính cuốn sách.
- Nhà xuất bản khoa học kỹ thuật.

Tập thể tác giả cảm ơn các thầy cô, các bạn đồng nghiệp trong và ngoài trường, các bạn sinh viên đã đóng góp nhiều ý kiến và khích lệ chúng tôi trong việc hoàn thiện cuốn sách. Tập thể tác giả mong nhận được sự góp ý xây dựng cho cuốn sách được hoàn chỉnh hơn trong những lần tái bản sau này. Mong rằng cuốn sách sẽ trở thành công cụ hữu ích cho sinh viên và các độc giả khác.

Các tác giả

CONTENT

PART 1

THE BASIC UNITS

CÁC BÀI KHÓA CƠ BẢN

UNIT 1 : CHEMISTRY AND ITS BRANCHES

Chemistry is the science of substances - of their structure, their properties, and the reactions that change them into other substances.

The study of chemistry may be divided into the following branches:

- General chemistry, which is an introduction to the entire science.
- Qualitative analysis, giving the methods of testing for the presence of chemical substances.
- Quantitative analysis, giving the methods of accurate determination of the amounts of different substances present in a sample of material.
- Inorganic chemistry, which is the chemistry of elements other than carbon, and their compounds.
- Organic chemistry, which is the chemistry of the compounds of carbon.
- Physical chemistry, which studies the quantitative relations among the properties of substances and their reactions.
- Biochemistry, which is the chemistry of the substances comprising living organisms.
- Structural chemistry, which deals with the molecular structure and its relation to the properties of substances.
- Radiochemistry, which is the chemistry of radioactive elements and of reactions involving the nuclei of atoms.
- Industrial chemistry, which is concerned with industrial processes.

Although chemistry is a very large and complex subject, which still continues to grow as new elements are discovered or made, new compounds are synthesized, and new principles are formulated. The chemists or chemical engineers need to have some knowledge of all its branches, even if he may be specialized in a particular line.

Chemistry science cannot do without physics and mathematics, and is also closely linked to some other sciences, e.g. inorganic chemistry is linked closely to geology, mineralogy, and metallurgy, while organic chemistry is linked to biology in general.

EXERCISES

A. Read and translate into Vietnamese

substances, reaction, chemistry, analysis, method, determination, material, inorganic, element, compound, organic, biochemistry, organism, molecular, radioactive, nuclei, industrial, atom, processes, synthesized, engineer, specialized, particular, accurate, mathematics, closely, geology, mineralogy, metallurgy, comprise, biology, concerned, knowledge, continue, sample

B. Answer the following questions

1. Give the definition of chemistry.
2. Which are the main branches of chemistry?
3. What is the difference between qualitative and quantitative analysis?
4. What is the difference between inorganic and organic chemistry?
5. What does physical chemistry study?
6. What does structural chemistry deal with?
7. What is radiochemistry?
8. Which branches of chemistry are you interested in?
9. Is it necessary for you to have some knowledge of all branches of chemistry?
10. Can chemistry as a science do without physics and mathematics?

C. Translate into English

1. Hóa học là khoa học về vật chất riêng biệt.
2. Hóa học được chia thành những ngành nào?
3. Toán học là khoa học về số, còn vật lí nghiên cứu ánh sáng và nhiệt.
4. Hóa học công nghiệp quan tâm đến gì?

UNIT 2 : HYDROGEN

Hydrogen, the first element in the periodic table, is a very widely distributed element. Its most important compound is water, H_2O. Hydrogen is found in most of substances, which constitute living matter: sugar, starch, fats, and proteins. It occurs in petroleum, petrol, and other hydrocarbon mixtures. It is also contained in all acids and alkalis. There are more compounds of hydrogen known than of any other element.

Pure hydrogen is a colorless, odorless, tasteless gas. It is the lightest of all gases, density being about 1/14 that of air, viz. 0.08987 gm.per liter. It does not support respiration, but is not poisonous. Hydrogen is a good conductor of heat as compared with other gases. Its specific heat is also higher than most other gases.

Hydrogen is a combustible gas, burning in air or oxygen with a nearly colorless flame to form water vapor. Hydrogen also readily combines with fluorine and chlorine, less readily with bromine, iodine, sulfur, phosphorus, nitrogen, and carbon.

The element is made commercially by the electrolysis of water, and is used in large quantities in the manufacture of ammonia, in the hydrogenation of liquid fats to form solid fats, and in the production of high temperatures.

In the laboratory hydrogen may be easily prepared by the reaction of an acid as sulfuric acid, with a metal such as zinc:

$$H_2SO_4 + Zn = H_2 + ZnSO_4$$

Hydrogen may be set free also by the action of certain metals on water. Thus sodium and potassium react with cold water, producing sodium hydroxide and hydrogen. Boiling water may be readily decomposed by ordinary magnesium powder, while steam is decomposed by heated magnesium, zinc, iron, cobalt, lead, tin, and nickel, but not by silver or copper.

Hydrogen is evolved by the action of zinc, magnesium and iron on dilute hydrochloric and sulfuric acid on aluminum and tin.

A solution of caustic soda or potash readily dissolves zinc or aluminum on warming, with evolution of hydrogen and formation of a soluble zincate or aluminate.

EXERCISES

A. Read and translate into Vietnamese

hydrogen, periodic, distributed, water, constitute, proteins, petroleum, petrol, hydrocarbon, alkalis, gases, density, combustible, oxygen, vapor, readily, combine, fluorine, chlorine, bromine, iodine, nitrogen, sulfur, electrolysis, ammonia, hydrogenation, liquid, production, laboratory, sulfuric acid, zinc, sodium, potassium, hydroxide, decompose, magnesium, iron, cobalt, lead, tin, nickel, copper, dilute, concentrated, hydrochloric acid, aluminum, solution, caustic, potash, dissolve, evolution, soluble, zincate, aluminate.

B. Answer the following questions

1. Where does hydrogen occur?
2. What are the properties of hydrogen?
3. What elements does hydrogen/ less/ readily combine with?
4. How can hydrogen be prepared?
5. What are its uses? Say a few sentences about hydrogen.

C. Translate into English

1. Hydro là chất khí không màu, là thành phần chủ yếu cấu tạo nên nước.
2. Trong tự nhiên hydro không tồn tại ở trạng thái tự do, nhưng tồn tại rất nhiều hợp chất hydro.
3. Hydro là một chất rất quan trọng cho công nghiệp hóa học, nó được sử dụng rất nhiều trong quá trình sản xuất như: sản xuất muối amôn, quá trình hydrogen hóa dầu thành mỡ.

UNIT 3 : WATER

Water is one of the most important of all chemical substances. It is the chief constituent of living matter. Its physical properties are strikingly different from those of other substances.

Ordinary water is impure, it usually contains dissolved salts and dissolved gases, and sometimes organic matter. For chemical work water is purified by distillation. Pure tin vessels and pipes are often used for storing and transporting distilled water. Glass vessels are not satisfactory, because the alkaline constituents of glass slowly dissolve in water. Distilling apparatus and vessels made of fused silica are used in making very pure water. The impurity, which is hardest to keep out of water, is carbon dioxide, which dissolves readily from the air.

The physical properties of water. Water is a clear, transparent liquid, colorless in thin layers. Thick layers of water have a bluish-green color. Pure water freezes at 0^oC, and boils at 100^oC. These temperatures are means of identifying water, for no other substance has these freezing and boiling points.

The physical properties of water are used to define many physical constants and units. The unit of mass in the metric system is chosen so that 1 cm^3 of water at 4^oC/ the temperature of its maximum density/ weighs 1.00000 gram. A similar relation holds in the English system: 1 cu. Ft. of water weighs approximately 1,000 ounces.

Steam and ice

Steam is water in the gaseous state. A cubic inch of water gives about a cubic foot of steam. When gaseous water is mixed with other gases, as in the air, we speak of it as water vapor; when unmixed, we call it steam. Water may exist as steam at temperature lower than 100^oC, provided the pressure is less than the usual atmospheric pressure of 15 pounds per square inch.

If water is cooled sufficiently, it solidifies at 0^0C to ice. There is considerable expansion during the solidification, and consequently ice is lighter than an equal volume of water.

If we apply heat to ice, it melts. The water that runs off the melting ice is at a temperature of 0^0C, the same temperature as the ice.

EXERCISES

A. Read and translate into Vietnamese

constituent, properties, strikingly, ordinary, impure, contain, purified, distillation, pure, vessel, pipe, distilled, alkaline, apparatus, fused, silica, impurity, carbon dioxide, air, transparent, bluish-green, identify, temperature, define, unit, weigh, approximately, ounce, gaseous, cubic, inch, pressure, atmospheric, square, sufficiently, equal, volume, ice, steam.

B. Answer the following questions

1. Why is water important to a human beings?
2. What are the characteristic properties of water?
3. Are glass vessels satisfactory for storing and transporting distilled water?
4. Where does carbon dioxide readily dissolve from?
5. What is the color of water?
6. How is the unit of mass in the metric system chosen?
7. What is steam?
8. What is the difference between steam and vapor?
9. What is ice?

C. Translate into English

1. Nước bình thường là một chất không tinh khiết, bao gồm các hợp chất khác nhau, vì vậy nó được tinh chế bằng chưng cất.
2. Điểm sôi và điểm đóng băng là những tính chất đặc trưng của nước, và được sử dụng để xác định nó.
3. Nước đóng băng được gọi là nước đá.
4. Nếu chúng ta đem đun sôi nước lên trên 100^0C, nó biến thành hơi.

UNIT 4 : CLASSIFICATION OF MATTER

Different materials may be distinguished by their properties, the most obvious of which is the physical state, or state of aggregation, on the basis of which all materials are classified as solids, liquids, and gases.

The characteristic feature of gas is that its molecules are not held together, but move about freely. Because of this freedom of molecular motion a gas does not possess either definite shape or definite size, it shapes itself to its container. A liquid, on the other hand, has a definite volume, but does not have a definite shape. Only a solid is characterized both by a definite shape and definite size.

By the word substance a chemist means an essentially pure substance/ Actually, all substances are more or less impure/ When referring to very impure substances, solutions, and mixtures, the word material should be used instead.

All substances can be divided into two classes: elementary substances and compounds. An elementary substance is a substance, which consists of atoms of only one kind, a compound is a substance which consists of atoms of two or more different kinds. These atoms of two or more different kinds must be present in a definite numerical ratio since substances are defined as having a definite invariant composition. Thus an elementary substance is composed of two or more elements./To avoid confusion, it is necessary for us to state exactly what a particular kind or atom in the above definition of an element means. By this expression we mean an atom whose nucleus has a given electrical charge. All nuclei have positive electrical charges which are equal to or integral multiples of the charges of the electron/ with an opposite sign./The integer which expresses this relation is called the atomic number.

The word mixture is used to refer to a homogeneous material/ exhibiting a uniform structure/, which is not a pure substance, or to a heterogeneous aggregate of two or more substances. The ingredients of a mixture are called its component. Sometimes a mixture consisting mainly of one component, with much smaller amounts of others, is called an impure substance. The components present in the smaller amounts are called impurities.

EXERCISES

A. Read and translate into Vietnamese

distinguished, aggregation, basis, characteristic, molecule, motion, possess, definite, container, characterized, essentially, actually, mixture, elementary, consist, numerical, ratio, invariant, composition, compose, confusion, expression, nucleus, electrical charge, equal, integral, integer, electron, changed, sign, relation, atomic, refer, homogeneous, exhibit, uniform, heterogeneous, aggregate, ingredient, component, amount.

B. Answer the following questions

1. Which are the three physical states?
2. Give the characteristic features of a gas, a liquid, and a solid.
3. What is a substance in chemistry?
4. What is the difference between an element and a compound?
5. What is the mixture? Say a few sentences about the classification of matter.

C. Translate into English

1. Các chất rắn, chất lỏng và chất khí được phân biệt dựa trên cơ sở trạng thái vật lí của nó.
2. Các chất khí không có hình dạng và kích thước nhất định, trong khi đó chất rắn được đặc trưng bằng hình dáng và kích thước nhất định.
3. Chúng ta hiểu cấu tạo vật chất từ nguyên tử như thế nào?
4. Các thành phần riêng biệt của hỗn hợp có thể được tách ra bằng các phương pháp khác nhau.

UNIT 5 : SOLUTIONS

If sugar and water, two pure substances, are mixed together, a solution result, uniform throughout in its properties, in which the sugar can neither be seen with a microscope nor filtered out. It is not distinguishable from a pure substance in appearance.

The experimental distinction between a pure substance and solution is quite simple when the solute /the dissolved substance/ is not volatile so that it is left behind when the solvent is evaporated. However, when both are volatile the matter is not quite so simple and it is necessary to find out whether any change in composition and hence in properties occurs during a change in state.

Suppose we wish to determine whether air is a pure substance or a solution. One method would be to liquefy a certain amount and then observe what happens to it as it slowly evaporates. As the evaporation proceeds one may observe that

a- The light blue color gradually becomes deeper

b- The temperature of the liquid slowly rises

c- The densities of both liquid and gas change.

Any one of these as well as other possible observations show that air must contain two or more components whose relative amounts change during the evaporation, causing the observed changes in properties due to differences between the components in color, volatility, density, chemical behavior. Still other properties might have been used.

The term solution is not restricted to liquid solutions. All gases are completely miscible with each other, forming but one phase, so that every mixture of gases is a solution. Alloys of silver and gold, no matter what the relative amounts of the two metals, contain but one kind of crystal,/the properties of which change continuously with the composition/, thus being a solid solution.

If liquid air is distilled in a scientifically constructed still, it is possible to separate it into two nearly pure constituents. One of these constituents, nitrogen, is found to be slightly lighter than air; it can be condensed to a colorless liquid boiling at -194^0C; it is very inert chemically, reacting with but few other substances. The other constituent, oxygen, is slightly heavier than air; it gives, when condensed at low temperatures, a blue liquid boiling at -182.5^0C, and it reacts readily with many substances.

As another illustration, suppose we have a solid metal, which appears to be perfectly homogeneous under the microscope. We could determine whether it is a solution or a pure substance by melting it, dipping into the melt a suitable thermometer and letting it cool slowly, taking temperature readings at regular intervals, and plotting temperature against time.

EXERCISES

A. Read and translate into Vietnamese

result, throughout, microscope, appearance, experimental, distinction, solute, volatile, solvent, evaporated, matter, occur, determine, liquefy, observe, evaporation, proceed, gradually, observation, relative, cause, changes, volatility, behavior, restricted, miscible, completely, phase, alloy, metal, continuously, solid, scientifically, constructed, separated, condensed inert, react, illustration, suppose, appear, perfectly, suitable, thermometer, interval.

B. Answer the following questions

1. What is a solution?
2. Is it distinguishable from a pure substance in appearance?
3. When is the experimental distinction between a pure substance and a solution simple?
4. What is the difference between a solute and a solvent?
5. How can you determine whether air is a pure substance or a solution?
6. Is the term solution restricted only to liquid solutions?
7. What does it mean when a substance is volatile?
8. Give the constituents of air and compare them with each other.
9. Give some liquids that are miscible.
10. Give some examples of solids soluble in liquids.

C. Translate into English

1. Nếu chúng ta đun nóng một dung dịch, chúng ta có thể quan sát thấy những thay đổi khác nhau của chúng.
2. Tất cả những sự thay đổi xảy ra là do những tính chất khác biệt của dung môi và chất hoà tan. Ví dụ: dung dịch Na_2CO_3 trong chất lỏng có được là do CO_2 hoà tan trong nước dưới áp suất và nhiệt độ.
3. Chất dễ bay hơi là chất dễ dàng biến thành hơi ở nhiệt độ thường.

UNIT 6 : ISOLATION AND PURIFICATION OF SUBSTANCE

Practical chemistry includes many special techniques for the isolation and purification of substances. Some substances occur very nearly pure in nature, but most materials are mixtures, which must be separated or purified if pure substances are desired, and most manufactured materials also require purification.

The separation of two different phases is often rather easy. Particles of a solid phase mixed with a liquid phase may be separated from the liquid by filtration. Often the solid is present because it has been produced from solution in the liquid by a chemical reaction or by change in conditions/such as by cooling/ the solid is then called the precipitate. The precipitate is removed by pouring the mixture on a folded filter paper in a funnel. The liquid/ called the filtrate/ runs through, and the grains of precipitate/ the residue/ are retained, unless they are too small. Ordinary filter paper contains pores about 0.001cm in diameter, and smaller particles pass through.

A precipitate may also be removed by letting the suspension stand quietly until the precipitate has settled to the bottom of the container under the influence of gravity. The supernatant liquid can then be poured off. This process of pouring off is called decantation.

The process of settling can be accelerated by the use of centrifugal force, in a centrifuge. Ordinary centrifuges produce forces of the order of 100 or 1,000 times that of gravity. Supercentrifuges have been built which give forces over 100,000 times as great as that of gravity.

Two liquid phases may be conveniently separated by use of a special device, the separatory funnel. A dropper may also be used for this purpose.

An impure substance may often be purified by fractional freezing. The impure liquid substance is cooled until part of it has crystallized, and the remaining liquid, which usually contains most of the impurities, is then poured off, leaving the purified crystals.

A liquid can be purified by distillation in a still. The liquid is boiled in a flask or some other container, and the vapor is condenser, forming a liquid distillate, which is collected in a receiver. The first portions/fractions/ of the distillate tend to contain the more volatile impurities, and the residue in the flask tends to retain the less volatile ones. Stills so special design have been invented, which are very effective in separating liquid mixtures into their components.

EXERCISES

A. Read and translate into Vietnamese

isolation, purification, include, technique, desire, manufacture, require, separation, particle, filtration, precipitate, removed, pour, funnel, filtrate, residue, retained, pore, diameter, suspension, influence, gravity, supernatant, decantation, accelerated, use, used, centrifugal, centrifuge, produce, conveniently, device, separatory, purpose, fractional, crystallized, crystal, distillation, condenser, distillate, collected, receiver, design, effective

B. Answer the following questions

1. Which methods can be used for purifying substances?
2. What is decantation?
3. How can the process of settling be accelerated?
4. What is a separatory funnel used for?
5. What does a still consist of?
6. Say a few sentences about the isolation and purification of substances.

C. Translate into English

1. Trong tự nhiên thường chỉ tồn tại rất ít các chất tinh khiết, phần lớn các chất tự nhiên phải được tinh chế bằng phương pháp nào đó.
2. Có rất nhiều phương pháp khác nhau để tinh chế vật chất và tách nó ra khỏi hỗn hợp.
3. Để tách chất rắn khỏi chất lỏng, người ta sử dụng phương pháp lọc hay lắng gạn.
4. Chúng ta hiểu quá trình lắng gạn là quá trình chất lỏng tự lắng chất kết lắng xuống đáy bình chứa.

UNIT 7 : THE RATE OF CHEMICAL REACTIONS

Every chemical reaction requires some time for its completion, but some reactions are very fast and others very slow. Reactions between ions in solution without change in oxidation state are usually extremely fast. An example is the neutralization of an acid by a base, which proceeds as fast as the solutions can be mixed. Presumable nearly every time a hydronium ion collides with a hydroxide ion reaction occurs, and the number of collisions is very great, so that there is little delay in the reaction. The formation of a precipitate, such as that of silver chloride when a solution containing silver ion is mixed with a solution containing chloride ion, may require a few seconds, to permit the ions to diffuse together to form the crystalline grains of the precipitate. On the other hand, ionic oxidation-reduction reactions are sometimes very slow. An example is the oxidation of stannous ion by ferric ion. This reaction does not occur every time a stannous ion collides with one or two ferric ions. In order for the reaction to take place, the collision must be of such a nature that electrons can be transferred from one ion to another, and collisions, which permit this electron transfer to occur, may be rare.

The factors, which determine the rate of a reaction, are manifold. The rate depends not only upon the composition of the reacting substances, but also upon their physical form, the intimacy of their mixture, the temperature and pressure, the concentrations of the reactants, special physical circumstances such as irradiation with visible light, ultraviolet light, X-rays, neutrons, or other waves or particles, and the presence of other substances which affect the reaction but are not changed by it/catalysts/.

Most actual chemical processes are very complicated, and the analysis of their rate is very difficult. As reaction proceeds the reacting substances are used up and new ones are formed; the temperature of the system is changed by the heat evolved or absorbed by the reaction; and other effects may occur which influence the reaction in a complex way. For example, when a drop of a solution of potassium permanganate is added to a solution containing hydrogen peroxide and sulfuric acid no detectable reaction may occur for several minutes. The reaction speeds up, and finally the rate may become so great as to decolorize a steady steam of permanganate solution as rapidly as it is poured into the reducing solution. This effect of the speeding up of the reaction is due to the vigorous catalytic action of the products of permanganate ion reduction: the reaction is rapidly accelerated as soon as they are formed.

EXERCISES

A. Read and translate into Vietnamese

require, completion, oxidation, extremely, neutralization, base, presumably, nearly, hydronium ions, collide, collision, delay, formation, chloride, permit, diffuse, crystalline, reduction, oxidation, stannous, transfer, manifold, depend, intimacy, concentration, reactant, circumstances, irradiation, ultraviolet, neutron, affect, effect, catalyst, evolved, absorbed, permanganate, detectable, decolorize, reduce, vigorous, product.

B. Answer the following questions

1. What is meant by the rate of a chemical reaction?
2. Name some factors affecting the rate of a chemical reaction.
3. What is the effect of temperature and pressure on reaction rate?
4. What is the function of catalysts?
5. What is the rate of complicated chemical processes?
6. Say a few sentences about the rate of chemical reactions.

C. Translate into English

1. Tốc độ của phản ứng hóa học là thời gian cần thiết để kết thúc phản ứng đó.
2. Tốc độ của phản ứng hóa học phụ thuộc vào thành phần của chất tham gia phản ứng và rất nhiều yếu tố khác.
3. Nhiệt độ cũng như áp suất có thể ảnh hưởng đáng kể đến quá trình xảy ra phản ứng.
4. Chất xúc tác là chất làm tăng nhanh phản ứng hóa học nhưng nó không tham gia trực tiếp vào phản ứng. Để dễ dàng thực hiện phản ứng hóa học, hỗn hợp phản ứng phải được đun nóng lên đến một nhiệt độ nhất định.

UNIT 8 *:* HYDROCARBONS

Hydrocarbons are compounds containing only carbon and hydrogen atoms. The simplest hydrocarbon is methane, CH_4. Its molecules are tetrahedral, the four hydrogen atoms lying at the corners of a regular tetrahedron around the carbon atom, and connected with the carbon atom with single bonds. Methane is a gas, which occurs in natural gas, and is used as a fuel. It is also used in large quantities for the manufacture of carbon black, by combustion with a limited supply of air. The hydrogen burn to water, and the carbon is deposited as very finely divided carbon, which finds extensive use as filler for rubber for automobile tires.

Methane is the first member of a series of hydrocarbons having the general formula C_nH_{2n+2}, called the methane series or paraffin series. The compounds of this series are not very reactive chemically. They occur in complex mixtures called petroleum. The molecules heavier than ethane are characterized by containing carbon atoms attached to one another by single bonds. The lighter members of the paraffin series are gases, the intermediate members are liquids, and the heavier members are solid or semi-solid substances. Gasoline is the heptane-nonane mixture, and kerosene the decane-hexadecane mixture. Heavy fuel oil is a mixture of paraffins containing twenty or more atoms per molecule. The lubricating oils and solid paraffin are mixtures of still larger paraffin molecules.

The substance ethylene, C_2H_4, consists of molecules in which there is a double bond between the two carbon atoms. This double bond confers upon the molecule the property of much greater chemical reactivity than is possessed by the paraffins. Because of this property of readily combining with other substances, ethylene and related hydrocarbons are said to be unsaturated.

Acetylene is the first member of a series of hydrocarbons containing triple bonds. Aside from acetylene, these substances have not found wide use, except for the manufacture of other chemicals.

The hydrocarbons, the molecules of which contain a ring of carbon atoms, are called cyclic hydrocarbons. Cyclohexane, C_6H_{12}, is representative of this class of substances. It is a volatile liquid, closely similar to normal hexane in its properties.

Another important hydrocarbon is benzene, having the formula C_6H_6. It is a volatile liquid/ b.p. 80^0C/, which has an aromatic odor. For many years there was discussion about the structure of the benzene molecule. August Kekule suggested that the six carbon atoms are in the form of a ring, and this has been verified: diffraction studies have shown that the six atoms form a regular planar hexagon in space, the six hydrogen atoms being bonded to the carbon atoms, and forming a larger hexagon. Kekule suggested that, in order for a carbon atom to show its normal quadrivalence, the ring contains three single bonds and three double bonds in alternate positions. Other hydrocarbons, derivatives of benzene, can be obtained by replacing the hydrogen atoms by methyl groups or similar groups. Benzene and its derivatives are used in the manufacture of drugs, explosives, photographic developers, plastics, synthetic dyes, and many other substances.

EXERCISES

A. Read and translate into Vietnamese

methane, tetrahedral, tetrahedron, bond, nature, natural, fuel, combustion, supply, deposited, extensive, series, formula, petroleum, ethane, intermediate, gasoline, kerosene, lubricating, ethylene, double, confer, reactivity, paraffin, unsaturated, acetylene, triple, cyclic, representative, hexane, benzene, aromatic, odor, discussion, structure, suggest, ring, verify, diffraction, planar, hexagon, quadrivalence, alternate, position, derivative, replace, methyl, explosives, developer, plastics, synthetic, dye.

B. Answer the following questions

1. What kinds of substances are hydrocarbons?
2. What is methane and what are its uses?
3. What is the difference between petroleum and petrol?
4. What is ethylene?
5. What is acetylene?
6. Which hydrocarbons are called cyclic hydrocarbons?
7. What is the representative of cyclic hydrocarbon class of substances?
8. What is benzene?
9. What did August Kekule suggest?
10. What are the uses of benzene?

C. Translate into English

1. Hydrat carbon là một hợp chất phổ biến rộng rãi nhất của hydro và carbon, được tồn tại trong tự nhiên.
2. Methan là loại khí có trong khí đốt tự nhiên được sử dụng chủ yếu làm nhiên liệu.
3. Phân tử benzen và các hợp chất carbon mạch vòng khác được đặc trưng bằng cấu tạo vòng các nguyên tử carbon.
4. Nếu phân tử carbon hóa trị 4, phân tử benzen được sắp xếp trong vòng có ba liên kết đôi và ba liên kết đơn.
5. Để thu được các dẫn xuất của benzen, nguyên tử carbon có thể được thay thế bằng các nhóm chất khác.

UNIT 9 : CHEMICAL LABORATORY EQUIPMENTS

Laboratories have now become indispensable in schools, factories and research institutes to test, confirm, or demonstrate on a small scale, phenomena and processes which occur in nature or which may find application in industry or be of importance to science.

The equipment of a chemical laboratory varies according to the nature of the work, which is to be carried out. It may be intended for the student to put to the test his theoretical knowledge/ school laboratory, for the technician/ technologist to verify and check processes to be employed in the factory/ works laboratory or to help the scientist and research worker to discover or confirm scientific facts/ research laboratory.

Every chemical laboratory should be provided with running water, gas and electricity. The water supply is conducted from the mains by means of pipes, the piping terminating in taps under, which there are sinks to take away waste water and other non-objectionable liquids. When one needs water one turns the tap on and stops it flowing by turning the tap off.

Similarly a system of pipes is attached to the gas main from where gas reaches the various kinds of burners. They serve for producing flames of different intensity, the Bunsen burner being the most common type used.

Apart from a gas supply there is electricity which serves for lighting and as a driving power. For operating electricity, switches or switch buttons are employed. That is why we talk about switching on the light or switching it off.

The laboratory is also equipped with a large variety of apparatus and devices. One of them, a desiccator, is used for drying materials. Ovens, furnaces or kilns serve for generating high temperatures. Where harmful vapors and undesirable odorous develop during the operation, a hood with suitable ventilation has to be provided for their escape.

Of primary importance are glass and porcelain vessels. Glass vessels for chemical processes are made of special materials. They have to resist sudden changes in temperature, to withstand very high temperature: refractory glass, and be affected by a few substances as possible. The necessary assortment of laboratory glassware includes test tubes, beakers, various flasks, watch glasses, funnels, bottles, and cylinders.

Porcelain articles consist of various kinds of dishes, basins and crucibles of various diameters. A grinding mortar with a pestle, desiccating dishes and stirrers are also generally made of porcelain.

At present, also plastic materials are finding increasing use in laboratories, many of them being chemically resistant, unattacked by alkalis or acids/ acid-or alkali-proof/, and unbreakable. Containers made of them are especially suitable for storing stock solutions.

The analytical balance, which is used for accurate weighing of samples, is usually kept in a separate room.

EXERCISES

A. Read and translate into Vietnamese

indispensable, research, institute, confirm, demonstrate, phenomena, industry, application, science, equipment, vary, theoretical, technician, technologist, verify, employ, scientist, scientific, electricity, terminate, attached, burner, intensity, power, powder, equipped, variety, desiccator, oven, furnaces, generate, porcelain, refractory, assortment, cylinder, basin, crucible, pestle, stirrer, increase, resistant, unbreakable, analytical, balance, polyethylene.

B. Answer the following questions

1. What is the task of laboratory work?
2. Why is it important and necessary for you as students of chemistry to make experiments in your school laboratories?
3. Describe the general equipment of chemical laboratories.
4. Which properties should the glass be used for making chemical vessels possess?
5. What does the necessary assortment of laboratory glassware include?
6. What do porcelain articles usually consist of?
7. What are the advantages of polyethylene bottles?
8. What are containers made of plastic materials especially suitable for?
9. What do burners serve for?
10. What is the analytical balance used for?

C. Translate into English

1. Mỗi một viện nghiên cứu, nhà máy và trường học phải có một phòng thí nghiệm hóa học tốt.
2. Trang bị phòng thí nghiệm hóa học phụ thuộc vào loại công việc được tiến hành trong đó.
3. Các thiết bị sử dụng điện được đóng mở nhờ công tắc điện.
4. Để các loại thiết bị khác nhau phù hợp với các loại mục đích hóa học thì chúng phải được sản xuất từ các vật liệu đặc biệt.
5. Thủy tinh được sử dụng để sản xuất các loại dụng cụ hóa học phải bền khi nhiệt độ, acid hay kiềm thay đổi đột ngột.

UNIT 10 : CHEMICAL NOMENCLATURE

A systematic nomenclature was devised towards the end of the 18th century. Elements already known retained their old names, e.g. silver, tin, gold, mercury, etc., but newly discovered elements generally have their names ending in -um if they are metals, and-on if they are non-metals/e.g. sodium, potassium, argon /.

The names of compounds are formed from those of their components so as to indicate their composition. In the names of binary compounds /i.e., compounds of two elements/ the name of the metal comes first, followed by that of the other element ended in -ide, e.g. sodium chloride /NaCl/, zinc oxide /ZnO/, aluminum oxide /Al_2O_3/. When a metal forms two compounds with oxygen, the two oxides are distinguished by adding -ous and -ic to the Latin name of the metal, signifying the lower and higher oxidation states respectively, e.g., cuprous oxide /Cu_2O/, cupric oxide /CuO/, and ferrous oxide /FeO/, ferric oxide /Fe_2O_3/. The salts corresponding to cuprous oxide are called cuprous salts, e.g. cuprous chloride and cupric chloride. Another way of distinguishing between different compounds of the same element is by the use of the Greek prefixes to the names of the elements. These prefixes are as follows: mono-, di-, tri-, tetra-, penta-, hexa-, hepta-, octo-. To these we may add the Latin hemi-, meaning one half, and sesqui-, meaning one and a half, and per-. By the use of these prefixes we can designate the compounds more precisely than by means of the prefixes -ous and -ic, especially when more than two compounds exist. As examples of the use of these prefixes we may mention carbon monoxide /CO/ and carbon dioxide /CO_2/, phosphorus trichloride /PCl_3/ and phosphorus pentachloride /PCl_5/, chromium sesquioxide /Cr_2O_3/ and chromium trioxide /CrO_3/, lead hemioxide /Pb_2O/, hydrogen peroxide /H_2O_2/.

Oxides, which form salts with acids, are known as basic oxides; by combination with water, basic oxides form bases. These contain the metal united with the group of atoms -OH/ the hydroxyl group/; they are, therefore, called hydroxides. Thus NaOH is sodium hydroxide, $Cu(OH)_2$ is copper hydroxide, and the compounds $Fe(OH)_2$ and $Fe_2O_3.H_2O$ are ferrous hydroxide and ferric hydroxide, respectively.

The endings -ous, -ic are also applied to acids, the -ous acid containing less oxygen than the -ic acid, e.g. sulphurous acid /H_2SO_3/ and sulfuric acid /H_2SO_4/, chlorous acid /$HClO_2$/. In addition to $HClO_2$ and $HClO_3$, the acids having the formulas HClO and $HClO_4$ are also known, the former having the name hypochlorous acid, the latter being designated by the name perchloric acid.

Salts are named in relation to the acids from which they are derived according to the following rules:

1. If the name of the acid ends in -ous, the name of the salt ends in -ite/ sodium chlorite, $NaClO_2$/.
2. If the name of the acid ends in -ic, the corresponding salt ends in -ate/ sodium chlorate, $NaClO_3$/
3. If the name of the acid involves also a prefix such as per- or hypo-, the prefix is retained on the name of the salt/ sodium hypochlorite, NaClO, and sodium perchlorate, $NaClO_4$/. Accordingly, salts of sulfurous acid are called sulfites, those of sulfuric acid, sulfates. Salts of phosphorous acid are phosphites, of phosphoric acid, phosphates, etc.

EXERCISES

A. Read and translate into Vietnamese

nomenclature, devised, binary, sodium chloride, respectively, designate, basic, bases, hydroxyl, formulas, salt, corresponding, sodium chlorite, cuprous oxide, cupric oxide, sodium chlorate, involve.

B. Answer the following questions

1. When was the systematic chemical Nomenclature devised and what is the difference between the names of elements already known at that time and the names of newly discovered elements?
2. How are the names of compounds formed?
3. What are the endings -ous, -ic used for and what is the difference between them?
4. When are the Greek prefixes mono-, di-, tri-, etc. used and what is their advantage?
5. What are the rules for forming the names of salts?

C. Translate into English

1. Các nguyên tố được cấu tạo nên bằng số lượng các liên kết với oxy.
2. Cấu tạo các nguyên tố thể hiện ở hóa trị của các nguyên tố liên kết nó.
3. Nếu như chỉ tồn tại một loại acid, thì tên gọi của nó có tiếp đuôi -ic, mà axit có tiếp đuôi -ic nhiều oxy hơn axit có tiếp đuôi -ous.
4. Các muối của acid nitric được gọi là nitrat.

UNIT 11 : WATER TREATMENT

Most municipalities must use a source of water in which the probability of pollution is rather high. Certainly, all our natural rivers and lakes and even the water stored in most reservoirs may be subjected to pollution, and generally cannot be considered safe for drinking purposes without some forms of treatment. The type and extent of treatment will vary from city to city, depending upon the conditions of the raw water. Treatment may comprise various processes used separately or in combinations, such as storage, aeration, sedimentation, coagulation, rapid or slow sand filtration, and chlorination, or other accepted forms of disinfection.

When surface waters serve as a municipal water supply, it is generally necessary to remove suspended solid, which can be accomplished either by plain sedimentation or sedimentation following the addition of coagulating chemicals. In the water from most streams that are suitable as a source of supply, the sediment is principally inorganic, consisting of particles of sand and clay and small amount of organic matter. In this water there will also be varying numbers of bacteria, depending upon the amount of bacteria nutrients, coming from sewage or other sources of organic matter, and upon the prevailing temperature. Many of the bacteria may have come from the soil and, as a result, during a season of high turbidity when there is a large amount of eroded soil in the water, the bacterial count from this source may be relatively high. If the organisms are derived from sewage pollution, the number will be highest during periods of low flow when there is less dilution, and at this time the turbidity will, in general, be low. The amount of sediment may vary a great deal from one river to another, depending upon the geological character of the various parts of the drainage system. The size of the suspended particles can also vary greatly. In some waters the clay particles may be extremely fine, in fact, they may be smaller than bacteria. The time required for satisfactory sedimentation differs for different waters, and generally must be established by actual experiments. Some waters can be clarified satisfactorily in a few days, while others may require weeks or months. As far as total weight of sediment is concerned, the bulk of it is probably removed in a few days, but this may not bring about a corresponding change in the appearance of the water, since the smaller particles may have greater influence than the large ones upon the apparent color and turbidity. When plain sedimentation is used primarily as a preliminary treatment, a high degree of clarification is not needed and, as a result, shorter periods of settling are adequate.

After flocculation treatment, water is passed through beds of sand with diatomaceous earth to accomplish sand filtration. As we mentioned previously, some protozoan cysts, such as those of G.lamblia, appear to be removed from water only by such filtration treatment. The microorganisms are trapped mostly by surface adsorption in the sand beds. They do not penetrate the tortuous routing of the sand beds, even through the openings might be larger than the organisms that are filtered out. These sand filters are periodically backflushed to clear them of accumulations. Water systems of cities that have an exceptional concern for toxic chemicals supplement sand filtration with filters of activated charcoal (carbon). Charcoal has the advantage of removing not only particulate matter but also some dissolved organic chemical pollutants.

Before entering the municipal distribution system, the filtered water is chlorinated. Because organic matter neutralized chlorine, the plant operators must pay constant attention to maintaining effective levels of chlorine. There has been some concern that chlorine itself might be a health hazard, that it might react with organic contaminants of the water to form carcinogenic compounds. At present, this possibility is considered minor when compared with the proven usefulness of chlorination of water.

One substitute for chlorination is ozone treatment. Ozone (O_3) is a highly reactive form of oxygen that is formed by electrical spark discharges and ultraviolet light. (The fresh odor of air following an electrical storm or around an ultraviolet light bulb is from ozone). Ozone for water treatment is generated electrically at the site of treatment. Use of ultraviolet light is also a possible alternative to chemical disinfection. Arrays of ultraviolet tube lamps are arranged in quartz tubes so that water flows close to the lamps. This is necessary because of the low penetrating power of ultraviolet radiation.

EXERCISES

A. Read and translate into Vietnamese

treatment, combination, storage, aeration, sedimentation, coagulation, chlorination, disinfection, bacterium, nutrients, sewage, pollution, beds of sand, drainage, influence, turbidity, diatomaceous earth, accumulation, activated carbon.

B. Answer the following questions

1. What are the various processes for water treatment?
2. What is the method for removing the suspended solids from surface waters?
3. What are the principal sediments from water of streams?
4. What are the methods for trapping the microorganisms from various kinds of water?
5. What is the purpose of chlorination of water?
6. What is the substitute for chlorination of water?
7. What is the kind of physical agent for water treatment of microorganisms in Vietnam?
8. Say a few words about the water treatment in Vietnam.

C. Translate into English

1. Hầu hết các thành phố đều sử dụng nguồn nước bị ô nhiễm khá cao.
2. Quá trình xử lý nước bao gồm các quá trình khác nhau như: lọc, đông tụ, lắng, khử trùng.
3. Các cặn lắng trong nước bao gồm các hạt đất sét hoặc các chất hữu cơ, vô cơ hòa tan và cả các vi sinh vật nữa.
4. Để khử trùng nước có thể dùng nhiều ương pháp: clo hóa, ozon hóa, hoặc dùng đèn tử ngoại.

UNIT 12 : TYPES OF REACTORS

Batch Reactors - The batch reactor is, in essence, a kettle or tank. It should have a number of accessories in order to operate satisfactorily.

First of all it generally must be closed, except for a vent, in order to prevent loss of material and danger to the operating personnel. For reactions carried out under pressure the vent is replaced by a safety valve.

High-pressure conditions frequently introduce complications in the design and greatly increase the initial cost. For example, the top closure must be able to withstand the same maximum pressure as the rest of the autoclave. At medium pressures a satisfactory closure can be assembled. It is usually necessary to agitate the reaction mixture in batch systems. This can be done mechanically with stirrers operated by a shaft extending through the reactor wall.

Provision for heating or cooling the reaction contents is often required. This may be accomplished by circulating a fluid through a jacket surrounding the reactor. Where heat effects are large enough to require the most rapid heat transfer, the jacket may be augmented by heating or cooling coils immersed in the reaction mixture.

Flow reactors. Flow reactors may be constructed in a number of ways. The conventional thermal-cracking units in the petroleum industry are examples of a noncatalytic type. The gas oil or other petroleum fraction is passed through a number of alloy-steel tubes placed in a series on the walls and roof of the furnace. Heat is transferred by convection and radiation to the tube surface in order to raise the temperature of the gas oil to the reaction level/ 600 to 1000^0F/ and to supply the endothermic heat of reaction. On the other hand, flow reactors may consist of a tank or kettle, much like a batch reactor, with provision for continuously adding reactants and withdraw product. From a design viewpoint the essential difference between tubular and tank reactors lies in the degree of mixing obtained. In the tubular type, where the length is generally large with respect to the tube diameter, the forced velocity in the direction of flow is sufficient to retard mixing in the axial direction. On the other hand, in tank reactors, it is possible to obtain essentially complete mixing by mechanical agitation. Under these conditions the composition, temperature and pressure are uniform through the vessel.

EXERCISES

A. Read and translate into Vietnamese

kettle, tank, accessories, autoclave, agitate, mixture, stirrers, circulating, jacket, coils, petroleum, roof, furnace, endothermic, batch reactor, tubular, velocity

B. Answer the following questions

1. What are the various kind of batch reactors?
2. Why must the batch reactors be closed?
3. Why does the top closure of batch reactors have to be installed with the vent or the safety valve?
4. What is the purpose of a jacket surrounding the reactor?
5. Tell something about the flow reactor?

C. Translate into English

1. Các thiết bị phản ứng gián đoạn được lắp các phụ kiện khác nhau phù hợp với quá trình vận hành nó.
2. Các thiết bị phản ứng dưới áp suất cao phải có van an toàn và chịu được áp suất cực đại.
3. Ống ruột gà lắp trong thiết bị phản ứng hoặc áo ngoài là phương tiện đun nóng hay làm lạnh thiết bị phản ứng hóa học khi cần nâng hay giảm nhiệt độ.

UNIT 13 : RELATIONSHIP OF CHEMICAL INDUSTRY TO OTHER INDUSTRIES

There is not any sharply defined frontier between chemical industry and many other industries, which makes it impossible to compose any precise definition of what constitutes the chemical industry. It is common practice, however, to regard it as consisting of two parts:

1. the chemical-product industry, and
2. the chemical-process industry

The chemical-product industry is perhaps the less difficult of the two to define. It may be said to consist of companies, which manufacture “chemical”. Strictly speaking, of course, all compositions of matter are “chemicals”, but the word may be limited for the purpose of definition to products, which can be described only by technical names. Chemicals of this type are chiefly used in the manufacture of other products and do not ordinarily take the form of familiar household products or articles of commerce. Thus, soda ash and sulfuric acid are universally recognized as “chemical”, but soap and paint are not commonly so regarded.

The chemical-process industry is even more dependent upon classifications of an arbitrary nature, and hence its scope is correspondingly more open to differences of opinion. According to the most widely accepted definition, the chemical-process industry consist of the companies which manufacture such products as drug, soap, paint, fertilizers, vegetable and animal oils, and a number of various related products. Contrary to more technically based definitions, however, this classification excludes companies engaged in the production of iron and steel, in petroleum refining, and in the manufacture of pulp and paper, rubber products, leather products and glass.

The exclusion of the companies engaged in these industries does not mean, of course, that their operations are any less “chemical” in nature than those used in the manufacture of soap, paint and many other products officially classified within the chemical industry. Their exclusion has probably been due primarily to the combination of their origin, large size, simple product structure, and well-defined markets. Hence, it has long been the custom of economists and statisticians to regard them as independent industries. As matter of fact, both the oil industry and the steel industry were, until comparatively recently, much larger in size than the chemical industry as officially defined.

Regardless of the arbitrary limitations of its official definition, however, the chemical industry has been steadily expanding. It has ignored industrial boundaries in the application of new manufacturing processes and in the development of new products. The already existing chemical companies have entered new industries, such as textiles, building materials, and drugs. And industries not recognized as chemical in nature have begun the manufacture of chemical products by new methods from new materials. A recent and conspicuous example of this latter type of chemical expansion has been the development of the so-called "petrochemical industry", in which chemical products are manufactured from petroleum raw materials.

EXERCISES

A. Read and translate into Vietnamese

relationship, sharply, manufacture, chemicals, classification, soap, arbitrary, correspondingly, drugs, fertilizers, vegetables, economists, statisticians, boundary, conspicuous, expansion, petrochemical industry.

B. Answer the following questions

1. Is there any sharply defined frontier between the chemical industry and many other industries?
2. Can you give some concepts about the chemical-product industry?
3. Can you tell something about the chemical-process industry?
4. Has the chemical industry been steadily expanding and how?
5. Can you give some concepts of "petro-chemical industry"?

C. Translate into English

1. Công nghiệp hóa học có mối quan hệ với các ngành công nghiệp khác.
2. Không có một ranh giới chính xác giữa công nghiệp hóa học và các ngành công nghiệp khác.
3. Ta có thể xem Công nghiệp hóa học gồm 2 bộ phận chính. Trong thực tế 2 bộ phận đó là:
   a. công nghiệp hóa chất và
   b. công nghiệp các quá trình tạo các sản phẩm hóa học
4. Công nghiệp hóa học đã và đang phát triển không ngừng và đặc biệt là ngành công nghiệp hóa dầu.
5. Công nghiệp hóa dầu là một ngành công nghiệp mà các sản phẩm của nó được chế biến từ dầu thô.

UNIT 14 : INVENTORIES

Inventories normally represent the largest single element of capital. They are generally classified as raw materials, semifinished and finished products, although some prefer to combine semifinished and finished products into a single classification, “processed materials”

Raw materials cover all kinds of materials that are purchased by the manufacturer and on which further work must be done before the product can be sold units final form. Sometimes the raw material is completely altered or “consumed” in processing, as in the case of iron in the manufacture of steel, while in other instances the raw material may remain in its original form in the final product as in the case of an assembly plant using purchased prefabricated parts. This illustrates the fact that a raw materials referred to here are those which become a part of the finished product itself or are used directly in manufacturing operations.

As has been indicated, this classification includes

1. semifinished product, which is material upon which manufacturing operations have been performed but which require further processing, and
2. finished product, which is all material fully manufactured and in salable form.

In the chemical industry the segregation between semifinished and finished product is particularly difficult, since many chemical products are not only sold as such but are also consumed in the manufacture of other end products. However, a material cannot be classified in two categories within a company, and one or the other must be selected. Usually, decision is influenced by the fact that more of the material is sold than consumed, or vice versa. If more is consumed, and then the material becomes a semifinished product; if more is sold, the material is classified as finished product.

EXERCISES

A. Read and translate into Vietnamese

inventory, materials, semifinished, products, raw materials, salable, prefabrication, illustrate, manufacture, perform, segregation, selected, category, influenced, consumed.

B. Answer the following questions

1. What are the inventories?
2. Can you tell something about inventories?
3. What are raw materials? Give an example.
4. What are processed materials?
5. Can you tell the difference between semifinished and finished products?

C. Translate into English

1. Nguyên liệu thô là các loại nguyên vật liệu dùng phục vụ cho sản xuất hoặc chế biến ra sản phẩm.
2. Nguyên liệu chế biến là nguyên liệu phải được chế biến tiếp để tạo ra sản phẩm
3. Trong công nghiệp hóa học, sự phân biệt giữa bán sản phẩm và sản phẩm cuối cùng khá khó khăn.

UNIT 15 : THE LABORATORY NOTEBOOK

The laboratory experience is not finished when you complete the experimental procedure and leave the laboratory. All scientists have the obligation to prepare written reports of the results of experimental work. Since this record may be studied by many individuals, it must be completed in a clear, concise and accurate manner. This means that procedural detail, observations and results must be recorded in a laboratory notebook while the experiment is being performed. The notebook should be hardbound with quadrille-ruled (gridded) pages and used only for the biochemistry laboratory. This provides a durable, permanent record and the potential for construction of graphs, charts, etc. It is recommended that the first one or two pages of the notebook be used for a constantly updated table of contents. Although your instructor may have his or her own rules for preparation of the notebook, the most readable notebooks are those in which only the right - hand pages are used for record keeping. The left - hand pages may be used for your own notes, reminders and calculations.

DETAILS OF EXPERIMENTAL WRITE - UP

Introduction

This section begins with a three- or four- sentence statement of the objective or purpose of the experiment. For preparing this statement, ask yourself, “What are the goals of this experiment? ” This statement is followed by a brief discussion of the theory behind the experiment. If a new technique or instrumental method is introduced, give a brief description of the method. Include chemical or biochemical reactions when appropriate.

Experimental

Begin this section with a list of all reagents and materials used in the experiment. The sources of all chemical and the concentrations of solutions should be listed. Instrumentation is listed with reference to company name and model number. A flowchart to describe the stepwise procedure for the experiment should be included after the list of equipment.

Experimental

(a) Table of materials and reagents

(b) List of equipment

(c) Flowchart

(d) Record of procedure

Data and Calculations

(a) Record of all raw data

(b) Method of calculation with statistical analysis

(c) Enter data in tables, graphs or figures when appropriate

For the early experiments, a flowchart is provided. Flowcharts for later experiments should be designed by the student.

The write-up to this point is to be completed as a Prelab assignment. The experimental procedure followed is then recorded in your notebook as you proceed through the experiment. The detail should be sufficient so that a fellow student can use your notebook as a guide. You should include observations, such as color changes or gas evolution, made during the experiment.

Data and Calculations

All raw data from the experiment are to be recorded directly in your notebook, not on separate sheets of paper. Calculations involving the data must be included for at least one series of measurements. Proper statistical analysis must be included in this section.

For many experiments, the clearest presentation of data is in a tabular or graphical form. The Analysis of Results section following each experimental procedure in this book describes the preparation of graphs and tables. These must all be included in your notebook.

Results and Discussion

This is the most important section of your write-up, because it answers the questions:. "Did you achieve your proposed goals and objectives? " and " What is the significance of the data?". Any conclusion that you make must be supported by experimental results. It is often possible to compare your data with known values and results from the literature. If this is feasible, calculate percentage error and explain any differences. Note if any problems were encountered in the experiments.

All library references (books and journal articles) that were used to write up the experiment should be listed at the end. The standard format to follow for a book or journal listing is shown at the end of this chapter in the reference section.

Everyone has his or her own writing style, some better than others. It is imperative that you continually try to improve your writing skills. When your instructor reviews your write-up, he or she should include helpful writing tips in the grading.

EXERCISES

A. Read and translate into Vietnamese

experience, obligation, observation, notebook, statement, goals, discussion, description, biochemistry, material, instrumentation, flowchart, stepwise, measurement, presentation, significance

B. Answer the following questions

1. What is the laboratory notebook?
2. How many steps are there in experimental write-up?
3. What is the first section of experimental write-up? Tell something about it?
4. Say a few words about calculations of experimental works?
5. Why should we need discussion of experimental results?

C. Translate into English

1. Thí nghiệm chưa kết thúc khi các bạn chỉ mới làm xong phần thực nghiệm.
2. Tất cả các cán bộ khoa học bắt buộc phải viết bản báo cáo về công việc thực nghiệm của mình.
3. Các phần chính của một bài báo cáo thí nghiệm bao gồm: phần mở đầu, phần mô tả thực nghiệm trình bày các số liệu và tính toán kết quả, cuối cùng là phần thảo luận kết quả thu được.
4. Các số liệu thí nghiệm phải được ghi trực tiếp vào sổ ghi chép, không ghi vào tờ rời.
5. Tài liệu tham khảo (sách, tạp chí) được ghi lại ở phần cuối bản báo cáo.

UNIT 16 : STUDY OUTLINE OF CHEMISTRY

Introduction

1. The interaction of atoms and molecules is called chemistry.
2. The metabolic activities of microorganisms involve complex chemical reactions.
3. Nutrients are broken down by microbes to obtain energy and to make new cells.

Structure of Atoms

1. Atoms are the smallest units of chemical elements that enter into chemical reactions.
2. Atoms consist of a nucleus, which contains protons and neutrons and electrons that move around the nucleus.
3. The atomic number is the number of protons in the nucleus: the total number of protons and neutrons is the atomic weight.

Chemical Elements

1. Atoms with the same atomic number and same chemical behavior are classified as the same chemical element.
2. Chemical elements are designated by letter abbreviations called chemical symbols.
3. There are about 26 elements commonly found in living cells.

4. Atoms that have the same atomic number (are of the same element) but different atomic weights are called isotopes.

ELECTRONIC CONFIGURATIONS

1. In an atom, electrons are arranged around the nucleus in electron shells.
2. Each shell can hold a characteristic maximum number of electrons.
3. The chemical properties of an atom are largely due to the number of electrons in its outermost shell.

HOW ATOMS FORM MOLECULES

Chemical Bonds

1. Molecules are made up of two or more atoms; molecules consisting of at least two different kinds of atoms are called compounds.
2. Atoms form molecules in order to fill their outermost electron shells.
3. Attractive forces that bind the atomic nuclei of two atoms together are called chemical bonds.
4. The combining capacity of an atom - the number of chemical bonds the atom can form with other atoms - is its valence.

Ionic Bonds

1. A positively or negatively charged atom or group of atoms is called an ion.
2. A chemical attraction between ions of opposite charge is called an ionic bond.
3. To form an ionic bond, one ion is an electron donor; the other ion is an electron acceptor.

Covalent Bonds

1. In a covalent bond, atoms share pairs of electrons.
2. Covalent bonds are stronger than ionic bonds and are far more common in organisms.

Hydrogen Bonds

1. A hydrogen bond exists when a hydrogen atom covalently bonded to one oxygen or nitrogen atom is attracted to another oxygen or nitrogen atom.
2. Hydrogen bonds form weak links between different molecules or between parts of the same large molecule.

Molecular Weight and Moles

1. The molecular weight is the sum of the atomic weights of all the atoms in a molecule.
2. A mole of an atom, ion, or molecule is equal to its atomic or molecular weight expressed in grams.
3. The number of moles of a substance equals its mass in grams divided by its molecular weight.

Chemical Reactions

Chemical reactions are the making or breaking of chemical bonds between atoms.

Energy of Chemical Reactions

1. A change of energy occurs during chemical reactions.
2. Endergonic reactions require energy, exergonic reactions release energy.
3. In a synthesis reaction, atoms, ions, or molecules are combined to form a large molecule.
4. In a decomposition reaction, a large molecule is broken down into its component molecules, atoms, and ions.
5. In an exchange reaction, two molecules are decomposed, and their subunits are used to synthesize two new molecules.
6. The products of reversible reactions can readily revert back to form the original reactants.

How Chemical Reactions Occur

1. For a chemical reaction to take place, the reactants must collide with each other.
2. The minimum energy of collision that can produce a chemical reaction is called its activation energy.

3. Specialized proteins called enzymes accelerate chemical reactions in living systems by lowering the activation energy.

EXERCISES

A. Read and translate into Vietnamese

interaction, metabolic, microorganisms, complex, nutrients, microbes, cells, behavior, symbol, properties, valence, covalent, attractive, attraction, express, subunits, collide, collision, activation energy, protein, enzymes

B. Answer the following questions

1. What is the atom?
2. Say some words about chemical elements.
3. Say something about chemical bonds.
4. How do the chemical reactions occur?
5. How many kinds of chemical reactions do you know? What are they?

C. Translate into English

1. Hóa học nghiên cứu sự tương tác giữa các nguyên tử và các phân tử.
2. Trong một nguyên tử các điện tử được sắp xếp xung quanh hạt nhân nguyên tử trên mạng điện tử.
3. Các liên kết hydro hình thành những liên kết yếu giữa các phân tử khác nhau hoặc giữa các phần của cùng một phân tử của một đại phân tử.
4. Các phản ứng hóa học là các phản ứng hình thành phá vỡ các liên kết hóa học giữa các nguyên tử.
5. Trong các phản ứng phân hủy, sự liên kết trong một đại phân tử bị phá vỡ để tạo thành các cấu tử nguyên tử tương ứng.

UNIT 17 : SEWAGE TREATMENT

After water has been used, it becomes sewage. Sewage includes all the water from a household that is used for washing as well as toilet wastes. Rainwater flowing into street drains and some industrial wastes enter the sewage systems in some cities. Sewage is mostly water and contains little particulate matter perhaps only about 0.03%. Even so, in large cities, this solid portion of sewage can total more than 1000 tons of solid material per day.

Until environmental awareness intensified, a surprising number of large cities in which had only rudimentary sewage treatment systems or no system at all. Raw sewage, untreated or nearly so, was simply discharged into rivers or oceans. A flowing, well-aerated stream is capable of considerable self-purification. Therefore, until increases in populations and their wastes exceeded this capability, casual treatment of municipal wastes caused little complaint. In the United States, most methods of simple discharge have been improved.

Primary Treatment

The usual first step in sewage treatment is called primary treatment. In this process, incoming sewage receives preliminary treatment - large floating materials are screened out, the sewage is allowed to flow through settling chambers so that sand and similarly gritty material can be removed, skimmers remove floating oil and grease, and floating debris are shredded and ground. After this step, the sewage passes through sedimentation tanks, where solid matter settles out. (The design of these primaries settling - tanks varies). Sewage solids collecting on the bottom are called sludge; sludge at this stage is called primary sludge. From 40% to 60% of suspended solids are removed from sewage by this settling treatment, and flocculating chemicals that increase the removal of solids are sometimes added at this stage. Biological activity is not particularly important in primary treatment, although some digestion of sludge and dissolved organic matter can occur during long holding times. The sludge is removed on either a continuous or an intermittent basis, and the effluent (the liquid flowing out) then undergoes secondary treatment.

Biochemical Oxygen Demand

Primary treatment removes approximately 25% to 35% of the biochemical oxygen demand (BOD) of the sewage. An important concept in sewage treatment and in the general ecology of waste treatment, BOD is a measure of the biologically degradable organic matter in water. BOD is determined by the amount of oxygen required by bacteria to metabolize the organic matter. The classic method of measurement is to use special bottles with airtight stoppers. Each bottle is first filled with the test water or dilutions of the test water. The water is initially aerated to provide a relatively high level of dissolved oxygen and is seeded with bacteria if necessary. The filled bottles are then incubated in the dark for five days at 20^oC, and the decrease in dissolved oxygen is determined by a chemical or electronic testing method. The more oxygen that is used up as the bacteria degrade the organic matter in the sample, the greater the BOD - which is usually expressed in milligrams of oxygen per liter of water. The amount of oxygen that normally can be dissolved in water is only about 10 mg/liter. Typical BOD values of waste water may be twenty times this amount. If this waste water enters a lake, for example, bacteria in the lake begin to consume the organic matter responsible for the high BOD, rapidly depleting the oxygen in the lake water.

Secondary Treatment

After primary treatment, the great part of the BOD remaining in the sewage is in the form of dissolved organic matter. Secondary treatment, which is primarily biological, is designed to remove most of this organic matter and reduce the BOD. In this process, the sewage undergoes strong aeration to encourage the growth of aerobic bacteria and other microorganisms that oxidize the dissolved organic matter to carbon dioxide and water. Two commonly used methods of secondary treatment are activated sludge systems and trickling filters.

In the aeration tanks of the activated sludge system, air or pure oxygen is added to the effluent from primary treatment. The sludge in the effluent contains large numbers of metabolizing bacteria, together with yeasts, molds, and protozoans. An especially important ingredient of the sludge are species of Zoogloans and bacteria, which form flocculent masses (flocs) in the aeration tanks. The activity of these aerobic microorganisms oxidizes much of the effluent's organic matter into carbon dioxide and water. When the aeration phase is completed, the floc (secondary sludge) is allowed to settle to the bottom, just as the primary sludge settles in primary treatment.

Soluble organic matter in the sewage is adsorbed onto the floc and is incorporated into microorganisms in the floc. As the floc settles out, this organic matter is removed with the floc and is subsequently treated in an anaerobic sludge digester. More organic matter is probably removed by this process than by the relatively short-term aerobic oxidation.

Most of the settled sludge is removed from the digester; some of the sludge is recycled to the activated sludge tanks as a starter culture for the next sewage batch. The effluent water is sent on for final treatment. Occasionally, when aeration is stopped, the sludge will float rather than settle out; this phenomenon is called bulking. When this happens, the organic matter in the floc flows out with the discharged effluent and often causes serious problems of local pollution. A considerable amount of research has been devoted to the causes of bulking and its possible prevention. It is apparently caused by the growth of filamentous bacteria of various types; the sheathed bacteria *Sphaerotilus natans* is often mentioned as the primary offender. Activated sludge systems are quite efficient: they remove from 75% to 95% of the BOD from sewage.

EXERCISES

A. Read and translate into Vietnamese

sewage, treatment, environment, awareness, rudimentary, discharge, self-purification, settling chambers, gritty, skimmer, grease, debris, shred, sludge, flocculation, biochemical oxygen demand (BOD), ecology, bacteria, metabolize, incubation

B. Answer the following questions

1. Give the definition of sewage.
2. Why does the sewage have to be treated?
3. Tell something of primary treatment of sewage?
4. What is BOD?
5. Why does the sewage have to carry out secondary treatment after primary treatment?

C. Translate into English

1. Nước thải bao gồm các loại nước thải sinh hoạt, nước mưa và nước thải công nghiệp.
2. Nhiều thành phố trong nước ta chỉ có những hệ thống xử lý nước thải đơn giản hoặc thậm chí chưa có.
3. Bước xử lý đầu tiên là cho lắng các hạt lơ lửng lớn trong các bể lắng.
4. BOD là số đo khả năng oxy hóa sinh học của các chất hữu cơ có trong nước thải.
5. Bùn hoạt tính chứa các vi sinh vật phân hủy có hiệu quả từ 75 - 95% chất hữu cơ có trong nước thải.

UNIT 18 : CHEMICAL ENGINEERING

Chemical engineering, like other branches of engineering, is concerned essentially with applied physics. In actual practice the chemical engineer is principally concerned either with physical operations entirely or with the purely physical effects of chemical reactions, such as the transport of solids, fluid flow, mixing and agitation, heat transfer, etc. To obtain the product of a chemical reaction in a marketable form further operations may be involved, such as filtration, crystallization, distillation, evaporation, drying, and grinding. These, in fact, are also physical operations, and the indicating appliances used to control them are usually based on physical rather than on chemical principles.

One of the most important contributions of the chemical engineer is to guide industry in the choice of materials for the construction of plant. The chemical engineer can select materials suitable for each particular part of the plant, with consequent improvement in the life of the apparatus and general economy in working. Examples may be found in the development of metals capable of resisting corrosion, chemical reagents, heat and creep at high temperatures.

New processes call for new technique in plant design. Today there is much talk of the production of motor spirit and other oils by high-pressure reactions. Such developments would still be at the laboratory stage had it not been for the work of the chemical engineer in taking advantage of the development of high-tensile steel and then applying his special knowledge to the design of new kinds of plant in which hydrogen and other gases and vapors are handled at high pressure and temperatures.

Thus, commercial success in translating a laboratory method of a preparation into a full-scale manufacturing process depends as much upon the careful plant design as upon consideration of the precise chemical reactions to be employed; in short, industrial efficiency and the profits expected to accompany this can only be realized by sound chemical engineering.

EXERCISES

A. Read and translate into Vietnamese

engineering, branches, physical operations, agitation, heat transfer, marketable form, grinding, drying, evaporation, crystallization, construction, reagents, creep, motospirit, full-scale, sound chemical engineering

B. Answer the following questions

1. What is the chemical engineering concerned?
2. What is the most important contribution of the chemical engineer?
3. Can you tell some main operations involved in the industrial process?
4. What is the commercial success of scientific research of chemical reaction?
5. How can you get the industrial efficiency?

C. Translate into English

1. Trong thực tế hiện nay, các quá trình hóa học liên quan chủ yếu đến các quá trình vật lý hay tác động vật lý lên các phản ứng hóa học.
2. Công nghệ hóa học cần chọn các nguyên vật liệu thích hợp cho xây dựng nhà máy tương ứng.
3. Chúng ta cần phải tìm các loại kim loại có khả năng chống được ăn mòn, có khả năng giãn nỡ ở nhiệt độ cao.v.v.

UNIT 19: GAS MANUFACTURE

Gas is made by the destructive distillation of that variety of coal, rich in hydrogen, known as bituminous coal. A typical bituminous coal has the following composition: carbon, 77%; hydrogen, 5%; nitrogen, 1.7%; oxygen, 7%; sulfur, 1.7%; ash, 3.5%; moisture, 3.4%.

The series of operations involved in gas manufacture includes the processes of distillation, condensation of the products of distillation which are liquid or solid at atmospheric temperature, exhaustion of the uncondensed gas from the retorts, wet purification, by washing with water, dry purification, estimation of the volume of the purified gas, and distribution to the mains from which the customer draws his supply.

The distillation of coal is carried out by the following systems:

1. Horizontal retorts
2. Continuously operated vertical retorts
3. Intermittent vertical retorts of chambers
4. Coke ovens: although large amounts of gas are produced as a by-product in coke ovens, their main concern is with the manufacture of hard, dense coke for use in the steel industry.

Most of the town gas supplied by the gas industry is made in horizontal or vertical retorts.

Vertical Retorts - Carbonization in vertical retorts may be continuous or intermittent. In the case of the former coal is fed continuously into the top of a retort by means of gravity, and is carbonized in its passage through the retort, coke being extracted by a slowly moving extractor at the base. As the coal is carbonized it swells considerably, and in consequence the retorts are wider in both dimensions at the bottoms than at the top. The retorts in cross-section are either rectangular or oval and are of various sizes to carbonize from 3 to 12 tons per day. The actual amount of coal passing through the retort depends upon the class of coal being carbonized and the calorific value of the gas produced. Steam is introduced at the base of the retort for the primary purpose of cooling the coke before it is discharge, but in so doing it produces water gas, thus increasing the gaseous yield. With continuous vertical retorts there is great possibility of flexibility in output and calorific value through variations in the rate at which coal is carbonized and in the amount of steaming. Steam is generated in waste-heat boilers in which the heat of the waste gases in utilized.

From the retort the gas passes to the hydraulic main. It leaves the main at a temperature of about 60^0C, and is reduced to the temperature of the air by condensers which are air-cooled or water-cooled, or both. It is then subjected to purification and passed to the gas holder where it is stored.

EXERCISES

A. Read and translate into Vietnamese

gas manufacture, condensation, atmospheric temperature, exhaustion, retorts, wet purification, estimation, distribution, horizontal retorts, vertical retorts, coke oven, extractor, carbonize, cross-section, rectangular or oval form, flexibility, hydraulic main, calorific value

B. Answer the following questions

1. What are the main composition of a typical bituminous coal?
2. Can you tell the systems for the distillation of coal in the gas manufacture?
3. What is the vertical retort?
4. What is the difference between the vertical retort and continuous vertical one?
5. What is concept of air-cooled or water-cooled apparatus?

C. Translate into English

1. Có nhiều công đoạn khác nhau trong quá trình sản xuất khí đốt như: chưng cất, ngưng tụ, tách hết phần khí không ngưng.v.v.
2. Từ lò, khí được chuyển qua bộ phận làm khô, thường giữ ở nhiệt độ là 60^0C.
3. Bộ phận ngưng tụ làm lạnh có thể làm lạnh bằng không khí hoặc bằng nước.

UNIT 20 : SULFURIC ACID

Sulfuric acid, H_2SO_4, is one of the most important of all chemicals, finding use throughout the chemical industry and related industries. It is a heavy, oily liquid, density 1.838 g/cm^3, which fumes slightly in air, as the result of the liberation of traces of sulfur trioxide which then combine with water vapor to form droplets of sulfuric acid. When heated, pure sulfuric acid yields a vapor rich in sulfur trioxide, and then boils, at 3380C, with the constant composition 98% H2SO4, 2% water. This is the ordinary concentrated sulfuric acid of commerce.

Concentrated sulfuric acid is very corrosive. It has a strong affinity for water, and a large amount of heat is liberated when it is mixed with water, as the result of the formation of hydronium ion:

$$H_2SO_4 + 2H_2O = 2H_3O^+ + SO_4^{-2}$$

In diluting it, the concentrated acid should be poured into water in a thin stream, with stirring; water should never be poured into the acid, because it is apt to sputter and throw drops of acid out of the container.

The Manufacture of Sulfuric Acid

Sulfuric acid is made by two processes, the contact process and the lead-chamber process, which are now about equally important. In the contact process sulfur trioxide is made by the catalytic oxidation of sulfur dioxide/ the name of the process refers to the fact that reaction occurs on contact of the gases with the solid catalyst/. The gas containing sulfur trioxide is bubbled through sulfuric acid, which absorbs the sulfur trioxide. Water is added at the proper rate, and 98% acid is drawn off.

The principle of the lead-chamber process is shown by the following experiment. A large flask is fitted with four inlet tubes and a small outlet tube. Three of the tubes come from wash bottles, and the fourth from a flask in which water may be boiled. When oxygen, sulfur dioxide, nitric oxide, and a small amount of water vapor are introduced into the large flask, crystals of nitrososulfuric acid/ sulfuric acid in which one hydrogen atom is replaced by the nitrous group/, are formed. When steam is sent into the flask by boiling the water in the small flask, the crystals react to form drops of sulfuric acid, liberating oxides of nitrogen, which serve to catalyze the oxidation of sulfur dioxide by oxygen.

In practice the reactions take place in large lead-lined chambers. The acid produced, called chamber acid, is 65% to 70% H_2SO_4. It may be concentrated to 78% by the evaporation of water by the hot gases from the sulfur burner or pyrite burner.

The Uses of Sulfuric Acid

Sulfuric acid is used for the manufacture of soluble phosphate fertilizers and in the manufacture of many chemicals and drugs. It is also used as the electrolyte in ordinary storage cells, and hot concentrated sulfuric acid is an effective oxidizing agent.

EXERCISES

A. Read and translate into Vietnamese

sulfuric acid, density, droplet, yield, sulfur trioxide, affinity, hydronium ion, pour, apt to, sputter, container, catalytic oxidation, bubble, fertilizer, electrolyte, drug

B. Answer the following questions

1. What is the sulfuric acid?
2. What is the b.p. of sulfuric acid? and tell the constant composition of ordinary concentrated sulfuric acid of commerce?
3. Can you describe the method for the manufacture of sulfuric acid?
4. What is the main principle of the lead-chamber process?
5. Give examples of some usages of sulfuric acid.

C. Translate into English

1. Axit sunfuric là một trong những hợp chất hóa học quan trọng nhất.
2. Axit sunfuric là một chất lỏng nặng hơn nước và linh động có tỷ trọng bằng 1,838 g/cm^3.
3. Axit sunfuric đậm đặc là một chất ăn mòn mạnh.
4. Khi pha dung dịch axit sunfuric luôn rót axit vào nước từng dòng nhỏ, không bao giờ rót nước vào axit vì nó làm bắn axit ra.

UNIT 21: GLASS

Glass is generally a mixture of several silicates, produced by melting together silica, an alkali and lime or lead. There are two general kinds of glass: lime glass and lead glass. The former is the more common, is cheaper, harder, more resistive and less fusible than lead glass. The latter has greater luster and brilliancy and is used chiefly for cut-ware and optical purposes. In general, the higher the percentage of silica the harder, less fusible, and more brittle the glass.

Fusibility is decreased and hardness increased by increasing the lime. In colored glass a part of the lime and lead is replaced by oxides of iron, manganese, cobalt, etc. The addition of borates and phosphates improves glass for various optical and chemical purposes, as do also zinc and barium. German optical glass contains both zinc and barium. Practically all glass is decolorized in manufacture by the addition of manganese dioxide.

Window glass is generally a soda-lime glass and, formerly, was always blown. Plate glass is usually soda-lime glass cast on large iron plates and subsequently ground and polished. Ground plate glass is extensively used for flooring. Pressed glass is made by forming heat-softened glass to shape in dies under pressure. It is fairly inexpensive. Wire glass is glass having an iron wire screen thoroughly embedded in it. It offers about $1^1/_2$ times the resistance to bending that plain glass does, and very thin sheets may be walked on. It is used for flooring, fireproof doors, etc. Pyrex glass is a low-expansion boro-silicate containing no metals of the magnesia-lime-zinc group and no heavy metals. Principal uses are chemical ware, baking ware, high-tension insulators, sight glasses for chemical apparatus, glass pipe lines for chemical plants, etc. Owing to the low coefficient of expansion Pyrex glass withstands sudden changes of temperature without breaking. Safety glass consist of two layers of plate glass firmly held by an intermediate layer of celluloid, attached to the glass by a suitable adhesive. It can be struck by a sharp hammer blow without shattering, and when sufficiently thick is practically bulletproof.

EXERCISES

A. Read and translate into Vietnamese

glass, silicate, silica, lime-glass, lead-glass, resistive, fusible, luster, brilliance, cut-ware, optical purposes, brittle, feasibility, soda-lime, cast, wire glass, embed, resistance, fireproof, insulator, adhesive, shattering, bulletproof

B. Answer the following questions

1. What is the glass?
2. How many kinds of glass do you know? And what are they?
3. What are the difference of lime glass and lead glass?
4. Can you tell something about the safety glass?
5. Say few words about the production of glass?

C. Translate into English

1. Thủy tinh nói chung là một hỗn hợp của các hợp chất silicat khi làm nóng chảy cát.
2. Độ nóng chảy của thủy tinh tăng lên khi tăng lượng canxi và độ cứng cũng vậy.
3. Thủy tinh quang học của Đức có cả kẽm và bari.
4. Trong thực tế các loại thủy tinh bị mất màu khi bổ sung oxit mangan vào.

UNIT 22 : THE RAPID METHOD OF DETERMINATION OF POTASSIUM IN MINERALS

Report of the development of a rapid method for detn. of K based on decompn. of minerals in molten $CaCl_2$. The method is based on the use of a high-frequency generator which offers the possibility of heating the reactants to high temps. under exceptionally pure conditions. The mineral sample is ground to particle sizes of 0.25 - 0.15 mm. Then 0.2g of the mineral is placed in a crucible of high-quality graphite. Then 1.2g of anhyd. $CaCl_2$ is added. The crucible is heated in a furnace at 200^0 for 20 min. To remove H_2O absorbed during weighing. After this the crucible is lowered into a dry quartz tube which is closed with a rubber stopper. The quartz tube is placed in a cooling jacket of running H_2O. The temp. of

the crucible is brought to 1500 - 1700^{0}C. As a result all the alk. elements are converted to chlorides. This reaction is completed after several min. Later complete dissolving of the salts from the crucible requires about 3 hrs. and requires no control. The soln. obtained is analysed photometrically. One difficulty encountered was the masking of the emission from K by an excess of Ca. An expt. was made in order to learn the relation between amt. of K extd. and time of fusion. Microcline was used as the mineral. It was found that complete extn. of K could be attained by a 3 - 4 min. fusion. A study of reproducibility of results was made by using Microcline, muscovite and biotite. Av. error did not exceed 0.97 relative %. In comparing the rapid new method with the usual methods for detg. K in minerals, It was found that the K content obtained was higher with the new method. Preliminary studies on using the new method in rock analysis have given entirely satisfactory results. A sketch of the app. is shown, and some data are given in tables.

EXERCISES

A. Read and translate into Vietnamese

detn.= determination, decompn.= decomposition, generator, temps.= temperature, crucible, anhyd.= anhydride, graphite, furnace, quartz tube, alk.= alkaline, convert, dissolve, masking, emission, excess, photometrically, amt.= amount, extd.= extracted, extn. extraction, av.= average, expt.= experiment, soln.= solution, detg.= determining, app.= apparatus

B. Answer the following questions

1. What is the rapid method for determination of potassium?
2. What are the particle size of mineral sample after grinding?
3. Tell some steps of preliminary studies on using a new method in rock analysis?
4. Write and read all words in abbreviations in the lesson.

C. Translate into English

1. Để xác định Kali có một phương pháp nhanh dựa trên sự phân hủy quặng trong $CaCl_2$ nóng chảy.
2. Mẫu quặng được nghiền nhỏ thành các hạt có kích thước từ 0,25 - 0,15 mm.
3. Phản ứng này kết thúc sau ít phút.
4. Một thí nghiệm được tiến hành để biết mối quan hệ giữa lượng K tách ra được và thời gian nóng chảy của nó.

UNIT 23 : THE USE OF RADIOACTIVE ELEMENTS AS TRACERS

An extremely valuable technique for research that has been developed in recent years is the use of both radioactive and non-radioactive isotopes as tracers. By the use of these isotopes an element can be observed in the presence of large quantities of the same element. For example, one of the earliest uses of tracers was the experimental determination of the rate at which lead atoms move around through a crystalline sample of the metal lead. This phenomenon is called self-diffusion. If some radioactive lead is placed as a surface layer on a sheet of lead, and sample is allowed to stand for a while, it can then be cut up into thin sections parallel to the original surface layer, and the radioactivity present in each section can be measured. The presence of radioactivity in layers other than the original surface layer shows that lead atoms from the surface layer have diffused through the metal.

Perhaps the greatest use for isotopes as tracers will be in the field of biology and medicine. The human body contains such large amounts of the elements carbon, hydrogen, nitrogen, oxygen, sulfur, etc. that it is difficult to determine the state of the organic material in the body. An organic compound containing a radioactive isotope, however, can be traced through the body. An especially useful radioactive isotope for these purposes is carbon 14. This isotope of carbon has a half-life of about 5000 years. It undergoes slow decomposition with emission of beta rays, and the amount of the isotope in a sample can be followed by measuring the beta activity. Large quantities of C^{14} can be readily made in a uranium pile, by the action of slow neutrons on nitrogen. The process can be carried out by running a solution of ammonium nitrate into the uranium pile, where it is exposed to neutrons. The carbon which is made in this way is in the form of bicarbonate ion, and can be precipitated as barium carbonate by adding

barium hydroxide solution. The samples of radioactive carbon are very strongly radioactive, containing as much as 5% of the radioactive isotope.

EXERCISES

A. Read and translate into Vietnamese

radioactive, non-radioactive, isotope, traces, phenomenon, self-diffusion, determination, surface layer, sheet, parallel, radioactivity, biology, medicine, pile, expose to, bicarbonate

B. Answer the following questions

1. What is an extremely valuable technique for research in recent years?
2. What is the phenomenon called self-diffusion?
3. Can you cite some usage of isotopes as tracers in the body?
4. How many elements are there in the body?
5. Is it difficult to determine the state of the organic material in the body.

C. Translate into English

1. Bằng sử dụng các chất đồng vị phóng xạ một nguyên tố người ta có thể quan sát được khi có mặt một lượng lớn ở các nguyên tố cùng loại.
2. Khả năng phóng xạ trên các lớp cắt mỏng song song lớn hơn ở lớp bề mặt ban đầu.
3. Quá trình này có thể được tiến hành bằng cách cho dung dịch nitrat amon vào lò phản ứng uran, ở đấy dung dịch này được chuyển thành các neutron.

UNIT 24 : ACETONE

Acetone is the simplest and most important of the ketones. It is a colorless, mobile, flammable liquid with a mildly pungent and somewhat aromatic odor. It is miscible in all proportions with water and with organic solvents such as ether, methanol, ethyl alcohol, and esters. Acetone is used chiefly as a solvent and as a raw material for the synthesis of organic compounds. Acetone is not easily oxidized; it is unaffected by nitric acid at room temperature and is stable to neutral permanganate. The more powerful oxidizing agents, such as alkaline permanganate and chromic acid, break it down to acetic and formic acid, and the latter decomposes further to carbon dioxide and water. Acetone does not reduce ammoniacal silver or Fehling's solution. The flash point of acetone is -20^0C. The explosive 1/mits of acetoneair mixtures appear to lie between 2.55% and 12.80% of acetone at room temperature.

Acetone occurs in small quantities in human blood and urine. It is also formed by thermal decomposition of coal peat, acetic acid salts, formates, and citric acid, and by the dry distillation of sugars with lime.

The largest use of acetone is in the production of acetic anhydride, which in turn is chiefly consumed in making cellulose acetate for acetate rayon, photographic film, and plastics. When acetone is passed through a heated tube at about 700^0C/ preferably of a non-ferrous metal, since iron increases carbon formation and reduces yields/, it is converted into ketene and methane; the ketene on reaction with glacial acetic acid forms acetic anhydride. Acetone is also an excellent solvent for nitrocellulose and is used in making films, cements, artificial leather, and other similar products.

By far the largest production of acetone is from petroleum-derived propylene by way of isopropyl alcohol. The production of acetone from isopropyl alcohol may be conducted either by catalytic dehydrogenation or by catalytic oxidation. Catalysts for the dehydrogenation include metals, such as copper, brass, and lead,/ sometimes with promoters/, and various metal oxides and salts or oxide-salt combinations, and recommended temperatures are of the order of 300^0C and higher. The oxidation, being exothermic, is difficult to control; typical catalysts are copper, copper alloys, silver, and metal oxides, and temperatures are in the range 200 to 800^0C.

The availability of high-quality acetone in large quantities from the petroleum chemical industry has been a major factor in the expansion of rayon production and other acetone-consuming industries in recent years.

EXERCISES

A. Read and translate into Vietnamese

acetone, ketone, pungent, aromatic odor, organic solvents, ether, methanol, ethyl alcohol, ester, synthesis, unaffect, permanganate, flash point, coal peat, lime, cellulose acetate, photographic film, plastics, dehydrogenation, promoters, exothermic, petroleum

B. Answer the following questions

1. What is acetone?
2. What is acetone chiefly used for?
3. Does acetone occur in human body? and where does it exist?
4. What is the largest usage of acetone?
5. Describe some methods of production of acetone.

C. Translate into English

1. Axêton là một chất lỏng không màu, linh động, có thể cháy cho mùi hơi cay và có thể xem như mùi hơi thơm.
2. Axêton còn được hình thành do quá trình phân hủy bởi nhiệt độ cao của than bùn, các muối của axit axêtic, axit xitric và bằng quá trình chưng cất khan của đường với nước vôi.

UNIT 25: ACETIC ACID

Certainly acetic acid is the most familiar of all the organic acids. It is best known as the chief acid constituent of vinegar. When cooled to below 16 degrees, pure acetic acid forms colorless crystals. These crystals resemble ice in appearance; hence the pure acid is usually called "glacial" acetic acid.

There are many ways to prepare acetic acid. It can be obtained by the oxidation of ethyl alcohol which in turn is prepared by fermentation. Or, it can be obtained from cider vinegar which is prepared from the juice of apples. For a long time acetic acid was produced by the distillation of wood. Seven gallons of acid were extracted from one ton of wood. Acetic acid is also produced by synthetic methods. One such method employs acetylene as the starting point which itself is obtained as a by-product in the production of hydrogen during the refining of petroleum. The acetylene is passed through a dilute solution of sulfuric acid containing a catalyst. Acetaldehyde is formed by this reaction and is then oxidized to acetic acid.

The most convenient way to prepare glacial acetic acid in the Lab is by the distillation of sodium acetate with sulfuric acid. Place 10 grams of sodium acetate in an evaporating dish. Apply gentle heat and continue heating, with stirring, until the water of crystallization is driven off and a dry powder remains. Be very careful not to heat too strongly, as the compound will decompose and char. Transfer the powder to a flask and add 7 cc. of concentrated sulfuric acid. If a condenser is available, fit it quickly to the flask. If not, substitute a one-hole stopper and glass tubing leading to another vessel immersed in ice water. Heat gently. Acetic acid distils over and collects in the receiving container. If you care to purify the acid, it must be distilled again and that potion boiling at about 116 degrees should be collected.

To demonstrate how easily acetic acid freezes, immerse a partially filled test tube of the pure acid forms salts. For example, neutralization with sodium carbonate will produce sodium acetate. And, using calcium carbonate, calcium acetate is obtained. By heating dry calcium acetate, acetone is produced. Similarly, ammonia will produce ammonium acetate and from this compound acetamide is prepared. With organic alcohols, acetic acid forms esters.

EXERCISES

A. Read and translate into Vietnamese

familiar, constituent, vinegar, in appearance, glacial acetic acid, fermentation, cider, juice, of apples, acetylene, refining, gentle, chat, acetaldehyde, decompose, vessel, immerse, collect, receiving, container, neutralization

B. Answer the following questions

1. What is the acetic acid?

2. Where can you see acetic acid every day?
3. Can you describe one of the methods for preparing acetic acid?
4. What is the most convenient way for preparing glacial acetic acid in the lab.?
5. Say a few words about acetic acid in your own way.

C. Translate into English

1. Khi làm lạnh đến nhiệt độ 16^0C axit axêtic tinh khiết tạo thành các tinh thể không màu.
2. Quá trình oxy hóa rượu êtylic thành axit axêtic gọi là quá trình lên men.
3. Cần chú ý cẩn thận không cấp nhiệt quá mạnh làm cho hợp chất này phân hủy và cháy thành than.

UNIT 26 : M-BROMONITROBENZENE PROCEDURE

In a 3 - 1. three-necked, round-bottomed flask, provided with an efficient reflux condenser bearing an outlet tube hole above a surface of water, a 100 cc, separatory funnel, and a mercury-sealed mechanical stirrer, is placed 270g /2.2 moles/ of freshly distilled dry nitrobenzene. The joints in the apparatus are made of asbestos paper covered with water glass. The flask is heated in an oil bath maintained at 135 - 145^0C, and 26g of iron powder and 562g /180 cc/ 3.5 moles/ of dry bromine are added in the following manner: Eight grams of iron powder is added through the side neck to the stirred nitrobenzene. From the separatory funnel 60 cc of bromine is added at such a rate that the bromine vapors do not traverse the condenser. This addition requires about one hour, and the mixture is stirred and heated for another hour before the addition of a second portion of iron and bromine. Two portion, each of 8g of iron powder and 60 cc of bromine, are added under the same conditions as the first addition, and the mixture is stirred and heated for one hour between the completion of one addition and the beginning of another. The evolution of hydrogen bromide slackens considerably toward the last of the heating, and there is practically no more bromine vapor in the condenser. A final addition of 2g of iron powder is made, and the heating continued for one hour longer.

The reaction product, which is a dark reddish-brown liquid, is poured or siphoned into 1.5 l of water to which 50 cc of a saturated solution of sodium bisulfite has been added. The mixture is distilled with steam and the first portion of the distillate is collected separately to remove a small amount of unchanged nitrobenzene. It is necessary to collect about 12 l of distillate in order to obtain all the m-Bromonitrobenzene. The yellow crystalline solid is filtered with suction and pressed well on the funnel to remove water and traces of nitrobenzene. The yield of crude product varies from 270 to 340g/ 60 - 75 per cent of the theoretical amount/. It melts at 51.5 - 52^0C and boils at 117 - 118^0C/ 9 mm. This product is satisfactory for most purposes. If a purer material is desired, the crude M-Bromonitrobenzene may be distilled under reduced pressure. The recovery on purification is about 85 per cent. Bruhl recorded the b.p. as 138^0/18 mm and the m.p. as 56^0C for pure m-bromonitrobenzene.

EXERCISES

A. Read and translate into Vietnamese

three-necked flask, round-bottomed flask, efficient reflux, outlet tube hole, separatory funnel, mechanical stirrer, nitrobenzene, asbestos paper, oil bath, side neck, bromine, slacken, dark reddish-brown liquid, siphon, saturated solution, suction, crude product, reduced pressure, recovery

B. Answer the following questions

1. Can you draw a three-necked, round-bottomed flask?
2. Can you explain the flask, provided with an efficient reflux condenser bearing an outlet hole above a surface of water?
3. What is the reaction product in the flask?
4. What is the method of producing purer Bromonitrobenzin from m-Bromonitrobenzen?
5. What is the b.p and m.p for pure m-bromonitrobenzene?

C. Translate into English

1. Dùng giấy amiăng để nối các phần thiết bị.
2. Bình này được đun nóng trong bể dầu để duy trì nhiệt độ 135 - 145^{0}C.
3. Cuối cùng bổ sung thêm 2g bột sắt và tiếp tục đun nóng thêm 1 giờ nữa.

UNIT 27 : SYNTHETIC RUBBER

Synthetic rubber is produced through a process known as polymerization, which involves inter-molecular combinations. The polymers resulting from this reaction are of the elastic type, such as synthetic rubbers, and the non-elastic types, such as synthetic plastics. The rubber-type of compounds are known as elastomers. Actually, the elastomers do not duplicate natural rubber, and in many respects superior to the natural product.

Among the many types of rubber like compounds, Thiokol is perhaps the most easily adapted for school laboratory preparation. It is produced essentially from the reaction of sodium tetrasulfide with ethylene dichloride.

Dissolve 3 grams of sodium hydroxide in 60 cc of water. Place the solution in a large beaker and heat to boiling. To the boiling liquid, add 6 grams of finely powdered sulfur. Add small portions at a time, stirring constantly. After all has been added, continue stirring and heating for a few minutes. Then, remove the heat, add about 50 cc of water, stir, and filter off any unreacted sulfur. The resultant filtrate should be a clear red liquid /sodium polysulfide/.

For an emulsifying agent, we will use a soap solution. Dissolve about one-half gram of soap flakes in 10 cc of hot water. Heat the sodium polysulfide solution prepared above in a large beaker to a temperature of 70 degrees, and add the soap solution into it. Next, while stirring, add 10 cc of ethylene dichloride in small portions. It is important that you keep the temperature at 70 degrees. If it should rise, remove the heat immediately, and if necessary, cool the beaker externally. Continue stirring at the 70 degrees temperature until the liquid becomes milky-white in color. The solution will pass through various shades of orange, yellow and ivory. But do not be satisfied until you obtain an entirely white color. This white emulsion is the "latex". Cool the solution and add 5 cc of concentrated ammonium hydroxide, which will act as stabilizer. Stir again and allow the mixture to stand for a day or two.

The latex emulsion will gradually settle to the bottom of the container. Carefully pour off the clear liquid from the top. Then add the white emulsion to 150 cc of water in a beaker. Add 5cc of concentrated ammonium hydroxide and stir well.

Our final step is to coagulate the rubber. This can be done with dilute acetic acid/ about a 20% solution/. Add the acetic acid in small quantities with continual stirring until the Thiokol separates out of solution as a lump in the bottom of the container. Remove the lump and wash is thoroughly with water. This is the crude synthetic rubber. Note that it is moderately elastic.

The elasticity can be increased by treatment with zinc oxide and carbon black. Place the lump of rubber in a mortar. Add about one-half gram of zinc oxide and small pinch of carbon black. Work the chemicals into the rubber by kneading with the pestle. Do not grind - rather press the chemicals in. Note the elasticity after you have treated the rubber for about 15 minutes.

The process you have just completed is similar to that of processing natural rubber. The difference, of course, is that the milky latex is obtained from the rubber tree instead of from chemical reactions. The natural latex is also stabilized and then coagulated with acetic acid. This rubber is then vulcanized and further treated with carbon black or zinc oxide which help to increase its resiliency, strength, and toughness.

Natural rubber is a complex polymerized form of isoprene. The Thiokol that you have prepared is actually a "substitute" rubber. It is unaffected by hydrocarbons and most solvents. Thus it is used in making hoses used to handle such liquids.

EXERCISES

A. Read and translate into Vietnamese

synthetic rubber, polymerization, inter-molecular combinations, polymer, elastic, synthetic plastics, elastomer, duplicate, Thiokol, sodium tetrasulfide, ethylene dichloride, filter off, sodium polysulfide, emulsifying, milky-white in color, latex, stabilizer, coagulate, moderately elastic, elasticity, pinch, vulcanize

B. Answer the following questions

1. What is synthetic rubber?
2. What is Thiokol?
3. Can you tell something about latex?

4. What is the method for increasing the elasticity of rubber?
5. Could you compare the difference of natural rubber and synthetic rubber?

C. Translate into English

1. Các hợp chất cao phân tử do quá trình trùng hợp tạo thành, có loại đàn hồi như cao su tổng hợp, có loại không đàn hồi như chất dẻo tổng hợp.
2. Chúng ta có thể dùng dung dịch xà phòng như là một tác nhân gây nhũ tương hóa.
3. Dịch mủ cao su sẽ từ từ lắng xuống đáy thiết bị.
4. Giai đoạn cuối cùng của chúng ta là làm đông đặc cao su.

UNIT 28 : CLASSIFICATION OF FUELS

Fuels are employed in the solid, liquid, and gaseous condition. The solid fuels are essentially naturally occurring materials, principally wood, peat, and coal, although for special purposes they are carbonized for the production of charcoal and coke. Coal is usually classified as hard and soft. Hard coal, which is called anthracite coal, is about 90 per cent carbon. It is a hard, dense, shiny substance that burns with practically no flame or soot. Anthracite has been subjected to the greatest temperatures and pressures for the longest period of time, and most of the volatile compound have been removed. Bituminous coal is often called soft coal. This form has not been subjected to as great pressures as has hard coal, and still contains some compounds of C and H, and some NH_3. It is generally used as household and industrial fuel. Lignite is softer that bituminous coal. When stored, it disintegrates and changes to a powdery substance. Coke is made by the destructive distillation of bituminous coal. It is a grey solid that looks somewhat like coal. It is a valuable fuel and excellent reducing agent. It readily takes oxygen away from the oxide of a metal, leaving the metal. Charcoal is made by heating wood without contact with air, usually in large holding capacities, if this is done on an industrial scale.

Liquid fuels are mostly direct natural products, such as the petroleum oils, but considerable quantities are obtained as the result of destructive distillation of solid fuels, such as coal. One of the arising by-products is coal tar, which is a mixture like petroleum, and can be separated into its several ingredients by fractional distillation.

Gaseous fuels occur naturally locally as natural gas, but are also the result of destructive distillation of solid fuels /coal gas, coke oven gas/, or liquid fuels /oil gas/, or the result of the incomplete combustion of solid fuels in gas producers either by an air blast /producer gas/, steam /water gas/, or a combination of air and steam /semi-water gas/.

EXERCISES

A. Read and translate into Vietnamese

fuels, wood, peat, coal, charcoal coke, anthracite coal, soot, volatile compound, shiny substance, bituminous coal, lignite, disintegrate, powdery substance, petroleum oils, coal tar, fractional distillation, incomplete combustion

B. Answer the following questions

1. Can you name some kinds of fuels?
2. What is charcoal and coke?
3. What is anthracite coal?
4. What is coal tar, and what is it used for?
5. Can you tell the difference of gaseous fuels and solid ones?

C. Translate into English

1. Các loại nhiên liệu rắn thường là các vật liệu tồn tại trong tự nhiên như: gỗ, than bùn, than đen...
2. Than thường chia ra hai loại: loại cứng và loại mềm.
3. Than bitum là loại than mềm thường dùng làm nhiên liệu trong công nghiệp và trong gia đình.
4. Các nhiên liệu lỏng thường là sản phẩm lấy trực tiếp từ tự nhiên ví dụ dầu mỏ.

UNIT 29 : PETROLEUM

Petroleum, or crude oil, is a dark oily liquid found in underground deposits in various parts of the earth. Probably it had its origin millions of years ago at the bottoms of ancient seas, where the remains of countless animal and vegetable organisms settled. Then they were overlaid by sediment. During hundreds of years they were subjected to pressure and to chemical and bacteriological action, which eventually transformed them into oil.

Crude oil is composed very largely of compounds of two elements, hydrogen and carbon. In this family of compounds the boiling point increases with increasing molecular size. Methane, ethane, propane and butane are gases; next come liquids boiling in a range suitable for motor fuel, such as petrol/ gasoline/; then kerosene/ or paraffin/, diesel fuel and heavier fuel and heavier fuel oils; and, finally, petroleum bitumen which is used for road paving, roofing and all kinds of industrial purposes. Lubricating oils come up the range of boiling points and are separated by special vacuum distillation and other processes, as also are the solid paraffin waxes used for candles, waxed paper and polishes.

A cracking process means the decomposition by heat with catalysis of petroleum or heavy petroleum fractions, with the production of lower-boiling materials. It was discovered by Burton in 1913, and a number of cracking processes have come into use since that time. In all of them the oil is heated to a fairly high temperature, and the molecules of the less volatile hydrocarbons are decomposed to form molecules of lower molecular weight, which have boiling points within the gasoline range. In some of the processes, the cracking takes place in the liquid phase, at pressure from a few hundred pounds to a thousand pounds per square inch, and temperatures of 400 - 500^0C. In other processes, the cracking occurs in the gas phase at ordinary pressures, and temperatures up to approximately 600^0C.

In many of these processes catalysts, usually based on aluminum silicates, are used. Free carbon is formed during the cracking processes, but the yield of gasoline is greatly increased. Further improvements have been made by developing processes with involve hydrogenation at the same time as cracking, and thus avoid the great loss due to the formation of uncombined carbon. These processes are carried out by heating the petroleum to be cracked with hydrogen at high pressure, in the presence of a catalyst. The process is subject to operating control so as to increase greatly the yield of the product for which the industrial demand is the greatest.

EXERCISES

A. Read and translate into Vietnamese

petroleum, deposit, overlaid, chemical and bacteriological action, crude oils, methane, ethane, petrol, gasoline, kerosene, paraffin, diesel fuel, petroleum bitumen, lubricating oils, waxes, candles, waxed paper, waxed polishes, cracking process, aluminum silicates, hydrogenation

B. Answer the following questions

1. What is petroleum?
2. What are the main compounds in crude oil of petroleum?
3. Can you describe a cracking process?
4. What are the main temperatures in the cracking process in petroleum industry?
5. What is the catalysts used in the cracking process?

C. Translate into English

1. Các xác động thực vật trải qua hàng trăm năm dưới đáy biển bị phân hủy do tác nhân hóa học và vi sinh vật học biến thành dầu mỏ.
2. Quá trình chưng cất dầu mỏ được phát minh từ năm 1913 do nhà bác học Burton để tinh chế dầu mỏ.

UNIT 30 : MAIN BIOLOGICAL MOLECULES

Inorganic Compounds

1. Inorganic compounds are usually small, ionically bonded molecules.
2. Water, and many common acids, bases, and salts are examples of inorganic compounds
3. Water
4. Water is the most abundant substance in cells.
5. Because water is a polar molecule of the decomposition reactions of digestion.
6. Water is an excellent temperature buffer.

Acids, bases, and salts

1. An acid dissociates into H^+ ions and anions
2. A base dissociates into OH^- ions and cations
3. A salt dissociates negative and positive ions, neither of which is H^+ or OH^-

Acid-base balance

1. The term pH refers to the concentration of H^+ in a solution
2. A solution with a pH of 7 is neutral; a pH below 7 indicates acidity; a pH above 7 indicates alkalinity.
3. A pH buffer, which stabilizes the pH inside a cell, can be used in culture media.

Organic Compounds

1. Organic Compounds always contain carbon and hydrogen.
2. Carbon atoms form up to four bonds with other atoms.
3. Organic Compounds are mostly or entirely covalently bonded, and many of them are large molecules.

Functional groups

1. A chain of carbon atoms forms a carbon skeleton.
2. The letter R may be used to denote a particular functional group of atoms are responsible for most of the properties of organic molecules.
3. Frequently encountered classes of molecules are R-OH (alcohols), R-COOH (organic acids), H_2N-R-COOH (amino acids)

Macromolecules

1. Small organic molecules may combine into very large molecules called **macromolecules.**
2. **Monomers** usually bond together by dehydration synthesis or condensation reactions that form water and a polymer.
3. **Carbohydrates**
   - Carbohydrates are compounds consisting of atoms of carbon, hydrogen, and oxygen, with hydrogen and oxygen in a 2:1 ratio.
   - Carbohydrates include sugars and starches.
   - Carbohydrates can be divided into three types, monosaccharides, disaccharides, and polysaccharides.
   - Monosaccharides contain from three to seven carbon atoms.
   - Monosaccharides may form disaccharides and polysaccharides by dehydration synthesis.
   - Polysaccharides and disaccharides may be broken down by hydrolysis, a reaction involving the splitting of water molecules.
4. **Isomers** are two molecules with the same chemical formula but different structures and properties - for example, glucose ($C_6H_{12}O_6$) and fructose ($C_6H_{12}O_6$).
5. **Lipids**
   - Lipids are a diverse group of compounds distinguished by their insolubility in water.
   - Simple lipids (fats) consist of a molecule of glycerol and three molecules of fatty acids.

- A saturated fat has no double bonds between carbon atoms in the fatty acids; an unsaturated fat has one or more double bonds.
- Phospholipids are complex lipids consisting of glycerol, two fatty acids, and phosphate.
- Steroids have carbon ring systems with functional hydroxyl and carbonyl groups.

6. Proteins

- Amino acids are the building blocks of proteins.
- Amino acids consist of carbon, hydrogen, oxygen, nitrogen, and some time sulfur.
- Twenty amino acids, peptide bonds (formed by dehydration synthesis) allow the formation of polypeptide chains.
- Protein have four levels of structure - primary (sequence of amino acids), secondary (regular coils or pleats), tertiary (overall three-dimensional structure of a polypeptide), and quaternary (two or more polypeptide chains).
- Conjugated proteins consist of amino acids combined with other organic or inorganic compounds.

7. Nucleic Acids

- Nucleic acids - DNA and RNA - are macromolecules consisting of repeating nucleotides.
- A nucleotide is composed of a pentose, a phosphate group, and a nitrogenous base.
- A DNA nucleotide consists of deoxyribose (a pentose) and one of these nitrogenous bases: thymine or cytosine (pyrimidines) or adenine or guanine (purines).
- DNA consists of two strands of nucleotides wound in a double helix. The strands are held together by hydrogen bonds between purine and pyrimidine nucleotides: A-T and G-C.
- An RNA nucleotide consists of ribose (a pentose) and one of these nitrogenous bases: cytosine, guanine, adenine, or uracil.

8. Adenosine Triphosphate (ATP)

- ATP stores chemical energy for various cellular activities.
- When the bond to ATP's terminal phosphate group is broken, energy is released.
- The energy from decomposition reactions is used to regenerate ATP from ADP and phosphate.

EXERCISES

A. Read and translate into Vietnamese

digestion, buffer, dissociates, ions, anions, cations, neutral, functional groups, macromolecules, monomers, dehydration synthesis, isomers, carbohydrates, insolubility, fatty, acids, phospholipids, protein, conjugated, nucleic acids, strands, double helix, adenosine, release, triphosphat, regenerate

B. Answer the following questions

1. What are organic compounds?
2. What are functional groups?
3. What are carbohydrates?
4. Can you give the definition of lipids and proteins?
5. What is DNA, ATP?

C. Translate into English

1. Nước, nhiều loại axit, bazơ, muối là những ví dụ về các hợp chất vô cơ.
2. Từ pH dùng để chỉ nồng độ ion H^+ trong dung dịch.
3. Dùng pH dung dịch đệm để ổn định pH trong tế bào và điều chỉnh môt trường nuôi cấy vi sinh vật.
4. Các polysacarit và disacarit có thể bị cắt mạch bằng axit hoặc enzim.

UNIT 32: STUDY OUTLINE IN MICROORGANISMS

Bacteria

1. Bacteria are one-celled organisms. Because they have no nucleus, the cells are described as procaryotic cells.
2. The three major basic shapes of bacteria are bacillus, coccus, and spiral.
3. Most bacteria have a peptidoglycan cell wall; they divide by binary fission; and they may possess flagella.
4. Bacteria can use a wide range of chemical substances for their nutrition.

Fungi

1. Fungi (mushrooms, molds, yeasts) have eucaryotic cells (with a true nucleus). Most fungi are multicellular.
2. Fungi obtain nutrients by absorbing organic material from their environment.

Protozoans

1. Protozoans are unicellular eucaryotes and are classified according to their means of locomotion.
2. Protozoans obtain nourishment by absorption or ingestion through specialized structures.

Algae

1. Algae are unicellular or multicellular eucaryotes that obtain nourishment by photosynthesis.
2. Algae produce oxygen and carbohydrates that are used by other organisms.

Viruses

1. Viruses are noncellular entities that are parasites of cells.
2. Viruses consist of a nucleic acid core (DNA or RNA) surrounded by aprotein coating. An envelope may surround the coating.

Multicellular Animal Parasites

1. The principal groups of multicellular animal parasites are flatworms and roundworms, collectively called helminths.
2. The microscopic stages in the life cycle of helminths are identified by traditional microbiologic procedures

Modern Developments in Microbiology

1. The study of AIDS, analysis of interferon action, and the development of new vaccines are among the current research interests in immunology.
2. New techniques in molecular biology and electron microscopy have provided tools for advancement of our knowledge of virology.
3. The development of recombinant DNA technology has helped advance all areas of microbiology.

Naming and Classifying Microorganisms

1. In a nomenclature system designed by Carolus Linnaeus (1735), each living organism is assigned two names.
2. The two names consist of a genus and specific epithet, both of which must be underlined or italicized.
3. In the five-kingdom system, all organisms are classified into Procaryotae (or Monera), Protista, Fungi, Plantae and Animalia.

Microbes and Human Welfare

1. Microorganisms degrade dead plants and animals and recycle chemical elements to be used by living plants and animals.
2. Bacteria are used to decompose organic matter in sewage.
3. Bioremediation processes use bacteria to clean up toxic wastes.

4. Bacteria that cause diseases in insects are being used as biological controls of insect pests. Biological controls are specific for the pest and do not harm the environment.
5. Using recombinant DNA, bacteria can produce important human proteins, such as insulin, beta-endorphin and hepatitis B vaccine.
6. Microorganisms can be used to help produce foods. They are also food sources (single-cell protein) themselves.

Microbes and Human Disease

1. Everyone has microorganisms in and on the body; these make up the normal flora.
2. The disease-producing properties of the species of microbe and the host's resistance are important factors in determining whether a person will contract a disease.

Microbes in Our Lives

1. Living things too small to be seen with the naked eye are called microorganisms.
2. Microorganisms are important in the maintenance or an ecological balance on Earth.
3. Some microorganisms live in humans and other animals and are needed to maintain the animal's health.
4. Some microorganisms are used to produce tools and chemicals.
5. Some microorganisms cause disease.

The golden age of microbiology

Rapid advances in the science of microbiology were made between 1857 and 1914.

Fermentation and Pasteurization

1. Pasteur found that yeast ferments sugars to alcohol and that bacteria can oxidize the alcohol to acetic acid.
2. A heating process called pasteurization is used to kill bacteria in some alcoholic beverages and milk.
3. Robert Koch proved that microorganisms transmit disease. He used a sequence of procedures called Koch's postulates (1876), which are used today to prove that a particular microorganism causes a particular disease.

Vaccination

1. In a vaccination, immunity (resistance to a particular disease) is conferred by inoculation with a vaccine.
2. In 1798, Edward Jenner demonstrated that inoculation with cowpox material provides humans with immunity from smallpox.
3. About 1880, Pasteur discovered that a virulent bacteria could be used as a vaccine for chicken cholera; he coined the word vaccine.
4. Modern vaccines are prepared from living virulent microorganisms or killed pathogens, and by recombinant DNA techniques.

EXERCISES

A. Read and translate into Vietnamese

bacterium, one-celled organisms, bacillus, coccus, spiral, flagella, peptidoglycan, binary fission, fungus (fungi), procaryotic cells Eucaryotic cells, multicellular, protozoans, alga (algae), photosynthesis, viruses, parasite, flatworms, roundworms, helminths, interferon, virology, epithet, italicize, welfare, bioremediation, spontaneous generation, maggot, broth, postulate

B. Answer the following questions

1. What are bacteria?
2. What are fungi?
3. What are protozoans?

4. What are algae?
5. What are microorganisms?
6. Can you name and classify microorganisms?
7. What are useful microbes in our lives?

C. Translate into English

1. Quan sát của nhà bác học Hook là những nghiên cứu cơ bản cho sự phát triển lý thuyết về tế bào.
2. Louis Pasteur đã chỉ ra rằng vi sinh vật có ở khắp nơi trong đất, trong nước, trong không khí.
3. Các phát minh của Pasteur đưa đến sử dụng kỹ thuật vô trùng trong phòng thí nghiệm và trong y học để ngăn chặn sự nhiễm tạp vi sinh vật.
4. Robert Koch đã chứng minh rằng vi sinh vật gây nên quá trình truyền bệnh.

UNIT 32 : FOOD MANUFACTURE AND NUTRITION

Many social and economic changes have aroused great interest in the role of manufactured foods in nutrition. The first group of these changes includes growing interest by the consumer in the nutritional value of foods, distrust of manufactured products, the advent of nutritional labeling and the growing interest of governmental and legislative bodies. A second group is the rapid development of food engineering and processing which results both in new foods and in traditional foods manufactured by unconventional methods. The latter is illustrated by interest in extrusion-cooking processes, reformed meat products, texturization and large-scale use of enzymatic methods. These are applicable to a wide range of foods and not only result in novel preparations but can be used in the production of conventional and even staple foods such as biscuits and bread. Extrusion cooking differs from conventional baking or any simple heat process and includes shearing effects on the foodstuffs as well as high temperatures and high pressures involving depolymerization of starches, cellulose and proteins with little-known effects on conventional value. It has been reported that dietary-fiber-like substances are formed by starch-protein interaction.

It is essential for nutritionists to keep abreast of such developments. the lesson of "instant potato" does not appear to have been learned. When this product was re-introduced onto the British market during the 1960's - having been originally marketed during the 1940's, several brands were found to be low or even devoid of vitamin C. Since the average person in Europe obtains about one third of his vitamin C from potatoes, rising to one-half in winter, and since there are many people above the average consumption, this product could have led to nutritional problems. Since then most, if not all, such products contain added vitamin C-sufficient to make the manufactured product superior to the "natural" potato. It is surprising that no one in that particular industry predicted the problem. The partial destruction of thiamin in potatoes (and 15 percent of the average intake of thiamin in Britain comes from potatoes) white with sulfite also appears to have slipped by unnoticed. It is difficult to place full responsibility for the nutritional content of food products upon the manufacturer - even American nutritional labeling is enforced only when the manufacturer makes nutritional claims. A manufacturer justifiably may claim that his product makes so small a contribution to the diet that it is unimportant whether it contains nutrients. On the other hand, a large part of our diet consists of processed foods so that between them the manufacturers should provide us with a significant part of our nutrient intake.

It might be argued that it is not possible to ban the purification of oils from their source materials, nor of purified sucrose although, together with alcohol, the average individual in the Western world is obtaining 60 to 70 percent of his energy intake from these three sources of nutritionally "empty calories". The responsibility is usually placed on the public health authorities that are given the responsibility of educating the consumers.

Changes in such thinking are already taking place and responsibility is coming to rest on the manufacturer. The British Department of Health published recommendations in 1980. Since meat is an important source of protein, iron and vitamins B_1 and B_{12} and since textured vegetable products which may replace meat may contain enough phytate and dietary fiber to render the zinc unavailable, the novel foods must contain these nutrients in specified quantity and so far as the protein is concerned, with a minimum quality. The responsibility for maintaining the nutritional value of the new form of food is being laid on the manufacturer.

Some nutritional losses are a result of food processing, storage and distribution, but all evidence indicates that the development of food processing over the last generation has led to cheaper and more abundant food supplies and, apart from isolated instances, nutritional deficiencies appear to have been eliminated. Instead our main problem is over consumption of calories, although we can never be certain that the majority of individuals are completely satisfying their nutritional requirements. With the growing concern and processed foods in Europe, the U.S., and most other developed areas, this subject of nutritional changes in food processing is becoming a matter of greater importance.

Many losses are intentional or inevitable. Major losses occur when wheat or rice is milled but this is in response to consumer demand. Similarly, the extraction of oil from their nuts or seeds, and extraction of sugar and the preparation of fish filets involve discarding of protective nutrients. The inevitable losses take place in any wet process, which leaches out water-soluble nutrients.

When losses occur, they are usually in place of losses that occur in domestic cooking, not additional such losses. Commercial preparation of frozen peas involves three minutes of blanching when 11 percent of the vitamin C was lost. When cooked for eventual consumption the product require only three minutes cooking in place of the normal six minutes and a further 30 percent loss resulted.

In comparison, fresh peas cooked for six minutes (plus 1.1 minutes required to bring the temperature to boiling point) resulted in the loss of 40 percent of the vitamin C. All canned and bottled foods are already cooked, all frozen and dried foods have been blenched and are partially cooked.

It follows that domestic cooking must be included with the term processing. It is clear those domestic preparation results in enormous losses in many homes - the evidence from institutional cooking verifies this - but there is still no evidence of any resultant nutritional harm to those consuming such foods...

EXERCISES

A. Read and translate into Vietnamese

nutrition, distrust, advent, labeling, legislature, texturization, staple foods, depolymerization, dietary-fiber-like substances, abreast, devoid, predict, slip, enforce, justifiably, diet, nutrients, phytate, render, deficiency, discarding, blanch

B. Answer the following questions

1. What are nutritional foods?
2. Name some kinds of new foods and traditional foods in Vietnam.
3. What are the kinds of fruits containing sufficient vitamin C in Vietnam?
4. What are reasons for some nutritional losses in food processing?
5. Could you say few words about food manufacture and nutritious foods?

C. Translate into English

1. Nhiệt độ và áp suất cao gây nên sự phân hủy (cắt mạch polyme) của tinh bột, xenlulôza và protein.
2. Giá trị dinh dưỡng bị mất đi một phần do quá trình chế biến, bảo quản và phân phối không tốt.
3. Thực tế cho thấy đậu tươi đun sôi trong 6 phút làm mất khoảng 40% vitamin C.
4. Đồ ăn nấu tại nhà cũng bị mất nhiều chất dinh dưỡng.

UNIT 33 : JELLIES, JAMS, PRESERVES, MARMALADES AND FRUIT BUTTER

Partly as a result of the manner in which the preserving industry developed, a clear differentiation between these products cannot always be made. Jelly is distinct from the others since it contains little or no insoluble solids. The term "preserve" and "jam" are generally used synonymously, however, preserves have sometimes been differentiated from jams on the basis of the size of the fruit pieces present, the preserve containing whole fruit or large pieces whereas jams contain the crushed or disintegrated fruit. Marmalade was originally an English product prepared from bitter varieties of oranges. American marmalades have been variously defined as fruit preserves of pulpy or semisolid consistency, as preserves consisting of slices of a fruit suspended in a jelly, and as a preserve made only from citrus fruits. Confusion in the use of the term "marmalade" could be avoided if it were restricted to preserves made

from citrus products since the other definitions apply more nearly to fruit preserves or jams. Fruit butters are the smooth, semisolid products obtained by cooking a screened fruit with either sugar or a fruit juice.

Manufacturing methods. Fruit intended for preserve manufacture should be selected and prepared by methods similar to those used in preparing fruit juices. Jellies are prepared from fruit-juice ingredients. The fruit, which may be fresh, frozen, or canned, is usually heated to aid in removing the juice and to increase the quantity of color and of pectin extracted. Firm fruits such as apples and plums are crushed, and water is added to aid in extracting the juice. The actual quantity or fruit-juice component present in extracts which contain added water is based on the soluble solids content of the extract.

Fruits may be crushed, sliced, or left whole in preparation for jam, preserve, and marmalade manufacture. The fruit may be frozen or canned if it is to be stored for future use. Fruit butters may be prepared from fresh, frozen, canned, or dried fruits. The fruit is passed through a fine screen to give the desired consistency.

The cooking process, by which concentration is achieved, also causes a partial inversion of sucrose, a partial hydrolysis of pectin, and some loss of aroma and flavor. To reduce the loss of aroma and flavor and pectin decomposition, the boiling period should be as short as possible. Three methods of concentration are used commercially. The oldest is the batch method using as open steam jacketed kettle. The size of the kettle is usually limited to 50 gal. so that rapid concentration is obtained. A second method employs evaporation under vacuum at temperatures sufficiently low to prevent flavor changes caused by heat. Larger kettles may be employed when evaporation is conducted under vacuum and the mixture is usually heated to a temperature of 180 to 190^0F either before or after concentration to obtain the desired degree of sugar inversion. The third method involves the use of continuous jelly machines, which permit an uninterrupted flow of fruit, sugar, and other ingredients into finished preserves.

EXERCISES

A. Read and translate into Vietnamese

Jellies, Jams, preserves, Marmalades, fruit butters, synonymously, crush, disintegrate, bitter varieties, pulpy, slices, citrus fruits, confusion, smooth, semisolid, a screened fruit, pectin extracted, firm fruits, consistency, inversion, partial hydrolysis, batch method, evaporation under vacuum, uninterrupted flow

B. Answer the following questions

1. Give the definition of Jellies and Jams.
2. What is preserve?
3. What is the difference between marmalades and Jams?
4. What is fruit butter?
5. Can you tell the main steps for the manufacturing of fruits into fruit butter?

C. Translate into English

1. Các loại quả có thể nghiền, cắt miếng hoặc để nguyên khi chế biến thành các sản phẩm quả.
2. Quá trình xử lý nhiệt (nấu) làm mất một phần hương vị tự nhiên của quả.
3. Có ba phương pháp xử lý nhiệt chính: nấu gián đoạn bằng hơi, bốc hơi trong điều kiện chân không và nấu dòng liên tục.
4. Các loại quả rắn như mận, táo... phải qua nghiền, chuyển hóa và bổ sung nước để chiết tách hết nước, thịt quả.

UNIT 34 : THE IMPORTANCE OF BIOTECHNOLOGY

Biological processes have had central importance in the foodstuffs industry, in particular, for thousands of years, but it is only in the last hundred years that they have been applied more intensively in chemical technology.

At the present time, modern biotechnology is capable of becoming a part of industry of increasing economic importance.

The field of operation of biotechnology consists of three large areas:

1. Microbiology, including microbial genetics;
2. Biochemistry, physical chemistry, and technical chemistry; and
3. Process engineering and apparatus constructions.

Biotechnology is developing by close interweaving between these areas and can develop further only by means of an interdisciplinary cooperation between them.

Many products can be manufactured only biotechnological. This applies particularly to most of the secondary metabolic products such as, for example, antibiotics, vitamin B_{12}, and many other, but it also applies to many products that are manufactured by a microbial transformation and which cannot be produced profitably in any other way, such as, for example, steroids and many estrogenic ovulation inhibitors that are used as "antibaby pills". At the present time about 90 antibiotics for medical use are manufactured industrially. The production of antibiotics is in the order of more than 30 000 tons per year. Even special antibiotics, such as monensin, a coccidiostat and animal feed supplement, and validamycin, which is used in Japan for the control of phytopathogenic bacteria, are already being manufactured on the ton scale.

More than 20 amino acids are offered by various industries as biotechnological prepared products. Of these the glutamic acid is particularly important with a current production of about nearly 300 000 tons per year.

More than 25 enzymes are produced technically. It is impossible nowadays to imagine the economy without their use, for example, rennet in the USA, for the manufacture of cheese, and as proteases and amylases in many branches of industry. The situation is similar with citric acid, the manufacture of which has assumed an important place in foodstuffs chemistry.

Millions of people in the world owe their lives to the use of antibiotics. The same applies to other therapeutic agents, including vaccines, which are likewise largely produced biotechnological. Many people do not realize that for us the antibiotics practically represent the "philosophers'stone" of the Middle Ages which was sought and pursued with such great labor.

Together with many different chemical and physical purification processes, the biotechnological purification of sewage is the most important means of rendering sewage harmless and clarifying it so that it can be returned to the natural water cycle.

Recent developments of biotechnology in close connection with its neighboring areas make up an increasing proportion of environmental protection. Recycling processes with biomass are currently being intensively studied and tested in order to achieve processes for the degradation of environmentally harmful substances with the aid of microorganisms.

Biotechnological industries often use ecologically beneficial processes. They frequently require less energy, since many reactions are performed at low temperatures and without substantial overpressure.

In the technical field, it has been possible in the last few years, particularly through investigations in the field of the production of biomass, to apply measuring and controlling technology, including the use of computers, to the vital processes of cells taking place in reactors. The importance of this application of modern technologies for living systems will certainly increase in the future.

Another highly interesting field is the use of fixed systems. By being fixed to matrices, both living cells and also their enzymes can be used repeatedly, and at the same time the advantages of smaller dimensions of plants are obtained, since biotechnology is usually carried out in highly diluted aqueous solutions.

Molecular biology, with its first attempts at application as genetic engineering, is certainly capable of opening up completely new possibilities for biotechnology. It has become likely that by manipulating cells, in combination with measuring and controlling techniques and the technical developments of the last few years, complicated natural substances normally very difficult to obtain can be manufactured in controlled fashion. If basic science is to understand nature and technology is to apply what is understood, a broad field is opened up here to biotechnology, which could possibly be a decisive factor in human society during the next few decades.

EXERCISES

A. Read and translate into Vietnamese

biological process, biotechnology, foodstuffs, microbiology, genetics, engineering, construction, interweaving, interdisciplinary, transformation, estrogen, ovulation, coccidiostat, therapeutic, rendering, biomass, microorganisms, matrices, molecular biology

B. Answer the following questions

1. What are the large areas of operation of biotechnology?
2. Name some main care products produced biotechnologically.
3. Why the glutamic acid is produced more than other amino acids every year ?
4. Can you say something about biotechnology in the technical field?
5. What is molecular biology?

C. Translate into English

1. Hiện nay có khoảng 90 loại kháng sinh được sản xuất trong công nghiệp.
2. Hơn 20 loại axit amin cung cấp cho các ngành công nghiệp khác nhau đều được sản xuất theo phương pháp công nghệ sinh học.
3. Ngày nay sự phát triển công nghệ sinh học liên quan mật thiết đến quá trình bảo vệ môi trường.

UNIT 35 : THE DEVELOPMENT STRATEGY OF A MICROBIAL PROCESS

Introduction

The development of a microbial process for the formation of biomass or products is aimed at maximizing three factors:

1. the yield of product per gram of substrate;
2. the concentration of the product;
3. the rate of product formation.

In order to achieve this, the following main features of a microbial process development have to be observed:

a. isolation, identification and initial selection of microorganisms;
b. determination of optimum values of nutritional requirements, temperatures, pH and oxygen supply;
c. modification of the genetic structure of the organism to increase the product formation;
d. cell cultivation systems.

All four aspects are basically concerned with the adjustment of metabolic regulation in the organism, whereby metabolism means that all of the available carbon is converted into biomass and the endproduct(s) of energy metabolism. Microbial process development can therefore be regarded as the ideal example for basic scientific research with an applied goal. The knowledge gained in such process development can then be translated into the microbial process technology, which can be classified into high, intermediate, and low or village technology. Over the pass decade, biotechnology has emphasized the development of technologies for organisms preserved in culture collections, which have never been investigated along the lines mentioned above. If one wants to develop a technology of a process, one has to know the catalyst first. The latter, of course, is the appropriate microorganism in question and its suitability for a process development.

In terms of total biomass of our planet, microorganisms are equal to the animal kingdom (including human beings), together taking about half and higher plants the other half. The question was thus raised whether mankind has taken or is taking full advantage of this almost untapped natural resource. Microorganisms are still most frequently referred to as the cause of disease in human beings, animals or plants, and only slowly do we recognize that many more types are beneficial than harmful to higher forms of life. The reasons for this increasing awareness over the last decade are the realization that biological systems may be utilized for many new purposes in addition to food production. It is the biological sciences, which have provided important potentialities for development in the second half of twentieth century and beyond.

Isolation, identification and initial selection of microbial strains.

A great number of culture collections, together with the recently established MIRCENs (Microbiological Resources Centers), contain large lists of microbial strains of more or less known

characteristics. If one looks for a particular strain, the World Data Center on microorganisms is available to locate the strain in the particular affiliated culture collection. The majority of these available strains, however, have neither been isolated nor explored with an aim to process development. It is therefore necessary to search for new, more suitable cultures, which possess the properties for producing the desired product in high yield, or reinvestigate the existing strains from culture collections with the same aim, and at the same time economically utilize the available substrate. New cultures may be found by chance observations (e.g. Fleming's culture of *Penicillium notatum*) or more likely by a systematic search.

A systematic search for new cultures may depend on two major approaches:

1. the pure scientific approach;
2. the process development oriented search.

Whichever direction is chosen, it is absolutely necessary to be well acquainted with the microorganisms, that is, one must be able to place them correctly into the system of living entities. Every isolation is connected with an evaluation of various features of microorganisms. The initial features in microbial process development would undoubtedly be related to resource utilization and/ or product formation. In sharp contrast to the usual requirements of academic research, organism isolation and initial selection for an industrial process is dependent on a range of criteria that are relevant to the optimization of the particular process. Their features may be morphological, physiological, genetically, immunological etc. and the sum of all these features of a microorganism is referred to as its phenotype. A phenotype therefore represents any measurable characteristic or distinctive trait possessed by an organism. In contrast, genotype can be explored via the phenotypic expression.

The isolation, identification and initial selection of organisms for microbial process development depends therefore on the phenotypic expression of the organism. Despite the selective aim, one should not forget that every microbial culture must possess certain general attributes:

a. the strain should be a pure culture and be free of phages;
b. the strain must be genetically stable;
c. the strain must produce readily many vegetative cells, spores or other reproductive units;
d. the strain should grow vigorously and rapidly after inoculation;
e. the strain should produce the required product within a short period of time;
f. if possible, the strain should be able to protect itself against contamination;
g. the strain should produce the desired product, which should be easily separable from all others; and
h. the strain should be amenable to change by certain mutagenic agents.

In most cases it is useful to isolate a culture from a natural resource of decomposing or organic materials. Rapid screening techniques for testing the phenotypic expression normally combines isolation and selection simultaneously. The techniques used for these tests are numerous and depend, of course, on the expected phenotypic expression. Any isolated culture should immediately be deposited with a culture collection for maintenance and preservation.

The isolation and identification of a new culture on phenotypic expression also gives some indication on the metabolism of the organism. It is of utmost importance, however, to investigate in details the basic metabolic processes of the organism as part of the selection program. Traditionally, screening procedures are based on agar plate techniques or enrichment cultures. It should be realized that both could be very restrictive if one aims at certain microbial process developments. The agar plate techniques are very important for enzyme - and antibiotic - producing strains. They give excellent results for polymer degradation (e.g. starch, cellulose) by exoenzymes or antibiotic production, that is, phenotypic expression related to products excreted out of the cell. They also could be indicators for acidic or alkaline product formation. However, these procedures are very labor-intensive and time-consuming. Enrichment cultures, on the other hand, are carried out under substrate excess conditions and thus select organisms on the basis of maximum specific growth rate. This characteristic may not be the key criterion for the process being developed. It also must be realized that in batch enrichment the time of sampling is important for the selection of the most desirable organism, since the growth conditions change as a function of time. It could therefore be possible to miss the particular stage when the particular organism is present in sufficient numbers to guarantee its isolation.

An attractive alternative has been developed more recently, which involves a continuous flow enrichment technique. This technique allows the selection and isolation of organisms on the basis of their substrate affinity (using a chemostat), maximum specific growth rate (using a turbidostat), resistance to toxic materials, etc.

Different screening techniques select therefore different types of organisms and it is in the experimenter's hand to choose which one of these techniques will lead to the isolation and selection of the microorganism wanted for the envisaged development.

It was mentioned earlier that sound knowledge in microbial biochemistry, that is the basic metabolic processes, is an absolute requirement for a successful and speedy isolation and selection program. Aerobic, facultative anaerobic and anaerobic organisms can be isolated separately for their substrate specificity, growth rate or product formed.

EXERCISES

A. Read and translate into Vietnamese

the yield, the rate of product formation, isolation, identification, selection, nutritional requirements, modification, genetic structure, cell cultivation, adjustment, metabolism, end-product, goal, disease, criteria, morphological, physiological, immunological, phenotype, agar, plate technique, exoenzymes, indicator, aerobic, anaerobic

B. Answer the following questions

1. What are the factors maximizing a microbial process for the formation of biomass?
2. Over the past decade, what field has biotechnology emphasized on?
3. What is the purpose of isolation, identification and initial selection of microbial strains?
4. What is a systematic search for new culture?
5. What are the demands for every microbial culture?

C. Translate into English

1. Những kiến thức thu được trong quá trình nghiên cứu vi sinh vật từ phòng thí nghiệm có thể áp dụng vào quá trình công nghệ sản xuất.
2. Vi sinh vật có nhiều ứng dụng có lợi nhưng nó cũng là nguyên nhân gây nên các bệnh tật cho con người và động vật, thực vật.
3. Các loại vi sinh vật hiếu khí, yếm khí và yếm khí tùy tiện có thể phân lập và nuôi cấy riêng lẻ.

UNIT 36: BIOREACTOR

In a bioreactor, the transformation of raw materials into desired products is carried out by the enzyme systems of living microorganisms or by isolated enzymes.

The cells continuously strive by modifying their environment to achieve and maintain the optimal conditions for their growth. In a bioreactor, this tendency of the cells is assisted. The reactor has the task of ensuring the supplying of the cells with the means for growth or for the production of metabolites, i.e., of guaranteeing as far as possible the optima of temperature and pH and a sufficient supply of substrate, nutrient salts, vitamins, and oxygen.

The optimum conditions for the selected strain must be determined experimentally. This is carried out in the laboratory, frequently in shake cultures. However, these have the disadvantage that their pH value and the concentration of dissolved oxygen cannot, as a rule, be controlled. Consequently, only the optimum temperature and composition of the nutrient solution and the supplementation of the substrate in them can be determined. The optimization of the pH and of the concentration of dissolved oxygen in the medium is generally carried out in small laboratory reactors which should be provided with a pH control and, if possible, with stirrer speed and gas flow measurement.

To find the optimum conditions for the enzyme reactions, the same laboratory units can be used as for fermentations. The products of these biochemical reactions must be separated from the medium, purified, and, if necessary, processed further. The unconverted or unconsumed components of the medium and the intermediate products and by-products must be utilized elsewhere or be disposed of without harming the environment.

The total manufacturing process must be carried out in such a way that when all the boundary conditions are satisfied. The product is competitive with respect both to quality and price. Since, in general, an increase in the production capacity of a unit lowers both the product-specific investment costs and the variable costs, attempts are made to erect large single-line units. In the case of fermentation products, this economic drive leads to large fermenters. This requires knowledge on the design of large

reactors. The information obtained in small units is not adequate for large scale design, since the fluid dynamics, the transport processes, and even the behavior of the cells may change considerably (e.g., by an intensification of turbulence) when the size of the unit is increased. For these reasons, the laws that operate in the geometric enlargement of a reactor should be known. Because of the absence of this information, pilot plants have to be constructed which subdivide the large step of this "scaling-up" procedure between laboratory and production units in order to reduce the risk involved in the design of the production unit.

Most of the information that is discussed below was obtained on small pilot plants. Only a few results from industrial demonstration plants have been published.

In process engineering, the passage from the model to the production unit can often be facilitated with the aid of similarity theory. In general, this theory can be used to only a limited extent in chemical and biochemical reactors, since when the unit is enlarged the geometric similarity is not necessarily matched by that of fluid motion and mass transfer of the individual transport processes. If, however, a single parameter is rate determining, similarity theory can be very helpful in the calculation of reactors.

Similarity theory deals with the criteria, which permit a calculation of the performance of a system on the large scale, based on small-scale model experiments. For each elementary process, the process-determining factors can be comprised within a characteristic number which must remain constant during the enlargement of the reactor if the similarity between the laboratory and the pilot reactors (or between the pilot and production reactors) in relation to this process is to be preserved. If this similarity exists, the results that were obtained on laboratory or pilot reactor scale can be used for the production reactors, also.

In order to reduce the number of variables these quantities are brought together according to definite rules to form dimensionless characteristic numbers (dimensional analysis). The results found in the laboratory or pilot reactor are then correlated by a combination of these characteristic numbers.

Before the mode of operation (discontinuous, continuous, semicontinuous), the type, the size, and the operating conditions of the reactor are determined, a preliminary choice must be made of the mode of operation and of the type of reactor, which are predetermined by the organisms used, the media, the characteristics of the biochemical process, and the site. The mode of operation and the type of the reactors for enzymatic transformations are affected by a comparatively small number of properties (molecular mass, stability) of the enzyme. To discuss these questions quantitatively, some basic concepts must first be defined.

EXERCISES

A. Read and translate into Vietnamese

bioreactor, transformation, modify, environment, disadvantage, nutrient solution, supplementation, boundary, fluid motion, mass transfer, parameter, large-scale, dimensional, analysis, mode of operation, type of reactor

B. Answer the following questions

1. What is the main process that occurs in a bioreactor?
2. What are the optimum conditions for enzymatic actions in a bioreactor?
3. What is "scaling-up" for designing the bioreactor?
4. Can you apply the information obtained in lab or pilot reactor scale to production reactors?
5. What are the modes of operation in the reactor?

C. Translate into English

1. Các điều kiện thích hợp cho việc chọn chủng vi sinh vật phải được xác định bằng thực nghiệm.
2. Các điều kiện thích hợp cho các phản ứng enzim phải được nghiên cứu từ phòng thí nghiệm như một quá trình lên men.
3. pH, nhiệt độ và nồng độ oxy hòa tan thích hợp trong môi trường nuôi cấy phải thu được từ thiết bị phản ứng trong phòng thí nghiệm.

UNIT 37 : ETHYL ALCOHOL

Ethyl alcohol may be derived from four classes of raw materials:

1. saccharine materials/ containing sugar, such as molasses, sugar beets, sugar cane/
2. starchy materials/ cereal grains, potatoes, etc./
3. cellulosic materials /wood, agricultural residues/ and
4. hydrocarbon gases.

With the first class of raw materials, alcohol is produced by the fermentation of sugars with yeast. Raw materials of the second class consist of the more complex carbohydrates, such as starch, which must first be converted to fermentable sugars by enzymatic action using malt, or by the use of molds or of mineral acids. The cellulosic materials of the third class are converted to fermentable sugars by hydrolysis with mineral acids. With the fourth class of raw materials, the processes used are entirely different, and no biological organisms are used.

Fermentation - The molasses must first be brought to the appropriate conditions. Water is added to bring the sugar concentration within the desired range, 12%-15% being frequently used. When the concentration is too high it reacts adversely on the yeast, i.e. the alcohol produced may inhibit the action of the yeast, with the consequence that the fermentation time is prolonged and some of the sugar is not properly utilized. The use of too low a concentration of sugar is uneconomical. Although molasses generally contains most of the nutrient substances required for fermentation, ammonium salts, such as ammonium sulfate or phosphates, may be added to the mash to supply deficiencies in nitrogen or phosphorus.

Fermentation proceeds satisfactorily when the mash has been adjusted to a pH of 4.5 to 5.0. Sulfuric acid is commonly used to adjust the reaction of the mash, although lactic acid is satisfactory. The temperature of the mash when inoculated should be in the range 60 - 80^0F, depending on the external temperature.

The starter is then mixed with the mash in the fermentation tank. For the first few hours multiplication of the yeast cells takes place up to a concentration of about 150,000,000 cells per ml and depending somewhat on the strain used . The optimum temperature for yeast propagation is 86-88^0F. A vigorous fermentation then sets in, during which carbon dioxide is given off rapidly. The time for the whole process depends on the temperature, sugar concentration, and other factors.

EXERCISES

A. Read and translate into Vietnamese

ethyl alcohol, saccharine materials, molasses, sugar beets, sugar cane, starchy materials, cereal grains, cellulose materials, agriculture residues, hydrocarbon gases, fermentable sugars, enzymatic action, malt, molds, hydrolysis, fermentation, yeasts, ammonium sulfate, phosphates, mash, adjust, inoculate, starter, multiplication, yeast cells, strain, propagation

B. Answer the following questions

1. How many classes of raw materials are used in producing ethyl alcohol?
2. What is the fermentation of the molasses in producing ethyl alcohol?
3. Why the mash beer adjusted to an optimal pH?
4. What is the optimal temperature for the culture of yeasts in fermentation process?
5. What is the concentration of the yeast cells in the starter for inoculation in fermentor?

C. Translate into English

1. Rượu êtylic được tạo thành do quá trình lên men các loại đường có khả năng lên men bằng nấm men như *S. cerevisiae*.
2. Rỉ đường phải được pha loãng, xử lý và bổ sung nitơ, muối amôn và muối phôtphát.
3. Chúng ta phải điều chỉnh nhiệt độ và pH của dịch lên men.

UNIT 38 : DISTILLATION

Distillation consists in the vaporization of a substance, either liquid or solid, and the condensation of the vapors in a vessel other than the one used for the vaporization.

A single, individual substance may be distilled readily with an ordinary distillation apparatus consisting of a distillation flask fitted with a thermometer and appropriate condenser. If the substance is low boiling and particularly if it is flammable, the flask is heated by a water bath or on a steam cone.

In both laboratory and technical operations the problem often arises of separating or purifying by distillation a mixture of two or more liquids, all of which are present in appreciable amounts. The separation of such a mixture into various fractions, some of which are rich in a particular component, often may be achieved by what is termed fractional distillation. Fractional distillation consists essentially in the systematic redistillation of distillates. Fractionations can be carried out using an ordinary distilling flask, but in cases where the components do not have widely separated boiling points it is a very tedious process. A device known as a fractionating column is essentially an apparatus for performing a large number of successive distillations without the necessity of actually collecting and redistilling the various fractions.

A fractionating column is so designed that it provides a continuous series of partial condensations of the vapor and partial vaporizations of the condensate and is similar in effect to a number of separate distillations. The column consists of a long vertical tube or series of bulb through which the distilling vapor passes upward and is partially condensed; the condensate flows down the column and is returned eventually to the distillation flask. In the column the returning liquid is brought into intimate contact with the ascending vapor, and a heat interchange occurs, whereby the vapor is enriched in the more volatile component at the expense of the liquid. To obtain a good separation it is necessary to have a large amount of liquid continually returning through the column, a thorough mixing of liquid and vapor, and a large active surface of contact between liquid and vapor.

Steam distillation offers a convenient means of separating many organic materials that are substantially immiscible with water. The operating of the apparatus for general-purpose steam distillation is based on two principles: direct steam distillation and recycle of the condensed water phase. The heterogeneous mixture of water and organic substance is heated in the distilling flask to form the two-phase vapor. The condensate from the attached reflux condenser separates in the straight column. This column acts as a receiver when the three-way stopcock is closed. When water appears as the top layer, it continually over-flows through the upper feedback into the distillation flask for re-use. The organic product accumulates in the receiver. When water appears as the bottom layer, its recycle is affected through the lower feedback via the three-way stopcock. In either case, the organic layer may be drawn off through the same stopcock at any time.

EXERCISES

A. Read and translate into Vietnamese

distillation, vaporization, condensation, thermometer, flammable, a steam cone, separation, fractional distillation, bulbs, systematic redistillation, components, tedious process, a fractionating column, partial condensations, ascending vapor, a heat interchange, recycle, substantially immiscible, stopcock

B. Answer the following questions

1. Give the definition of the distillation.
2. What is the method of fractional distillation?
3. What is the advantage of a fractionating column for separate distillation?
4. What is the convenience of steam distillation?
5. What is the three-way stopcock?

C. Translate into English

1. Thiết bị chưng cất đơn giản bao gồm 1 bình cất nối với nhiệt kế và một bộ ngưng tụ tương ứng.
2. Chưng cất phân đoạn dùng để tách một hỗn hợp gồm các cấu tử có nhiệt độ bay hơi khác nhau trong chất lỏng.

3. Tháp chưng cất được thiết kế gồm hàng loạt các bộ phận ngưng tụ hơi liên tục để tăng nồng độ chất ngưng tụ trong dung dịch.
4. Chưng cất bằng hơi nước dựa trên 2 nguyên tắc: chưng cất hơi bay lên trực tiếp và tuần hoàn hồi lưu lại một phần.

UNIT 39*:* BEER AND ALE

Beer and ale are malt beverages, produced by fermentation, each having a characteristic flavor and aroma. They must contain not less than ^{s} of 1% of alcohol. Their alcoholic content generally ranges between 3 and 6% by volume. A gallon of beer or ale weighs $8^3/_4$ lbs. Beer and ale are similar, but beer is produced by bottom fermentation/ although this procedure is not always used/, and ale by top fermentation. The type of yeast used, the temperature of fermentation, and, in rare cases, bacterial action, all influence the characteristics of the brew.

The general process of producing beer, ale, and similar products, is called brewing. Barley malt is first made by sprouting grain and drying the malt, which develops, among other things, the enzyme, diastase. The malt is dried at about 50^0C to 120^0C for light-colored beer, and up to 160^0C-200^0C or higher for darker beers, ales, porters, and stouts. The malted barley, the most important ingredient, is ground, mixed with warm water, into a mash. The other ground but unmalted cereals are, when used with Malt and other Enzymes as Termamyl-120L at different Temperratures as 75^0C; 86^0C,95^0C, boiled in water in certain duration of times, Then cooled, or run into large copper brewing kettles with malt and other enzymes at about 50^0C; 63^0C and 73^0C in certain duration of Time. During this period the ruptured starch grains are converted into fermentable sugar. This liquid obtained after the filtration the mash , now called wort, it boiled with 2% or more of hops in a hop jack. The filtered and cooled liquid is then yeasted, and after fermentation is drawn into settling and maturing vats. Some brews retain a great deal of carbon dioxide of fermentation but many must be artificially carbonated to some extent so that they may have the full standard effervescence before being put into commercial kegs, bottles, and cans. The uses of corn products, rice and brewer's sugar as substitutes for malt reduce the content of protein, ash, and phosphoric acid in the finished beer.

EXERCISES

A. Read and translate into Vietnamese

beer, beverage, characteristic flavor, aroma, gallon, bottom fermentation, top fermentation, bacterial action, brewing, barley malt, sprouting, enzyme, diastase, light-colored beer, darker beer, mash, unmalted cereals, kettles, rapture, fermentable sugar, wort, hop, maturation, maturing vats, artificially carbonated, effervescence, kegs, cans, substitutes

B. Answer the following questions

1. What is beer and ale?
2. Generally, what is the percentage of alcohol in beer?
3. What is barley malt?
4. What is the main difference between the light-colored and dark-colored malt?
5. What is hop? Is it necessary for the production of beer?

C. Translate into English

1. Bia là một loại đồ uống lên men từ dịch malt đại mạch và có mùi vị thơm đặc trưng của malt và hoa huplông.
2. Lên men bia theo hai phương pháp: lên men nổi và lên men chìm.
3. Trong quá trình nấu bia, các hạt tinh bột được chuyển hóa thành đường có khả năng lên men.
4. Các nguyên liệu thay thế được dùng để giảm lượng malt đại mạch và lượng protein, lượng tro trong bia.

UNIT 40 : POST-HARVEST SYSTEM

This section outlines the steps involved in traditional processing of cereals. It is vital that project planners and managers consider the traditional technologies in their particular socio- economic context when introducing any technical improvements or adaptations. The following main components of the post-harvest food system are discussed.

Harvesting, threshing, winnowing, drying and storage primary processing methods

Post harvest grain losses are a major concern in the traditional system. This section describes some improved technologies, which have been developed to further reduce losses and increase productivity in cereal processing together with essential relevant technical background. Most of the cereals discussed are processed in much the same way, but where relevant, differences in processing techniques are mentioned.

Harvesting

There is an optimum time for harvesting which depends upon the maturity of the crop and climatic conditions and has a significant effect on the subsequent quality of grain during storage. Harvesting often begins before the grain is fully ripe and extends until mould and insect damages are prevented. Grain not fully ripened contains a higher proportion of moisture, and will deteriorate more quickly than mature grains because the enzyme systems are still active. If the grain remains in the field after maturity, repeated wetting from rain and dew at night, along with drying by the hot sun by day, may cause grain to crack .Advice is therefore frequently necessary on the correct harvesting time.

Cereal crops are traditionally harvested manually, requiring high labor demand and therefore in many situations providing an important means of work to landless laborers.

Threshing and Winnowing

Threshing is the removal of the grains from the rest of the plant. In the case of maize the removal of the grain from the cob is referred to as shelling. Most manual threshing methods use some implement, the simplest is stick or hinged flail with which the crop, spread on the floor, is beaten. Such tools are simple and cheap but they are also laborious to use. Maize is shelled mainly with the bare hands, by rubbing one cob against another. Threshing and shelling will contribute to losses if carried out in a manner that results in cracking of grains. Other traditional methods of threshing, such as use of animals to trample the sheaves on the threshing floor or the modern equivalent using tractor wheels may result in loss of unseparated grain. This method also allows impurities to become mixed with the grain, which may cause subsequent storage problems.

Winnowing involves separating the chaff from the grain, if there is plenty of wind, the threshed material is tossed in the air using forks, shovels, baskets, etc. The lighter chaff and straw blow away while the heavy grains fall more or less vertically. Final cleaning may be done with a winnowing basket, which is shaken until any chaff and dust separate at the upper edge. An alternative method is to use winnowing sieves or open weave baskets. Separating impurities from threshed grain can require almost as much labor as the original threshing. Once threshed the grains much be dried and stored. In many cases these two functions are performed together so that grain is drying during storage.

Drying

During drying the moisture content of the grain is reduced. This helps prevent germination of seeds, the growth of bacteria and fungi and considerably retards the development of mites and insects. In traditional method the rate and uniformity of drying is difficult to control, as it depends on the prevailing environmental conditions. Moreover, it is essential that food grains be dried quickly and effectively. However, in most cases, regardless of the disadvantages, the small farmer still prefers sun drying because it is cheap and simple.

Air is one environmental factor used as the drying medium, causing water to vaporize and conveying the moisture vapour away from the grain. The moisture carrying capacity of air is dependent upon its temperature and increases with the rise in temperature (e.g. at 30°C the air is capable of holding twice as much moisture as 16°C). Reducing post harvest grain losses during drying is a major objective of an improved technology. Some of the following traditional drying methods highlight where losses can occur.

The simplest and most common method is to lay the cut stalks on the ground in the fields, either in swaths of loose bundles or stacks or heaps, until the crop is dry. When the plants are piled in large stacks they may suffer from lack of circulation leading to sprouting, discoloration, and microbial damage.

Sometimes racks are used for hanging unthreshed sorghum, millet, and paddy. Most racks are designed to permit air movement through the drying material.

At the homestead the crop is further dried by spreading on woven mats, hard surfaces including roads, plastic sheets, or on the roof or ground. The drying time depends on the prevailing climatic conditions. Some farmers periodically turn or rake the grain during the drying period in order to obtain uniform drying. During rainy period the crop must be protected until the weather is again favorable. In other cases some farmers dry their produce on raised platforms of various shapes.

After drying many farmers store their produce in the home, where the smoke and heat produced during cooking helps complete the drying of the grain and reduces insect infestation. The smoke produced and heat lost in traditional cooking stoves thus serve a useful purpose, which should not be ignored in the development of improved stoves.

Storage

Traditional storage systems have evolved over long periods within the limits of the local culture. Large amount of grain for human consumption is stored containers constructed of plant material, mud, or stones, often raised off the ground on platforms and protected from the weather by roofing material. The design and materials vary according to local resources and custom. In the humid areas of the Ivory Coast, Tanzania, and Kenya, maize is dried from a tree, by hanging it on tacks, or by suspending it from poles. Because of the fear of theft, and because of the problem of rain, rodent, and other predator, these methods are becoming less popular. In the parts of East Africa and Central America wood ashes or rice husk ash is mixed with grain being stored to control infestation.

Storage conditions influence the rate of deterioration of grains. High temperatures and humidities encourage mould growth and provide condition for rapid growth of insect, in cool, dry areas, more marked in hot, dry ones, high in cool and damp conditions, and very high in hot, damp climates.

EXERCISES

A. Read and translate into Vietnamese

context, harvesting, threshing, winnowing, , ripe, mould, insect, , proportion, deteriorate, dew, likelihood, cob, shelling, hinged flail, bare hands, trample, sheaves, chaff, tossed, forks, shovels, baskets, straw, edge, weavebaskets, germination, mites, conveying, cut stalks, swaths, loose bundles, stacks, heap, sorghum, millet, paddy, woven mats, rodents, predator

B. Answer the following questions

1. What are the main steps of the post-harvest food system?
2. What does the optimum time for harvesting depend on?
3. What are the purposes of threshing and winnowing?
4. Why is it necessary to dry the grains after harvest?
5. What are the most suitable conditions for storage the dried grains?

C. Translate into English

1. Các tổn thất của hạt sau khi thu hoạch là mối quan tâm chủ yếu của người sản xuất.
2. Các công cụ đơn giản vẫn được dùng trong tuốt lúa và tách hạt ngô thủ công ra khỏi cọng lúa và lõi ngô.
3. Các phương pháp sàng, sảy, quạt được dùng để tách các tạp chất khác nhau khỏi hạt.
4. Không khí nóng được dùng để tách nước khỏi hạt làm cho hạt được khô nhanh nhất.

UNIT 41 : SECONDARY PROCESSING - CEREAL BASED FOODS

After primary processing, cereal products, flour or whole grain are further processed in the home and by small cottage industries into final products including foods with a porridge or dough consistency, baked products, whole grain goods, past and noodles, fermented drinks, snack foods, and weaning foods. Cereal-based foodstuffs such as these below are important both for home consumption and as a potential source of income.

Foods with a porridge or dough consistence

Flours from indigenous crops (sorghum, maize, millet, rice) can be mixed and stirred with boiling water to a dough consistency and formed into balls either with or without prior fermentation. Foodstuffs such as 'banku' and 'ugali' made from maize consumed in Western and Eastern Africa respectively and 'sankati' and 'tuivo' made from sorghum and consumed in South India and Nigeria respectively, are examples of non-fermented foods. Fermented types such as 'kenkey' in Ghana and 'bagone' in Botswana are prepared by leaving the whole grains to soak in water for a few days to allow fermentation before grinding to flour for mixing with water as before.

These dough-like cereal foodstuffs provide the basis for a daily meal in many households in Africa.

In India, fermented rice foodstuffs such as 'dosais' (rice cakes) and 'idlies' (rice pudding) are prepared from a mixture of rice and pulses.

Baked products

Unleavened breads made with maize, wheat or sorghum is popular worldwide as a daily food item. For example, 'chapatti' or 'roti' are consumed in India, 'kisra' in Sudan and 'tortillas' in Latin America.

Leavened breads are based on wheat flour and the popularity of these products is in many cases forcing countries to import wheat. The supplementation of part of the wheat with non-wheat flours has produced satisfactory bread formulations. It must not be overlooked, however, that such products are not identical to ordinary wheat flour bread and may therefore cause problems of acceptability.

Whole grain foods

Rice is consumed in the tropics mainly as a whole grain, cooked by boiling or frying. Pearled sorghum may be eaten in a similar way, while maize can be roasted or boiled on the cob.

Pasta and noodles

These are popular foodstuffs consumed in large amounts, which form the basis of daily meals in many countries. Pasta products require the use of wheat flours, but many noodle-like products, such as Srilanka string hoppers, are based on rice.

Fermented drinks

For many women informal beer production is very important source of income, but the competition from the 'modern' sector with local production has been observed in many parts of the Third World. It has been shown, for example in Zimbabwe, that as income rises, a larger amount of western or 'modern' beer is consumed to the detriment of local traditional activities. Local brewing, however, is not likely to disappear in the near future. Beers can be made from most cereals after they have been 'malted' or allowed to germinate. Examples include sorghum beer, rice wine and maize beers.

Snack foods

A whole range of snack foods can be made by extruding a flour paste into strands, (egg vermicelli) curls or flakes, by popping (as in puffed rice or popped corn) or by drying to thin sheets (e.g. Papads). Flavored mixes such as 'Bombay mix' are also popular.

Weaning foods

Simple weaning foods based on cereals blended with other ingredients can be produced at a small scale. Obviously great attention has to be paid to the composition of the product, the avoidance of any ingredient that might be toxic and unsafety from the point of view of hygiene. Small children require essential nutrients such as protein, fat, vitamins, and minerals in the correct proportions and a blend must satisfy this need.

EXERCISES

A. Read and translate into Vietnamese

porridge, dough, baked products, pasta, noodles, snack foods, weaning foods, indigenous, soak, grinding, pulse, pearled sorghum, hopper, extruding, strands, curls, flakes, puffed rice, popped corn

B. Answer the following questions

1. What are the common final products as foods based on cereals?
2. Can you mention some foods with a porridge or dough consistency in Africa, in India and in Vietnam?
3. What are baked products in Latin America or in Sudan?
4. What are the main whole grain foods in Vietnam?
5. What are the purposes for preparing of weaning foods?

C. Translate into English

1. Mì ăn liền là loại thực phẩm phổ biến dùng hàng ngày ở nhiều nước trên thế giới.
2. Các loại thức ăn dạng 'snack food' được sản xuất bằng công nghệ ép đùn và nấu chín từ hỗn hợp các loại bột, trứng, gia vị,...
3. Trẻ con cần khẩu phần ăn đủ các chất dinh dưỡng như protein, chất béo, vitamin, và các muối khóang với tỷ lệ cân đối.

UNIT 42 : PROCESSING TECHNIQUES AND EQUIPMENTS FOR ROOT CROPS

Traditional processing of root crops has developed to suit local situations. A whole range of processing techniques, equipments and products has been developed which vary not only from country to country but also within individual countries. It would not be feasible to describe all the variations that exist, so in this section we shall look at typical processing systems used in Africa, Asia and Latin America. A description of some traditional equipments is allowed by an account of traditional processing methods covering the more common products in areas of the three regions. The products described are arranged by crop type. In view of the emphasis on cassava so far in this section will start by looking at some of the other important root crops. Prior to recommending methods for improving traditional processing systems, it is essential to understand fully how and why they have been developed, how they fit into local social conditions and the relevant food science principles outlined earlier. The examples of some equipments and commercial products are given as following:

Traditional equipments

The items described below are very simple, low in cost and available locally. These important factors determine the suitability of equipments to local processors. Most of the items have been designed for cassava processing because of the more elaborate procedures involved making this crop safer to eat.

Peelers

Peeling of roots is commonly carried out using knives made of bamboo, flint or metal.

Graters

Examples of the wide range of traditional graters used particularly for cassava include, in South America, rough stone, the prickly trunk of palms and shells. A stone or piece of wood covered with shark skin or sharp stones set in basketwork has been used in the West Indies. Graters made from flat pieces of wood into which splinters of thorn, teeth or fish bone are driven or embedded in a wax coating are used in Venezuela, parts of the Amazon and Brazil.

In Ghana, Nigeria and Sierra Leone graters are made from sheets of tin or iron which have been pierced with nails on one side in order to produce a rough surface on the other.

Presses

The 'Tipiti' is used in Latin America, particularly in Brazil, for de-watering cassava. It is a complex cylindrical basket press, which is diagonally woven, such that it can be stretched lengthwise to squeeze its contents. It is suspended from a beam or tree while the lower loop is weighted down with a stone or a pole is inserted so that one can exert pressure by pulling. More simply, strips of bark are spirally wrapped around the grated cassava and twisted to squeeze the contents.

Such devices are not found in Africa where bags filled with cassava pulp are commonly pressed with heavy stones.

Sieves

Woven baskets or suspended cloth pieces holding the mash are used to allow the liquid to drain away or separate excess fibrous material.

Pounding/ Grinding equipment

In South America and Africa pestles and mortars made of heavy wood are used to pound both fresh roots prior to processing and also to produce flours. Some of these may be large enough to require as many as eight women pounding simultaneously.

Roaster

A whole range of systems is used to roast root crop products over a fire. Examples include pans; oil drum cut in half and specially constructed raised clay semi-circles common in Nigeria. As the material is roasted it is continuously turned with a wooden spoon or calabash.

EXERCISES

A. Read and translate into Vietnamese

feasible, describe, relevant, peelers, graters, prickly trunk, splinters, sheets of tin, pierce, nails, diagonally, woven, squeeze, beam, the lower loop, pulling, strips of bark, twist, sieve, woven basket, pounding, grinding, roaster, semi-circle

B. Answer the following questions

1. What is the purpose of peelers?
2. What are the graters made from?
3. What is the purpose of sieves?
4. Is it difficult to cultivate the potato as comparision with cultivation of cassava?
5. What is the name of toxic complex containing in cassava?

C. Translate into English

1. Kỹ thuật chế biến, thiết bị và các sản phẩm đã phát triển và thay đổi theo các nước, và ở những vùng khác nhau trong một nước.
2. Thiết bị nghiền các loại củ đơn giản ở các nước Nam phi và Nam mỹ có khi chỉ dùng cối, chày,...
3. Thông thường người ta ăn khoai tây, sắn dạng củ tươi luộc chín hoặc dạng tinh bột hay các loại thức ăn sẵn khác.

UNIT 43 : INTRODUCTION TO BISCUIT - MAKING

What is a biscuit?

One of the difficulties in writing about biscuits is that the very word means different things to different people. In America the word 'biscuit' is used to describe a chemically leavened bread-type product the nearest equivalent of which in the UK might be a scone. The products known as 'biscuit' in the UK are called 'cookies and crackers' in the USA. Throughout this book - which is being written by an English man - the word 'biscuit' is used as a generic term to include 'Biscuit, Cookies and Crackers'.

Outline of the Basic Processes used in Biscuit - Making

Commercial biscuit manufacture comprises a series of highly mechanized operations, which progressively convert the original ingredients into the finished products. Dough mixing is still frequently carried out as a batch operation but the remainder of the processing steps is now usually continuous. The design of equipment used at each stage can vary quite widely and the operating conditions have been determined by previous experience refined by an on-going process of trial and error. The changes taking place during each of the processing stages and the factors affecting these changes are the subject of this unit.

Ingredient metering

Most large biscuit factories now receive and store their main ingredients - flour, fat, sugar, syrups, etc. - in bulk. The required amounts of these ingredients are then metered automatically into the appropriate dough mixer as required. However smaller ingredients and 'chemical' (salt, sodium bicarbonate, aerating agents, etc.) are still frequently weighed out and added to the mixers by hand.

Dough mixing

With the possible exception of some yeast-leavened products subject to a long fermentation process, biscuit dough mixing is much more than a mere intermingling of the ingredients. Some processing also takes place. Dough mixing conditions fall into two main groups. One group consists of the hard doughs where the flour protein is converted into a gluten network. The second group consists of the short and soft doughs, where the conditions are chosen to minimize the formation of a gluten network. The hard doughs are very stiff and tight, particularly during the early stages of mixing, and require considerable amounts of work input from the mixer motor. This work is converted to heat via frictional forces and produces a significant increase in the temperature of the dough. It is for this reason that such doughs are sometimes known in the USA as 'hot' doughs. With short and soft doughs the work input to the dough during mixing is small and the temperature of the finished dough depends primarily on the temperatures of the major ingredients at the time they enter the mixer

Formation of the dough piece

Biscuit-shaped dough pieces for crackers and semi-sweet products are cut from continuous sheets of hard dough. The stiff, visco-elastic properties of these doughs require them to be formed into sheets of the required thickness by rolling with heavy steel rolls. Cracker doughs require extensive processing to build up a series of thin layers, or laminations, in the final dough sheet. These laminations are necessary in order to obtain the desired flaky structure in the finished biscuit. Doughs for making semi-sweet biscuits on the other hand, if treated with an appropriate dough-conditioning agent, merely require rolling in order to obtain a suitable sheet from which dough pieces can be cut.

Some short doughs are also cut from a continuous dough sheet but owing to their lack of conhesion such doughs are more difficult to handle in this manner. The majority of short doughs are currently formed into the shapes required by compression into dies engraved on a carefully designed roller. The equipment used for this process is known as a rotary moulder. Doughs which are to be formed on a rotary moulder require somewhat less water to be added to the doughs during mixing compared with those which are to be sheeted and cut. Short doughs with a high fat content, i.e. soft doughs, are usually formed into the required shape by extrusion, the extruded dough being subsequently cut to the required size by an oscillating wire (wire-cut cookies) or a guillotine (root-or bar-press products)

Baking and cooling

Large scale biscuit baking is now universally carried out in tunnel ovens (usually referred to incorrectly as ‘travelling ovens’) varying in length from about 30 to about 150 m. The products travel through the ovens on continuous baking supports which may be up to 1.2 m wide. Baking times vary from about 1 min to about 15 min, according to the product. Apart from some cracker products, which may be oil sprayed immediately after baking, most biscuit must be cooled considerably before they can proceed to secondary processing or packaging. This cooling in normally achieved by transferring the biscuits in a single layer or in a shallow ‘penny stack’ formation, onto a canvas conveyor and allowing them to travel around the factory for a time which may be typically one-a half to two times the baking time.

EXERCISES

A. Read and translate into Vietnamese

scone, merely, meter, intermingling, oscillating, wine stiff, tight, laminate, flaky, engrave, guillotine, shallow, penny stack, canvas

B. Answer the following questions

1. What is a biscuit?
2. What are the main ingredients in making biscuits?
3. Can you tell some things about dough mixing and formation of the dough pieces?

4. What is the purpose of baking and cooling in biscuit making?
5. Can you say some sentences about biscuit making?

C. Translate into English

1. Quá trình phối trộn bột nhão thường tiến hành gián đoạn nhưng có một số công đoạn được tiến hành liên tục.
2. Bột nhào xong cần cán mỏng thành lớp mỏng và cắt thành hình tròn như đồng xu.
3. Hiện nay các loại lò kiểu hầm tunel được dùng để nướng bánh bích quy.

UNIT 44 : VEGETABLE PROCESSING

The demand for preservation of vegetables for home consumption does not seem to be as great as for fruits. Preservation of vegetables for the market has a different characteristic in composition with fruits. As is mentioned in this section, the low acidity of the majority of vegetables makes some processing methods, such as canning, more difficult and less to be recommended for the persons without the necessary skills, equipments, and experiences using it.

The essential difference however between fruits and vegetables (high versus low acidity) must always be borne in mind. Improvements in the preservation of vegetables can be achieved by looking into better storage methods for fresh crops. Again, it should be stressed that if a vegetable-processing venture is being seriously considered, advice should be obtained from a qualified technical source.

The canning of vegetables cannot be recommended for small-scale production. Equipment costs are high and unless stringent control is maintained there is a real danger of causing food poisoning.

This unit is concerned with the processing methods for preservation of vegetables, which are safe for small-scale operation, and avoid costly investment.

There are:

- Salted/ brined and pickled products.
- Fermented vegetable products.
- Dried vegetable products.

1. Salted/ Brined and Pickled Vegetable Products

a. Dry salted vegetable products

In dry salting the food material is covered with salt and left for some time for the salt to penetrate the tissues.

The action of solid salt is quite complex, but essentially involves drawing out the moisture from the fruit or vegetable by osmotic pressure. The use of solid salt dates back to ancient times. It was found to have many useful properties, especially as a preservative of animal tissues, which give better results than vegetable tissues.

This is due to the different structure and chemistry of vegetables from those of meat or fish.

Salted vegetables must be washed in clean water to remove the salt to a level where the vegetable becomes palatable prior to use.

While salt is very important in the preservation of vegetables it is often used with some other preservatives such as vinegar.

The salting method does have disadvantages. Vegetables loose many of their nutrients through salting and should in fact only be salted when there are surplus fresh vegetables available and when other methods of preserving cannot be used.

The use of small amounts of salt with acid fermentation, as described later, can produce foods of better nutritional value.

b. Brined vegetable products

This preservation method has much in common with dry salting except that the vegetables are preserved in a solution of salt. The main disadvantage of brining is that the preserved vegetables can not be kept for long, after opening, if palatable levels of salt are used. A higher concentration would improve the keeping qualities of the preserve, but would also make it very unpalatable without washing. The

exclusion of air is essential to prevent the growth of yeasts on the surface. The quality of the salt is also of great importance. If the salt tastes bitter, its use is not recommended.

Brining vegetables, in bulk in barrels is a good way of preserving them where they are grown so that they can be transferred to other places for later processing.

c. Vegetable pickles and sauces

Whole range vegetable pickles can be made using vinegar and sometimes sugar. Prior to pickling many vegetables are dry salted or brined, the dry method being preferred if a crisp final texture is required. Removal of excess salt by washing may be necessary prior to use in the final product.

Some vegetables require blanching, a short hot water or steam treatment which prevents the action of enzymes and reduces the initial contamination of micro-organisms.

The production processes after these stages are more or less identical to those seen already for fruit pickles.

2. Fermented vegetable products

Fermentation of vegetables will take place when lactic acid bacteria ferment the sugars present in the vegetables. Lactic acid fermentation takes place in the absence of air at very carefully controlled conditions of pH and salt content.

Common fermented vegetables include German Sauerkraut or Korean Kim chi. Cucumbers, eggplants, beets, onions, and olives can also be fermented in this way.

Brining and lactic acid fermentation are useful methods of processing and preserving vegetables because they are low cost, have low energy requirements for both processing and preparing foods for consumption, and yield highly acceptable and diversified flavors. Acid fermentations modify the flavor of the original ingredients and often improve nutritive value.

3. Dried vegetable products

Drying is a very common method for the preservation of vegetables and the points made for air drying of fruits apply.

Most vegetables, in contrasts to fruits, should be blanched. Steam blanching is often preferred to water blanching because there is a small loss of nutrients by leaching. After blanching, sulfiting may be useful prior to drying.

As mentioned in the fruit section, quality improvements to sun drying are to be found in hygiene control and control over the drying speed and temperature, which has a direct influence on the preservation of the final product. Indirect drying methods, shielding the raw material from the sun, are the most suitable for vegetables. Choices include drying in the shade, indirect solar drier or artificial/ mechanical drying /. The market value of the end product will tend to suggest which drying system to choose. As in the case of dried fruit suitable packaging materials must be used to keep the final product dry.

EXERCISES

A. Read and translate into Vietnamese

preservation, fresh crops, versus, stress, adventure, advice, stringent control, investment, brine, pickled products, penetrate, drawing out, dates back, palatable, disadvantages, surplus, exclusion, brining vegetables, barrels, a crisp, cucumbers, eggplant, beets, onions, olives, lactic acid fermentation, improve, shielding, shade

B. Answer the following questions

1. What is the purpose of preservation of vegetables at home and in industry?
2. Can you tell some methods for preservation of vegetables?
3. What are the advantages and disadvantages of salted vegetable products?
4. Can you describe the method for preparation of vegetable pickles?

5. What kinds of microorganisms are used in the formation of fermented vegetable products?

C. Translate into English

1. Nồng độ muối cao có thể kéo dài thời gian bảo quản rau nhưng cần phải loại bỏ bớt muối trước khi ăn.
2. Quá trình lên men rau quả sẽ xảy ra khi các vi khuẩn lactic lên men các loại đường có sẵn trong rau quả.
3. Sấy khô là phương pháp thông thường để bảo quản rau quả và thường dùng năng lượng mặt trời hay không khí nóng.

UNIT 45 : INTRODUCTION TO FOOD SAFETY

1. Food safety and quality

The various components, which collectively contribute to overall food quality, were discussed. One of these components, arguably the most important, was safety. We all have to eat to survive and it is a basic human requirement that the food we eat is safe.

Unfortunately notified cases of food poisoning have been increasing world wide including in developed countries. The costs associated with food poisoning, both social and financial are substantial. The economic costs of food poisoning in the UK have been estimated to be in excess of ℑ1 billion and in the US between $10 - 30 billion. Social costs include pain, suffering, grief and even death. Most food poisoning has a microbial origin and some outbreaks have made headline news.

In addition other possible food risks have ensured that food safety has a high media profile. Any food organization that does not consider food safety to be vital runs the risk of causing illness or death, attracting bad publicity, closure and even bankruptcy. Numerous examples can be given of companies, round responsible for food poisoning, going out of business. In outbreaks where deaths have occurred managers have been prosecuted for manslaughter.

2. Food safety and hygiene

Hygiene is to do with health and food hygiene deals with ensuring that food is safe to eat. Food hygiene covers all aspects of processing, preparing, transport, handling or serving of food to ensure that it is safe to eat.

Food hygiene is vital throughout the food chain from primary production via processing and distribution through to serving i.e. from farm to fork. Like any other chain the food hygiene is only as strong as its weakest link.

3.How to audit

Many practices and procedures contribute to preventing microbial food poisoning and make up food hygiene although they all ultimately rely on one of two fundamental principles.

- Preventing contamination of food.
- Preventing growth/ survival/ of any contaminants.

Any auditor unsure of whether a particular action is hygienic or not should ask themselves the following, “Will it increase the risk of contamination? Will it increase the chances of growth/ survival ?/ If the answer to either be yes, the chances is the action was unhygienic.

The traditional strategic approach to food safety management has been to implement practices, often in a relatively uncoordinated way, based upon food storage, cleaning, pest control, personal hygiene etc. Subsequent microbiological testing of the end product has then been used to determine if the product was safe and of good keeping quality. Any auditing carried out was of the traditional floors, walls, ceiling approach.

Strategically this approach was designed to ‘inspect out’ foods which might be unsafe. The value of this approach has been questioned for a number of reasons including:

- It does not make safe food, it tells us if something has gone wrong
- Unsafe food is easily missed
- Unsafe food may be condemned unnecessarily
- Cases of foodborne disease have continued to increase.

4. Introduction to HACCP

a. Background to HACCP

The general food hygiene practices outlined are still very relevant, however it has been increasingly recognized that a different approach and philosophy to food safety were required. An additional approach, which concentrates on the product and specific threats to food safety throughout its life history has been developed. This is known as the Hazard Analysis Critical Control Point (HACCP) approaches.

The development of HACCP started in 1959 with requirements for the US space program and the need for food, which was pathogen free. However, it was not until the mid 1980's that the wide spread use of HACCP was advocated.

b. Seven HACCP principles identified by Codex

- Conduct a hazard analysis
- Determine the critical control points (CCPs)
- Establish target values and critical limits
- Establish a system to monitor control of the CCP
- Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control
- Establish procedures for verification to confirm that the HACCP system is working effectively
- Establish documentation concerning procedures and records appropriate to these principles and their application.

EXERCISES

A. Read and translate into Vietnamese

food safety, components, safe, substantial, pain, suffering, grief, outbreaks, media profile, bankruptcy, prosecute, manslaughter, hygiene, contamination, contaminant, condemn, advocate

B. Answer the following questions

1. What is the concept of food safety?
2. What is the food safety and hygiene?
3. What are the main methods for preventing contamination of food?
4. What is the background of HACCP?
5. Can you tell some things about the development of HACCP?

C. Translate into English

1. Những năm gần đây ở khắp nơi đều tranh luận và cảnh báo về vệ sinh an toàn thực phẩm.
2. Muốn đảm bảo chất lượng vệ sinh an toàn thực phẩm thì phải chú ý từ đầu dây chuyền sản xuất đến nhà xưởng và con người sản xuất.
3. Phải xây dựng cơ sở HACCP cho từng nhà máy để kiểm tra kịp thời và ngăn chặn nhiễm tạp trong sản xuất thực phẩm.

UNIT 46 : SOME MAIN OPERATIONS OF CANE SUGAR PRODUCTION

1. Delivery, unloading, and handling of cane

The factory takes delivery of the cane, either directly at the factory weighbridge, or at auxiliary weighbridges serving certain important or remote points in the area from which the mill draws its supplies.

Transport is arranged by the factory, either by railway, or more often by lorries or by tractors and trailers.

2. The cane carrier

The cane carrier is the moving apron which conveys the cane into the factory and which assures the feed to the mills by transporting the cane from the yard to the crusher.

3. Cane knives

The knives supply the cane in very short and small pieces. These small pieces settle together into a compact mass, which drops easily into the feed hopper and will absorb in a continuous manner.

The cane knives then perform two functions and have two advantages:

- They favor the capacity of the mills
- They assist the extraction of the mills by breaking the rind of the cane and so facilitating its disintegration and the extraction of its juice.

4. Crushers

The crusher is the first machine applying pressure, which the cane encounters on arriving at the milling plant. It consists of a mill, generally of two rollers, which performs two main functions:

- It assures the feeding of the whole tandem
- It prepares the cane in such a way as to facilitate the grip of the rollers and the extraction of juice by the mills.

5. Fine - bagasse separators

Many particles of bagasse drop from the mills falling through the space between feed plate and feed roller, or being extracted from the massecutte by the scrapers, or dropping between the trashplate and delivery roller.

The quality of such fine bagasse is very variable, but generally amounts to between 1 and 10 gram of dry material per liter of juice. The separator is an apparatus placed after the mills, serving to screen the mill juices, and to return to an intermediate carrier the pieces of bagasse recovered.

6. Defecation

Hundreds of materials have been tried for purification of juices. There are, however, only four of which are important:

- Lime (CaO) which, since the beginnings of sugar manufactures has retained the universal basic defecant; the treatment with lime is called “defecation”.
- Sulphurous acid, from SO_2: “sulfitation”
- Phosphoric acid, from P_2O_5: “phosphatation”
- Magnesia, MgO

7. Evaporation and crystallization

The massecutte after evaporation discharged from the pan is at high supersaturation. If it is allowed to stand the sugar still contained in the mother liquor will continue to be deposited as crystals, but this massecutte is very dense and the mother liquor is very viscous. Crystallization will soon cease, if the massecutte is left undisturbed, because the layer of mother liquor surrounding the crystals will be rapidly exhausted, and the viscosity of mass will prevent the more distant molecules of sugar from circulating and coming in contact with the crystals.

Crystallization, then, is a process which consists of mixing the massecutte for a certain time after dropping from the pan, and before passing to the centrifugal, and which aims at completing the formation of crystals and forcing further exhausting of the mother liquor.

8. Storage and drying of sugar

The commercial sugar leaving the centrifugal, which is to be dried and packed for sale or export, generally has a moisture content of 0,5 - 2%. Moisture is very detrimental to keeping qualities of the sugar, when it exceed a certain limit, and particularly when it rises above 1%.

9. Molasses

Molasses is by-product of sugar factory. The true density of molasses is generally of the order of 1.4 – 1.5. It normally contains about 50% of sugar and other ingredients but it normally contains fine air bubbles entrained during the fugalling process and also picked up by friction every time the molasses is discharged in a fine stream into a tank.

EXERCISES

A. Read and translate into Vietnamese

delivery, unloading, handling, weighbridge, convey, mill, yard, crusher, a compact mass, feed hopper, breaking the rind, two rollers, tandem, grip of the roller, bagasse, massecutte, trashplate, scraper, defecation, sulfitation, phosphatation, high supersaturation, mother liquor, deposit, cease, detrimental, molasses, fugalling process, pick up, friction

B. Answer the following questions

1. How many main steps are there in the sugar production?
2. What are the functions in casing of cane knives?
3. How many methods are used for defecation of cane juices?
4. What is the purpose of evaporation and crystallization of massecutte?
5. What is the molasses? What are used for them?

C. Translate into English

1. Các nhà máy có thể dùng tàu hỏa, xe tải, xe kéo... để vận chuyển mía tới.
2. Tách bã khỏi nước ép mía bằng hệ thống sàng lắp đặt sau máy ép mía.
3. Đường phải được sấy khô đến độ ẩm 0,5 - 2% mới bảo quản được sản phẩm lâu trên thị trường.

UNIT 47 : METHODS OF OIL EXTRACTION AND PROCESSING

Before attempts are made to introduce improved methods of oil extraction an effort should be made to understand the traditional methods employed. As will be seen in the section on case studies, technologies, which are not based on a good understanding of traditional processing, tend to have a low acceptance rate.

This section seeks to outline the various steps involved in traditional processing. As these differ somewhat from place to place it would not be feasible to record all the minor variations that occur. What is given, therefore, are examples of fairly standard processing methods which can serve as a basis for comparison with the system used in any particular area.

This section is divided into:

- Oil seeds (sunflower, sesame, mustard, etc.)
- Nuts: groundnuts (peanuts), palm kernel nuts, coconuts, shea-nut.
- Mesocarp (palm fruit)

Oil seed processing

Oil seeds (sunflower, sesame, etc.) are still commonly processed using traditional methods, which are usually time-consuming and strenuous. In most cases, seeds are ground to a paste without removing the husk or outer covering. In some instances sunflower seeds are dehusked. Seeds are ground manually unless a local mill is both accessible and affordable. The paste is heated, alone at first, and then with boiling water. The mixture is stirred and brought to the boil. After boiling, the mixture is allowed to cool during which at time the oil gathers at the top and is coped off. In traditional methods of processing oil seeds the extraction efficiency is about 40% (extraction efficiency refers to the percentage of oil extracted based on the total theoretical content).

Description of types of improved technologies

Improved technologies exist for the small-scale processing of all types of oil-bearing raw materials both at the pre-processing and oil extraction devices fall into three categories: expellers, ghanis, and plate presses. Expellers and ghanis are normally used for seeds and nuts because of the greater pressure that is required to extract oil from them. Screw operated plate presses are used for extracting oil from mesocarps, but hydraulic presses, because they generate high pressure, are able to process seeds and nuts. Some materials require a pre-processing stage prior to oil extraction and this section discusses both the pre-processing steps and the various oil extraction devices.

Where appropriate, information is included on the possibility of local manufacture. This is important because it gives an idea as to the scale of workshop that would be needed to produce equipment. Since skills and resources differ from region to region , it is important to find out what resources exist and judge what equipments can be made.

It is important to highlight further the implications of the term 'local availability'. Generally, what is meant by 'locally available' is, simply, 'not imported' into a country. For the villagers, however, anything that is not freely available in the village is effectively an import, whether imported from an urban center or from a neighboring country. For villagers seeking to construct any item, the main distinction is between materials, which can be acquired for nothing and those which have to paid for, since the latter implies greater demands on very limited capital resources.

Pre-processing methods and devices

Some raw materials need to be pre-treated before oil extraction and a range of devices is available for these steps. In some cases presses/ expellers are sold as complete units with pre-treatment equipment included, and several manufacturers supply pre-processing equipments. It is necessary to consult appropriate institutions about the suitability of particular machines.

Oil seeds and nuts

Seeds and nuts, in many cases, are heated before processing, although this depends to a large extent on the type of seed or nut and the particular model of expeller being used. Traditionally this heating is carried out over open fires but units known as seed scorchers are now available with a greater degree of temperature control and capable of handling substantially larger quantities of raw material.

Groundnuts

If groundnuts are to be processed using traditional methods then use of a decorticator to remove the shells before processing will reduce some of the labor. When processing groundnuts in an expeller however, the presence of fiber is needed to maintain a suitable operating temperature. The shell may be left on, some shells added, or some oil cake from a previous batch included to provide fiber for the unit to 'bite' on; otherwise a paste like peanut butter is produced rather than oil. Due to the high fiber in the residual cake when using this method, it can be difficult to sell it in the form of balls or fried cakes.

Palm kernel nuts

Palm kernel nuts need to be cracked and heated before processing. Crackers, which depend on centrifugal force, can now be used to replace traditional hand cracking. Both manual and power driven crackers are available, but verbal communication during the preparation of this document questions of their applicability. Depending on the type of expeller the palm kernels may need to be roasted for example in an oil drum roaster, which is hand-roasted over a fire. In order for a roaster to be fuel efficient, its use is recommended only when larger quantities of nuts are being used. Finally oil is extracted from the palm kernel nuts by passing them through an expeller.

Coconuts

Various types of manual coconut graters are available which are hand foot operated. The design of the scraper blade of the grater (the number and size of grooves) is very important and affects oil yield. The grating stage is tedious and arduous and the use of small-motorized graters can ease the workload and can increase oil yields in the traditional oil extraction processes.

If coconuts are to be processed using expellers then the coconut meat needs first to be dried to copra. Prior to oil extraction the particle size must first be reduced by chipping or grinding.

Refining

Oil produced in large commercial mills passes through a refining stage, which includes neutralization, decolourisation, filtration and deodorization. Some of these processes can be adapted for use at the rural level. For example, clarification of oil can be improved by treatment with charcoal or by filtering through cloth or sand. If sand is used attention should be paid to its quality. Palatability may be improved by boiling. Packaging in well cleaned and properly closed containers will improved the market value.

Systems for oil processing

From the description of the different traditional oil processing technologies and suggestions for their improvements discussed so far it can be seen that no general solution applies. Essentially each oil-bearing materials has to be considered separately as do the steps it has to go through during its processing.

Complete package systems are readily available for medium to large-scale commercial production for particular kinds of oil-bearing materials. However, complete packages, suitable for small, rural village situations are far less common.

The process includes the following steps:

- Sterilizing cooking the fruit
- Pounding by hand to loosen pulp from nuts
- Reheating the pounded material with steam
- Pressing
- Clarifying the oil.

EXERCISES

A. Read and translate into Vietnamese

sunflower, sesame, mustard, groundnuts, peanuts, palm kernel nuts, coconuts, shea-nuts, palm fruit, strenuous, husk, accessible, affordable, scoop off, expeller, ghanis, plate press, mesocarps, decorticator, fiber, be cracked, cracker, be roasted, roaster, coconut graters, scraper blade, groove, grating stage, tedious, arduous, copra, chipping, grinding, refining stage, neutralization, decolourisation, deodorization, charcoal, palatability, bearing material, gap, pounding, loosen pulp

B. Answer the following questions

1. What are the main oil seeds existing in Vietnam?
2. What is the first step for oil seed processing?
3. Why are the expellers normally used in ghanis for extract of hard seeds and nuts?
4. Why are the pressed plates normally used for extracting oil from mesocarp fruits?
5. What are the main stages for refining of commercial oils?

C. Translate into English

1. Trước khi hiểu quá trình sản xuất dầu ăn hiện đại, chúng ta cần hiểu rõ một số phương pháp cổ điển đã áp dụng vào sản xuất.
2. Trong phương pháp cổ điển, hiệu suất trích ly dầu chỉ đạt khoảng 40% (có nghĩa là hiệu suất chiết tức là phần trăm dầu trích ly được so với hàm lượng dầu có trong hạt tính theo lý thuyết)
3. Quy trình chế biến dầu thường bao gồm các công đoạn sau: tách hạt khỏi vỏ, nghiền và hấp chín bằng hơi, ép tách dầu và tinh chế dầu thô thành dầu tinh khiết.

UNIT 48 : TEA, COFFEE AND COCOA

Introduction

It is interesting to note that all three of these beverage plants grow approximately between the same latitudes and can be regarded as plants of the rainy tropics and sub-tropics. Of these, the tea plant is perhaps the most hardy as it can be grown within the tropics, but at considerable altitudes, thus being able to survive the cooler spells which occur in these elevated sites.

Although these are natives of three different continents they have one thing in common: when they are made into an infusion with hot water and drunk they produce in the consumer a ‘lift’. This is due mainly to the presence of two related compounds, namely theobromine and caffeine, which occur in combination or singly. This stimulatory effect must have been noted early in the use of tea, coffee and cocoa and it is of interest to see that people in quite different geographical locations must have come to the same conclusions about their particular beverage plant.

During the early part of their very long usage these beverages were confirmed to those zones in which they could be grown. However, with the great sea journeys by the European merchant ventures these commodities were discovered and gradually spread across Europe and to other parts of the world. Today, it is true to say that, with the huge areas of plantations devoted to the cultivation of these crops, there is probably no country in the world where the beverages produced from tea, coffee and cocoa plants are not available.

Tea

Name and origins: The name is *Camellia sinensis*. The plant has borne the generic name *Thea*, but this now seems to have been abandoned in favor of the present name. It belongs to the family Theaceae. Three all hybridize freely. The naming of tea has passed through many phases and these are described by Eden .

It is thought that the plant originated near the Irrawaddy river and was dispersed from there to southeast China, Indo-China and Asean. There is some doubt, however, that this was the original distribution center and the true one may have been further north. It has been cultivated in southeast China for some two to three thousand years.

Tea was first introduced into Europe by the Dutch East India Company towards the end of the 16th century and reached Britain in the early part of the 17th century. From that time onwards its consumption has steadily mounted and it can truly be said to be the most popular non-alcoholic beverage right up to the present day. Because of increasing demand in the last century traditional supplies from China were not enough to meet it, so commercial plantations were established in countries where tea had not been growth previously.

Green Tea: The process described here is for the production of black tea, which gives the usual brown liquid when infused with hot water. There is, however, a small quantity of green tea produced. This is achieved by heating the leaves and inactivating the enzymes. This gives rise to a pale yellow liquid when infused with hot water. It would appear to a black tea drinker to be insipid in flavor.

Coffee

Name and origins: The names are *Coffea arabica* and *C.robusta* (sometimes called *canephora*). These are the two main species used in the production of coffee which belong to the family Rubiaceae. The plant is a native of Ethiopia and it is thought that the name derives from the world 'Kaffa', which is the name of an Ethiopian province. An alternative explanation is that it was derived from the Arabic word 'kaweh', which means strength. The plant is found growing wild in various well-separated countries in the Africa, probably indicating that it is a native of that continent.

Coffee was known in the Middle East at least by AD900 and gradually increased in popularity until by the 15th century it was a very popular drink with the Arabs. About 1600 it appeared in Venice and Vienna. The later became acquainted with it when an invading Turkish army was repelled leaving behind some 500 sacks. About this time coffee spread all over Europe and in 1650 the first coffee house was established in London. These became the meeting places for commercial and cultural exchanges, and in London two famous financial institutions arose from them, namely the Stock Exchange and Lioyds. America first saw tea in Virginia and a similar pattern of coffee houses arose in what were then the colonies. However, tea remained a favorite with the Americans until 1773, the year of the Boston Tea Party. From then onwards the popularity of coffee increased and that of tea declined.

Cocoa

Name and origins: The name is *Theobroma cacao* L. According to Chittenden ,the generic name means food of the gods, and it is this which has given the trivial name, theobromine, to one of the two stimulants found in the beverages discussed. Sterculiaceae, the family to which the genus *Theobroma* belongs, contains some 22 species, of which *T. cacao* is the only one yielding seed suitable for chocolate making. This is in contrast to tea and coffee, where several species can be used to produce different kinds of raw materials for these respective beverages.

The plant is a native of Central America where the Mayas and Aztecs used the seeds as an article of diet. Capsicums and other spices were added to make the beans more attractive, since by themselves their flavor is somewhat unpleasant, being bitter and astringent. They also made a thick drink from the pounded beans mixed with maize, which was called by the Aztec name chocolate .The Spaniards, who invaded Central America in 1519, did not find this beverage much to their liking and they added sugar, a practice that has continued until the present day.

***Extension of the Cocoa industry*:** Cocoa as an item of diet was not established in Europe until the 16th century and the two countries mainly responsible for its spread were Spain and Holland. The Spaniards exported from Venezuela. Once cocoa had been discovered, it was not long before the plants were spread around the world. The Spaniards introduced it into Trinidad and from there it was dispersed round the Caribbean. As the demand increased plants were grown in the Philippines, the East Indies and Sri Lanka. Later, cocoa was cultivated in the Brazil where it grows wild. In the early 19th century it reached the islands of São Tome and Fernando Poo, both in the Gulf of Guinea. From these offshore islands cocoa reached the African mainland and by the end of the 19th century Ghana, Nigeria, the Ivory Coast and the

Cameroons were being established as major producers. Since then Asian countries have started to grow cocoa, among them Malaysia, where a small but growing trade has been established.

Eating chocolate, as opposed to that for drinking, dates back to the invention of the cocoa press by Van Houten in 1828. This made possible the removal of cocoa butter, thus producing a less fatty cocoa powder suitable for drinking, and at the same time a residue of cocoa butter.

EXERCISES

A. Read and translate into Vietnamese

latitude, altitude, spell, elevate, native, infusion, lift, merchant ventures, huge area, disperse, mount

B. Answer the following questions

1. Give the definitions of tea, coffee, and cocoa.
2. What are the things in common of tea, coffee and cocoa?
3. What is the difference between Green tea and Black tea?
4. When was the coffee known?
5. Where was cocoa cultivated easily and are a lot of products from cocoa used?

C. Translate into English

1. Chè, cà phê, ca cao khi pha với nước nóng thành một loại đồ uống kích thích người sử dụng vì trong đó có chứa 2 thành phần chính là bromin và cafein.
2. Chè đã trở thành một loại nước uống không có rượu phổ biến từ thế kỷ 17 đến nay trên khắp thế giới.
3. Sau khi coca được phát hiện, chỉ sau 1 thời gian ngắn loại cây này đã phổ biến trên toàn thế giới.

UNIT 49 : MEAT AND FISH PRODUCTS

Meat products

Mediterranean. The Romans knew that ground meat with added salt, sugar and spices turns into a palatable product with a long shelf life if prepared and ripened properly. Probably the normal winter climate in the Mediterranean countries with its moderate temperatures and frequent rainfall is favorable for sausage ripening. In contrast, salting and drying of ungrounded meat was the traditional way of meat preservation in Germany and other European countries. In Germany, the manufacture of fermented sausages commenced only some 150 years ago, and most of the fermented sausages are smoked, while in the Mediterranean countries, France, Hungary and the Balkan countries air-dried, spicy sausages predominate. Other types of fermented sausages emerged later as a consequence of advanced meat processing techniques and the availability of refrigeration. Such products include spreadable, undried sausages common in Germany, and semi-dry sausages common in Northern America. Other criteria include the casing diameter, degree of communication of the ingredients, animal species, seasoning and other features. The term ‘sausage ripening’ is used to describe changes occurring between case filling and the time when the product is ready for sale, while the term ‘sausage fermentation’ is restricted to the lactic acid formation and concomitant processes.

As with many other fermented foods, intensive research on the microbiology and chemistry of sausage ripening was triggered when traditional empirical methods of manufacture no longer met the requirements of large-scale, low-cost industrial production, i.e. short ripening times and highly standardized products. It is, therefore, not surprising that such research commenced in the United States in the 1930s, whereas in Europe the first systematic studies on the microbiology and chemistry of sausage ripening were published in the 1950s.

Nước-mắm

In translation from Vietnamese, this literally means fish sauce. However, the sauce is eaten by large proportion of the population and early reports suggested intakes up to 400 cm^3 per day. However, mostly it is used to give rice a good flavor and aroma and 40 - 50 cm^3 may be consumed over two meals. This would give a salt intake of 12 - 13g per day. The sauce is a clear brown liquid with a distinctive meaty/ sharp aroma/. The taste is predominantly salty but the contribution of many other compounds, including the

volatiles, is very apparent. Generally the cheaper products have far less aroma and often they are more bitter to the Western taste.

Although nước-mắm can be prepared from shrimp, it is generally manufactured using species of small fish, which do not find such a ready market as whole fish.

The fish are caught by seine netting. They are kneaded and pressed by hand. They are then placed in layers with salt in an approximate ratio of 3:1 fish to salt, in earthenware jars that are almost buried in the ground. After filling, the jars are tightly sealed and left for several months.

After fermentation the pots are carefully removed and after a few days of setting the supernatant liquor is decanted off carefully.

Nowadays in some areas, larger vats fitted with taps near the bottom are used, and the partly fermented mixtures from a number of village sites are combined and fermented further.

In some cases the initial bloody liquid (nuoc-boi) is drained off. Some of this is added back to the vat and some is returned at a later date.

The period of fermentation can be about 6 months for the small fish and up to 18 months for the larger species.

A common procedure adopted at a factory site is to remove some but not all of the supernatant when it is formed. This is referred to as first quality 'nước-mắm' or 'nước-cốt'. The residual mass, which contains some of the supernatant liquor is then extracted with boiling seawater to lixivate the fish and the liquid is then referred to as second quality. Sometimes several vats are extracted with the same brine. The extraction procedure may be repeated to give poorer qualities of nước-mắm. These extracts may be improved by the addition of higher qualities of 'nước-mắm'. Generally, the lower quality sauces have poorer keeping properties as they may have a low salt concentration. They may be improved by the addition of caramel, molasses, roasted maize or roasted barley to the fish before the second and subsequent extractions. This improves the color and also improves the keeping qualities. An advantage with these poorer quality sauces is that more may be consumed so that the protein obtained from them may be near to that of first quality sauce. The undissolved residue (xác-mắm) is used for animal foodstuffs.

Rosé (1919) analyzed nước-mắm and established that it contained 2.3%w/w nitrogen of which 46% was in the form of titratable amino acids and 17% as ammonia. The total organic nitrogen can be expressed in terms of soluble protein; however, most of it is in the form of amino acids and small peptides.

The formation of various organic compounds during the fermentation period of nước-mắm was examined by Uyenco et al. (1953). These workers showed that the total nitrogen in the sauce increased over a 120 - day period and that the organic nitrogen, which represents the soluble protein, polypeptides, amino acids and ammonia, reaches a maximum of approximately 2.0% with a total nitrogen of 2.38%. During the fermentation, the free amino acid content increased steadily as did the formol nitrogen (this indicates that some polypeptide is being formed in addition to amino acids). At the end of the fermentation, approximately 86% of the total nitrogen was organic and of this 63% titrated in the presence of formol. As the free amino acid content was 49% then the polypeptide was probably 14% of the total organic nitrogen and the ammonia was 17%. The decomposition of the fish flesh was complete after 4-5 months, although the ammonia concentration continued to increase. The nitrogen content varied with the quality of sauce being offered for sale.

EXERCISES

A. Read and translate into Vietnamese

Mediterranean, a palatable product, spreadable, undried sausages, semi-dry sausages, fermented sausages, casing diameter, degree of communication, sausage ripening, sausage fermentation, disrupt, concomitant, trigger, the fish flesh

B. Answer the following questions

1. What is the difference between the term "sausage ripening" and sausage fermentation?
2. Can you describe some product types of fermented sausage?
3. What is 'nước-mắm' in Vietnam? What kinds of it are usually consumed in Vietnam?
4. How long has the fermentation times of fish been used for production of 'nước-mắm' in Vietnam?
5. What are the main constituents of 'nước-mắm' in Vietnam?

C. Translate into English

1. Thịt nghiền có bổ sung thêm muối, đường, gia vị... để sản xuất một số sản phẩm làm tăng hương vị và thời gian bảo quản thịt.
2. Nhu cầu nước mắm trong dân ta ngày càng tăng, đặc biệt là loại nước mắm ngon.
3. Người ta có thể bổ sung thêm caramel, rỉ đường hoặc ngô, gạo rang kỹ làm tăng mùi vị và màu sắc cho nước mắm.

UNIT 50 : SOME TRADITIONAL FERMENTED MILK PRODUCTS

1. Cheese

Cheese and cheese products derived from the fermentation of milk are of major nutritional and commercial importance throughout the world. These foods range from simple cheese of variable characteristics and quality, made by empirical methods in the home in countries where conditions are generally unsuitable for milk production, to consistent high quality international varieties made in the primary dairying countries by highly industrialized modern practices.

Cheese is a wholesome and interesting foodstuff, which can provide a large part of the human's requirements of protein, fat - a good source of energy- calcium and minerals.

The variety of cheese types is seen in the fact that one authoritative book Cheese Varieties and Descriptions gives an index of 800 cheese names and contains descriptions for more then four hundred. The same source gives the following means of classifying cheese.

a.Very hard (grating):

Ripened by bacteria: Asiago old, Parmesan, Romano, Sapsago,

b. Hard:

Ripened by bacteria, without eyes: Cheddar, Granular

Ripened by bacteria, with eyes: Swiss, Emmentaler and Gruyere.

c. Semi-soft:

Ripened principally by bacterial: Brick and Munster.

Ripened by bacteria and surface micro-organisms: Limburger,

Ripened principally by blue mould in the interior: Roquefort, Gorgonzola, Blue Stlton ..

d. Soft:

(a) Ripened: Brie, Butter, Camembert, , Hand and Neufchatel

(b) Unripened: Cottage, Pot, Bakers, Cream, Neufchatel …

More recently the International Dairy Federation (IDF, 1981) has produced a catalogue of cheese based on the following characteristics: raw material; type of consistency; interior; exterior. The IDF method of grouping cheese is based on the sequence of characteristics in terms of their recognition by consumer. The type of milk, which is subjected to a process of fermentation and ripening, influences the flavor of the cheese and is given top priority in the listing. Thereafter comes consistency and internal appearance, external features and then fat and moisture contents that are important but less vital to the consumer, unless very detailed information is required, than to regulatory or marketing agencies.

2.Yogurt

Original yogurt is prepared in Bulgaria from goats' or cows' boiled, high solids milk, inoculated at 40-45°C with a portion of previously soured milk. To keep the temperature constant the pot containing inoculated milk is thoroughly wrapped in furs and placed for 8-10 h in the oven until a smooth, relatively highly viscous, firm and cohesive curd with very little wheying off is formed.

There are controversial data concerning the original microflora of yogurt. The presence of various physiological groups of microorganisms was reported in early investigations on original products but these reports also pointed out that the predominant role in production of yogurt lays with *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. Widely distributed yeasts (*Candida mycoderma, C.krusei, C.tropicalis*) were regarded as spoilage microorganisms. Other bacterial strains, *Streptococcus lactis*,

Str.lactis subsp. *Diacetylactis, Leuconostoc* spp., *Str.lactis* var. *taette* (slime producer), were regarded as supplementary microflora.

Rasic and Kurmann (1978), summarizing the findings concerning the original yogurt microflora, divided it into three groups:

Essential microflora - consisting of *Streptococcus thermophilus* and *Lactobacillus bulgaricus.*

Non-essential - represented by homofermentative lactic acid strains other than in group (a) and by heterofermentative lactic acid bacteria. Some of them may be used beneficially for supplementing the original microflora: for example, *Lactobacillus acidophilus, Bifidobacterium bifidum, Propionibacterium shermanii, Streptococcus lactis* subsp. *Diacetylactis.*

Contaminants: yeasts, moulds, coliforms and other undesirable microorganisms.

The metabolic activity of yogurt bacteria results in a considerable increase in cell numbers. The total count of viable yogurt bacteria ranges between 200 and 1000 million per ml of fresh yogurt, but decreases during subsequent storage.

Finished yogurt is thus the end product of a symbiotic culture of *Streptococcus thermophilus* and of *Lactobacillus bulgaricus* growing at temperatures in the range 40-45^{0}C.

Faster growth of streptococci at the beginning of fermentation brings about accumulation of moderate amounts of lactic and acetic acids, acetaldehyde, diacetyl and formic acid, availability of format and the growth of *Lactobacillus bulgaricus.* Yogurt is finished at pH 4.2 - 4.3.

Lactobacillus bulgaricus demonstrates a much stronger proteolytic activity than does *Streptococcus thermophilus.* By liberating from milk proteins a number of amino acids, stimulation of growth of *Streptococcus thermophilus* occurs. The content of liberated amino acids is considerably higher than that are necessary to meet the nitrogen requirement of *Streptococcus thermophilus*, and hence a considerable increase occurs in the free amino acids content of finished yogurts. Of the individual amino acids glutamic acid and proline are present in the highest amounts.

Yogurt bacteria, particularly *Streptococcus thermophilus* exhibit a marked sensitivity to antibiotics and other inhibitory substances present in milk. Their destruction may be also caused by bacteriophage.

Yogurt, as a product, is relatively highly viscous, firm and cohesive. Its body characteristics are greatly influenced by the careful regulation of production conditions. Top quality yogurt is smooth, without grittiness or granules and without effervescence. It is highly acid product.

The quality of strains used in starters is of particular importance. The characteristic flavor is contributed mainly by lactobacilli producing lactic acid and acetaldehyde. But the complexity of flavor is secured by the balanced level of many by-products represented by other carbonyl compounds as well as by the amino acids released into milk.

Yogurts exhibit an antagonistic effect against a number of pathogenic and saprophytic organisms but this effect shows many variations depending on the bacterial strains used, and on their particular antagonistic properties.

EXERCISES

A. Read and translate into Vietnamese

empirical methods, a wholesome, recognition, be wrapped, furs, cohesive curd, controversial data, investigation, point out, yogurt lay, spoilage, essential microflora, subsequent storage, a symbiotic culture, bacteriophage, grittiness, effervescence, the complexity, an antagonistic effect, pathogenic, saprophytic organisms

B. Answer the following questions

1. What is the semi-soft cheese producing from cow milk?
2. How many types of cheeses are classified in the world?
3. What is yogurt?
4. How many groups of original yogurt microflora are divided into a symbiotic culture?
5. Can you describe some useful effects of yogurt.

C. Translate into English

1. Fomát là một loại thực phẩm được ưa thích vì nó có thể cung cấp phần lớn nhu cầu protein, chất béo và nguồn năng lượng cho con người.
2. Sữa chua có nguồn gốc sản xuất ở Bungari từ sữa bò, sữa dê, được giữ ở nhiệt độ ổn định 40 - 45^{0}C với giống sữa chua giống của đợt trước.
3. Tổng lượng vi khuẩn sống sót trong sữa chua có từ 200 - 1000 triệu/ ml sữa chua tươi nhưng giảm đáng kể trong thời gian bảo quản tiếp theo.

UNIT 51 : GENERAL PRINCIPLES FOR INDUSTRIAL PRODUCTION OF MICROBIAL EXTRACELLULAR ENZYMES

Very little specific information has been presented in the public domain that details the particular methods applied to the production of any one enzyme. This is largely due to the extremely competitive state of enzyme production and marketing resulting in very real differences in the way each producer arrives at a cost-effective process for his products.

There are some main steps of enzyme production as follow:

1. The Production Strain

Some principal microorganisms that have found acceptance for production of industrial enzymes. The species listed are generally considered to present the least risk of toxin production during fermentation as well as being non-pathogenic to man.

Bacillus species are comparatively easy to isolate and despite the problems associated with spore formation, many have been isolated as non-sporing strains. The *Aspergilli* are similarly placed amongst the fungi, although the formation of conidial spores is desirable for the ease of inoculation of large-scale fermentations. In every case, the strain selected for production will have a highly improved enzyme producing capability compared with the wild strains and will have undergone stringent screening to ensure that it does not produce toxins or antibiotics in order to meet increasingly stringent standards for food applications of enzyme product.

2. Fermentation

The choice of fermentation method lies between ‘solid state’ (which is also called semi-solid) and submerged or ‘deep’ fermentation. In rare cases the organism will dictate the choice by virtue of either non-production or low yields by one method. Generally, however, the nature of the final enzyme product and its designated performance objective determine the method. Enzymes from solid state cultivation are generally found to be complex mixtures, often including amylase, protease, lipase and non-starch carbonhydrases in definite proportions that are regulated by the cultivation. If a high level of a single activity is desired, it is commonly produced by submerged fermentation.

Submerged ‘deep’ fermentation has been adopted as the most economic route for the preparation of bulk industrial enzymes. Suspended insoluble nutrients and inexpensive additional sources of nitrogen, phosphate and trace elements in soluble forms are used. The medium selected must support good growth of the microorganism and be as inexpensive as possible. Soybean meal, starch hydrolysates and corn steep liquor dominate the list of typical ingredients. The specific additional growth the enzyme synthesis stimulating requirements are determined for each organism selected as a production strain.

Despite great developments of sophisticated instrument monitoring of research fermentations, the industrial enzyme fermentation system utilizes basic but large fermentation equipment. Main vessels can reach 150 m^3 in practice and they are an essential feature of the economics of bulk processing. Controls to monitor pH, temperature and in some cases dissolved oxygen, are typical. Where the use of suspended medium is encountered, it is often necessary to have efficient foam detection and antifoam treatment as an extra control facility. Bulk medium is generally prepared separately in tanks that allow pH adjustment and

direct or heat exchange steam sterilization. Most systems pump the sterile medium into the fermentation vessels that have been previously sterilized with live steam.

3. Broth Purification

The bran extract or fermentation broth contain the enzyme, residues of the suspended medium components, the soluble medium components and the cells of the fermented microorganism. Initially, the solids are removed by filtration or centrifugation aided by the use of flocculents to increase the particle size, e.g. calcium salts, polyelectrolytes and aluminum salts typified by modern water treatment methods. It is common to load a proportion of diatomaceous earth or other filter aid into the stirred broth before filtration, which is most often performed on rotary vacuum filters. Where centrifugation is adopted, the high-speed disc machine with continuous operation is preferred.

Concentration of enzyme liquids is a compromise between energy efficiency and activity loss. Low temperature vacuum evaporation is most commonly applied to stable enzymes and ultrafiltration is used for the more sensitive products, since it can successfully be performed at temperatures around 5 ^{o}C.

Purification is usually necessary both to eliminate microorganisms and to reduce the preparation to the lowest practical contamination with other enzymes produced by the fermentation. Polishing and germ filtration steps are able to remove microorganisms and a series of precipitations may be performed to select the desired enzyme. The addition of an inorganic salt such as sodium or ammonium sulfate to a specified concentration will precipitate a range of proteins which may include the desired enzyme or leave it in the soluble phase. Further solution and precipitation stages may be performed with different concentrations of precipitant to achieve a desired purification. Organic solvents that lower the dielectric constant of the system and so reduce the solubility of proteins are also used to precipitate enzymes. The most effective treatments are performed using chilled solvents and adding them to the aqueous broth, whose pH has been adjusted to the isoelectric value for the enzyme being processed.

Purified liquid enzymes are standardized by dilution and the diluents generally include stabilizing salts, polyalcohols or sugars and any permitted preservatives deemed necessary. In the limited applications where a dry enzyme product is required, it is now recognized that the spray drying should include a granulation to minimize the potential hazards of dusty, dry products. The inhalation of any protein dust is likely to increase the risk of allergic response to further exposures to the same protein and it is recommended to take full precautions when handling enzymes in powder form. Granulation will follow standardization with acceptable materials such as sugars, starch, flour or inorganic salts.

EXERCISES

A. Read and translate into Vietnamese

conidial spores, stringent screen, foam detection, antifoam treatment, bulk medium, pH adjustment, bran extract, fermentation, diatomaceous earth, rotary vacuum filters, germ filtration steps, precipitant, organic solvents, dielectric constant, chilled solvents, standardized, spray drying, a granulation, hazards of dusty, dust, allergic response, exposures, precautions

B. Answer the following questions

1. What are the main steps for the production of enzymes?
2. What is the advantages of microbial extracellular enzymes?
3. What are different methods of fermentation in the production of enzymes?
4. What are the main factors for choosing the Micoorganisms in the production of enzymes?
5. What is the purpose of broth purification?

C. Translate into English

1. Tuyển chọn một chủng vi sinh vật thích hợp là bước quan trọng đầu tiên cho quá trình sản xuất một sản phẩm của công nghệ sinh học.
2. Một loại enzim được sử dụng trong công nghiệp thực phẩm cần có các đặc tính ổn định và không tạo độc tố hoặc các sản phẩm phụ không mong muốn khác.

3. Phương pháp nuôi cấy chìm cần kiểm tra và điều chỉnh pH, nhiệt độ, ôxy hòa tan và dùng cả tác nhân khử bọt.

UNIT 52 : CITRIC ACID ($C_6H_8O_7$)

History

Citric acid is on of the most widely spread plant acids occurring as a natural constituent of citrus fruits, pineapples, pears, peaches and other fruits and tissues.

The importance of "natural" citric acid has, however, greatly diminished since the development of the fermentation process from sugar solutions. Wehmer, in 1893, described the production of citric acid by mould fermentation. He designated the moulds as *Citromyces* and later reported that *Penicillium* and *mucor* could produce similar reactions. But it was left to Currie, in 1917, to point out that strains of *Aspergillus niger* were in fact best for the fermentative production of citric acid.

Properties

Although sugar solutions of various origins have been used to produce citric acid, for production of an industrial scale sucrose and technical glucose remain the easier raw material, with maltose and molasses as second best.

Beet molasses has had more success than blackstrap or invert cane molasses, but in the USA these last two raw materials have been used for a large number of years. In most cases a certain amount of oxalic acid is produced together with the citric acid.

It is not possible to delve here into many theories, which have been advanced about the citric acid fermentation process. The Krebs or tricarboxylic acid cycle offers a partially suitable solution, indicating that pyruvic acid from glucose yields acetyl ~ SCoA, which condenses with oxalo acetic acid, already formed in the cycle, to produce citric acid.

Surface fermentation

We refer to the process as practiced at Ladenburg, Germany, in 1945. The plant had a capacity of 6-10 tons per day of calcium citrate. The raw material is beet molasses (48-50% sugar) obtained preferably from sugar factories producing raw sugar. Improved strains of *Aspergillus niger*, with spores grown on molasses agar, are used as inoculum.

'The molasses is diluted to 30% sugar, adjusted to pH 6.5 ,aided with sulfuric acid, treated with ferrocyanide and phosphoric acid, heated to 100^0C for 1h for sterilization, and diluted to 15% sugar for fermentation. The amount of phosphoric acid should be sufficient to bring the P_2O_5 content of the molasses to at least 0.02 %. The treated molasses is then run into the fermentation chambers, each containing 80 aluminum trays 2 x 2.5 m x 15 cm deep. They are filled to a depth of 8 cm with the diluted molasses, inoculated by means of spores blown in with the air supply and incubated for 9-11 days at 30^0C.

The mould mats are removed by hand and extracted, 15% of the total yield being obtained from the washing. The fermentation liquor is heated, treated with calcium oxide at a pH of 8.5, and the precipitated crude calcium citrate filtered off. The air supply to the fermentor chambers is "sterilized" by passing through a 5-cm-thick cotton filter impregnated with salicylic acid, then moistened to 40% relative humidity at 30^0C. The air supply is changed at the rate of one volume of air per volume every 4.3 minutes".

Before each fermentation cycle, the fermentation chambers are sterilized by washing with 1% caustic soda, then with water, then with 6% formaldehyde. Finally, sulfur dioxide is blown into the chambers with the air stream. The yield claimed is 70% of the added sugar, presumably as monohydrate citric acid.

Johnson when commenting on this process as practiced at the Benckiser Works at Ladenburg, drew attention to the inadequate provisions for sterilization and asepsis, although it is claimed that very little trouble was experienced from contamination.

Submerged fermentation

Compared with surface fermentation, submerged fermentation should have many advantages: higher yields, shorter cycle, simpler operation, lower labor and maintenance costs, minimum contamination, etc.

A factory employing submerged fermentation started operation in the USA in 1951 but no precise data has so far been published on its operative procedure.

The published data from patents and research laboratories show a tendency to use mould strains different from *A.niger: A.fimaricus, japonicus* and *wentii* have been mentioned. Aeration and agitation of the medium as essential, and with cane molasses as raw material the addition of methanol seems greatly beneficial.

The following description is based on a report from Taiwan by S.F.Lin. Clarified molasses from carbonation factories was diluted to 20^0 Brix to bring the sugar content to 13-14% of total sugars and added with Phosphoric acid (0.0005%) and ammonium sulfate.

After sterilization, the medium was adjusted to pH 6.0 and 3% of methanol was added 8 hours after inoculation. The strain of *Aspergillus niger* used was ML-516 and 2% of inoculum was added. The medium was kept under aeration and agitation at 29^0C during fermentation, which was completed in about 8 days. The reported yield of citric acid was 60% of total sugar used.

A reported from Mexico by Sanchez-Marroquin indicates the following medium as optimum for the production of citric acid from cane molasses with *A.niger* in submerge cultures. Molasses diluted to 10% sugar concentration is treated with potassium ferrocyanide and the following nutrients are added: ammonium nitrate (0.15%), zinc sulfate (0.0044%), monopotassium phosphate, KH_2PO_4 (0.02%); corn steep liquor (0.02%); and ethanol (3.5%) or methanol (3%). The medium is adjusted to an initial pH of 6.5-7.0, kept under aeration and agitation with a fermentative temperature of 30-32^0C after receiving a suitable vegetative inoculum of 1.5%. Yields of up to 68% are reported.

EXERCISES

A. Read and translate into Vietnamese

diminish, designate, molasses, blackstrap, cane molasses, beet molasses, delve, surface fermentation, mould mats, impregnate, inadequate provisions, asepsis

B. Answer the following questions

1. Give the definition of citric acid.
2. What are the main raw materials for production of citric acid?
3. Describe the fermentation chambers for production of citric acid by surface fermentation method.
4. What are the main advantages of submerged fermentation of citric acid?
5. Tell some main operations of simplified flow sheet of citric acid.

C. Translate into English

Rỉ đường củ cải được dùng để sản xuất axit xitric tốt hơn rỉ đường mía và dịch nước mía ép ra.

Trong các phòng nuôi cấy bề mặt, mỗi phòng chứa khoảng 80 khay nhôm hoặc inox có kích thước 2 x 2,5 m x 15 cm bề sâu và dịch rỉ đường pha loãng ngập sâu khoảng 8 cm.

Môi trường được điều chỉnh đến pH ban đầu là 6,5-7,0 giữ nhiệt độ 30-32^0C, khuấy trộn và sục khí vô trùng liên tục khi lên men axit xitric theo phương pháp nuôi cấy chìm.

UNIT 53 : PLANT AND ANIMAL CELL CULTURES

Introduction

In the last few years, the interest of biotechnology in plant and animal cell cultures has dramatically expanded. The increasing importance of cell cultures can be recognized from the fact that in books on biotechnology space is being made more and more frequently for information on higher cells and that biotechnological symposia now always devote some sections to biological and technological aspects for plant and animal cell cultures.

The aim of this section to acquaint the leader with the nature, the maintenance, the problems, and the literature of plant and animal cell cultures. Many aspects must necessary be left out of consideration. However, we hope that our choice gives the reader a clear overview of the present state, the possibilities, and the difficulties of using higher cell in biotechnology. Plant and animal cell cultures in effort so greatly in their characteristics that are two systems are treated separately.

Plant cell cultures

General

The number of laboratories dealing with plant cell cultures has increased continuously in the some few years. In 1972, 940 scientists from 41 countries belonged to the "international association for plant tissue cultures". In 1980, an Association already had more than 2000 members in 63 countries. An International congress for plant cell cultures is held by the group every four years. The programs of these congresses best reflect the fact that work with plant cells is being performed for many different purposes. For example, plant cell cultures are an excellent tool for answering some basic biological questions. As we will show, answers to basic questions are as necessary as applied research for planning a broad biotechnological utilization of plant cell cultures in industry and agriculture. Commercial application of cell cultures is seen, in particular, in the production of important natural compounds and in the improvement of crop plants. These two areas cannot be considered equally here; the product-oriented aspect of plant cell cultures will be emphasized more, since biotechnological - at least in the past - has dealt to some extent with fermentation and product recovery. The decision to favor product-oriented cell culture research does not mean that this area will become accessible to a broader commercial application earlier. On the contrary, at the present time it appears that the improvement of useful plants through cell culture technique may be achieved before the production of natural compounds from cell cultures at economically acceptable cost.

For two reasons it seems necessary to give an introduction into working with plant cell cultures before describing the biotechnological aspects. First, the field is uncharted territory for many biotechnologists, and, second, at the present time there is no collection of plant cell cultures from which definite lines can be obtained. Consequently, as a rule, in most cases one has to establish the required cell culture oneself.

Work with plant cell cultures

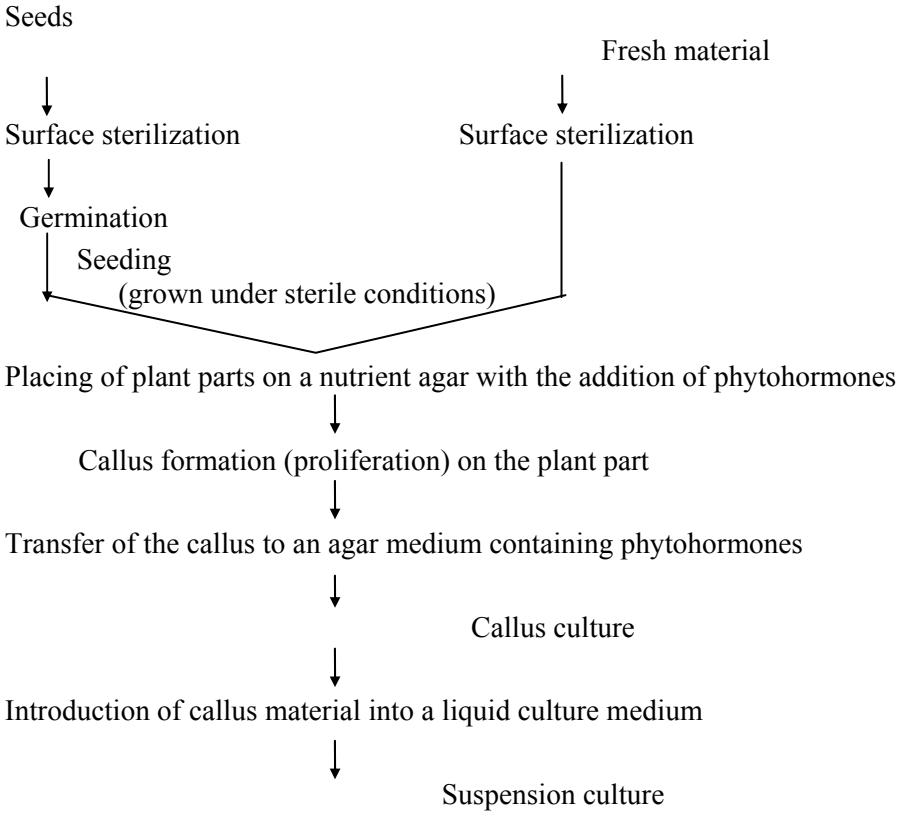
Equipment of a cell culture laboratories: Since plant cell cultures grow much more slowly than many microorganisms, the highest commandment in handling plant cell cultures is sterile working. A cell culture laboratory should therefore have available a clean bench with laminar air flow. Plant cell cultures should be maintained under constant conditions. Cultivation may take place in climatized chests, or still better, in climatized rooms. In most laboratories, plant cultures are maintained both on agar media and in liquid media. Suspension cultures must be shaken continuously on shaking machines for continuous operation. The biosynthetic productivity of a culture is frequently affected by light. In order to test these effects on the cultures, different light fields should be available for such experiments. Anyone requiring detailed information on the construction and equipment of a cell culture laboratory may be referred to an article

Media for plant cell cultures

The choice of medium is a device factor for setting up a culture and for the growth and biosynthetic productivity of a cell culture. The cells of most plants can be grown on definite synthetic media. Only a few cases have additives such as yeast extract, casein hydrolysate, and coconut milk proved to be necessary. An outstanding position has been achieved by the MS medium according to

Murashige-Skoog. All media for plant cell cultures contain mineral salts (major and trace nutrient elements), vitamins, sucrose, and growth regulators (phytohormones).

Setting up of cell cultures



The numerous publications on the influence of media on growth processes may be regarded as guides for one's own procedure in establishing a culture. The optimum conditions for a newly set up callus culture and for suspension cultures derived from it, however, must be determined in each case according to the question under investigation. Up to the present, plant cell cultures of dicotyledons, monocotyledons, gymnosperms, ferns, and mosses have been set up. It may therefore be assumed that in principle cell cultures of any plant can be established.

Animal cell cultures

General

During the last 20 years, the prerequisites for the maintenance and propagation of animal cells in culture have been worked out systematically. The present state of development is characterized by the fact that the cultivation of animal cell has been established in many laboratories and clinics in order to deal with biochemical, physiological, and morphological questions. Thus, cell culture techniques are firmly established in diagnostic virology, in the analysis of oncogenic and cytostatic substances, in amniocentesis, in aging research for the mapping of genes, and of cell cycle related events. Since most types of animal cells are suitable for in-vitro cultivation, the present annual demand of 280 millions of experimental animals world wild will be reduced as further developments become available.

Besides diagnosis and basic research, mammalian cells are of increasing importance for the production of a variety of pharmaceutically important macromolecules. Extensive efforts are currently being undertaken to transfer animal cells from the laboratory to the production level. To promote such developments, the NSF (National Science Foundation of the USA) has founded two cell culture centers in 1975 at the Massachusetts Institute of technology, Cambridge...

The cultivation of cells on a large technical scale started with BHK (baby hamster kidney) cells which were adapted to growth in suspension in 1962 and have been used industrially since 1967 in the United Kingdom, Italy... particularly for the production of foot-and-mouth disease vaccines, Girard (1977) has reported the construction of a factory in which every year 500 000 liters of cell suspension are processed in 3000 liter fermentors. More advanced processes are already based on fermentors with a capacity of up to 10.000 liters.

A large range of other substances, such as hormones, enzymes, antibodies and cytokines are on the threshold of industrial manufacture. Because of its tremendous current interest, the developments relating

to interferon have proceeded furthest and will be reported in greatest detail below as they represent an example of the rapid advance that is possible today as the result of directed development in such systems.

Animal cell culture deals with the study of parts of organs, tissues or individual cells in vitro. The starting point for such a culture is an explain; as long as this retains its structure and its function one speaks of an organ or tissue culture. If the organization of a tissue is destroyed by mechanical, chemical, or enzymatic action, transition to a true cell culture is complete.

Cells or tissue taken from an organism forms the primary culture. The term "cell line" is applied to the generations obtained after the first subcultivation and all subsequent ones. One should speak of a "cell strain" only when, by selection or cloning, cells with specific stable properties have been obtained (marker chromosomes, marker enzymes, resistances, and antigens). A cell line can become a continuous (permanent) cell line by "culture alteration". Continuous cell lines possess the potential for an unlimited subcultivation in vitro.

In the present state of our knowledge, it is impossible to determine the moment when the transition to continuous cell line has taken place. However, a common criterion, is an at least 70-fold subcultivation (passage) at intervals of about three days? The result of culture alteration was formerly generally called "transformation": however, this term should now be used only in those cases in which the alteration can ascribed unambiguously to the introduction of foreign genetic material.

EXERCISES

A. Read and translate into Vietnamese

acquaint, a clear interview, plant cell cultures, uncharted territory, a clean bench, climatized chests, callus culture, dicotyledons, monocotyledons, gymnosperms, ferns, unambigunously, prerequisite, diagnostic, oncogenic, cytostatic, amniocentesis, antibodies, ascribe, interferon, transition, transformation, mosses

B. Answer the following questions

1. What are the purposes of plant cell cultures?
2. What are the main commercial applications of plant cell cultures?
3. What kinds of equipments of a cell culture laboratory are necessary installed?
4. Describe some main operations of the establishment of plant cell cultures.
5. What are the purposes of animal cell cultures?

C. Translate into English

1. Trong những năm gần đây, công nghệ sinh học ngày càng quan tâm tới việc nuôi cấy tế bào động vật và thực vật.
2. Chọn môi trường nuôi cấy thích hợp là yếu tố quyết định cho quá trình phát triển và hiệu quả cao của sinh tổng hợp trong nuôi cấy tế bào.
3. Một loạt các chất khác nhau như: hoocmôn, enzim, kháng thể,... đã được sản xuất ở mức độ lớn trong công nghiệp bằng phương pháp nuôi cấy tế bào động vật.

UNIT 54 : ANTIBIOTICS

Of the toughly 8000 microbial metabolites already described, only a few have come into comparative wide use. The largest amounts of secondary microbial metabolites are used today in plant protection and animal nutrition while the market for antibiotics in human meloine is financially by far the most important.

The amounts of secondary metabolites that are formed per liter of culture by the wild strains fluctuate very widely but are generally less than 10 mg/l. However, yields of 5g/l, and more were necessary for an economically profitable fermentation. Without a substantial rise in yield, in many cases, not even the amount necessary for evaluation can be prepared. Raising the yield and the processing of the metabolite to make it suitable for use must take place in parallel if one is not to be delayed by the other. Often the researcher faces difficulties in explaining to the production manager that enormous effort must be put into increasing yield and concentration for a given product.

Of the many investigations in quite different fields that must be carried out before a product can be introduced, only those of biotechnological relevance, i.e., those mainly serving to increase yields, will be mentioned here. They can be classified in three groups:

a. Optimization of the fermentation process through the composition of the nutrient solution, the temperature, the pH, pO_2, density of inoculation, preparation of the inoculum, speed of stirring, feeding system, etc.
b. Study of the biogenesis and biosynthesis of the metabolite in order to achieve appropriate improvements of the nutrient solution of feeding and in order to have a basis for a program of mutation at the same time.
c. Modification of the strain by
   - random search for mutants with higher yields;
   - search for mutants in the intermediate metabolism in those areas that are related to the biogenesis of the metabolite with the aim of increasing the availability of constructional units;
   - search for mutants that are resistant to high concentration of their own metabolite;
   - search for permeation damaged mutants;
   - search for mutants with other properties favorable for the fermentation process, e.g., the absence of undesired components, with higher osmotolerance, etc.;
   - construction of strains by crossing according to classical methods or by the fusion of protoplasts.

The methods of "genetic engineering" have so far found no application in raising the yield of secondary metabolites of microorganisms. On the one hand, the gap between what can be done today in the case of *Escherichia coli* and that which can be realize with these methods in the case of Penicillium or Cephalosporium, for example is still very large. On the other hand, the successes achieved by the classical methods are so significant that in the industry there have so far been relatively few research workers dealing with the genetics of microorganisms. However, a rapid charge is taking place here. The "International Symposium on the Genetics of Industrial Micro-organisms" that are held regularly have created the necessary contacts between scientists, and the recent investigations of Hopwood have made important advantage in the genetics of the *Streptomycetes* available to a large circle.

With the introduction of a product, however, its microbiological, biochemical and biotechnological treatment should not be broken off. On the one hand, biotechnological processes can always be improved further, even above yields of 30g/l, and, on the other hand, the evaluation of practical experience may lead to modified products. Here is brief list of them:

a) A substance is transformed enzymatically, for which purpose living cells, fixed cells, isolated free enzymes, or carrier bound enzymes can be used. This field is known today as biotransformation.
b) A producing strain is induced by the mention of inhibitors to form a different spectrum of substances.
c) A producing strain is supplied with modified precursors (e.g., in the production of penicillin V).
d) A strain is subjected to a program of mutation, and mutants are selected which have a different spectrum of secondary metabolites.
e) A strain is mutated in such a way that can no longer synthesize certain precursors itself, and then modified precursors supplied so that a modified cud product formed. This method, which is known mutasynthesis, is being, applied intensively to the aminoglycosides.
f) All antibiotics prepared technically today obtained in batch processes, although they have been no lack of attempts to introduction continuous fermentation for the production of antibiotics, as well. The reasons are, on the other hand, the greatly increased cost of a multistage continuous fermentation in comparison with the batch process, while, on the one hand, the highly productive strains used to be frequently represent reduced forms in relative to growth, and the probability that a spontaneously occurring antibiotic-minus mutants would multiply faster and higher. In continuous fermentation, the minus mutants would rapidly out grow the reproductive strain and this can be substantially avoided in the bioprocess by the use of special propagation media and production media differing from them.

EXERCISES

A. Read and translate into Vietnamese

fluctuate, raising the yield, in parallel, inoculation, biogenesis, biosynthesis, a program of mutation, modification of the strain, search, osmotolerance, fusion of protoplasm, the gap, modification, inhibitor, mutant, propagation

B. Answer the following questions

1. What are the main technical conditions for optimization of the fermentation process?
2. What are the purposes of the study of biogenesis and biosynthesis of the metabolites?
3. What are the different methods for transformation of substances by enzymes?
4. What is the purpose of methods of genetic engineering in the production of antibiotics?
5. What kind of process is used for production of antibiotics today?

C. Translate into English

Nhiều quá trình nghiên cứu trong nhiều lĩnh vực khác nhau được thực hiện trong phòng thí nghiệm trước khi đưa ra sản xuất lớn.

Một chủng vi sinh vật được gây đột biến để nó có thể tổng hợp nên các tiền chất và sau đó có thể chuyển tiếp thành sản phẩm mong muốn.

Nghiên cứu tạo ra các chủng đột biến với các tính chất phù hợp cho các quá trình lên men ví dụ như: tạo ra các sản phẩmphụ không mong muốn, có khả năng chịu áp suất thẩm thấu cao hơn...

UNIT 55: PRODUCTION OF MICROBIAL BIOMASS

Definition and Review

The term biomass denotes the organic cell substance plant or animal organisms. It is used both for the total body substance of an organism and as a group term for a biological raw material produced from plants and animals. Correspondingly, by microbial biomass is understood the cell substance of microorganisms that arises during their mass cultivation:

The production of microbial biomass is the technical manufacture of the cell mass of microorganisms from suitable organic raw material.

In technical fermentation processes, in addition to the desired synthesis of a nature substance (e.g. penicillin, citric acid), the multiplication and growth of the culture of microorganisms itself also takes place. As early as the beginning of the twentieth century, it was recognized that this cell mass, or microbial biomass, forms a useful product, so that is production with the substantial exclusion of accompanying processes was made the subject of a new development, the production of microbial biomass.

Chemically, the production of biomass can be formulated in the following manner:

$$\underset{\text{Carbon substrate}}{C(H_2O)} + \underset{\text{Oxygen}}{O_2} + \underset{\text{Ammoniac}}{NH_3} + \underset{\text{Mineral substances}}{P, S, K, Na, Mg, Ca, Fe}$$

$\Downarrow$ are converted by cell multiplication and biosynthesis into

$$\underset{\text{Biomass}}{(CHNO)} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O} + \underset{\text{Heat of reaction}}{\Delta H}$$

As a total substance, biomass is composed of carbohydrates, lipid, protein, nucleic acids, and special natural products such as vitamins, steroids, isoprenoids, and mineral substances, and it contains structurally bound water.

Here, the main interest is in protein component of the biomass. Consequently, microbial biomass is also called single-cell protein (SCP) or bioprotein. The subsidiary components that it contains can, however, also be utilized, e.g. the lipid fraction (single-cell fat, SCF), the nucleic acid, or the vitamin component (particularly the vitamin B complex). In comparison with other biological natural materials this products is produced in relatively large amounts (mass product). Process engineering uses for this purpose on the large technical scale the cheapest possible raw materials and sources energy that are available in large amounts in simple and low-energy processes.

As an industrial product, microbial biomass completes with biomass products from agriculture, forestry, and fisheries, which, although, of course, they are obtained in a different manner, are similar in their basis composition and applicability in view of the universality of biochemistry. It is precisely in these facts that a challenge to biotechnology is seen – namely the production of biomass industrially in a technically controllable manner independent of soil, climate, and weather. Its development received another impulse when it was discovered that fossil materials can be used as substrates for

microorganisms. Through this new raw material basis, it is possible once again to include the fossil carbon compounds into the life cycle from which they have been excluded for millions of years.

In the meantime, the production of microbial biomass has taken a firm and important place in research, development and technical production and has led to new groups of tasks for microbiology, process engineering and the development of new bioproducts.

The production of microbial biomass takes place in a fermentation process. Here, selected strains of microorganisms are multiplied on suitable raw material in a technical cultivation process directed to the growth of the culture, and the cell mass so obtained is isolated by separation processes. Process development begins with microbial screening, in which suitable production strains are obtained from samples of soil, water and air or from swabs of inorganic or biological materials (mineral ores, fruit peel) and are subsequently optimized by selection, mutation, or other genetic methods. Then the technical conditions of cultivation for the optimized strains are worked out and any special metabolic pathways and cell structures are determined (biochemistry, molecular biology). In parallel to these biological investigations, process engineering and apparatus technology adapt the technical performance of the process and the apparatus in which the production of biomass is to be carried out in order to make them ready for use on the large technical scale. Here economic aspects (investment, energy, operation costs, scale-up) come to the fore, or the overall profitability of biomass processes, the raw materials, their production and preparation, and the energy demands play the most important role. The various raw materials carriers must be investigated for the special biological process.

The biomass product proper is regarded as a new industrially accessible raw material and requires its own independent product development the task of which is, by analyses and biological tests, to determine the properties and composition of the total product and then to find possibilities for utilizing it or its constituents. New applications are opened up by further processing. These range from the fodder sector through foodstuffs to technical, pharmaceutical, dietetic, and cosmetic products.

Safety demands and questions of environmental protection arise in the production of microbial biomass in relation both to the process and to the product. Finally, safety and the protection of innovation throw-up legal and patent aspects, namely operating licenses, product authorizations for particular applications, and the legal protection of new processes and strains of microorganisms.

Thus, the production of microbial biomass includes a complex of technical fields and is becoming an interdisciplinary example of new biotechnology.

EXERCISES

A. Read and translate into Vietnamese

Biomass, mass cultivation, multiplication, single-cell protein (SCP), challenge, impulse, fossil, swab, fodder sector

B. Answer the following questions

1. What is the microbial biomass ?
2. What are essential substances for the production of microbial biomass ?
3. What are the raw materials in Vietnam for production of biomass?
4. Can you tell the advantages of the production of microbial biomass?
5. Can you describe some special metabolic pathways to form microbial biomass?

C. Translate into English

1. Sinh khối vi sinh vật được sản xuất từ các nguồn nguyên liệu sẵn có, rẻ tiền ở Việt Nam.
2. Sinh khối vi sinh vật được lựa chọn phù hợp các nhu cầu sử dụng khác nhau và an toàn cho người, gia súc sử dụng.

UNIT 56: SINGLE-CELL PROTEIN: PRODUCTION MODIFICATION AND UTILIZATION

Single-cell protein (SCP) refers to any unicellular source of protein, including yeasts, bacteria, fungi, and algae. The value of SCP is in its use as a nutritional supplement where conventional protein sources are not available or are uneconomical.

The production of SCP can be simply defined as the process of converting raw materials into cellular biomass. The production cost of SCP is dependent upon substrate cost, operating expenses, and capital investment for fermentation equipment. A significant reduction in the cost of SCP would be realized if cheaper substrates could be developed without loss of conversion efficiency.

Another important factor in SCP production is protein content quality. The chemical composition of yeast, bacteria, fungi and algae vary, depending upon the genera and growth conditions. The gross chemical composition of various microorganisms is presented as protein content of yeast (45 – 55%); algae (47 – 63%); bacteria (50 – 83%); fungi (31 – 55%).

Although the protein content can be varied by growth conditions, genetic manipulation can also be employed to alter the amino acid spectrum.

The production of SCP is most amenable to manipulation as a biotechnological process. Improvements in SCP yields, productivity, and quality can be obtained by optimizing the various stages in the process. This review will highlight some of the recent developments in SCP production and strategies to improve SCP production via genetic engineering. Recently some authors have reviewed SCP production and described methods for producing SCP from various substrates using both photosynthetic and nonphotosynthetic microorganisms.

Genetic engineering of the ideal SCP microorganism

Most SCP processes are designed to take advantage of an available substrate using a microorganism, which can readily convert that substrate into microbial biomass. The choice of SCP microorganism is usually limited to that particular process, and a change in substrate often necessitates a change in the type of SCP microorganism used. Other considerations include the potential toxicity, functionality, and organoleptic performance of the SCP. In most SCP processes the selection of the SCP microorganism involves some compromise in each of these areas. It would be ideal if the best attributes of each SCP microorganism could be combined. Recent developments in genetic engineering have made the "construction" of SCP microorganisms possible. The required tools for the genetic engineering of a microorganism are a vector and a transformation system. A vector is a DNA sequence, which functions to maintain the desired gene in the host. A vector is usually constructed from an extrachromosomal element, for example, a plasmid or an integrative virus. The only requirement is that it replicates whenever the host replicates to avoid its segregation and loss during mitosis.

The second tool for the genetic engineering of SCP microorganisms is a transformation system. Transformation is the uptake of naked DNA by a cell. Since most genetic engineering is performed in vitro, it is essential that introduction of the engineered gene into the host be possible. A cell can be transformed through a variety of techniques, which make its competent (capable of DNA uptake). Competence can be achieved either naturally or by treatment with divalent cations. Alternatively, the cell wall can be removed, rendering the protoplast capable of DNA uptake.

EXERCISES

A. Read and translate into Vietnamese

expenses, amenable, highlight, compromise, plasmid, integrative virus, replicate, mitosis, segregation, uptake, nake, in vitro.

B. Answer the following questions

1. What is the SCP ?
2. What are the factors effecting to the production cost of SCP ?
3. Can you describe the protein content of various microorganisms as sources of SCP?
4. What are the advantages of most SCP processes ?
5. What is a transformation system in the genetic engineering of SCP microorganisms?

C. Translate into English

1. Quá trình sản xuất protein đơn bào có thể định nghĩa đơn giản như là một quá trình biến đổi nguyên liệu thành sinh khối tế bào vi sinh vật.

2. Muốn tăng hiệu suất, năng suất và chất lượng của sản phẩm protein đơn bào ta phải tiến hành tối ưu hóa các giai đoạn khác nhau của quá trình tạo sinh khối vi sinh vật lựa chọn phù hợp cho SCP.

UNIT 57: IMMOBILIZATION OF ENZYMES AND CELLS

Introduction

The technology for immobilization of cells and enzymes evolved steadily for the first 25 years of its existence, but in recent years it has reached a plateau, if not a slight decline. However, the expansion of biotechnology, and the expected developments that will accrue from advances in genetic technology, has revitalized enthusiasms for immobilization of enzymes and cells. Research and developments work has provided a bewildering array of support materials and methods for immobilization. Much of the expansion may be attributed to developments to provide specific improvements for a given application. Surprisingly, there have been few detailed and comprehensive comparative studies on immobilization methods and supports. Therefore, no ideal support material or method of immobilization has emerged to provide a standard for each type of immobilization. Selection of support material and method of immobilization is made by weighing the various characteristics and required features of the enzyme / cell application against the properties / limitations / characteristics of the combined immobilization / support. A number of practical aspects should be considered before embarking on experimental work to ensure that the final immobilized enzyme and / or cell preparation/ is fit for the planned purpose or application and will operate at optimum effectiveness.

Choice of support and principal method

In solution, soluble enzyme molecules behave as any other solute in that they are readily dispersed in the solution and have complete freedom of movement.

Fundamental considerations in selection a support and method of immobilization

Property	Points for consideration
Physical	Strength, noncompression of particles, available surface area, shape/form (beads/sheets/fibers), degree of porosity, pore volume, permeability, density, space for increased biomass, flow rate, and pressure drop
Chemical	Hydrophilicity (water binding by the support), inertness toward enzyme/cell, available functional groups for modification, and regeneration/reuse of support
Stability	Storage, residual enzyme activity, cell productivity, regeneration of enzyme activity, maintenance of cell viability, and mechanical stability of support material
Resistance	Bacteria/ fugal attack, disruption by chemicals, pH, temperature, organic solvents, proteases, and cell defense mechanisms (protein/cell)
Safety	Biocompatibility (invokes and immune response), toxicity of component reagents, health safety for process workers and end-product users, specification of immobilized preparation for food, pharmaceutical, and medical applications
Economic	Available and cost of support, chemicals, special equipment, reagents, technical skill required, environmental impact, industrial-scale , chemical preparation, feasibility for scale-up, continuous processing, effective working life, reusable support, and CRL or zero contamination (enzyme/cell-free product)
Reaction	Flow rate, enzyme/cell loading and catalytic productivity, reaction kinetics, side reactions, multiple enzyme and/or cell systems, batch, and so on; diffusion limitations on mass transfer of cofactor, substrate, and products

Enzyme immobilization is a technique specifically designed to greatly restrict the freedom of movement of an enzyme. Most cells are naturally immobilized one way or another, so immobilization provides a physical support for cells. The first consideration is to decide on the support material, the main method of immobilization, taking into account the intended use and application. There are five principle methods for immobilization of enzymes/cells: adsorption, covalent binding, entrapment, encapsulation, and crosslingking.

EXERCISES

A. Read and translate into Vietnamese

plateau, accrue, revitalize, a bewildering array, attribute, support, emerge, embarking, disperse, hydrophilicity, disruption, biocompatibility, invoke, immune, feasibility

B. Answer the following question

1. What are the purposes of immobilization of enzymes and cells ?
2. What are physical properties for selecting a support and method of immobilization of cells or enzymes ?
3. What are the main points for evaluation of stability of selected immobilization method ?
4. Can you tell the ability of resistance of supports in immobilization of microbial cells ?
5. Can you describe the principal methods for immobilization of enzymes/cells ?

C. Translate into English

1. Trong dung dịch, các phân tử enzim hoặc các tế bào cố định dễ dàng phân tán vào dung dịch và hoàn toàn chuyển động tự do.

2. Về phương diện kinh tế phải xét đến các vấn đề như: chất mang có sẵn, rẻ tiền, thiết bị phù hợp, kỹ năng cố định, tác động đến môi trường, quá trình liên tục, sử dụng lại các chất mang, mật độ enzim và tế bào khi dùng kỹ thuật cố định.

UNIT 58: GENETIC MANIPULATION - ISOLATION AND TRANSFER OF CLONED GENES

Organisms used in the production of food, feed, and fermentation are categorized under either the prokaryotes, such as bacteria, or eukaryotic organisms such as yeast, plant, and animal cells. The bulk of fermentation, metabolite synthesis, and production of enzymes, cofactors, vitamins, and other food ingredients used by industry is carried out by microorganisms. Selection and construction of mutants for the purpose of genetic and biochemical analysis has been a fundamental tool of genetic research.

In most cases of genetic engineering, isolation of new cloned genes occurred through the insertion of foreign DNA into transposons, phages, and cosmis. Theses phages and transposons contain an easily assayable marker whose expression indicates the presence of cloned gene. As such, cloned DNAs could be found within any number of transformed microbial colonies using appropriate molecular manipulation. The procedures led to cloning genes that contained material from various gene libraries and vectors that were used for the isolation of specific eukaryotic cloned DNA. This was followed by more sophisticated radioisotopic and immunological screening of such genes and their expression in microbial organisms. The history of the transposon is interesting, as this phenomenon was first observed in the early 1950s by Barbara McKlintosk. She observed that the control of the dormant genes in corn were often unstable. The instability could not be explained in terms of mutation, but in terms of controlling elements that could get in and out of genes and generate new phenotypes. Transposons, through their insertion and excision across the DNA, can create new features and mutations in many organisms. Such movable genetic elements have been found in fruit flies, yeasts, bacteria, and several plants. In bacteria an additional aspect of the transposable element is that it is often found in conjunction with conjugal plasmids responsible for the transfer of such genetic elements to appropriate recipient bacteria. Thus, through a process of conjugation or mating, transformation, and transduction, we find that some genetic information can be transmitted to another cell to generate a new character(s). In eukaryotic cells such as in yeasts and plants, not only these processes but also those of protoplasm fusion and hybridization are observed. In these cases, aside from genetic exchange, mixing of the cytoplasmic material of the two cells can occur.

Protoplast formation is generally simple in that it requires digestion of the cell wall and liberation of membranous structures called protoplasts.

Genetic applications to biotechnology: food production as a system

The wide variety of genetic principles described above can be applied to the production of food and beverages. Genetics can be used to enhance and change the quantity and quality of ingredients that are used in human and animal food and feed systems. This can be done by alterations in the material used for obtaining substances from plants and animals or the production of chemicals or pharmacological ingredients. Such items can also be changed to provide higher-value material or more readily utilizable materials for the food and chemical industry.

EXERCISES

A. Read and translate into Vietnamese

genetic manipulation, mutants, mutation, recombinant DNA, cloned genes, insertion, transposons, phage, cosmid, sophisticate, excision, conjunction, recipient, mating, transduction, transformation, protoplasm fusion, cytoplasmic material.

B. Answer the following questions

1. What is the purpose of genetic manipulation ?
2. Can you describe briefly the method of isolation and transfer of cloned genes in genetic engineering ?
3. Can you tell some main methods using in genetic engineering of bacteria, yeasts, fruit flies or several plants ?
4. What are the hybridization and fusion of yeasts ? It is important in genetic engineering ?
5. Can you describe some genetic application to biotechnology?

C. Translate into English

1. Tuyển chọn và tạo nên các chủng đột biến có lợi là mục đích chính của kỹ thuật di truyền hiện nay.

2. Trong các tế bào thuộc Eukaryote như nấm men, thực vật, ngoài kỹ thuật di truyền chung, người ta thường dùng kỹ thuật lai tạo các chủng và dung hợp tế bào trần.

UNIT 59: BIOLOGICAL REGULATION AND PROCESS CONTROL

The basis of any biotechnological process is the growing or resting cell and its constituents (organelles, enzymes). The metabolic processes that are to be utilized for economic purposes in biotechnology are catalyzed by specific catalysts (= biocatalysts = enzymes) the activities of which are subject to certain control mechanisms.

A simple bacteria cell such as *Escherichia coli* has available more than 1000 – 2000 enzymes (actual or potential) which may make up as much as 70% of the total cell weight. In using them, the practical man is therefore employing a complex system he is quite incapable or viewing in its totality. Consequently, in process development he is usually forced to carry out empirical procedures and with his technical measures (design and performance of the process) acts on biological regulations of which he knows only an overall result.

Process control must start from the biological facts and utilize them for technical application. The metabolism of added substrates takes place via about 20 steps and yields about 20 amino acids, four deoxyribonucleotides, four ribonucleotides, about ten vitamins, and several fatty acids, from which more than 1000 protein, three types of RNA, DNAs (+ plasmid), mucopeptides, polysaccharides, and lipids must be synthesized. In procaryotes, these processes may take place in 15 to 20 min (= one generation time), the coordination of the activities of the catalytic elements ensuring that undesired overproductions do not occur.

It is interesting that the regulation of enzyme activity takes place according to principles similar to those applied in technology (closed action cycle).

The organization and treatment of the material is adapted to the special use, and the total complex is constructed on the basis of the methods of measurement. This procedure takes place into accounts the fact that measurement technique primarily follows independent tasks and aims precisely within the

biotechnological process. Thus, the information obtained by measurement concerning the instantaneous state of operation of the process leaves open the question of whether and what useful application is made of the information obtained. Within the framework of process analysis, this application is limited to the search for the functional relationships between the variables of state and understand the principles of the biological system better. In the first place, therefore, this analysis follows the aim of broadening our knowledge on the interaction of the organisms with their environment.

On the basis of this knowledge, it is then possible to affect features of the process in a desired manner by control or regulation. Here, the possibilities of the controlled performance of the process must be made use of by establishing and maintaining the optimum environmental conditions for the growth of the organisms and for the formation of products by them.

On the various levels of process study and directed action on the occurrence of the process, the process computer is an effective aid. In association with process analysis this can bring into prominence the particular possibilities of a rapid concentration of information. When improved instrumentation is taken into account, it can readily be seen that these tasks are not trivial, and the desired information is often available only after the various process magnitudes have been combined. In addition to these tasks from the field of data processing and analysis, development has the aim of an increasing use of the computer in process control and regulation. In this connection it must be expected that even complex control strategies will be capable of being realized to an increased degree. From the point of view of control techniques, the possibility of the mathematical formulation of individual biological andchemical-engineering process steps is also of particular importance. In this way, the process computer can finally make a contribution to the utilization of increasing knowledge concerning regulation phenomena within the cell for an improved performance of the process.

An optimization can be carried out on the basis of earlier knowledge (off-line) but, in the present state of the art, on-line calculations, made possible by the availability of modern digital computers, can also be used. Consequently, the interrelationship of the techniques of measurement, control, and computering must be studied.

The number of process quantities and parameters in fermentation is very large. For the description of microorganisms, biologists use about 100 different magnitudes, and in technical processes with microorganisms. Physical chemical, and process-engineering magnitudes are involved in still greater number, so that the complex system of a fermentation cannot be calculated or described totally even in an approximation. Limits are still set to the determination of measurements in biotechnology by technical factors, so that many process magnitudes can be measured

- not at all,
- not sufficiently accurately, or,
- not on-line (and therefore not frequently enough).

Biotechnology, as a scientific technology, is still a very young field. In measurement and control techniques, experience and, to a large extent, apparatus, have been taken over from chemical process engineering. In some measuring processes, adaptations have already been made to the particular features of biotechnology but other methods have been very incompletely used in biotechnology, in many cases. This applies particularly to control technique. Again, methods can be taken over from other sciences and applied to fermentation technique; e.g., from medicine.

In a bioprocess, four types of process magnitudes can be distinguished:

a. Control magnitudes (manipulated variables, imput magnitudes)
b. Magnitudes of state (measurements)
c. Magnitudes of quality (optimization magnitudes, output magnitudes)
d. Characterization magnitudes (parameters)
   - theoretical parameters (physical, chemical, biological model)
   - experimental parameters (experimental process identification).

EXERCISES

A. Read and translate into Vietnamese

measurement technique, instantaneous state, broadening, magnitude, organelles, control mechanism.

B. Answer the following questions

1. Is it necessary to control and regulate the biological process ?
2. What is the purpose of process control in biological process ?
3. How many steps are taken place in the metabolism of added substrates ?
4. Is it important to use possibility of the mathematical formulation and computer for individual biological or chemical-engineering process steps ?
5. What are the number of process quantities and parameters in fermentation ?

C. Translate into English

1. Vấn đề điều chỉnh và kiểm tra thường xuyên các quá trình sinh học xảy ra là rất quan trọng.
2. Mỗi một quá trình lên men bởi các chủng vi sinh vật khác nhau phải hình thành các bước kiểm tra, điều chỉnh phù hợp.

UNIT 60: PRODUCT RECOVERY IN BIOTECHNOLOGY

Introduction

Bioproducts are produced by living cells or are localized in cells from which they must be isolated. This means that the majority of substances are sensitive compounds the structure and biological activity of which can be maintained only within sharply defined conditions of the medium. Accordingly, methods for their recovery and processing must be used that are adapted to their labile structures and range within narrow limits in relation to temperature, salt concentration, or pH. In addition, the recovery of enzymes its frequently restricted to the use of aqueous solutions, since in most cases organic solvents bring about a denaturation of proteins.

While the methods for the recovery of bioproducts were originally taken over from the repertoire of chemical process engineering, recently special methods have been developed to an increasing degree. Furthermore, recovery methods that can be carried out under sterile conditions are gaining importance, particularly in the pharmaceutical industry.

Separation

The size of an individual bacterial cell range about 0.2 to 5 μm in its largest dimension. The specific gravity of bacterial cells is in the order of 1.03, i.e., the difference in density between the particles to be separated and suspending medium is very small, which makes separation extraordinarily difficult. The separation of bacteria therefore, as a rule, requires a pretreatment of the suspension to be separated. This situation is more favorable in the separation of, for example, yeast cells with sizes in the order of 15 to 20 μm, which can be concentrated by the use of separators up to a very high solid-matter content in the separated deposit. The operations may be considered both for the mechanical separation of cells and for the concentration of products for the subsequent purification steps.

Flocculation and flotation

It can be deduced from the Stokes law for the setting velocity can be achieved by increasing the diameter of the particle, i.e., the separation of cells from culture solutions can be facilitated by agglomeration of individual cells to larger flocs. Reversible flocculation can be achieved by the neutralization of the charges present on the cell surface by polyvalent ions of opposite charge, the cells then coming into close contact with their neighbors. On the other hand, the use of polymeric compounds leads to an irreversible agglomeration into flocs because of the formation of bridges between individual cells. Flocculating agents that can be considered include inorganic salts, mineral hydrocolloids, and organic polyelectrolytes. However, compounds such as protein, polysaccharides, and nucleic acids which bring about an agglomeration of individual cells may also be liberated by partial autolysis. The flocculation of cells depends on various factors, such as temperature, ionic environment, physiological age of the cells, surface forces, and the nature of the organisms, as has been shown by investigations with various organisms. Polyelectrolytes have been used extensively for the treatment of sewage. The most effective agents are mineral colloids and polyelectrolytes. Their activity as flocculants depends substantially on the state of the cell surface and of the flow situation during the flocculation process. The cell surface is normally negatively charged out but can on balance exhibit positive total charge through the absorption of ions from the fermenter liquor, which explains the good effect of negatively charged polyelectrolytes.

In those cases where flocculation reactions lead only to the formation of unstable agglomerates of cells, flotation can be used for the enrichment of microorganisms. In flotation, particles are adsorbed on gas bubbles, which are either blown into the suspension or are generated in the suspension. The separated particles collect in a foam layer and can be taken off. The formation of a stable foam layer is supported by the use of insoluble "collector substances", such as longchain fatty acids or amines. Microflotation processes have been developed in experiments with bacteria and algae. The separation effect in flotation is highly dependent on the size of the gas bubbles. With electrolytically produced nascent hydrogen / oxygen, very small (ca. 30 μm) gas bubbles can be produced in the suspension to be separated, while in normal flotation processes sufficiently small gas bubbles (ca. 40 μm) can be obtained only at pressures of at least ca. 5 bar. By electroflotation from a preflocculated suspension of bacteria with a cell concentration of 16 g/l.

Some other methods as: surface (cake) filtration; depth filtration; sieving filtration; centrifugation; filter centrifuges and sieve – type centrifuges; decanter and sedimenting centrifuges; disintegration of animal and plant tissue or of microorganisms, Drying etc.

EXERCISES

A. Read and translate into Vietnamese

labile structure, repertoire, pretreatment, deposit, flocculation, flotation, deduce, agglomeration, flocs, ultrafiltration, investigation

B. Answer the following questions

1. What are differences between separation and centrifugation in the product recovery 0f biotechnology ?
3. What are differences between flocculation and flotation in the recovery of products of a biological process?
4. What are differences between filtration and ultrafiltration in the product recovery of biotechnology ?
5. Why do you have to disintegration of animal, plant tissue or microorganisms before recovery of final products ?
6. Can you tell something about sedimenting centrifuges or decantion in the product recovery of biotechnology ?

C. Translate into English

1. Để thu hồi sản phẩm từ môi trường nuôi cấy vi sinh vật, ta phải dùng nhiều phương pháp khác nhau tuỳ thuộc loại vi sinh vật và loại sản phẩm.
2. Các phương pháp thu hồi sản phẩm như: tách tế bào vi sinh vật bằng ly tâm, lọc, siêu lọc, lắng, gạn, phá vỡ tế bào, cô đặc và tinh chế sản phẩm thu được theo các phương pháp hoá lý, cơ học khác nhau.

PART 2 : GRAMMAR

NGỮ PHÁP TIẾNG ANH TRONG KHOA HỌC

I. Abbreviations - Chữ viết tắt

1. *General* - Chữ chung

cf.	- confer	viz.	namely
e.g	- for example	ca	circa = about, approximately
et.al	- and other	P.M	post meridiem = afternoon
etc.	- et cetera, and so on	A.M	ante meridiem = morning
i.e.	- that is	B.C	before Christ
v.	- see	A.D	Anno Domini

2. *Units* - Đơn vị

cm	- centimeter	hr.	- hour
c. ; cu.	- cubic	in.	- inch
cc.	- cubic centimeter	lb.	- pound = 0,453 kg
cps.	- cycles per second	l.	- litre
ft.	- foot = 12 in. =0,3048 m	m.	- metre
F.P.S.; ft-lb-sec	foot-pound second/system/	oz	- ounce = 28,35 g
		psi.	- pounds per square inch
g; gr	- gramme	sec.	- second
gal.	- gallon	sq.	- square

3. *Chemical* - Hóa học

b.p.	- boiling point	m.p.	- melting point
conc.	- concentrate	soln.	- solution
dil.	- dilute	vol.	- volume
f.p.	- freezing point		

II. Reading chemical and mathematical signs and formulas

(Cách đọc các kí hiệu hóa học và toán học)

1. *Chemical* - Hóa học

+	plus, and, together with	$2MnO_2$	/ 'tu: 'molikju:lzəv
_	minus		'em 'en 'ou 'tu:/
=	give, form	Cl	
→	give, pass over to, lead to	Cl- C -Cl	/ 'si: 'si: 'el 'fɔ:/
↔	forms and is formed from.form and are formed from	Cl	
H^+	univalent hydrogen ion	0^0C	zero degrees centigrade
Cl^-	negative chlorine ion, negative univalent chlorine ion	0^0F	zero degrees Fahrenheit
		100^0C	one /a/ hundred degrees
H_2O	/ eitʃ 'tu: 'ou/	100^0F	one /a/ hundred degrees

2. *Mathematical* - Toán học

+	plus	x	multiplied by, times
_	minus	:	divided by, the ratio of
( )	round brackets, parentheses	k'	k prime
/ /	square brackets, brackets	s_1	s sub one
=	equals, is equal to, is, are		

III. Một số qui tắc phát âm

1. Một số qui tắc cơ bản

Đối với phát âm tiếng Anh có một số qui luật cơ bản. Sự khác biệt thể hiện cụ thể nhất là phụ âm và nguyên âm, giữa các từ viết có nguyên âm đóng và mở:

- Âm đóng là những âm mà từ của nó được bắt đầu và kết thúc bằng phụ âm.
  Ví dụ: sit - sitting
- Âm mở: là những âm mà từ của nó được bắt đầu hoặc kết thúc bằng nguyên âm.
  Ví dụ: no - note

1.1. Các nguyên âm a, e, i, o, u. Nhìn chung các âm thường ở dạng âm đóng ngắn: / æ, e, i, o, a, u/ hoặc âm mở dài:/ ei, i:, ai, ou, ju:/

a — /æ/ - plan
/ei/ - plane

e — /e/ - gen
/i:/ - genus

u — /a/ - tub
/u/ giữa /p, b, f, - l, s/ - bull
/ju:/ - tube
/u:/ sau /r, l, dz/ - brute

i — /i/ - pill
/ai/ - pile

o — /o/ - hop
/ou/ - hope

1.2. Các nguyên âm a, e, i, o, u khi trước phụ âm r thường đọc

* ở dạng âm mở: /e, ia, o:, ju - jo:/

a + r — /a:/ - bar
/eə/ - bare

u + r — /ə:/ -burn
/ju; (jo:)/ sau /-uə (ɔ:)/

e + r — /ə:/ - her
/iə/ - here

a + rr — /æ + r/ carry

e + rr — /e + r/ berry

i + r — /ə:/ - fir
/aiə/ - fire

i + rr — /i + r/ mirror

o + rr — / ɔ + r/ borrow

o + r — / ɔ:/ - form
/ ɔ:/ - ore

u + rr — /a + r/ current

Kiểu phát âm này rất thông dụng đối với cả âm ngắn và âm dài giúp người học khi chưa biết phiên âm gặp từ có những âm dạng như trên có thể đọc được một cách tương đối chính xác. Tuy nhiên một số từ không đúng theo qui luật đã nêu.

Ví dụ: have, very, live, body, study, spirit...

2. Sau các phụ âm vô thanh

a- Từ âm tiết (e, ei, ai, i) phần lớn chuyển sang /i/ trong âm vô thanh.
Ví dụ: get - target; age - village; try - country; key- donkey

b- Từ các âm tiết /a:, u, o/ phần lớn chuyển sang /ə / trong âm vô thanh.
Ví dụ: car - vicar; tor - doctor; prefer - preference;
plus - surplus; lot - pilot; band - husband

3. Cách phát âm một số phụ âm đặc biệt

ch — /k/ - chemistry (trong các âm tiết có nguồn gốc la tinh)
/tʃ/ - change (trước o, u, a và phụ âm)
/ʃ/ - machine (trước i, e, y)

c — /k/ - coal, car, cup, clean (trước o, u, a và phụ âm)
/s/ - certain, city, cycle (trước e, i, y)

g — /g/ - gas, go, gun, green (trước o, u, a và phụ âm)
/dz/ - general, gin, biology (trước e, i, y)

Chú ý: get, give, girl
th /ð/ - ether (trong các âm tiết có nguồn gốc La tinh)
ph /f/ - sulphur
qu /kw/ - liquid

4. Cách phát âm một số tiếp đầu ngữ và tiếp vị ngữ

a)	bi-	/bai-/	binary	/bainəri/
	di-	/dai-/	diatomic	/daiə'tɔmic/
	tri-	/trai-/	trivalent	/trai'veilənt/
	re-	/ri:-/	re-distil	/'ri:dis'til/

	de-	/di:-/	de-oxide	/di:'ɔksaiz/
	hypo-	/haipou-/	hypophosphate	/,haipou'fɔsfeit/
	hydro-	/haidrou-/	hydrocarbon	/haidrou'ka:bən/
b)	-ation	/-eisən/	neutralization	/,nju:tralai'zeisən/
	-tion	/-sən/	dilution	/di'lju:sən/
	-ture	/-tʃə/	culture	/kaltʃə/
	-age	/-idz/	percentage	/pə'sentidz/
	-ese	/-i:z/	manganese	/,mængə'ni:z/
	-ide	/-aid/	chloride	/klɔ:raid/
	-ite	/-ait/	chlorite	/klɔ:rait/
	-ate	/-it; eit/	chlorate	/klɔ:rit,-eit/
	-ine	/-i:n/	chlorine	/klɔ:ri:n/
	-ene	/-i:n/	benzene	/benzi:n/
	-ime	/-aim/	oxime	/oksaim/
	-ile	/-ail/	nitrile	/naitrail/
	-ol	/-oul/	catechol	/kætəkoul/
	-ic	/-ik/	lactic	/læktik/
	-ous	/-əs/	ferrous	/ferəs/
	-able	/-əbl/	fermentable	/fə:mentəbl/
	-ible	/-ibl/	combustible	/kəm'bastibl/
	-ize	/-aiz/	neutralize	/nju:trəlaiz/
	-fy	/-fai/	classify	/klæsifai/
	-ity	/-iti/	density	/densiti/

5. Sự khác nhau giữa tiếng Anh và tiếng Mỹ

a. Anh: -our colour, vapour — Mỹ: -or color, vapor
-re centre, litre, metre — -er center, liter, meter
-mme Gramme — -m gram

b. Cuối từ là phụ âm L, khi chuyển sang bị động phân từ hay động từ quá khứ, tiếng Anh hay gấp đôi phụ âm, tiếng Mỹ để nguyên.

Anh: travel - travelled — Mỹ: traveled /trævəld/
distil - distilled — distilled /dis'tild/

c. Chữ ph trong tiếng Anh thì trong tiếng Mỹ thường viết f.

sulphur - sulfur

6. Viết và phát âm trong tiếng Anh

a /ei/	f /ef/	k /kei/	p /pi:/	u /ju/	z /zed/
b /bi:/	g /dzi:/	l /el/	q /kju/	v /vi:/	
c /si:/	h /eitʃ/	m /em/	r /a:/	w /dablju:/	
d /di:/	i /ai/	n /en/	s /es/	x /eks/	
e /i:/	j /dzei/	o /ou/	t /ti:/	y /wai/	

7. Cách phát âm một số chữ viết nguồn gốc Hy lạp

α - alpha /ælfə/ — ε - epsilon /epsailon/ — β - beta /bi:tə/
λ - lambda /læmdə/ — γ - gamma /gæmə/ — π - pi /pai/
δ - delta /deltə/ — ω - omega /oumigə/

IV. Sự tạo thành danh từ số nhiều của một số danh từ đặc biệt

1. Không thay đổi ở số ít và số nhiều

a means - means a series - series

2. Các danh từ nguồn gốc La tinh và Hy lạp

nucleus	- nuclei	basis	- bases
datum	- data	analysis	- analyses
spectrum	- spectra	phenomenon	- phenomena

V. Mức độ so sánh

1. Mức độ nhỏ hơn của tính từ dài

volatile	*less* volatile	*the least* volatile
(bay hơi)	(khó bay hơi hơn)	(khó bay hơi nhất)

(thêm vào trước tính từ *less* và *the least* để chỉ hai mức độ so sánh)

2. The... the...

The lighter *the* percentage of silica, the harder *the* glass.

(Phần trăm oxit silic càng thấp thì thủy tinh càng rắn)

VI. Đại từ quan hệ

1. Whose

An atom *whose* nucleus has a given electrical charge

(Một nguyên tử mà hạt nhân của nó có điện tích đã cho)

* Chú ý: Đại từ quan hệ "*whose*" dùng cho cả người và vật

2. Of which

The physical state, on the basis *of which* all materials are classified...

Trạng thái vật lý mà trên cơ sở của nó toàn bộ vật chất được phân loại hoặc toàn bộ vật chất được phân loại trên cơ sở trạng thái vật lý của nó...

* Đại từ quan hệ "*of which*" chỉ dùng để chỉ đồ vật và thường đứng sau danh từ và phụ thuộc vào nó.

3. Which

There is not any sharp frontier between the chemical industry and many other industries, *which* makes it impossible to compose any precise definition of chemical industry.

(Không tồn tại giới hạn rõ ràng giữa công nghiệp hóa học và nhiều ngành công nghiệp khác. Điều đó không có thể tạo nên định nghĩa chính xác nào của công nghiệp hóa học).

Đại từ quan hệ "*which*" ở đây quan hệ thay cho cả câu ở trên

***4.* What**

It is necessary to state exactly *what* is meant by a particular kind of atom.

VII. Đại từ không xác định "some, any, no"

1. Some

If *some* radioactive lead is placed on a sheet of lead...

(Nếu như một ít chì hoạt động phóng xạ được sắp xếp trên mạng lưới của chì...)

* "*some*" được liên kết với danh từ của vật chất thì chúng ta dịch ra là: một ít, một phần, một mẩu, một số...

2. Any

a. *Any* of these observations shows that...

"*Any*" dịch là mỗi một hoặc bất kỳ một chất..., một chất nào đó...

b. The catalyst...; if *any*...; is added...

(Chất xúc tác...; nếu như bất kì một chất nào đó...; được thêm vào...)

c. There is not *any* sharp frontier.

(Không hề tồn tại một giới hạn chính xác nào)

*"*any*" đứng sau động từ phủ định, dịch là: không tý nào...; không...nào...

3. No

No other substance has these freezing and boiling points

(Không có bất kì một hợp chất nào khác có điểm đông đặc và điểm sôi như vậy)

* "*no*" nghĩa là không hề có, nối với động từ khẳng định

4. None

None of these substances occurs pure in nature.

(Không hề có chất nào của các chất này tồn tại tinh khiết trong tự nhiên)

* "*none*" nghĩa là không hề có, được dùng trước giới từ "*of*" như một danh từ độc lập

5. Each other, one another

- All gases are completely miscible with each other

(Tất cả các chất khí hoàn toàn có thể trộn lẫn với nhau)

- The carbon atoms are attached to one another by single bones.

(Những nguyên tử cacbon được liên kết với nhau bằng các mối liên kết đơn giản)

* ở đây có thể dịch *each other; one another*: với nhau hoặc chất này với chất khác...

6. Other - the other

Số ít		Số nhiều	
Trước danh từ đếm được	Trước danh từ không đếm được	Trước danh từ	Đứng độc lập
Another substance (chất khác)	*other* glass (loại thủy tinh khác)	*other* substances (những chất khác)	*others* (những loại khác)
The other Substance (chất thứ hai này)	*the other* glass (loại thủy tinh thứ hai)	the other substances (những chất thứ hai còn lại)	*the others* (các 'thứ' còn lại)

7. Either

a. In *either* case

Trong trường hợp này hoặc trong một của các trường hợp đưa ra

*"*Either*" một trong hai trường hợp

b. A liquid does not have a definite shape *either*

(Chất lỏng cũng không có hình dạng nhất định)

* "*either*" ở cuối câu phủ định có nghĩa là cũng, cũng như câu phủ định

8. Either - or, neither - nor

a. Either - or

- A substance possesses *either* definite shape *or* definite size.

(Một vật chất hoặc là có hình dạng xác định hoặc là có kích thước xác định)

*"*Either... or*" nối với câu động từ khẳng định dịch ra: hoặc.... hoặc, hoặc...;...hay là có cái này...cái khác.

- A substance does not possess *either* definite shape *or* definite size.

(Một chất không hề có hình dáng xác định và không hề có kích thước xác định)

* "*Either...or*" nối với động từ phủ định dịch là không hề có.

b. *Neither - nor*

- A substance possesses *neither* definite shape *nor* definite size.

(Một chất không hề có hình dạng và kích thước xác định)

* "*Neither...nor*" không hề có cả... để nối với động từ trong câu khẳng định (không có cái này.... không có cái khác).

9. Both - And

a. *Both*

- *Both* substances are volatile

(Cả hai chất này đều dễ bay hơi)

* "*both*" dịch "cả hai" khi trong câu có 2 danh từ ở trước nó

b. *Both - and*

- A solid is characterized *both* by a definite shape *and* definite size

(Chất rắn được đặc trưng bởi cả hai tính chất là hình dạng xác định và kích thước xác định

* "*both - and*" bởi cả hai như là hoặc cả hai là...và...

10. That

a. *That* portion boiling at 116 degrees should be collected.

(Phần sôi ở 116^0 sẽ được chọn và quan tâm)

* "*that*": này; nào đó

b. The characteristic feature of a gas is *that* its molecules aren't attached

(Nét đặc trưng của chất khí là ở chỗ những phân tử của nó không được liên kết với nhau)

* "*that*" có thể dịch là: là..., ở chỗ là...

c. The reactions *that* change them into other substances

(Những phản ứng làm thay đổi chúng thành những chất khác)

* "*that*" làm chức năng thay cho danh từ số ít trước nó.

d. Hydrogen is the lightest of all gases, its density being about 1/14 *that* of air.

(hydro là chất khí nhẹ nhất trong tất cả các chất khí, trọng lượng riêng của nó vào khoảng 1:14 trọng lượng riêng của không khí) /*that* = density/

- The physical properties of water are different from *those* of other substances.

(Những tính chất vật lý của nước khác với những tính chất vật lý của các chất khác)

* /*those* = properties/ "*those*" dùng thay cho danh từ số nhiều trước nó để tránh nhắc lại.

11. One

a. Water is *one* of the most important of all chemical substances.

(Nước là một chất quan trọng nhất trong tất cả các chất hóa học)

* "*one*" dịch là "một"

b. As the evaporation proceeds, *one* may observe that...

(Khi quá trình bốc hơi xảy ra, chúng ta có thể quan sát thấy rằng...)

* "*one*" chỉ người hay chúng ta.

c. The first portions contains the more volatile impurities and the residue in the flask retains the less volatile *ones*.

(Phần thứ nhất chứa những chất không tinh khiết dễ bay hơi hơn và phần còn lại trong bình chứa những chất (không tinh khiết) khó bay hơi hơn. /*ones* = impurities /

* "*one*" (số ít) và "*ones*" (số nhiều) dùng thay cho danh từ trước nó để tránh lặp lại. Thường đi sau danh từ ở trước nó hoặc sau "this, that"...

12. The former - the latter

There are two kinds of glass: lime glass and lead glass. *The former* /= lime glass/ is the more common, cheaper and harder. *The latter* /= lead glass/ has greater, luster and brilliancy.

(Tồn tại hai loại thủy tinh: thủy tinh canxi và thủy tinh chì. Loại đầu (thủy tinh canxi) thì thông dụng hơn, rẻ hơn và cứng hơn. Loại thứ hai (thủy tinh chì) thì có tính á kim, dòn và độ bóng cao hơn).

* Loại biểu đạt này hay gặp trong tài liệu khoa học. "*The former*" có thể dịch: loại thứ nhất này, loại 1... "*The latter*" có thể dịch: loại thứ hai này, loại sau... để tránh nhắc lại phần danh từ câu trên.

VIII. Cách đọc số từ

1. Số lượng

a. Các số đếm trên 1000, 1 triệu được tách nhau bằng dấu phảy. Ví dụ: 3,521,703.

b. Dấu chấm giữa 2 số chỉ số lẻ và giữa hàng trăm và đơn vị đọc thêm chữ "and".

Ví dụ: 210 two hundred and ten

1,502 one thousand five hundred and two

3,025 three thousand and twenty five

c. Nếu như trước "hundred, thousand, million" có thêm các số đếm lớn hơn 1, thì nó cũng không biến đổi ra danh từ số nhiều và các danh từ đi sau nó không kèm theo giới từ "of".

2. Dấu chỉ số nhỏ hơn 10

- Trong tiếng Anh chỗ dấu phẩy trong tiếng Việt thay bằng dấu chấm và đọc "point".

Ví dụ: 182.53 - one hundred and eighty-two point five three

- Số 0 đọc là "nought" hoặc là "zero".

Ví dụ: 0.08987 - nought (zero) point nought (zero) eight nine eight seven

3. Phân số

- Thường đọc phân số bằng đọc số đếm cho tử số và số thứ tự cho số ở mẫu số.

Ví dụ: 1/3 one-third; 1/5 one-fifth; 1/14 one-fourteenth

- Thường đọc: 1/2 one-half; 1/4 one-quarter (fourth)
- Nếu như tử số lớn hơn 1 thì đọc số đếm, gạch ngang với số thứ tự kèm theo.

3/5 three-fifths; 5/2 five-halves

- Với các số lớn hơn hàng trăm thì sẽ đọc tử số + over + số đếm ở mẫu số.

$\frac{147}{293}$ one hundred and forty-seven over two hundred and ninety-three

$\frac{a+b}{x}$ /ei/ plus /bi:/ over /eks/

4. Cách đọc số mũ

Ngoài biểu thị bình phương "squared", lập phương "cubed" còn các số khác kèm theo giới từ "to" với số thứ tự.

10^2 ten squared; 10^3 ten cubed; 10^5 ten to the fifth; 10^{-n} ten to the minus n-th

5. Cách đọc số căn

$\sqrt[2]{10}$ square root of ten $\sqrt[3]{10}$ the cube root of ten

$\sqrt[5]{10}$ the fifth root of ten $\sqrt[n]{10}$ the n-th root of ten

6. Cách đọc số thứ tự

first/ly/; third/ly; second/ly/; fourth/ly/

IX. Động từ nguyên mẫu và trợ động từ

1. To be

He *is to do* it tomorrow. (Anh ấy phải làm việc đó ngày mai)

* Thể hiện sự cần thiết hay bắt buộc phải làm

2. To have

I *had* that device repaired. (Tôi đã đưa thiết bị đó đi sửa)

* Liên kết "*have + something + past participle*" có ý nghĩa "đưa cái gì đi để làm gì".

He had his students study systematically.

(Anh ta đã yêu cầu (bắt buộc) các sinh viên của anh ta học một cách có hệ thống)

* Kết cấu "*have + somebody + infinitive* (without to)" có ý nghĩa bắt buộc, mong làm được.

3. To do

- She does study very hard (Quả thật cô ta học rất chăm chỉ)

- Do turn the tap on (Hãy nhớ mở vòi nước đã)

* Trong câu khẳng định thêm 'do 'trước động từ để thể hiện sự nhấn mạnh hay mong muốn khẳng định hành động đó.

- She loved him as much as he did her. (Cô ta yêu anh ta say đắm như anh ta yêu cô ta vậy)

- Why study as you do? (Vì sao lại học giống anh học vậy?)(rập khuôn).

4. Shall - Should

a- You *shall* pass your examination in time. (Anh sẽ thi đậu đúng lúc (sắp đặt để thi đậu)

- You *shall* not add more water. (Anh không được thêm quá nhiều nước)

- These experiments *shall* be carried out several times.

(Những thí nghiệm này phải được tiến hành một số lần)

* "*shall*" ở đây thể hiện sự bắt buộc phải làm, người nói "bảo lãnh" cho hành động xảy ra

b- You *should* pass your examinations in time. (Anh có thể thi được đúng lúc)

- You *should* not add more water. (Anh không nên đổ thêm nước)

* Nếu dùng "*should*"(phải) thể hiện sự bắt buộc, gợi ý lịch sự hơn. Có thể dịch là: "anh có thể...làm..."

- These experiments *should* be carried out several times.

(Thí nghiệm này phải lặp lại một số lần nữa)

- You *should* have done it more carefully (Anh nên tiến hành một cách cẩn thận hơn)

* "*should*": (phải) thể hiện sự bắt buộc nhưng lịch sự hơn và có thể làm ngay hay có thể không làm, như một lời khuyên... theo chủ quan của người nói.

5. Will - Would

a- Sometimes the apparatus *will* go wrong without any apparent cause.

(Thỉnh thoảng các thiết bị vẫn bị hỏng mà không rõ nguyên nhân nào).

* "*will*" thể hiện một hành động lặp đi lặp lại mà dịch ra hiện tại

b- He *will* have finished his studies.

(hình như anh ta đã kết thúc việc học tập)

* "*will*" đi với thì hiện tại hoàn thành biểu thị một giả thuyết, dịch ra thì quá khứ.

c- Sometimes the apparatus *would go* wrong without any apparent cause.

(Thỉnh thoảng thiết bị này đã bị hỏng mà không rõ nguyên nhân nào).

* "*would + infinitive*" biểu thị một hành động lặp lại, dịch sang thì quá khứ.

6. Can - Could

a- You *can* make your experiments in our laboratory.

(Anh có thể được phép làm các thí nghiệm của anh trong phòng thí nghiệm của chúng tôi).

- You *can* start tomorrow.

(Anh có thể được phép bắt đầu vào ngày mai)

- He *could* make his experiments in their laboratory.

(Anh ta đã được phép làm các thí nghiệm của anh ta trong phòng thí nghiệm của họ).

* "*can*" dùng cho hành động tương lai, "*could*" dùng cho hành động quá khứ

b- He *can* speak English well.

(Anh ta sẽ nói tiếng anh giỏi)

- He *will be able* to speak English better after another year of study.

- He *could* speak English well.

- He was able to do it in time.

* "*can; could*" với nghĩa: biết, dẫn đến một khả năng nào đó. "*can*" dùng cho hành động tương lai, "*to be able*" dùng cho hành động quá khứ thường sử dụng cho một hành động kết thúc hoặc bắt đầu. Nếu chỉ một khả năng dùng "*could*" cho hành động quá khứ.

c- He *can not* have passed all his examinations with honours.

* "*can not* + động từ ở thì hiện tại hoàn thành" thể hiện một sự nghi ngờ, ngạc nhiên một hành động trong quá khứ. Dịch là: không thể nào...

d- He *could* study with honours.

* "*could* + infinitive" biểu thị một điều kiện cho phép ở hiện tại.

e- She *could* have finished her studies in time.

* "*could* + hiện tại hoàn thành" thể hiện hành động có thể xảy ra trong quá khứ nhưng nó đã không xảy ra. Dịch là: đáng lẽ...

7. May - Migh

a- *May* he carry out his experiments in your laboratory?

- *May* he do it tomorrow?
- Will he be allowed to do it?
- He was allowed to do it?
- You *may not* smoke there.
- I *must not* smoke.

* "*may; might*" thể hiện cách hỏi hay sự xin phép, cho phép trong tương lai. Thể phủ định là "*must not*".

b- It *may* be easily prepared by oxidation.

He *may* do it tomorrow.

He *may not* do it tomorrow.

He *may* have done it.

*"*may*" ở đây thể hiện một khả năng "có thể".

Muốn biểu thị ở quá khứ dùng "*may* + infinitive"

c- He *might* do it.

- He *might* have done it.

*"*might*" thể hiện một sự có thể, nghi ngờ, nhưng ở mức độ cao hơn "*may*". Đi với hiện tại hoàn thành của động từ chỉ sự có thể ở quá khứ.

8. Must

a- I *must* do it tomorrow.

I shall have to do it tomorrow.

I had to do it yesterday.

I need not do it in time.

*"*must*" biểu thị sự cần thiết phải làm trong tương lai. Muốn nhấn mạnh hơn dùng:

"shall have to do sth" mạnh hơn "must do sth"

Thì quá khứ dùng "had to do sth"; phủ định "need not".

b- He must be a good student.

He must have been a good student.

*"*must* + infinitive" thể hiện sự khẳng định. Dịch là: chắc chắn, nhất định...

ở thì quá khứ dùng "must + động từ ở thì hiện tại hoàn thành.

9- Ought

- You *ought* to do it in time.
- You *ought* to have done it in time.

*"*ought to* + infinitive" biểu thị một bắt buộc làm ở thì hiện tại.

"*ought to* + infinitive" của hiện tại hoàn thành" biểu thị một việc làm không thực hiện được trong quá khứ (gần như *should*).

X. Động từ thể hiện thay đổi trạng thái

- The light blue colour gradually becomes deeper.
- The litmus paper turn red.

* Các động từ "*to get; to grow; to become; to turn*" đi với các tính từ biểu thị sự thay đổi trạng thái.

XI. Các thì, thể cách của động từ

Thời gian	Thì của động từ	Thì của động từ dịch sang tiếng việt
Quá khứ	I had written I wrote I had been writing I was writing	quá khứ
Hiện tại	I have written I write I have been writing I am writing	hiện tại
Tương lai	I shall have written I shall write I shall have been writing I shall be writing	tương lai

1. Thì hiện tại đơn giản

He, she, it + verb + s, es You, we, they + verb infinitive

a- He studies very hard.

She speaks English well.

* Thể hiện các hành động thông thường lặp đi lặp lại, tính chất đặc trưng hay dẫn xuất của một đối tượng.

b- Compounds are substances which consist of atoms of two or more different kinds.

* Các thí dụ trên biểu thị thì hiện tại đơn giản nhưng nó có giá trị cả thì quá khứ và tương lai.

c- Subscription expires next month.

* Thí dụ này thể hiện hành động trong tương lai nhưng đã được quyết định theo kế hoạch, có thể dịch sang hiện tại hoặc tương lai.

2. Thì hiện tại tiếp diễn

To be + verb + ing

a- He is making an experiment /now/.

* Biểu thị hành động đang xảy ra. Dịch ra thì hiện tại, thường thêm: bây giờ, quả vậy, hiện nay...

b- I am studying chemistry.

* Biểu thị hành động đã bắt đầu, đang xảy ra, chưa kết thúc. Dịch ra thì hiện tại, thường thêm: đang tiếp tục học, làm...

c- What experiment are you making tomorrow?

When are you making your experiment?

* Biểu thị hành động ở tương lai gần, sự xác định nhất định của ngữ cảnh. Dịch sang thì hiện tại hay tương lai.

3. Thì hiện tại hoàn thành đơn giản

to have + past participle

* Thể hiện một hành động quá khứ, nhưng không nói đến thời gian.

a- John has passed his examinations.

b- Jonh has always passed his examinations with honours.

- I have never been in America.

* Trong các câu xác định ngữ cảnh, tần suất thường thêm các từ: ever, never, often, always, not yet, lately, recently, today, this week, this year, etc.

Khi dịch thì thêm các trạng từ: cho đến nay, từ trước đến nay...

c- We have finished our practice.

Professor Brown has just come.

* Biểu đạt một hành động vừa kết thúc. Dịch là: xong, vừa mới...

d- I have known Mr. Brown these five years/ for five years/ for the last five years/ since 1965/ since I was in England/.

- I haven't seen him for five years.

* Hành động bắt đầu từ quá khứ nhưng hiện nay vẫn đang xảy ra, có khoảng thời gian kèm theo dùng "for", còn đối với mốc thời gian ta dùng "since". Dịch sang thì hiện tại: đã, từ khi, từ...

4. Thì hiện tại hoàn thành tiếp diễn

To have + been + verb + ing

- He has been learning English for three years/ since 1969, atd./.

* Dùng biểu thị hành động đã và đang xảy ra, và còn kéo dài trong tương lai. Dịch là "đã". Trong câu kèm giới từ chỉ thời gian for, since.

5. Thì quá khứ đơn giản

Verb + ed (regular verb)

- Yesterday he got up at six. He went to school. He opened the door of the laboratory and came in. After a few minutes he was prepared for his experimentation. Professor Brown finished his lecture an hour ago. When did he come? He came just now.

* Biểu thị một hành động hay một trạng thái trong quá khứ không còn ở hiện tại. Thường kèm theo trạng từ chỉ thời gian cụ thể: at five, on Sunday, in May, yesterday, in the morning, last year, in 1970, from 7 to 10, ago, just now, when?

6. Thì quá khứ tiếp diễn

to be (in the past) + verb + ing

a- Peter broke a few flasks and test-tubes when he was carrying out his last experiment.

When he entered the room, his fellow workers were discussing his latest paper.

* Thì này thường ở câu phụ, tạo hành động tiếp theo của câu chính ở thì quá khứ đơn giản, dịch thường y thêm "ngay khi... vừa làm... thì.... Đã...ngay khi..."

b- While I was making some experiments, Jonh was doing his homework and Mary was learning some new English words.

* Thể hiện hành động tiến hành trong quá khứ (xẩy ra đồng thời)

7. Thì quá khứ hoàn thành đơn giản

had + past participle

a- He had finished his studies by June.

* Biểu thị hành động đã xảy ra trước một hành động khác trong quá khứ.

b- He came to England when he had learned enough English.

He posted the letter he had written himself.

* Sử dụng để diễn đạt một hành động hay một trạng thái được kết thúc trước một hành động trong quá khứ. Dịch thêm từ "khi mà, đã..."

8. Thì quá khứ hoàn thành tiếp diễn

had + been + verb + ing

- When he came to the university in 1970, professor Brown had already been teaching there for three years.

* Dùng biểu đạt một hành động quá khứ còn tiếp diễn trong hiện tại mà đồng thời có một hành động quá khứ đơn giản trước nó. Dịch sang thì quá khứ thêm "đã làm được bao lâu"

9. Thì tương lai đơn giản

he, she, it, you, they + will + infinitive *we, I + shall*

- How long will the work take?

- Mr. Brown will be fifty next year.

* Biểu thị một hành động hay một trạng thái trong tương lai.

10. Thì tương lai tiếp diễn

shall, will + be + verb + ing

- This time tomorrow I shall be passing the final examination.

- Jonh will be studying chemistry for two more years.

* Biểu thị một hành động trong tương lai sẽ xảy ra trong một khoảng thời gian xác định hay sau một thời điểm nhất định ở tương lai.

11. Thì tương lai hoàn thành

shall, will + have + past participle

- He will have finished his studies by June/ by the time when you come back.

* Biểu thị một hành động sẽ kết thúc trong tương lai trước một thời gian xác định "by" hoặc trước một hành động khác.

12. Thì tương lai hoàn thành tiếp diễn

will, shall + have + been + verb + ing

- When he comes to the university. Professor Brown will have been teaching there for three years.

* Biểu thị hành động tương lai và còn tiếp diễn khi có một hành động khác xảy ra trong tương lai.

XII. Điều kiện cách

a- You would go to the school and I should study at home.

* Điều kiện hiện tại: should, would + present infinitive. Dịch ra điều kiện hiện tại: "nếu...thì..."

b- You would have gone to school and I should have studied at home.

* Điều kiện quá khứ: should, would + động từ nguyên thể thì hoàn thành của động từ. Dịch ra câu điều kiện quá khứ.

XIII. Giả định thức

a- Dạng đơn giản: giống như thì hiện tại ở nguyên mẫu he, she, have, he speak. Thì quá khứ: như động từ thì quá khứ trừ động từ "to be" dùng cho tất cả các ngôi "were", I were, she had, she spoke.

* Thì hiện tại hoàn thành: dùng "have" cho tất cả các ngôi she have had, he have spoken.

* Thì quá khứ hoàn thành như các cách biểu thị khác: she had had, he had spoken.

b- Dạng viết được tạo thành chủ yếu nhờ trợ động từ "may, might, should, would" đi với động từ nguyên mẫu hiện tại hay nguyên mẫu của hiện tại hoàn thành ở câu phụ. Thể hiện ở tất cả các thì. Biểu thị chủ yếu cho sự mong muốn, có thể dịch là "nếu...thì..."

XIV. Động từ nguyên thể

Thể chủ động: to call, not to call
to have called, not to have called

Thể bị động: to be called, not to be called
to have been called, not to have been called

* Động từ nguyên mẫu một mặt tồn tại như một bộ phận động từ, một mặt tạo nên một số liên kết đặc biệt câu tiếng Anh thường có thể nó được dịch sang câu Việt như một câu phụ.

1. *Chỉ mục đích*: Động từ nguyên thể có "*to*" thường dùng trong câu chỉ mục đích. Nó có thể dùng ngay bản thân nó hay đi với liên từ "*in order to, so as*". Dịch là: để

a- Câu chỉ mục đích cùng chủ ngữ.

Hydrogen burns in the air to form water vapour.

To avoid confusion, it is necessary for us to state...

It is necessary to collect about 12 l of distillate in order to obtain all the M-bromonitrobenzene.

* Đại bộ phận các động từ nguyên thể chỉ mục đích cho câu có cùng chủ ngữ. Tuy nhiên vẫn dùng cho câu khác chủ ngữ nhưng phải thêm giới từ "for"

b- Câu chỉ mục đích khác chủ ngữ:

In order for the reaction to take place, the collisions must be frequent.

2. *Động từ nguyên thể như danh động từ, đi sau danh từ*, dịch là "để"

a- ở dạng chủ động: sinks to take away waste water.

b- ở dạng bị động: processes to be employed in the factory

Động từ ở dạng bị động có thể dịch theo nghĩa mà danh từ có thể được làm gì đó hay dùng các câu quan hệ thể hiện ở thì tương lai

3. *Liên kết của tân ngữ với động từ nguyên thể*

The collisions permit the electron transfer to occur.

* Liên kết này thường đi với một số động từ sau: to ask, to find, to know, prove, require, to allow, to permit...

* Liên kết này cho phép dịch ra câu phụ hay kèm theo một số từ như: để mà, cho phép...

4. *Liên kết động từ nguyên thể với chủ ngữ*

Nitrogen is found to be slightly lighter than air.

* Liên kết được với một số động từ "*to see, to appear, to prove*" và một số động từ hay dùng thể bị động. Khi dịch ra có thể dùng câu phụ vô chủ, vô nhân xưng cho động từ chính.

Có thể dịch câu trên: Người ta tìm thấy nitrogen là một loại tương đối nhẹ hơn không khí.

5. *Giới từ liên kết*

for + tân ngữ + infinitive...

- It is necessary for us to state exactly...

* Liên kết này thường được dùng sau tính từ theo các liên kết: It is /im/possible, necessary, important...Khi dịch sang tiếng việt thêm "để mà, là..." ở câu phụ

6. *Động từ nguyên thể chỉ tác dụng*

The rate may become so great as to decolorize a stream of permanganate solution.

(Tốc độ có thể được tăng lên như vậy để làm mất màu dòng dung dịch permanganat)

* Động từ nguyên mẫu loại này thường đi sau cụm từ "*so...as to...*" (như vậy...để mà); "*too*" (vậy để mà...); "*enough*" (đủ để mà). Thường dịch trong câu phụ có thêm liên từ: để mà, là để...

7. *Động từ "to be + infinitive "*

The work which is to be carried out (công việc mà nó được tiến hành)

* Mẫu câu này biểu thị một hành động bắt buộc hay đã có kế hoạch. Dịch thêm: có thể, chẳng hạn, có là có thể...

XV. Participle - Phân từ

	Chủ động	Bị động
Hiện tại	calling	being called
Quá khứ	-	called
Hoàn thành	having called	having been called

* Trong tiếng Anh, phân từ cấu tạo từ động từ chính gọi là tính động từ hay danh động từ.

Phân từ hiện tại để biểu thị một hành động xảy ra đồng thời với hành động chính. Phân từ quá khứ đóng vai trò tính động từ với ý nghĩa bị động. Phân từ hoàn thành thể hiện hành động hoàn thành trước hành động chính.

1- I am running home. (Tôi đang chạy về nhà)

* Tính động từ chủ động (hiện tại) cấu tạo nên thì tiếp diễn của động từ.

2- There is running water in that house. (Trong nhà đó có nước đang chảy)

* Tính động từ (phân từ hiện tại) đóng vai trò tính từ chủ động.

3- I met Tom running home. (Tôi đã gặp Tôm đang chạy về nhà)

* Dùng tính từ chủ động hay đại từ quan hệ phục vụ cho danh từ ngay trước nó (chủ động) làm ngắn câu.

4- Running home, I met Tom. (Khi đang chạy về nhà, tôi đã gặp Tôm)

I met Tom, running home. (Tôi đã gặp Tôm trong khi tôi chạy về nhà)

* Dùng trong trường hợp để rút ngắn câu, chú ý dấu phẩy ở giữa khi dịch nó thuộc chủ ngữ, không thuộc tân ngữ (danh từ liền nó)

5- Running very quickly, we shall be in time.

(Bởi chúng ta chạy rất nhanh nên chúng ta sẽ đến đúng giờ)

* Danh động từ ở đây làm ngắn câu nhưng khi dịch giống câu phụ và chỉ nguyên nhân cho chủ ngữ câu chính.

6- He sat on the desk running water into a flask.

(Anh ta đã ngồi trên bàn và mở nước chảy vào một cái bình)

* Làm ngắn câu để thể hiện nguồn gốc ban đầu của chủ ngữ. Dịch thì thêm "và làm gì"

7- I saw Tom running home. (Tôi đã gặp Tôm đang chạy về nhà).

Sau các động từ quan sát "*to see, to hear, to feel, etc...*"

* Biểu thị một hành động đang xảy ra. Dịch hành động cho danh từ kế trước nó.

I saw Tom run home. (Tôi gặp Tôm đã chạy về nhà)

ở đây *danh từ + infinitive* (không có "*to*") biểu thị một hành động đã kết thúc.

8- Tom running some hot water into the flask, the apparatus was in good order.

(Khi Tôm mở nước nóng vào bình thì thiết bị vẫn hoạt động tốt)

* Phân từ có chủ ngữ khác với động từ ở câu chính được dịch ra theo hai vế của câu. Dịch thêm "khi...đang làm gì...,thì..."

9- Tom running his car into the garage, could not pass through.

(Vì Tôm đang lái xe vào gara nên chúng ta không thể đi qua được)

* Liên kết này thay câu chính chỉ nguyên nhân, dịch như một câu phụ.

10- Tom running very quickly, the man will be saved.

(Nếu Tôm chạy thật nhanh thì người này sẽ được cứu)

* Liên kết này thay cho câu chỉ điều kiện. Dịch có câu phụ.

11- They talked about the function of the new device, Tom running the water off the tank.

(Họ đã trao đổi về chức năng của thiết bị mới trong lúc Tôm mở nước ra từ bể chứa)

* Liên kết này thay cho câu chỉ ngữ cảnh ban đầu. Khi dịch thêm từ nối "trong khi, và, đồng thời..."

12- Run over, he had to be taken to the hospital.

đôi khi dùng "*being*" và "*having been*".

XVI. Danh động từ

	Dạng chủ động	Dạng bị động
Hiện tại	calling	being called
Hoàn thành	having called	having been called

* Cũng như phân từ, danh động từ hiện tại có cùng ý nghĩa hay cùng thể hiện hành động với câu chính.

Danh động từ hoàn thành biểu thị hành động xảy ra trước hành động của câu chính. Danh động từ có tính chất của danh từ. Sử dụng chủ yếu trong các trường hợp sau:

a- Sau một số động từ như: *to admit, to excuse, to finish, to mind, to need...*

b- Sau các giới từ.

c- Sau một số liên kết như: *it is no use, it is worth*.

Ví dụ: - I cannot admit running quickly.

- I am proud of running so quickly.
- It is no use running so quickly.
- Running a car very quickly may be dangerous.
- Give me your reasons for running so quickly.
- He is clever at running quickly.
- The only other thing is running.
- After running home I took a bath.
- He must apologize for running very quickly.
- He lagged behind for the purpose of running very quickly

* Rút gọn câu sau các giới từ liên kết "for, of, with"

- You can win by running very quickly.
- You wish miss the train without running.
- Besides running very quickly he is a good jumper.

* Dùng biểu hiện ngữ cảnh "besides, instead of, without"

- I looking forward to John's /his/ running.
- I am looking forward to John /him/ running.
- I am looking forward to the car running very quickly.
- I am looking forward to its /it/ running very quickly.

* Để động danh từ cạnh danh từ làm chủ ngữ cho câu sau để rút ngắn câu.

- I like running very quickly. (Tôi thích chạy nhanh)
- I should like to run very quickly. (Tôi mong muốn chạy thật nhanh)

* Danh động từ biểu thị một thói quen, một hành động lặp đi lặp lại. Còn động từ nguyên thể xảy ra một trường hợp. Trong tiếng Anh danh động từ được sử dụng rất đa dạng. Nó được dùng để rút ngắn và làm đơn giản câu.

XVII. Thể bị động

1. The experiment is made.

was made.

has been made.
had been made.
will be made.
will have been made.
would be made.
would have been made.
is being made.
was being made.

* Thể bị động được cấu tạo từ "*to be*" với phân từ quá khứ của động từ. Thì tiếp diễn chỉ có ở hiện tại và quá khứ.

2. The experiment was made by Jonh.

Chủ ngữ chính chuyển ra sau bởi "*by*"

- The experiment was made with this apparatus.

3. Hydrogen found in most of the substances which constitute living matter.

- The experiment was finished last week.

4. They gave him a new device.

A new device was given to him. / He was given a new device.

* Trong tiếng Anh hay dùng thể bị động, nhất là trong văn phong khoa học, chủ ngữ chuyển thành tân ngữ và ngược lại.

5. He was disappointed when /he was/ told that he had not been successful.

6. The laboratory was originally directed by Doctor Brown, now it is headed by Professor Smith.

XVIII. Các loại câu - Thứ tự - Cách chia

- I believe	that he studies very well
I have always believed	that he studied/ has studied/ well
I shall believe	that he will study very well
	that he would study very well.
- I believed	that he studied very well.
I had always believed	that he had studied very well.
I should believe	that he would study very well.
	that he would have studied very well.

* Cách diễn đạt các thì của động từ giữa câu chính và câu phụ phải tương ứng như các ví dụ ở câu trên.

XIX. Câu phức hợp có các mệnh đề chỉ

1. Thời gian

- We shall go on making experiments when he comes.
- When we have finished our experiments, shall go for a walk.

Thường có các giới từ: when, after, before, till, until, as soon as, as long as, etc.

2. Nguyên nhân - Hệ quả

- I will not do it however he prepares it / he | may / might | prepare it/.
- I will do it even though it take me a lot of time.
- I would do it even if took me a lot of time.
- The material reacts as though it were pure.
- He speaks as if nothing had happened.

3. Mục đích

- I came earlier to have more time for my experimentation.

* Cùng chủ ngữ, dùng động từ nguyên thể có "*to*";

Khác chủ ngữ dùng "*that, so that, in order that + câu phụ hiện tại + may(might)"*

- I come earlier	in order that	he may have more time for
- I have come earlier	so that	his experimentation
- I shall come earlier		that
- I came earlier	in order that	he might have more time for
- I had come earlier	so that	his experimentation.
- I should come earlier	that	

- She fears /feared/ less he should fail.

* Từ nối "*less*" để nhấn mạnh ý ngược lại. "*should*" dùng cho thì hiện tại và quá khứ.

- The compound must be heated so that it may decompose.

- You should use that new apparatus for the experiment to be successful.

- In order to obtain the product in a marketable form we must involve further operations /further operations must be involved/.

4. Điều kiện

a- If you heat the compound, it will decompose.

* Câu điều kiện thường đi với "if, unless, provided that, in case". Chỉ điều kiện ở thì hiện tại hay tương lai có thể thực hiện được.

b- If you heated the compound, it would decompose.

- If you had heated the compound, it would have decomposed.

* Chỉ điều kiện ở thì quá khứ đã không thể thực hiện được.

- If you should come in time, we should make our experiment.

* "should" trong câu điều kiện chỉ một sự nghi ngờ, một sự việc có thể xảy ra tương tự.

- Did you heat the compound, it would decompose.

- Had you heated the compound, it would have decomposed.

5. Câu giả thiết

- It is necessary that you should add more sulphuric acid.

- It is possible that he may /might/ be late.

Trong câu loại này biểu thị sự cần thiết, sự có thể, sự xảy ra tương tự, thường đi với "should, may, might".

6. Câu chỉ mong muốn

a- They suggested that John should be the head of their department.

b- Professor Brown wishes we started our experiments today.

- I hope that he may pass his examinations.

XX. There is - There are

- There are many ways to prepare acetic acid.

- There is a new apparatus in our laboratory.

* Liên kết này thường dùng để nhấn mạnh chủ ngữ. "*There is*" dùng cho danh từ số ít; "*There are*" dùng cho danh từ số nhiều. Dùng để chỉ có hoặc không có cái gì trong một vị trí, một thời gian nhất định.

- Where is the book?

- The book is on the table.

- What is on the table?

- On the table there is a book./There is a book on the table.

* Bên cạnh "*to be*", "*there*" còn được dùng với một số động từ: *to exist, to come, to live...*

There exist many ways how to prepare it.

XXI. Sự biến đổi một số loại từ

Trong tiếng Anh có thể sử dụng các từ không biến đổi nhưng chức năng ngữ pháp thì khác nhau. Thường có các loại sau:

1. Danh từ và động từ

a shape (hình dạng, loại); to shape (tạo thành dạng)

a result (kết quả); to result (có kết quả, xuất hiện)

2. Danh từ và tính từ

glass (thủy tinh) vessel (thùng, nồi, bình, thiết bị)

a glass vessel (bình thủy tinh)

* Nếu trước hai loại danh từ gần nhau thì tính từ đứng trước có thể thuộc danh từ gần nó và chú ý khi dịch.

a pure tin vessel (thiết bị từ thiếc tinh khiết)

a clean tin vessel (thùng thiếc sạch)

XXII. Các tiếp đầu ngữ cơ bản

1. Tạo nghĩa ngược lại

un-	usual	- unusual	in-	organic	- inorganic
im-	purity	- impurity	non-	metal	- non-metal
dis-	appear	- disappear	mis-	calculate	- miscalculate

2. Tiếp đầu ngữ re-

Tạo nghĩa lặp lại, có nghĩa làm cẩn thận hơn. Dùng cho cả động từ và danh từ.

to distil - to redistill (chưng cất lại)

crystallization - recrystallization (sự kết tinh lại)

3. Tiếp đầu ngữ de-

Thường nối với động từ và danh từ để biểu thị một hành động hay một quá trình ngược lại.

to colorize - to decolorize (tẩymàu).

to compose - to decompose (phân hủy)

XXIII. Các tiếp vị ngữ

1. Tiếp vị ngữ của danh từ

- *er* tạo thành các danh từ tương ứng từ các động từ

work - worker (người công nhân); stir - stirrer (máy khuấy)

- *ing* tạo thành tên của hành động tương ứng

test - testing

- *ity* tạo thành danh từ tính từ

dense - density

* Các tiếp vị ngữ tạo thành các danh từ tương ứng:

- *ance*: appear - appearance - *ence* : differ - difference
- *ation*: distil - distillation - *ion* : discuss - discussion
- *ment*: measure - measurement - *age* : pass - passage

2. Tiếp vị ngữ tạo thành tính từ

- *full*: biểu thị một tính chất tồn tại thực từ danh từ - harmful
- *less*: biểu thị một tính chất ngược nghĩa của danh từ - harmless
- *able*: tính chất của tính từ có thể thực hiện được - distinguishable
- *ible*: dịch như dạng tính từ bị động - reproducible

3. Tiếp vị ngữ tạo ra động từ

- *ify*: solid - solidify
- *ize*: special - specialize
- *ate*: to separate

* Chú ý: - i, y đọc thành -ai

- ate đọc thành -it

PART 3 THE EXERCISES

BÀI TẬP

Ex 1: Hãy đọc các từ viết tắt

i.e. , etc, e.g., viz, cu., ft., lb., sq., in., oz., cc., psi., hr., g, gal, l, sec., f.p., m.p., b.p., vol., Fig., Tab., ca., et. al., v., cf.

Ex 2: Hãy đọc các công thức hóa học sau

H_2O, H_2SO_4, $CaCO_3$, CO_2, NaCl, H_2S, $CaCl_2$, C_2H_4, HIO_3, C_nH_{2n+2}, $FeCl_3$, N_2O_5, PbO, Mn_2O_3

Ex 3: Hãy đọc bằng tiếng Anh kí hiệu các nguyên tố sau

Br, C, Cl, Cr, Co, F, Au, H, I, Fe, Pb, Mg, Hg, N, O, K, Ra, Si, Na, S, Sn, W, Zn.

Ex 4: Tập đọc: **âm đóng và âm mở**

fat	- fate	hard	- hare	- harry	rate	genus	win	coke
leg	- egal	term	- zero	- error	rat	wine	hurt
sit	- site	bird	- spire	- squirrel	cock	square	tarry
not	- note	pock	- pore	- porridge	wire	herring	germ
push	- flute	turn	- sure	- hurry	cord	turret	lorry

Ex 5: Hãy tập đọc chú ý các phần không có trọng âm

rest	-	forest	face	-	preface	richest	carpet
mar	-	grammar	sure	-	measure	courage	husband
bus	-	rebus	don	-	London	Scotland	cupboard
late	-	palate	nest	-	cleanest	foreign	sportsman
man	-	human	refer	-	reference		

Ex 6: Hãy tập đọc chú ý các từ *ch, c, g, th, ph, qu*

mechanic	chamber	chromium	compound	cast	quartz
circulate	cubic	cream	cylinder	char	quality
generate	gigantic	grind	gallon	cell	phosphorus
gymnasium	method		synthesis	gold	phase

Ex 7: Hãy tập đọc chú ý các tiếp đầu ngữ và các tiếp vị ngữ

Bicarbonate	dibasic	Triangle	regenerate	decolourize
hypothetic	nature	manganese	phosphate	hydrogenation
percentage	iodine	benzene	phosphite	indispensable
cuprous oxime	oxidize	phosphate	combustible	liquefy
affinity				

Ex 8: Hãy chuyển sang số nhiều

A mean of transport, that series, a nucleus of an atom, this spectrum, the basic, a detailed analysis, an important datum.

Ex 9: Hãy dịch ra tiếng Việt - chú ý cấp so sánh

I.1. We have less time than you have.

2. I study less than my friend does.
3. The weight of some synthetic materials is less than that of metals.
4. This is a less complicated case.
5. He speaks German less correctly.
6. They have not the least idea about it.
7. The last factor is the least important of all.

II.1. The sooner you start studying for your English examination, the better for you.

2. The more efficient machines we have, the fewer workers are required.
3. The younger you start learning languages, the more easily you learn.
4. The longer I think of it, the less I understand it.
5. The higher the temperature, the more readily the substance will decompose.

Ex 10: Hãy đọc các số từ sau

100	203	1,000	30,479	0.001	0.321	1.6093	3.240	
194	589	1,050	45,359	0.08987	0.68	2.003	8.295	182.5

Ex 11: Hãy đọc các phân số sau

$$\frac{1}{2}, \frac{3}{2}, \frac{3}{4}, \frac{2}{5}, \frac{1}{6}, \frac{9}{11}, \frac{1}{14}, \frac{258}{397}, \frac{86}{35}, \frac{a}{b}, \frac{a+b}{x-1}, \frac{y-1}{c}$$

Ex 12: Hãy điền các liên từ vào chỗ trống và dịch ra tiếng Việt

1. The metric system, ___ is used in most countries, has not been introduced to England.
2. In the laboratory you will find the apparatus ___ you need.
3. Who is the young engineer ___ we met at the conference?
4. I shall send you the catalogues ___ you are interested in.
5. We shall study the physical state, on the basis ___ all materials are classified.
6. Professor Brown, ___ lectures are very interesting, has been our teacher for two years.
7. They used some synthetic material the volume ___ weighs much less than the same volume of aluminium.
8. He translated an English summary for me, ___ helped me very much.
9. There are limits to ___ we can do for him.
10. The separation of this kind of mixture may be achieved by ___ is termed fractional distillation.

Ex 13: Hãy dịch ra tiếng Việt và chú ý các từ *some, any, no, none*

1. Some chemists are specialized in physical chemistry.
2. He has some knowledge of English.
3. Pour some water into the test-tube.
4. Any metal may be used as a substitute.
5. Are there any further questions?
6. We shall observe if any change in colour will occur.
7. They did not collect any new material.
8. There are no such substances in nature.
9. No other material can be used instead.
10. None of these properties is characteristic for ideal gases.

Ex 14: Hãy điền *other, another, the other, others* vào chỗ trống và dịch ra tiếng Việt

1. I shall study ___ language next year.
2. Will you have ___ cup of tea.
3. I have ___ work for today.
4. Is there any ___ difference.
5. Automatic devices have photographed ___ side of the moon.
6. ___ examples are given in Table I.
7. Only John was at home, ___ boys were in the cinema.
8. Some students study English, ___ study German or French.
9. Only I did not pass the examination, ___ did.

Ex 15: Hãy dịch ra tiếng Việt và chú ý các từ *one, that, the former, the later*

I.1. This procedure is much more simple than that developed by Dr. Green.

2. In all these cases the value of x determines that of y.

3. He published more than one hundred papers including those published abroad.

4. The properties of this substance resemble those of glass.

5. It would be interesting to compare our results with those obtained in your laboratory.

II.1. I think that your plan is a very good one.

2. This method is too old, is there a more recent one?

3. He had to study all the records, even the earliest ones.

4. Smaller units are preferable to large ones.

5. In a chemical reaction the reacting substances are used up and new ones are formed.

III.1. I passed examinations in physics and in mathematics. The former was difficult, the latter was easier.

2. The book was translated by Mr. Smith and later by Mrs. Black. The later translation is much better than the former.

3. Of the two procedures, the later is the more widely used.

Ex 16: Hãy dịch ra tiếng Anh (chú ý trợ động từ)

1. Dung dịch này phải được đun nóng lên 80^0C.
2. Ông Brown đã cho phép Jana được dự kỳ thi này vào mùa đông tới.
3. Cô ta quả thật học tốt như anh ta.
4. Giáo sư Smith phải làm lại 10 thí nghiệm trong một số lần.
5. Có lẽ nó không đổ đủ nước vào bình kia.
6. Điều đó chứng tỏ rằng nó chuẩn bị thi trong một thời gian rất ngắn.
7. Chúng ta có thể tăng nhanh phản ứng này bằng cách cho thêm loại xúc tác mới này.
8. Không được hút thuốc trong phòng thí nghiệm.
9. Điều có thể là anh phải kết thúc thí nghiệm này.
10. Dung dịch này có thể được tinh chế bằng quá trình chưng cất.
11. Karel phải thi lại kỳ thi này 3 lần.
12. Điều chắc chắn là họ sẽ đến nghe giảng.
13. Chắc chắn là cô ta là sinh viên.
14. Anh cần phải loại trừ kết tủa này.
15. Anh có thể học nhiều hơn được không?

Ex 17: Điền thì thích hợp của động từ và dịch ra tiếng Việt

1. I /finish/ my experiments before my next examination.
2. She /cross/ the street when I /meet/ her yesterday.
3. A few days ago he /buy/ a new text-book as his old one /be lost/.
4. We /go for a walk/ tomorrow after he /finish/ his work.
5. She /study/ English for five years and chemistry since 1970.
6. He usually /pass/ his examinations with honours.
7. John /lose/ his text-book and cannot remember where he last /see/ it.
8. This time next week they /sit/ for an examination inorganic chemistry.
9. He /study/ chemistry for two years and then /give/ it up.
10. When she /come/ to the university in 1971, he /study/ there for two years.

Ex 18: Hãy chuyển sang câu điều kiện hiện tại và quá khứ, dịch sang tiếng Việt

1. The compound will decompose.
2. Our laboratory will be equipped with a large variety of new apparatus and devices.
3. We shall carry out our experiments.
4. I shall study biology.
5. The liquid will be purified by distillation in a still.

Ex 19: Hãy dịch ra tiếng Việt (chú ý động từ nguyên thể)

I.1. An experiment was made in order to learn the relation between the rate of decomposition and the time of heating.

2. More water was added so as to achieve lower concentration.
3. Be careful not to heat too strongly as the compound will decompose.
4. In order to obtain best results, samples must be taken daily.
5. To prepare synthetic acid salt, place a piece of sodium in a flask of chlorine.

II.1. In order for the reaction to occur, the temperature must not decrease below 150^0C.

2. More water must be added in order for the salt to dissolve completely.
3. The teacher brought twenty copies for each student to have one.

Ex 20: Hãy nối hai câu

Ví dụ: He stood up. He wanted to see better.

→ He stood up to see better.

He had to sit down. She wanted to see better.

→ He had to sit down for her to see better.

1. She studies at a technical university. She wants to be come an engineer.
2. I shall write the number down. I must not forget it.
3. We went to the lecture early. We wanted to get good seats.
4. He wants to finish his experiment by the end of the term. he must use a computer.
5. They took a taxi. They did not want to be late.
6. I left the letter on the table. You can read it.
7. The teacher spoke slowly. Everybody understood him.
8. He will buy the tickets. All of us will see the film together.

Ex 21: Hãy dịch (chú ý chủ ngữ, vị ngữ + infinitive)

I.1. We found the measurements to be incorrect.

2. If we allow a gas to expand under pressure, it cools.
3. We know the value to depend on many different factors.
4. We expect the computers to be widely used in the future.
5. The engineer asked the worker to control the amount of heat.

II.1. The device appears to be widely used in industry.

2. All workers were supposed to know the instructions.
3. The student is expected to possess at least this minimum knowledge of the subject.
4. The liquid was observed to change its colour.
5. Such forces are known to be due to electrical charges.

Ex 22: Hãy dịch ra tiếng Việt (chú ý động từ nguyên thể bổ trợ)

I.1. Is there any water to drink?

2. I have still much work to do.

3. There are several ways to prepare chlorine from sodium chloride.

II.1. The samples to be analyzed were brought to the laboratory.

2. The problem to be discussed in the present paper has not been studied so far.

3. The results obtained were compared with those to be expected.

Ex 23: Dịch ra tiếng Việt (chú ý "to be + infinitive")

1. The chief engineer is to come at 6.
2. Where am I to sign my name?
3. All suggestions are to be carefully studied.
4. The explanation is to be found in the following fact.
5. The machine was to be controlled by means of an automatic device.

Ex 24: Hãy rút ngắn câu bằng cách dùng phân từ hay danh động từ và dịch

1. He is sorry that he will be late for his lectures.
2. As she spoke two languages, she got a well-paid job.
3. As he is studying hard, he will pass his examinations.
4. Mr. Brown stood at the blackboard and wrote some chemical equations on it.
5. Several students were criticized because they did not attend the lectures.
6. When Charles was making the experiment, everything was in good order.
7. She was afraid that he /her friend/ would fail.
8. I remember that professor Brown has mentioned that problem.
9. We shall write a dictation in this lesson, its correction will be done next time.
10. As he had been invited to England, he applied for a visa.

Ex 25: Chuyển sang thể bị động và dịch

1. You can purify a liquid by distillation in a still.

2. They may conveniently separate two liquid phases by use of the separatory funnel.

3. Professor Hall Heads the Department of Foreign languages.

4. They are equipping the laboratory with a large variety of new devices.

5. The lecturer gave the students good information on chemical literature.

6. What foreign language will they teach at your school?

7. They would offer Dr. Smith the chair of chemistry.

8. Have you dealt with that experiment?

9. What shall I understand by this expression?

10. We had discussed the results of our work before we referred them to the Scientific Council of the university.

Ex 26: Hãy chuyển các câu trực tiếp sau sang câu gián tiếp và dịch

I.1. John answered: "Mary is ill."

2. The lecturer replied: "I have made that experiment ten times."

3. My friend remarked: "I passed my examination with honours."

4. It was announced: "The meeting will take place on Monday."

5. The teacher said: "Hydrogen is an element."

II.1. They asked:

2. When will your experiments be completed?

3. Did he attend that lecture?

4. Where have you finished your studies?

5. Would the question require a through re-examination?

Ex 27: Dịch ra tiếng Anh (chú ý các mệnh đề phụ)

1. Nếu anh thi đạt kỳ thi cuối cùng thì anh bảo vệ được luận án tốt nghiệp của anh.
2. Thiết bị này làm việc có vẻ như là thiết bị mới.
3. Phản ứng này không thể xảy ra ngay cả khi cho thêm chất xúc tác vào đó.
4. Học hành chăm chỉ để thi đạt kết quả cao nhất.
5. Lên lớp nói từ từ để sinh viên có thể ghi tóm tắt được.
6. Nếu sau một vài phút mà phản ứng không xảy ra, anh phải cho thêm chất xúc tác.
7. Nếu ông chủ nhiệm khóa đến muộn, giáo sư Hillar sẽ tiếp các đại biểu một mình thay ông ta.
8. Bài giảng này của anh sẽ rất quan trọng.
9. Tôi chúc anh đạt kết quả trong công việc.

Ex 28: Dịch ra tiếng Anh (chú ý các cụm từ there is..., there are...,thức bị động...)

1. Lần tới, giáo sư Black sẽ giảng về sản xuất axit sunfuric.
2. Giáo sư Milla đã điều khiển cuộc họp về các chất nhân tạo.
3. Quả thật tôi rất ngạc nhiên khi biết anh ta đã học tập ở nước ngoài.
4. Có rất nhiều phương pháp để tinh chế chất như vậy.
5. Trong phòng thí nghiệm có rất nhiều loại hóa chất.
6. Các loại ống nghiệm đã để trên bàn làm việc.
7. Đã có điện thoại trên bàn làm việc của anh.
8. Có nhiều sách mới loại này trong thư viện của chúng tôi.
9. Hãy cẩn thận không để các bình trên bàn rơi xuống đất.
10. Nhiệm vụ bắt buộc là không để cặn bẩn rơi xuống đất.

Ex 29: Dịch ra tiếng Việt

I.1. Ice, snow and steam are different forms of water. With inorganic compounds, acetic acid forms salts. Chlorine combines with metals to form chlorides.

2. What was the result of your experiment? Many new useful products result from distillation of petroleum. Chemical changes generally result in changes in properties.

3. It is necessary to find the primary cause. Cooling may cause only partial condensation.

4. The new method yields excellent results. The addition of iron reduces yields.

5. Chemical factories manufacture chiefly chemicals. Amonia is used for the manufacture of nitric acid.

6. Plastics can substitute metals for many purposes. Synthetic rubber is an ideal substitute for the natural product.

7. Samples should be stored in a dark and cool place. Place the solution in a beaker and heat to boiling. Separation takes in a large column. When will the conference take place? Plastics have taken the place of many conventional materials.

8. Copper is an excellent conductor of heat. If we apply heat to ice, it melts. Do not heat too strongly, as the compound will decompose.

9. Shake before use. Use fresh samples only.

10. What is the subject of your thesis? The process was subjected to careful control.

II.1. If necessary, cool the beaker externally. When cool, the compressed ammonia liquefies.

2. Continue heating until a dry powder is obtained. Dry the test-tube over the flame.

3. Dilute sulphuric acid is not so corrosive as the concentrated acid. Dilute the acid with water.

4. Close text-book for a moment. When heated close to its boiling point, the liquid will evaporate.

5. Filtration is used to separate solids from liquids. Fractional distillation is similar in effect to a number of separate distillations.

6. Switch on the light, please. The light blue colour is characteristic for the liquid. Aluminium is a white light metal used for making air-planes. Could you light me a cigarette?

III.1. University library, hydrogen atom, water solution, carbon compound, heat conductivity, sample analysis, research worker, laboratory assistant, steam engine, temperature range.

2. A glass plate - plate glass, laboratory work - works laboratory, water glass - a glass of water, laboratory research - research laboratory, heat radiation - radiation heat, fuel gas - gas fuel, sugar beet - beet sugar.

3. To manufacture marmalade - marmalade manufacture, to transfer heat - heat transfer, to change temperature - temperature change, to design a plant - plant design, to supply fresh air - fresh air supply.

4. Large-scale production, solid state physics, high-pressure reaction, water vapour formation, pilot-plant scale, a complex hydrocarbon mixture, a concentrated sulphuric acid solution, a clean glass test-tube, oxidation-reduction reaction, milk and fat technology.

Ex 30: Hãy ghi các danh từ tương ứng

differ, engine, science, physics, chemistry, pure, react, produce, solid, crystal.

Ex 31: Thêm tiếp vị ngữ vào các từ sau để chuyển chúng sang danh từ: -er, -tion, -ation, -able, -ible,...

- manufacture, produce, research, observe, cool, compute, mix, stir, contain, burn.
- form, condense, separate, distill, filter, combine, react, concentrate, discuss, evaporate.
- transport, measure, break, market, control, compare, change, rely, reproduce, convert.

Ex. 32: Tìm từ trái nghĩa

natural, certain, stable, breakable, active, complete, dependent, direct, soluble, probable, possible, pure, elastic, zero, aromatic, ferrous, conductor, appear, order, advantage.

Ex. 33: Dịch ra tiếng Việt (chú ý các tiếp đầu ngữ)

reorganize, reformulate, re-examine, re-enter, remeasure, redistillation, re-use, renumber, rebuild, re-form.

de-activation, decarbonize, dechlorinate, dehydrated, demineralize, deoxidation, desulphurizer.

TABLE OF ELEMENTS

AC	actinium	/æk'tiniəm/
Al	aluminium	/æljuminjəm/
Am	americium	/æmə'risiəm/
Sb	antimony	/æntiməni/
Ar	argon	/a:gon/
As	arsenic	/a:snik/
At	astatine	/æstətiːn/
Ba	barium	/beəriəm/
Bk	berkelium	/bə:kliəm/
Be	beryllium	/be'riljəm/
Bi	bismuth	/bizməð/
B	boron	/bo:rən/
Br	bromine	/broumi:n/
Cd	cadmium	/kædmiən/
Ca	calcium	/kæsiəm/
Cf	californium	/kæli'fo:njəm/
C	carbon	/ka:bən/
Ce	cerium	/siəriəm/
Cs	caesium	/si:zjəm/
Cl	chlorine	/klo:ri:n/
Cr	chromium	/kroumjəm/
Co	cobalt	/kə'bo:lt/
Cu	copper	/ 'kopə/
Cm	curium	/kjuəriəm/
Dy	dysprosium	/dis'prousiəm/
Es	einsteinium	/ains'tainiəm/
Er	erbium	/ə:biəm/
Eu	europium	/juə'roupiəm/
Fm	fermium	/fə:miəm/
F	fluorine	/fluəri:n/
Fr	francium	/frænsiəm/
Gd	gadolinium	/,gædə'liniəm/
Ga	gallium	/gæliəm/
Ge	germanium	/dzə:meiniəm/
Au	gold	/gould/
Hf	hafnium	/hæfniəm/
Rd	radon	/reidən/
Re	shenium	/ri:niəm/
Rh	rhodium	/roudjəm/
Rb	rubidium	/ru:bidiəm/
Ru	ruthenium	/ru:'ði:njəm/
Sm	samarium	/se'meəriəm/
Sc	scandium	/skændiəm/
Se	selenium	/si'li:njəm/
Si	silicon	/silikən/
Ag	silver	/silvə/
Na	sodium	/soudjəm/
Sr	strotum	/stronsiəm/
S	sulphur	/salfə/
Ta	tantalum	/tæntələm/
Tc	technetium	/tekni:siəm/

He	helium	/hi:ljəm/
Ho	holmium	/houlmiəm/
H	hydrogen	/haidridzən/
In	indium	/indiəm/
I	iodine	/aiədi:n/
Ir	iridium	/ai'ridiəm/
Fe	iron	/aiən/
Kr	krypton	/kriptən/
La	lanthanum	/lænðənm/
Pb	lead	/led/
Li	lithium	/liðiəm/
Lu	lutetium	/lju:'ti:siəm/
Mg	magnesium	/mæg'nizj: əm/
Mn	maganese	/,mæŋgəni:z/
Md	mendelevium	/,mendə'leiviəm/
Hg	mercury	/mə:kjuri/
Mo	molybdenum	/mo'libdinəm/
Nd	neodymium	/,ni:ou'dimiəm/
Ne	neon	/ni: ən/
Np	neptunium	/nep'tju:njəm/
Ni	nickel	/nikl/
Nb	niobium	/nai'oubiəm/
N	nitrogen	/naitridzən/
No	nobelium	/nou'beliəm/
Os	osmium	/ozmiəm/
O	oxygen	/oksidzən/
Pd	palladium	/pe'leidjəm/
P	phosphorous	/fosfərəs/
Pt	platinum	/plætinəm/
Pu	plutonium	/plu:'tounjəm/
Po	polonium	/pe'lounjəm/
K	potassium	/pe'tæsiəm/
Pr	praseodymium	/preziou'dimiəm/
Pm	promethium	/pre'mi:ðjem/
Pa	protactinium	/,proutæk'tiniəm/
Ra	radium	/reidjəm/
Te	tellurium	teljuəriəm/
Tb	terbium	/tə:biəm/
Tl	thallium	/ðæliəm/
Th	thorium	/ðɔ:riəm/
Tm	thulium	/ðju:liəm/
Sn	tin	/tin/
Ti	titanium	/tai'teinjəm/
W	tungsten	/taŋstən/
	wolfram	/wulfrəm/
U	uranium	/jue'reinjem/
V	vanadium	/ve'neidjəm/
Xe	xenon	/zenɔn/
Yb	ytterbium	/i'tə:bjəm/
Y	yttrium	/i'təbjəm/
Zn	zinc	/zink/
Zr	zirconium	/zə:'kounjəm/

PART 4 : VOCABULARY

TỪ VỰNG TỪ ĐIỂN

A

abandon	/ə'bændən/	bỏ, từ bỏ
abbreviation	/ə,bri:vi'eiʃn/	sự làm tắt, cách viết tắt
abrasion	/əbreizən/	sự mài mòn, sự ăn mòn
a. resistance		độ bền mài mòn, độ chống mài mòn
absorb	/əb's:b/	hấp thụ
absorber	/əb'sɔ:bə/	thiết bị hấp thụ, chất hấp thụ
absorption	/əb'sɔ:pʃən/	quá trình hấp thụ
acceptor	/ək'septə(r)/	chất nhận
access	/ækses/	cửa vào, đường vào, sự xâm nhập
accelerate	/æk'seləreit/	tăng tốc, gia tốc
accessible	/æk'sesəbl/	có thể đạt được, dễ bị ảnh hưởng
accessory equipment	/æk'sesəri /i'kwipmənt/	thiết bị phụ trợ
accrue (+from)	/ə'kru:/	đồn đại, tích lũy lại, sinh ra từ
acidity	/'əsiditi/	tính axit, độ axit
accommodation	/,ækom'deiʃn/	sự điều tiết, sự thích ứng, chỗ ở
accomplish	/ə'kompliʃ/	hoàn thiện, tiến hành, chỉ rõ
accordingly	/ə'kɔ:dili/	do đó, vì vậy, theo đó, cho phù hợp
accumulate	/ə'kju:mjuleit/	tích tụ, tập hợp lại
accumulation	/ə'kju:mju'leiʃən/	quá trình tích tụ
accurate	/ækjurit/	xác định chính xác
acetamide	/'æsit'æmaid/	axetamit, amit của axit axetic
acetate	/æsitit/	muối axetat
acetic	/ə'si:tik/	axetic
a. acid		axit axetic
acetone	/æsitoun/	axeton
acetylene	/ə'setili:n/	axetylen
achieve	/ə'tʃi:v/	đạt được
acid	/æsid/	axit
acquire	/ə'kwaiə/	dành được
action	/ækʃən/	tác động. hoạt động
activation	/,ækti'veiʃn/	sự hoạt hóa, quá trình hoạt hóa
active	/æktiv/	hoạt động
actual	/æktjuəl/	thực sự, hiện thời
adapt for	/ə'dæpt/	thích nghi, phù hợp
adaptable	/ə'æptəbl/	thích hợp được, có thể phù hợp
add	/æd/	cộng, bổ sung
addition	/ə'diʃn/	sự bổ sung
adhesive	/əd'hi:siv/	dính, cố kết, nhựa dính
adequate	/ædikwit/	tương xứng, đầy đủ, phù hợp
adhere to	/əd'hiə/	dính chặt, bám chặt
adjust	/ə'dzast/	điều chỉnh, hiệu chỉnh
adjustment	/ə'dzastmənt/	sự điều chỉnh, sự hiệu chỉnh
advance	/əd'va:ns/	tiến độ, tác động tích cực
advantage	/əd'va:ntidz/	ưu điểm, thuận lợi
to take a. of		tận dụng, sử dụng
advent	/ædvənt/	quy trình, tiến độ, tìm ra
adventure	/ɔd'ventʃə/	phiêu lưu, may rủi, tình cờ
adverse	/ædvə:s/	có hại, không phù hợp, đối lập, bất lợi
advice	/əd'vais/	lời khuyên, tin tức
advocate	/ædvəkeit/	bào chữa, biện hộ
aeration	/eiə'reiʃn/	quá trình thông khí, nạp gaz
affect	/ə'fekt/	tác động đến, ảnh hưởng đến
affinity	/ə'finiti/	ái lực

affordable	/əfɔ:dəbl/	cấp cho, ban cho, đủ điều kiện
agar	/eigə:/	aga, thạch
a. slopes, a. slants	/sloups/, /sla:nts/	môi trường thạch nghiêng
agent	/eidzənt/	tác nhân, chất gây phản ứng
cleansing a.	/klensiŋ/	tác nhân tẩy rửa
reducing a.		tác nhân khử
agenus	/ə'dzenəs/	vô sinh
agglomeration (n)	/ə,gləmə'reiʃn/	sự kết tụ, sự liên kết, chất đống
agglomerate (v)		
aggravate	/ægrəveit/	làm cho trầm trọng thêm, chọc tức
aggregate	/ægrigit/	cụm, tập hợp, tổ hợp
aggregation	/,ægri'geiʃn/	sự kết tụ, quần tụ, tập hợp
agitate	/ædziteit/	khuấy trộn, lắc
agitation	/,ædzi'teiʃən/	quá trình khuấy trộn, quá trình lắc
agricultural	/,ægri'kaltʃurəl/	(thuộc) nông nghiệp
air blast	/eəbla:st/	sự thổi khí, luồng không khí
alcohol	/ælkəhol/	rượu, cồn etylic
aldehyde	/ældihaid/	anđêhit
ale	/eil/	một loại bia vàng của Anh
algae	/'ældzi:/; /'ældgai/	tảo, thạch
sing. alga	/'ælgə/	
alkali, pl. -es	/ælkəlai, -z/	chất kiềm
alkaline	/ælkəlain/	(thuộc) kiềm
alkalinity	/,ælkə'liniti/	tính kiềm, độ kiềm
allow for	/ə'lao/	tính đến cái gì, bao gồm, kể cả
allowance	/ə'louəns/	sự cho phép, kể cả
alloy	/æloi/	hợp kim
alloy steel		thép hợp kim
alter	/ɔ:ltə /	thay đổi, biến đổi
alternate	/ɔ:l'tə:nit/	xen kẽ, luân phiên
altitude	/æltitju:d/	độ cao, đỉnh cao, nơi cao ráo
alum	/'æləm/	muối mỏ trắng, phèn
aluminate	/ə'lju'mineit; -nit/	aluminat, muối nhôm
aluminium	/,æljuminjəm/	nhôm, Al
ambiguity	/,æmbig'juti/	sự mơ hồ, tính lưỡng nghĩa
ambigously	/'æmbigjuəsli/	không rõ ràng, mơ hồ, tối nghĩa
amenable	/ə'mi:nəbl/	Chịu trách nhiệm, tuân theo
amend	/əmend/	sửa đổi, bổ sung
ammonia	/ə'mounjə/	amoniắc
a. water		hydroxyt amôn
ammonium	/ə'mounjəm/	amonium, NH_4^+
ammoniacal	/ə,mou'naiəkl/	(thuộc) amoniắc, chứa NH_4^+
amniocentesis	/æmnjəsentesis/	sự chọc ối
amount	/ ə 'maunt/	lượng, tổng số
amount to		kể cả, kể đến
analyse	/ænəlais/	phân tích
analysis, pl. analyses	/ə'nælisis; -i:z/	sự phân tích, phép phân tích
ancient	/einʃənt/	cổ, cổ kính
anhydrous	/ən'haidrəs/	khan
aniline	/ænilain/	anilin
animalia	/'æniməli/	(thuộc) động vật cổ
anneal	/ə'ni:l/	ủ, tôi luyện, luyện ở một nhiệt độ
anhydride	/æn'haidraid/	anhidrit
antagonistic effect	/æntægə'nistik i'fekt/	tác động tương phản
anthracite	/ænðrəsait/	antraxit
aperture	/æpətjuə/	lỗ, miệng, kẽ hở, khe hở

apparatus n. apparatuses	/æpə'reitəs/	máy, thiết bị
apparent	/ə'pærənt/	rõ ràng, trong suốt, biểu kiến
appear	/ə'piə/	xuất hiện
appearance	/ə'piərəns/	vẻ bề ngoài, sự xuất hiện
appliance	/ə'plaiəns/	thiết bị, dụng cụ, phụ tùng
indicating a.		dụng cụ đo
recording a.		thiết bị ghi chép
regulating a.		thiết bị điều chỉnh
application	/,æpli'keiʃən/	sự ứng dụng, sự áp dụng
apply	/ə'plai/	áp dụng, sử dụng, kèm vào
a. to		ứng dụng vào, liên quan đến
a. heat		cung cấp nhiệt
appreciable	/ə'pri: ʃəbl/	có thể đánh giá được, đánh giá
apron	/'eiprən/	tấm chắn, tấm che, băng tải
appropriation	/ə,proupri'eiʃn/	thích hợp, phù hợp, dự trữ trước, dành riêng
approximately	/ə'proksimitli/	gần đúng, xấp xỉ
approximation	/ə,proksi'meiʃən/	phép tính gần đúng
apt to	/æpt/	phù hợp, khuynh hướng, chiều hướng
aqueous	/eikwəis/	ngậm nước
argon	/a:gon/	agon, Ar
aroma	/ə'roumə/	mùi thơm, hương thơm
aromatic	/,ærə'mætik/	thơm, (thuộc) hương liệu
arbitrary	/a:bitrəri/	tùy ý
arduous	/ə:djuəs/	khó khăn, hết sức mình, gắng gỏi
arguably	/a':juəble/	không chắc chắn, đang tranh cãi
arrange	/ə'reindz/	sắp xếp, bố trí
arsenic	/a:snik/	asen, As
article articles of commerce	/a:tikl/	vật phẩm, mặt hàng, sản phẩm, phần tử hàng thương phẩm
artificial	/,a:ti'fiʃəl/	nhân tạo, thay thế được
asbestos	/æ'zbestos/	sợi amiăng
ascend	/ə'send/	nâng lên, trục lên
ascribe	/əs'kraib/	quy cho, gán cho
aseptic (al)	/ei'septik (əl)/	(thuộc) khử trùng, vô trùng
aside from	/ə'said/	ngoài ra
ash	/æʃ/	tro
assembly	/əə'sembli/	sự lắp ráp, tập hợp lại/ trưng bày, tổ hợp
assistant	/ə'sistənt/	người giúp việc, phụ tá, cộng tác viên
assortment	/ə'so:tmənt/	sự phân loại, sự lựa chọn
atmospheric	/,ætməs'ferik/	(thuộc) khí quyển
atom	/ætəm/	nguyên tử
atomic a. number	/ə'tomik/	(thuộc) nguyên tử số nguyên tử
attach to	/ə'tætʃ/	gắn vào, tham gia vào, tác dụng vào
attack	/ə'tæk/	sự tấn công, sự ăn mòn/ phá hỏng, ăn mòn
attaind	/ə'teind/	đạt tới, đạt được
attend	/ə'tend/	dự, có mặt, đi kèm
attendance	/ə'tendns/	sự có mặt, sự đi kèm
augment	/ɔ:gmənt/ / ɔ:g'ment/	tăng lên, sinh ra
autoclave	/ ɔ:tokleiv/	nồi hấp, áp lực
automatic	/ ɔ:tə'mætik/	tự động, ngẫu nhiên
automation	/, ɔ:tə'meiʃən/	sự tự động hóa
automobile	/, ɔ:tə'moubi:l/	ngành ô tô

auxiliary	/ ɔ:g'ziljəri/	phụ, bổ trợ
availability	/ ə,veilə'biliti/	sự có hiêu lực, có thể sử dụng, có sẵn
average	/æv(ə)ridz/	số trung bình
avirulent	/eivi'rjulənt/	chất không độc, tính không độc
avoid	/ə'void/	tránh
award	/ə'wɔ:d/	phần thưởng, sự quyết định/ tặng, quyết định cấp cho
axial	/æksiəl/	(thuộc) trục, hướng trục

B

bacillus; pl. -cilli	/bə'siləs/; /-silai/	vi khuẩn hình que, trực khuẩn
bacteria	/bæk'tiəriə/	Các vi khuẩn (số nhiều)
bacterial	/bæk'tiril/	(thuộc) vi khuẩn
bacterium, pl. bacteria	/bæk'tiriəm, -i/	vi khuẩn
bacteriological	/bæk,tiri'lodzikl/	ngành vi khuẩn học
bagasse	/bəgæs/	bã mía
baking	/beikiŋ/	sự nướng, sự khô
balance	/bæləns/	sự cân bằng
bank	/bæŋk/	bờ, ngân hàng
bankruptcy	/'bæŋkrəptsi/	phá sản, mất giá trị
bare	/b'eə/	trống, trần, võng
barium	/'beəriəm/	bari, Ba
bark	/ba:k/	vỏ, bóc vỏ
barley	/ba:li/	đại mạch, hạt đại mạch
malted barley		malt đại mạch
barrel	/bærəl/	thùng đựng bia, bom bia, thùng trụ tròn
base	/beis/	bazơ, cơ sở, nền tảng
be based on		dựa trên nền tảng, cơ sở
basic	/beisik/	(thuộc) cơ sở
basin	/beisn/	bồn rửa, cái bát
basis, pl. bases	/beisis, -i:z/	cơ sở, nền tảng
batch	/bætʃ/	định lượng, mẻ, từng đợt, gián đoạn
bath	/ba:ð/	bể, thùng
bead	/bi:d/	giọt, viên, mép
beaker	/'bi:kə /	cốc có mỏ
beaking	/bi:kiŋ/	vật hình mỏ, vòi ấm
beam	/bim/	xà, giầm
bearing	/beəriŋ/	ổ trục, bệ đỡ, giá tựa
beat (beat, beaten)	/bi:t/	va chạm, đập, gõ, nhào bột
b. out		va đập
beer	/biə/	bia
beet	/bi:t/	cây củ cải đường
behaviour	/bi'heivjə/	thái độ, tính cách, tính chất
bending	/bendiŋ/	độ uốn cong
benefit	/'benifit/	lợi ích, hiệu quả
beta-endorphin	/'bitə/	β-endophin
beverage	/'bevəridz/	nước giải khát, nước uống
bewildering array	/bi'wildəriŋə'rei/	mạng chằng chịt, mạng phức tạp
bicarbonate	/bai'ka:bənit/	bicacbonat, HCO_3^-
binary	/'bainəri/	đôi, thành hai phần
biochemistry	/'baiou'kemistri/	hóa sinh học
biogenesis	/baio'dzenisis/	nguồn gốc sinh hóa, thuyết phát sinh sinh vật
biology	/bai'ɔlədzi/	sinh học
biomass	/'baiəmæs/	sinh khối
bioremediation	/bai'ɔrəmədieiʃn/	chữa trị được bằng phương pháp sinh học

biotite	/'baiətait/	biotit, mica đen
bisulfite	/bai'salfait/	hydrosunfat, bisunfit
bitter	/bitə/	vị đắng, chất đắng
bitumen	/bitjumən/	bitum
bituminous	/bi'tju:minəs/	(thuộc) bitum
b. coal		than bitum
blade	/bleid/	tấm bản, phiến, lá, cánh (quạt...), cánh khuấy
blaze	/bleiz/	ngọn lửa, cháy sáng, mốc, dấu ấn
bleach	/bli:tʃ/	tẩy trắng, làm sạch
blend	/blend/	hỗn hợp, trộn lẫn, phối trộn
blood	/blad/	(thuộc) máu
blow	/blou/	sự va đập, thổi, quạt thông khí
boil (at)	/bɔil/	đun sôi
boiling point		điểm sôi
bolt	/boult/	bulông
bond	/bɔnd/	mối liên kết/ liên kết lại
borate	/bɔreit/	borat
bottle	/bɔtl/	chai
rubber-stopped b.		chai đậy nút cao su
bottom	/bɔtəm/	đáy
boundary	/baudəri/	biên, giới hạn, phạm vi
bracket	/brækit/	giá treo, giá đỡ, dấu ngoặc
branch	/bra:ntʃ/	nhánh, ngành
b. of study		ngành học
brass	/bra:s/	đồng thau
break (up), (broke, broken)	/breik/	đập vỡ
breeder	/bri:də/	lò phản ứng tái sinh, người nhân giống
brew	/bru:/	nấu bia, làm bia
brewing		quá trình nấu bia, quá trình sản xuất bia
brewery	/bruəri/	nhà máy sản xuất bia, xưởng bia
brick	/brik/	gạch
brilliancy	/briljənsi/	độ chói, độ sáng bóng
brilliant	/briljənt/	sáng chói
brine	/brain/	ngâm nước muối, nước mặn
brittle	/britl/	giòn, dễ vỡ, gạch
bromide	/broumaid/	bromua
bromine	/broumin/	brom, Br
bromonitrobenzene	/'broumə'naitrə' benzi:n/	bromonitrobenzen
bronze	/brɔnz/	đồng thau
broth	/brəð/	nước thịt, canh trường, dịch dinh dưỡng nuôi cấy vi sinh vật
bubble	/bʌbl/	bọt khí, sủi bọt, bọt
bud	/bʌd/	chồi, nụ, búp
budding	/bʌdiŋ/	sự nảy chồi, sự nảy mầm
bulk	/bʌlk/	khối, đống, bó
bullet-proof	/bulit-pru:f/	không xuyên qua được, chống đạn
bulb	/bʌlb/	bong bóng, bọt, bình cầu, bóng điện, bầu (nhiệt kế)
bundle	/bʌndl/	bó
burn	/bə:n/	cháy
burner	/bə:nə/	đèn xì
Bunsen b.	/bansn/	đèn xì kiểu Bunsen
butter	/bʌtə/	bơ, mỡ thực vật
fruit b.		bơ hoa quả, mứt quả mịn
button	/bʌtn/	nút, nút bấm

switch b.		công tắc điện
by-product	/'bai,prodəkt/	sản phẩm phụ

C

cable	/keibl/	cáp, dây dẫn điện
calcium	/kælsiəm/	canxi, Ca
c. chloride		clorua canxi, $CaCl_2$
c. hydroxide		hydroxit canxi, $Ca(OH)_2$
c. sulphate		sulfat canxi, $Ca_3(PO_4)_2$
calorific value	/,kælə'rifik væælju:/	giá trị calo, năng suất tỏa nhiệt
can	/cæn/	hộp sắt tây, hộp, lon, can/ có thể, đóng hộp, đóng lon
candle	/kændl/	nến/ soi trứng
cane	/kein/	cây mía, gậy
canteen	/kæn'ti:n/	căng tin, quán ăn tập thể
canvas	/'kænvəs/	vải bạt, bức vẽ, lều
capable	/keipəbl/	có thể được, có khả năng
capacity	/kə'pæsiti/	thể tích, dung lượng, năng suất, sản lượng
capture	/kæptʃə/	sự thu dẫn nước
carbide	/ka:baid/	cacbua, cacbit
carbon	/ka:bən/	cacbon
c. monoxide		CO
c. dioxide		CO_2
c. black		muội, mồ hóng
carbohydrate	/ka:bou'haidreit/	hydrat cacbon
carbonaceous	/,ka:bə'neiʃəs/	có chứa các hợp chất cacbon
carbonate	/ka:bənit/ /ka:bəneit/	cacbonat
basic c.		cacbon kiềm tính
carbonization	/,ka:bənai'zeiʃn/	quá trình cốc hóa, sự cacbon hóa, than hóa
carbonize	/ka:bənaiz/	hóa than, cacbon hóa, luyện cốc
carcinogenic	/ka:'sinə'dzenik/	chất gây ung thư
cardboard	/ka:dbɔ:d/	bìa cứng, cactông, băng dán
care	/keə/	cẩn thận, chú ý đến, sự bảo dưỡng
carry on	/kæri/	tiếp tục, tiến hành, duy trì
carry out	-	tiến hành, thực hiện
case	/keis/	trường hợp, ngăn, vỏ, bao/ đóng hộp
casein	/keisiin/	cazein
casing	/keisiŋ/	áo, vỏ, tấm bọc, đóng hộp
casing diameter		kích thước vỏ ngoài
cast	/ka:st/	khuôn đúc, vật đúc
casting	/ka:stiŋ/	sự đúc, sự rót
catalyze	/kætəlaiz/	xúc tác
catalysis	/kə'tælisis/	sự xúc tác
catalyst	/kætəlist/	chất xúc tác
catalytic	/,kætə'litik/	(thuộc) chất xúc tác
category	/kætəgəri/	phạm trù, loại
cause	/kɔ:z/	nguyên nhân/ gây ra
caustic	/kɔ:stik/	kiềm ăn da, xút ăn da
c. potash		potat ăn da, KOH
c. soda		xút ăn da, NaOH
caution	/'kɔ:ʃən/	thận trọng, chú ý
cave	/keiv/	hang, động, hốc
cease	/si:s/	dừng, kết thúc
cell	/sel/	tế bào, buồng nhỏ, ắc quy
celluloid	/seljuloid/	xeluloit

cellulose	/seljulous/	xeluloza
cement	/si'ment/	xi măng, mactit, chất gắn
centrifugal	/sen'trifjugl/	sự li tâm
centrifuge	/sentrifju:dz/	máy li tâm
ceramic	/si'ræmik/	bằng gốm
cereal	/siəriəl/	ngũ cốc, hạt ngũ cốc
certificate	/sə'tifikit/	giấy chứng nhận, cấp chứng chỉ, bằng
certification	/,sə:tifi'keiʃn/	giấy chứng nhận, bằng
certify	/sə:tifai/	chứng nhận, cấp chứng chỉ, hợp
chain	/ʧein/	xích, chuỗi, mạch
long-chain molecule		hợp chất cao phân tử, mạch dài
ch. reaction		phản ứng dây chuyền
challence	/'ʧælindz/	thách thức, đòi hỏi, yêu cầu, không thừa nhận
chamber	/'ʧeimbə/	ngăn, phòng, khoang
chancellor	/ʧa:nsələ/	tể tướng, thủ tướng, hiệu trưởng, quy cách
change	/ʧeindz/	thay đổi, biến đổi
charge	/ʧa:dz/	nhiệm vụ, tải trọng, phụ tải, nạp liệu, điện tích
free of charge		không tải, không phải trả tiền
be in charge of		được giao nhiệm vụ
char	/ʧa:/	than, hóa than
charring temperature		nhiệt độ hóa than
characteristic	/,kærikt'ristik/	đặc điểm, đặc tính
charcoal	/ʧa:koul/	than củi
chatf	/ʧat/	vỏ trấu
check	/ʧek/	kiểm tra, thẩm tra, xét lại
cheese	/ʧi:z/	phomat
chemical	/'kemikl/	(thuộc) hóa học
chemical behaviour		tính chất hóa học
chemist	/'kemist/	nhà hóa học
chemistry	/'kemistri/	môn hóa học
chest	/ʧest/	ngực, rương, hòm,hộp, nhà kính
chip(ing)	/ʧip/	thái lát mỏng, bào, đập vỡ
chloride	/'klɔ:raid/	clorua
chlorine	/klɔ:'ri:n/	clo
chlorination	/,klɔ:ri'neiʃn/	xử lí bằng clo, clo hoá
chloroform	/klɔ:rəfɔ:m/	clorofom, $CHCl_3$
chlorophyll	/'klɔrəfil/	chất diệp lục, clorophin
cholera	/'kɔlərə/	căn bệnh truyền nhiễm thường gây tử vong, bệnh tả
chromic acid	/kroumik/	axit cromic
chromium	/kroumiəm/	crom, Cr
churn	/ʧə:n/	thùng khuấy bơ, máy ép dầu, đánh, khuấy
cider	/saidə/	vang quả, nước quả lên men độ rượu thấp
circulate	/sə':kjuleit/	tuần hoàn, luân chuyển
circumstance	/'sə:kəmstəns/	môi trường lưu thông, xung quanh
citric acid	/sitrik/	axit xitric
citrus	/sitrəs/	các quả thuộc họ chanh cam
clarification	/,klærifi'keiʃn/	sự làm trong, làm sạch, sự lọc
clarify	/k'lærifai/	làm sạch, lọc, gạn
classification	/,klæsifi'keiʃn/	sự phân loại, phân hạng
classify	/k'læsifai/	phân loại, phân hạng
clay	/klei/	đất sét
cleanse	/klenz/	làm sạch, tinh chế, tráng lại

closely	/klousli/	khít, kín, sát gần lại
closure	/klouzə/	sự đóng, sự khép kín, tấm ngăn, bế mạc
cloudy	/klaudi/	đục, có mù (hơi, sương)
cluster	/klastə/	chùm, bó, đám
coagulate	/kou'gjuleit/	làm đông tụ, lắng xuống
coagulation	/kou,gju'leiʃn/	sự đông tụ, sự lắng xuống
coal	/koul/	than đá, than cốc
c. gas		khí than, khí đốt
coat	/kout/	vỏ, lớp phủ, lớp mạ, sơn, lớp tráng
cob	/kəb/	lõi, bắp
cobalt	/kə'bɔ:lt/	coban, Co
coccus	/'kɔkəs/	cầu khuẩn
coconuts	/'kɔkɔnʌts/	cùi dừa
coefficient	/,koui'fiʃənt/	hệ số
coin	/kɔin/	đồng tiền xu, tạo ra hình tròn
cock	/kouk/	than cốc/ cốc hóa
c. oven		lò luyện cốc
c. oven gas		khí lò cốc
colabash	/'kɔləbæʃ/	quả bầu, ống hình quả bí đặc
cold storage room	/kould/	kho bảo quản lạnh
coliform	/kəlifɔ:m/	vi khuẩn đường ruột E. côli (*Eschrichia coli)*
collaboration	/kə,læbə'reiʃn/	cộng tác viên
colleague	/kɔli:g/	đồng nghiệp
collect	kə'lekt/	tập hợp, sưu tập, tuyển chọn
college	/kɔlidz/	trường đại học, ban, viện
c. of advanced technology		trường đại học công nghệ cao
collide	/kəlaid/	va chạm, va đập
collision	/kəʊ'lizn/	sự xung đột, sự va chạm, sự đâm vào nhau
colloidal	/kɔloidəl/	(thuộc) keo, chất keo
colon	/'koul ən/	dấu hai chấm, ruột kết
colony	/kɔləni/	tập đoàn, khuẩn lạc
colo(u)r	/kalə/	màu sắc
colo(u)rless	/kaləlis/	không màu
combination	/,kɔmbi'neiʃn/	hỗn hợp, sự kết hợp
combine (with)	/kəm'bain/	kết hợp với, trộn với
combustible	/kəm'bastəbl/	dễ cháy, có thể cháy được
combustion	/kəm'basʃn/	sự cháy, sự đốt cháy
comma	/komʌ/	dấu phảy
commercial	/kə'mə:ʃl/	(thuộc) thương mại
c. solution		dung dịch pha chế theo kỹ thuật
commerce	/kɔm(ə:)s/	thương mại
commodities	/kə'mɔditiz/	loại hàng, mặt hàng
compact	/kəm'pækt/	bánh ép, kết rắn chắc
company	/kampəni/	công ty
compare with	/kəm'peə/	so sánh với
compete (for)	/kəm'pi:t/	cạnh tranh, tuyển chọn
complete	/kəm'pli:t/	hoàn thiện, kết thúc
completion	/kəm'pli:ʃn/	sự hoàn thiện, sự hoàn chỉnh
complex	/kɔmpleks/	phức tạp
complexity	/kəm'pleksiti/	sự phức tạp, độ phức tạp
complicated	/kɔmplikeitid/	bị phức tạp hóa

complication	/,kɔmpli'keiʃn/	quá trình phức tạp, rối loạn, hỗn loạn
component	/kəm'pounənt/	cấu tử, thành phần
compose of	/kəm'pouz/	có, gồm có, bao gồm
composite	/'kəmpəzit/	hợp lại, ghép lại
composition	/,kɔmpə'ziʃn/	bố cục, thành phần, cấu thành
compound	/kɔmpaund/	hợp chất, hỗn hợp
compress	/kəm'pres/	nén ép
comprise	/kəm'praiz/	bao gồm, chứa đựng
compromise	/'kəmprəmaiz/	dàn xếp, thoả hiệp, làm hại
compulsory	/kəm'palsəri/	bắt buộc, ép buộc, nghĩa vụ
concentrate	/kɔnsen'treit/	tập trung, cô đặc
concentration	/,kɔnsen'treiʃn/	sự tập trung, sự cô đặc
be concerned with	/kən'sənd/	chú ý, quan tâm đến, liên quan đến
concise	/kən'sais/	súc tích, ngắn gọn
concominant processes	/kən'kɔmitənt	các quá trình đồng phát, đồng thời xảy ra
concrete	prou'sesiz/ /kɔnkri:t/	bê tông
concurrent	/kən'karənt/	đồng quy, trùng nhau/ xảy ra đồng thời, phù hợp
condemn	/kən'dem/	xử phạt, kết án
condense	/kən'dens/	ngưng tụ, đông tụ
condensation	/,kɔnden'seiʃn/	sự ngưng tụ, sự đông tụ
condenser	/kən'densə/	thiết bị ngưng tụ
conduct	/kən'dakt/	sự điều khiển/ dẫn đến
conductivity	/,kɔndak'tiviti/	tính dẫn, độ dẫn (điện, nhiệt)
conductor	/kən'daktə/	ống dẫn, vật dẫn, dây dẫn
cone	/koun/	hình nón, chóp, côn
confer	/kən'fə:/	trao đổi, so sánh, đối chiếu
confer a degree		tặng thưởng danh hiệu
confine	/ kən'fain/	hạn chế, giới hạn
confirm	/kən'fə:m/	xác định, công nhận, khẳng định
confusion	/kən'fju:zn/	sự hỗn loạn, hòa lẫn, pha trộn
conjugate	/'kɔndzugeit/	tiếp hợp
conjunction	/kən'dzʌŋkʃn/	Sự tiếp hợp
connect	/kə'nekt/	nối vào, liên kết vào, gắn vào
consecutively	/kən'sekjutivli/	nối tiếp, liên tiếp, dần dần
considerable	/kən'sidərəbl/	đáng kể, quan trọng
consideration	/kənsidə'reiʃn/	sự lưu tâm, đánh giá
consist in	/kən'sist/	xuất phát từ
consist of		bao gồm, sắp xếp
consistency	/kən'sistənsi/	độ sệt, độ đặc, độ kiên cố
consistent	/kən'sistənt/	đặc sệt, quánh, nhất quán
conspicuous	/kən'spikjuəs/	dễ thấy, rõ ràng, nổi tiếng, đáng chú ý
constant	/'kɔnstənt/	hằng số, bền vững, không thay đổi
continual	/kən'tinjuəl/	tiếp tục, liên tục, liên miên
constituent	/kən'stituənt/	thành phần, hợp phần
constitute	/kɔnstitju:t/	tạo thành, lập nên
construct	/kən'strakt/	xây dựng, thiết kế
construction	/kən'strakʃn/	sự xây dựng, cấu tạo, kết cấu, cấu trúc
consume	/kən'sju:m/	tiêu thụ, đốt cháy hết
consumption	/kən'sampʃn/	sự tiêu thụ, mất mát, thiệt hại
contact	/kɔntækt/	sự tiếp xúc, va chạm
contain	/kən'tein/	chứa đựng, bao hàm
container	/kən'teinə/	thùng chứa, dụng cụ chứa, chai, bình...

contaminant	/kən'təminənt/	chất gây nhiễm, vật gây bệnh
content	/'kɔntent/	hàm lượng, dung lượng, nội dung
context	/'kəntekst/	khung cảnh, văn cảnh
contingency	/kən'tindzənsi/	sự việc xảy ra ngẫu nhiên
continuous	/kən'tinjuəs/	liên tục, mạch lạc, trôi chảy
contradiction	/,kɔntrə'dikʃn/	sự đối lập, tương phản
contrary	/kɔntrəri/	trái với, tương phản với
contribution	/,kɔntri'bju:ʃn/	sự đóng góp, góp phần, công hiến
control	/kən'troul/	kiểm tra, điều khiển, hiểu sâu sắc, giám sát
controllable	/kən'trouləbl/	có thể điều khiển được, có thể kiểm soát được
controversial date	/kən'trəvəʃl date/	thời kỳ tranh cãi
covalent	/kou'vælənt/	đồng giá trị, đồng hóa trị
covalent bond		liên kết đồng hóa trị
convection	/kən'vekʃn/	sự thỏa thuận, quy ước
convenient	/kən'vi:njənt/	thuận tiện, phù hợp
convert to	/kən'və:t/	biến đổi, chuyển hóa thành
convey	/kən'vei/	chuyên chở, vận chuyển, chuyển dời
conveyer	/kən'veiə/	băng chuyền, băng tải
cool	/ku:l/	nguội, mát/ làm nguội, làm lạnh
cooling	/ku:liŋ/	sự làm nguội, quá trình làm lạnh
cooperation	/kou,ɔpə'reiʃn/	sự hợp tác
copper	/kopə/	đồng, đồng thau/ bọc đồng
copra	/'kɔprə/	cùi dừa khô
corn	/kɔ:n/	ngô, bắp, sần
corner	/ko:nə/	góc
correspond to	/,koris'pond/	phù hợp với
correspondingly	/,koris'pondiŋli/	một cách tương ứng, phù hợp
corrosion	/kə'rouzən/	sự ăn mòn, gỉ, phá hỏng
corrosive	/kə'rousiv/	bị ăn mòn, bị gỉ ra, bị phá hỏng
cosmid	/'kəsmid/	cosmit
cost	/kost/	giá, chi phí, phí tổn
count	/kaunt/	tính, đếm, có giá trị, kể đến
counteract	/,kauntə'rækt/	phản tác dụng, làm mất tác dụng, trung hòa
county	/kaunti/	tỉnh, nhân dân tỉnh, ngoại ô, quận
cover	/kʌvə/	phủ, bao bọc, che đậy, chứa đựng, bao gồm, nắp đậy
cow	/kau/	bò cái, bình có ống nhánh để lắp ghép lại
cowpox	/kaupoks/	bệnh truyền nhiễm nhẹ của gia súc do vi rút
crack	/kræk/	vết nứt, khe nứt/ rạn, làm nứt ra
cracker		máy dát mỏng, máy rán dòn
cracking	/krækiŋ/	sự rạn nứt, quá trình chưng cất dầu mỏ
cream	/kri:m/	kem, váng sữa, váng bọt/ đông tụ
create	/kri'eit/	sáng tạo, tạo thành, gây ra
creep	/kri:p/	trườn ra, sự nóng chảy, dòng chảy
crisis, pl. crises	/kraisis/;/kraisi:z/	khủng hoảng, quyết định nhanh
crisp	/krisp/	giòn, nát, rán giòn
crop off	/krɔ:p of/	tách ra, thu được
cross - link	/krɔs'liŋk/	liên kết ngang
cross - section	/krɔs'sekʃn/	mặt cắt ngang, tiết diện ngang
crucible	/kru:sibl/	chậu, chén nung, chén sứ
crude	/kru:d/	thô, nguyên liệu thô, không tinh, có tạp chất
crush	/krʌʃ/	sự nghiền, vắt, ép
crusher		máy ép, máy chà

crust	/krʌst/	vỏ cứng, cặn kết, da
crystal	/kristl/	tinh thể, pha lê
crystalline	/kristəlain/	(thuộc) tinh thể, kết tinh
crystallization	/,kristəlai'zeiʃən/	sự kết tinh
crystallize	/kristəlaiz/	kết tinh
cubic	/kju:bik/	khối, lập phương, (thuộc) thể tích, hình khối
culture	/kʌltʃə/	trồng, nuôi cấy vi sinh vật
c. medium		môi trường nuôi cấy
c. tube		ống giống, ống môi trường
cupric	/kju:prik/	chứa đồng hóa trị 2, Cu^{2+}
cuprous	/kju:prəs/	có đồng, chứa đồng 3, Cu^{3+}
curd	/kə:d/	sữa đông, chất đông tụ, protit vón/ đông tụ lại
cure	/kjuə/	bảo dưỡng, xử lí, điều trị, đóng hộp, sắp đặt
customer	/kʌstəmə/	khách hàng
cut	/kʌt/	cắt, lật lên, biến thành, băm nhỏ
cut ware		hàng rời, tách biệt
cutting tool	/kʌtiŋ tu:l/	dụng cụ cắt, dao cắt
cycle	/saikl/	vòng, chu kỳ, dãy, hàng, giai đoạn, mùa
cyclic	/siklik, saiklik/	tuần hoàn, theo chu kì
cylinder	/si'lində/	xi lanh, ống đong
cyst	/sist/	cơ quan rỗng, bọng chứa chất lỏng, túi, bao, nang
		phân chia tế bào
cytokin	/sitɔkin/	xitôzan
cytosine	/sitɔzin/	chất sinh tế bào
cytostatic substance	/saitɔstətik/	

D

dam	/dæm/	con cái, con mẹ/ ngăn, bao quanh
damage	/'dæmidz/	sự thiệt hại/ làm hư hỏng, gây thiệt hại
date back	/deit back/	đẩy lùi ngày tháng, xác định ngày tháng
datum, pl. data	/deitəm, deitə/	trị số cho trước, dữ liệu
dazzling	/dæzliŋ/	lóa mắt, chói
dean	/di:n/	chủ nhiệm, trưởng đoàn
debris	/deibri:/	mảnh vỡ, mảnh vụn
decantation	/'di:kæn'teiʃn/	sự lắng cặn, lắng gạn
decay	/di'kei/	sự phân rã, phân hủy, làm mủn
decision	/di'sizən/	quyết định
decolo(u)rize	/di:'kaləraiz/	làm mất màu, khử màu
decompose	/,di:kəm'pouz/	phân hủy, phân ly
decomposition	/,di:kɔmpə'ziʃn/	sự phân hủy, sự phân li
decorticate	/di'kɔ:tikeit/	bóc vỏ, xát
decorticator	/di'kɔ:tikeitə/	máy bóc vỏ, máy xát
decrease	/di'kri:s/; /dikri:s/	làm giảm, làm nhỏ đi, giảm bớt
defecate	/ de'fikeit/	làm sạch, làm trong, gạn, lọc
defecation	/de'fikeiʃn/	sự làm sạch, sự làm trong, sự gạn, sự lọc
defense	/di'fens/	sự bảo vệ, sự phòng vệ
deficiency	/di'fiʃənsi/	sự thiếu hụt, không hoàn thiện
define	/di'fain/	định nghĩa
degree	/di'gri:/	độ, mức độ, danh hiệu
d. centigrade	/sentigreid/	độ C ; ^oC
d. communication		mức truyền tin, mức giao tiếp
dehydration	/,di:hai'dreiʃn/	sự mất nước hoặc hơi ẩm, sự khử nước
		làm trì hoãn, hoãn lại, làm chậm lại
delay	/di'lei/	

delivery tube	/di'livəri tju:b/	ống thóat ra, ống phân phối, ống dẫn
delve	/delv/	đào bới, tìm tòi, chỗ trũng
demand	/di'ma:nd/	sự yêu cầu, nhu cầu
demonstrate	/'demənstreit/	chứng minh, biểu thị
dense	/dens/	rậm rạp, đậm đặc
density	/'densiti/	mật độ, tỉ trọng, độ đậm đặc
deodorize	/di:oudəraiz/	khử mùi
deodorization	/di:oudərai'zeiʃn/	quá trình khử mùi
department	/di'pa:tmənt/	ban, khoa
depend (on, upon)	/di'pend/	phụ thuộc
dependent	/di'pendənt/	tính phụ thuộc
deplete	/di'pli:t/	làm hết, làm kiệt
deposit	/di'pɔzit/	chất lắng/ kết tủa, trầm tích, lắng xuống
depreciation	/di,pri:ʃi'eiʃn/	sự sụt giá, giảm giá
derivative	/di'rivətiv/	chất dẫn xuất
derive	/di'raiv/	dẫn xuất từ, thu được từ
describe	/dis'kraib/	mô tả, trình bày
desiccate	/desi'keit/	làm khô, khử ẩm, sấy khô
desiccation	/,desi'keiʃn/	sự làm khô, sấy khô
desiccator	/desikeitə/	tủ sấy, máy sấy, bình hút ẩm
design	/di'zain/	bản thiết kế, sơ đồ bố trí, phương án
designate	/dezigneit/	ấn định, quy định, xác định, đặt tên
desirable	/di'zaiərəbl/	tốt, đánh giá tốt, phù hợp yêu cầu
desire	/di'zaiə/	yêu cầu, mong muốn
detectable	/di'tektəbl/	phát hiện ra, dò được, tìm ra được
deteriorate	/di'tiəriəreit/	làm hư hỏng, làm giảm giá trị
determine	/di'tə:min/	xác định, định rõ, dành được
determination	/di,tə:mi'neiʃn/	sự xác định, định rõ
detract	/di'trækt/	lấy, đoạt, thu hồi
detriment	/'detrimənt/	sự tổn hai, thiệt hại
develop	/di'veləp/	phát triển, hiện hình, phát sinh, tạo nên
developer	/di'veləpə/	chất hiện hình, chất giữ màu
development	/di'veləpmənt/	sự phát triển
device	/di'vais/	dụng cụ, thiết bị
devise	/di'vaiz/	nghĩ ra, tưởng tượng ra, bịa ra
dew	/du/	sương, ẩm
diameter	/dai'mitə/	đường kính
diastase	/daiəsteis/	hoạt lực diastaza
diacide	/daiəcid/	(thuộc) diaxit
diagonal	/dai'ægənl/	chéo, xiên, nghiêng
diatomaceous	/'daiətəmæsiəs/	(thuộc) chất trợ lọc diatomit
dicotyledon	/'daikɔti'lidən/	cây hai lá mầm
die	/dai/	khuôn đúc, khuôn ép/ chết
differentiate	/difə'renʃieit/	phân biệt
differentiation	/difə,renʃi'eiʃn/	sự sai khác, sự phân biệt
diffraction	/di'frækʃn/	sự nhiễu xạ
diffuse	/di'fju:z/	khuyếch tán (ánh sáng)
diffusion	/di'fju:zn/	sự khuyếch tán, hiện tượng khuyếch tán
digestion	/di'dzestʃən;dai-/	sự tiêu hóa, khả năng tiêu hóa thức ăn
dimension	/di'menʃən/	kích thước, xác định kích thước, cỡ
dip	/dip/	sự ngâm, nhúng, chìm, nhuộm màu
direct	/di'rekt/	trực tiếp, thẳng
dirt	/də:t/	bùn, đá không quặng
disagreeable	/,disə'gri: əbl/	không đạt hiệu quả
disappear	/,disə'piə/	biến mất

discharge	/dis'tʃa:dz/	sự tháo, xả, lưu lượng
discover	/dis'kavə/	phát hiện, khám phá
discovery	/dis'kavəri/	sự phát hiện, sự khám phá
dish	/di:ʃ/	đĩa, hình đĩa
disinfectant	/,disin'fektn/	chất sát trùng
disinfection	,disin'fekʃn/	sự tẩy uế, khử trùng
disintegrate	/dis'intigreit/	phân rã, phân hủy
disperse	/dis'pə:s/	phân tán, tán xạ, tán sắc
displace	/dis'pleis/	dời chỗ, dịch chuyển
disposal	/di'spouzl/	sự vứt bỏ, loại trừ
dispose of sth	/dis'pouz/	sắp xếp, bố trí, khử
disrupt	/dis'rʌpt/	đập vỡ, phá vỡ, đập gãy
dissociation	/di,souʃi'eiən/	sự phân ly, phân tách
dissolve	/di'zolv/	hòa tan
distill	/di'stil/	chưng cất
distillate	/distilit, -leit/	chưng cất
distillation	/disti'leiʃn/	sản phẩm chưng cất
fractional d.		chưng cất phân đoạn
distinct	/dis'tiŋkt/	rõ, phân biệt, khác biệt
distinction	/dis'tiŋkʃən/	sự phân biệt, khác biệt
distinguish	/dis'tiŋgwiʃ/	nhận biết, phân biệt
distribute	/distribju:t/	phân phối, phân bố
distribution	/,distri'bju:ʃn/	sự phân phối
disturb	/di'stə:b/	rối loạn, gây nhiễu
diverse	/daivə:s/	nhiều loại khác nhau, đa dạng
diversify	/dai':və:sifai/	đa dạng hóa
divide	/di'vaid/	chia, phân chia, phân độ
donor	/'dounə/	người cho, người tặng, chất cho
double	/dʌbl/	gấp đôi
dough	/dəu/	bột nhào
drain	/drein/	máng, rãnh, tiêu nước, tháo nước
drainage	/dreinidz/	sự tiêu nước, tháo nước, hệ thống tiêu nước, thóat nước
draw (drew, drawn)	/drɔ:, dru:, drɔ:n/	kéo, hút
d. off		hút ra, kéo ra
dressing	/dresiŋ/	sự ăn mặc, băng bó, sự đẽo gọt
drive (drove, driven)	/draiv, drouv, drivn/	dẫn động, kéo, điều khiển, lái xe
driving power		công suất kéo
drop	/drɔp/	làm rơi, giọt, giảm/ nhỏ giọt
droplet	/drɔplit/	nhỏ giọt
dropper	/drɔpə/	ống nhỏ giọt, bình nhỏ giọt
drug	/drʌg/	thuốc
dry	/drai/	sấy khô, làm khô
ductile	/dʌktail/	dẻo, dễ kéo sợi, rèn được
ductility	/dʌk'tiliti/	tính dẻo, tính dễ rèn
due	/dju:/	hướng chính xác, tương ứng
due to		gây nên do
duly	/dju:li/	đúng, thích đáng, thích hợp
duplicate	/dju:plikeit/	bản sao/ nhân đôi
durability	/,djurə'biliti/	tính bền lâu, tuổi bền
dust	/dʌst/	bụi
dye	/dai/	thuốc nhuộm/ nhuộm màu

E

ecological	/ˌekə'lodzik(ə)l/	(thuộc) sinh thái học
economics	/ˌi:kə'nomiks/	môn kinh tế học, ngành kinh tế
economist	/i'kənəmist/	nhà kinh tế học
economy	/i'kənəmi/	tính kinh tế, tính toán
edge	/edg/	lưỡi dao, mép, gờ, viền
effect	/i'fekt/	kết quả, hiêu lực/ tác dụng, ảnh hưởng
to the effect		để có hiệu quả, với hiệu lực
effective	/i'fektiv/	(thuộc) hiệu quả, hiệu ứng
effervescence	/ˌefə'vesəns/	sự sủi bọt, bong bóng, sự thóat khí
efficiency	/i'fiʃnsi/	hiệu lực, hiệu quả sử dụng
efficient	/i'fiʃnt/	có hiệu quả, có hiệu suất
effluent	/'efluənt/	chất lỏng thừa, nước cống, suối, sông, nhánh
		quả cà, cây cà
eggplant	/egplənt/	thiết lập, dựng lên, tạo nên
elaborate	/i'læbərət/	tính chất đàn hồi, tính biến dạng
elastic	/i'læstik/	
elasticity	/əlæs'tisiti/	tính đàn hồi, tính biến dạng
elastomer	/ə'læstəmə/	đàn hồi kế
electric(al)	/i'lektrik(l)/	(thuộc) điện
electricity	/ilek'trisiti/	điện, điện học
electrolysis	/ilek'trɔlisis/	quá trình điện phân
electrolyte	/i'lektroulait/	chất điện phân, dung dịch điện phân
electron	/i'lektrɔn/	điện tử, electron
electronics	/ilek'trɔniks/	điện tử học
element	/elimənt/	nguyên tố, thành phần
elongation	/ˌilɔŋ'geiʃn/	quá trình kéo dài, quá trình kéo dãn ra
emanation	/ˌemə'neiʃn/	sự tỏa ra, phát sáng, xạ khí
embassy	/embəsi/	đại sứ, sứ mệnh
embed	/im'bed/	đưa vào, gắn vào, mạ (kim loại)
emphasis	/'emfəsis/	sự nhấn mạnh
emission	/i'miʃən/	sự phát xạ, sự bức xạ
employ	/im'plɔi/	làm việc, sử dụng được
emulsify	/i'malsifai/	nhũ tương hóa
emulsion	/i'malʃn/	chất nhũ tương
enclose	/in'klouz/	xung quanh, bỏ kèm theo, bao gồm
enclosure	/in'klouzə/	sự vây quanh, sự đặt xung quanh
encounter	/in'kautə/	sự va chạm, tính đến, đọ sức, kết lại, đông lại
		giúp đỡ, ủng hộ, động viên, hỗ trợ
encourage	/in'kʌridz/	
ending	/endiŋ/	sự kết thúc, sự chấm dứt, phần cuối
energy	/’enədzi/	năng lượng
be engaged (in)	/in'geidzd/	được dẫn vào, bị kéo vào
engine	/endzin/	động cơ, đầu máy
engineer	/ˌendzi'niə/	kỹ sư, kỹ thuật viên
engineering	/endziə'niriŋ/	kỹ thuật, ngành kỹ thuật
engrave	/in'greiv/	khắc, chạm trổ
enrich with	/in'ritʃ/	làm giàu thêm, điều chỉnh
enrichment	/in'ritʃmənt/	biến đổi tốt hơn, làm giàu thêm
ensure	/in'ʃuə/	bảo đảm, chắc chắn
enter	/'entə/	nhập vào, đưa vào
enterprise	/entəpraiz/	xí nghiệp, cơ quan
entire	/in'taiə/	toàn bộ, tổng thể, đầy đủ, hoàn toàn
entrap	/in'træp/	bắt được, giữ được, bẫy được
entry	/'entri/	sự đi vào, sự ghi vào, cửa vào
envelope	/'enviloup/	bao, phong bì, màng bao, vỏ bao

Esq. (uire)	/is'kwaiə/	Thưa các ông, các bà (văn viết)
environment	/in'vaiərənmənt/	môi trường, xung quanh
enzyme	/en’zaim/	enzim
epithet	/'epiðet/	tính ngữ
equation	/ik'weiʃn/	phương trình, sự cân bằng
equilibrium	/,i:kwi'libriəm/	trạng thái cân bằng, vị trí cân bằng
equip	/i'kwip/	trang bị, lắp đặt
equipment	/i'kwipmənt/	thiết bị, máy móc
equivalence	/i'kwivəələns/	sự tương đương, tính tương đương
erode	/i'roud/	xói mòn, ăn mòn
error	/erə/	sai sót, sai số, sai lệch
escape	/is'keip/	sự thóat, chỗ rò rỉ, đầu ra
essence	/esəns/	tinh dầu nước hoa/ thực chất
essential	/i'senʃl/	cần thiết, thiết yếu
ester	/’estə/	este
estimate	/’estimit/	đánh giá, dự trù
ethane	/eðein/	êtan
ether	/iðə/	ête
ethyl alcohol	/eðil/	rượu êtylic
ethylene	/’eðili:n/	êtylen
e. dichloride		diclorit êtylen
evaporate	/i'væpəreit/	bay hơi, bốc hơi
evaporation	/i,væpə'reiʃən/	quá trình bay hơi, quá trình bốc hơi
eventually	/i'ventjuəli/	cuối cùng, có giới hạn
evidently	/'evidəntli/	một cách hiển nhiên, một cách rõ rệt
evolution	/i:və'lu: ʃən/	quá trình phát triển, giải thóat
evolve	/i'volv/	phát sinh, sinh ra, giải phóng ra
exceed	/ik'si:d/	làm dư, vượt quá mức, vượt cao hơn
excess	/ik'ses/	phần dư ra, phần thừa ra
exchange	/iks'tʃeindz/	đổi, trao đổi, thay thế
exclude	/iks'klu:d/	thóat ra, tiết ra, tách ra
exclusion	/iks'klu:zn/	quá trình tách chiết, thóat ra, tống ra
excursion	/iks'kə:ʃn/	cuộc tham quan
exergonic	/'eksəgonik/	tỏa nhiệt, tỏa năng lượng
exert	/igzət/	tăng cường, cố gắng, lượng dư
exhaust	/ig'zɔ:st/	lấy hết, lấy kiệt, xả khí, triệt để
exhaustion	/ig'zɔ:stʃn/	dùng hết, tiêu thụ hết
exhibit	/ig'zibit/	triển lãm, trưng bày, chỉ dẫn ra
exhibition	/,eksi'biʃn/	sự trưng bày, quá trình triển lãm
exist	/ig'zist/	tồn tại, có sẵn
exothermic	/egzə':ðəmik/	tỏa nhiệt, giải phóng năng lượng
expand	/iks'pænd/	mở rộng, phát triển, trương lên, căng lên
expansion	/iks'pænʃn/	sự mở rộng, sự giãn nở
expenditure	/iks'penditʃə/	chí phí, phí tổn, sự tiêu dùng
expense	/iks'pens/	tiêu hao, tiêu phí, chi phí
at the e. of		trả giá bằng, với giá là, để thiệt hại cho ai
experiment	/iks'periment/	thí nghiệm
experimental	/eks,peri'mentəl/	(thuộc) về thí nghiệm
expert	/ekspə:t/	chuyên gia, cố vấn, nhà thông thái
exploitation	/,eksplɔi'teiʃn/	sự khai thác, sự lợi dụng
explosive	/iks'plousiv/	nổ, chất gây nổ, dễ nổ
expose to	/iks'pouz/	trình bày, phơi bày
express	/iks'pres/	biểu thị, giải thích
extend	/iks'tend/	mở rộng, kéo dài, dãn ra
extensive	/iks'tensiv/	rộng, bao quát, đáng kể
extent	/iks'tent/	kích thước, mức độ, phạm vi

external	/eks'tə:nl/	bên ngoài, phần xung quanh
extract	/'ekstrækt/	chiết ra, phần chiết, trích ly ra
extraction	/iks'trækn/	quá trình chiết, quá trình trích ly
extractor	/iks'træktə/	thiết bị trích ly, bộ trích ly

F

facilitate	/fə'siliteit/	làm cho dễ dàng hơn, làm đơn giản hơn, thuận tiện hơn
facility	/fə'siliti/	trang thiết bị, có thể có, điều kiện dễ dàng, điều kiện thuận tiện
factory	/fæktəri/	nhà máy, xưởng sản xuất
fail	/feil/	làm hỏng, làm sai lệch
fail in an exam		thi trượt, thi rớt
fairly	/feəli/	rõ ràng, rõ rệt, ngay thẳng
familiar	/fə'miljə/	giống, tương tự
family	/'fæmili/	gia đình, họ, lớp, nhóm
fashion	/'fæʃn/	mẫu, mốt, loại
fat	/fæt/	béo, chất béo, mỡ
fatty	/fæti/	(thuộc) mỡ, bị béo
feasible	/'fi:zəbl/	khả thi, có khả năng thực hiện
feature	/fi:tʃə/	đặc điểm, đặc tính, dấu hiệu đặc trưng
feed	/fi:d/	cung cấp, cho ăn, bổ sung, tiếp liệu
feedback	/fi:dbæk/	cơ cấu ngược, cho quay lại
fellowship	/'felouʃip/	tình bạn, giao hữu
ferment	/fə:ment/; /fə'ment/	lên men, chất men (enzim) cho lên men
fermentable	/fə'mentəbl/	có thể lên men được
fermentation	/,fə:men'teiʃn/	quá trình lên men
bottom f.		quá trình lên men chìm
top f.		quá trình lên men nổi
fern	/fə:nz/	cây dương xỉ
ferric	/'ferik/	(thuộc) sắt
ferrous	/'fermentationəs/	(thuộc) muối sắt
fertilizer	/fə:tilaizə/	phân bón, máy chế phân bón
fiber	/faibə/	sợi, dạng sợi
figure	/'figə/	con số, hình vẽ, đồ thị, biểu đồ
filament	/filəmənt/	sợi, que nhỏ, mảnh
file	/fail/	gọt dũa, sắp đặt, hàng, dãy
fill	/fil/	đổ đầy, chiết dịch vào chai
filler	/filə/	chất chiết, máy chiết (chai, lon)
filter	/filtə/	bộ lọc/ lọc
filtrate	/filtrit, -eit/	chất lọc, dịch lọc
filtration	/fil'treiʃən/	quá trình lọc
final	/'fainl/	cuối cùng, phần cuối
fine	/fain/	tinh khiết, sạch, tốt, mịn
fireproof	/'fai əpru:f/	gạch chịu lửa, không cháy
firm	/fə:m/	hãng, vững chắc, khẳng định
fission	/fiʃən/	phân chia, phân rã
fit	/fit/	phù hợp, vừa, ăn khớp, thích hợp
f. to		làm thích ứng, làm cho phù hợp
f. with		trang bị, sắm, tạo ra, cho thêm
fix	/fiks/	cố định, định vị/ hãm, cô đặc, ngưng kết
flagella	/'flædzələ/	tiên mao
flail	/fleil/	đập, cái đập lúa
flake	/fleik/	bông, hạt bỏng, vảy gỉ
flaker	/fleikə/	máy nổ, máy cán tão cốm
flakes	/fleiks/	mì thanh, cán mỏng

flaky	/'fleiki/	có bông, dễ bong ra từng mảng
flame	/fleim/	ngọn lửa, cháy, bốc cháy, bùng cháy, hơ lửa
		cháy được, dễ cháy, dễ bắt lửa
flammable	/flæməbl/	
flange	/flændz/	(mặt) bích, vai, gờ, vành gờ/ tạo bích, bắt bích
flash	/flæʃ/	tia sáng, sự bốc cháy/ lóe sáng, bắn tia sáng
flash point		điểm sáng, điểm lóe sáng
flask	/fla:sk/	bình tam giác, bình, chai
flat-bottomed f.		bình đáy bằng
round-bottomed f		bình đáy tròn
flatworm	/flætwɔ:m/	giun móc
flavo(u)r	/f'leivə/	mùi, hương thơm, chất thơm
flexibility	/,fleksi'biliti/	tính dễ uốn, tính mềm dẻo
flint	/flint/	đá màu
float	/flout/	cái phao, làm nổi
floccular	/f'lɔkjulə/	bộ kết bông, bộ lông cuối
flocculation	/flɔkju'leiʃn/	sự kết bông, sự kết bợn, sự kết khóm
flocculent	/'flɔkjulənt/	phủ bông, chất kết bông
flooring	/flɔ:riŋ/	ván lát, gạch lát, sự lát nền
floral	/flɔ:rəl/	(thuộc) cây cỏ, hệ thực vật
fork	/fɔ:k/	chĩa, cái nĩa ăn, cái xêu
flow	/flou/	sự chảy, sự loang ra, sự tràn ra, dòng chảy/ chảy
f. from		dòng chảy ra từ, tràn ra từ
fluctuate	/'flʌktjueit/	dao động, thay đổi bất thường, bấp bênh
fluid	/fluid/	chất lỏng, (thuộc) chất lỏng
fluorine	/fluəri:n/	Fluor, F
foam	/foum/	bọt/ tạo bọt
food	/fud/	thực phẩm, thức ăn, sự nuôi dưỡng
force	/fɔ:s/	lực, sức đẩy, lực tác dụng
forge	/fɔ:dz/	đường rèn, lò rèn
form	/fɔ:m/	hình dạng, loại, hạng/ tạo hình, tạo dạng, tạo thành
formaldehyde	/fɔ:'mældihaid/	formaldehyt, HCHO
format	/fɔmeit/	format, 1- HCOOM; 2- HCOOR
formation	/fɔ:'meiʃən/	sự hình thành, sự tạo thành, sự tạo hình
formic acid	/fɔ:mik/	axit formic, HCOOH
formula	/fɔ:mjulə/	công thức
pl. formulae	/fɔ:mjuli:/	
forward	/'fɔ:wəd/	ở trước, đưa đến, tiến bộ, bổ sung
fountain	/'fauntin/	vòi nước, máy nước, vòi phun, suối
fraction	/'frækʃən/	phân đoạn, tách đoạn
fractional	/frækʃənl/	từng phân đoạn
fractionation	/,fræk'ʃəneiʃn/	cắt phân đoạn, tách chiết
frank	/fræŋk/	miễn cước, thẳng thắn, chân thành
free	/fri:/	tự do, không liên kết, sạch, tinh khiết
f. from		tách khỏi, tự do từ
set f.		giải phóng ra, tự do tách ra
freeze (froze-frozen)	/fri:z/	đóng băng, đông đặc
freezing point		điểm đóng băng
frequency	/fri:kwənsi/	tần số, tần suất, độ lặp lại
fresh	/freʃ/	tươi, còn ướt, mới
friction	/frikʃn/	ma sát, cọ sát
frontier	/'frʌntiə/	biên giới, ranh giới

fruit	/fru:t/	hoa quả, quả
fruit butter		mứt quả, mứt nhừ
fuel	/fjuəl/	nhiên liệu
f. oil		dầu đốt
diesel f.		dầu diesel
motor f.		dầu máy
fugal (ling)	/gju:gəl/	băng, vận chuyển
fume	/fju:m/	khói, xông khói, hút thuốc
fungus, pl. fungi	/fʌŋgəs, -ai/	nấm, nấm mốc
funnel	/'fʌnl/	phễu
separatory f.	/sepə 'reitəri/	phễu chiết
fur	/fə:/	cặn, cáu, loài thú có lông mao, bộ da thú
fural aldehyde	/fə:rəlældihaid/	fural alhydrit
furnace	/fə:nis/	lò nung, lò đốt
furnish	/fə:niʃ/	cung cấp, trang bị
fuse	/fju:z/	cầu chìm cái tự ngắt mạch, ngòi nổ/ nấu chảy, làm nóng
fusibility	/fju:zi'biliti/	khả năng nóng chảy
fusible	/fju:zibl/	có thể nóng chảy được
fusion	/fju:zən/	sự nóng chảy
f. of protoplasm		dung hợp tế bào trần

G

gallon	/gælən/	đơn vị đo chất lỏng 1 gallon Mỹ = 3,787 lít 1 gallon Anh = 4,546 lít
gap	/gæp/	khe hở, lỗ hổng, chỗ trống
gas	/gæs/	khí, chất khí
become a gas		chuyển thành trạng thái khí
gaseous	/geiziəs/	(thuộc) thể khí
gasket	/gæskit/	miếng đệm, dây thừng nhỏ
gasoline	/gæsəli:n/	xăng, dầu hoả
gelatin	/,dzelə'ti:n/	gelatin, keo gelatin
gelatinous	/dzə'lætins/	(thuộc) chất gelatin, keo động vật
general	/'dzenərəl/	chung
generate	/'dzenəreit/	sản xuất ra, tạo ra (khí, nhiệt, điện)
generation	/,dzenə'reiʃn/	sự tạo ra, sản sinh ra
generator	/dzenəreit/	lò hơi, máy phát điện, máy phát nhiệt
gentle	/dzentl/	vừa phải, trung bình, từ từ
genus, pl. genera	/'dzi:nəs/ /dzenərə/	giống vi sinh vật
geology	/dzi'ɔlədzi/	ngành địa chất học
germicide	/dzə:misaid/	chất sát trùng, chất diệt khuẩn
give off	/givɔf/	tách ra, tiết ra, phân tách, chọn ra
glacial	/gleisiəl/	(thuộc) đá, băng, kem
glass	/gla:s/	thủy tinh, cốc thủy tinh
watch g.	/wɔtʃ/	kính đồng hồ
glassware	/gla:sweə/	dụng cụ thủy tinh
glassy	/gla:si/	(thuộc) thủy tinh
glucose	/glu:kous/	đường glucoza, $C_6H_{12}O_6$
glycerol	/glisərol/	glyxerin, $C_3H_3O_8$
glycogen	/g'likodzen/	glycogen, hạt tinh bột
goat	/gout/	con dê
gold	/gould/	vàng
g. leaf		vàng lá
goods	/gudz/	hàng hóa
gradually	/grædjuəli/	dần dần, từ từ, từng bước

graduate	/grædjueit/	chia độ, tăng dần dần
to graduate (from)	/grædjueit/	tốt nghiệp (đại học)
grain	/grein/	hạt
grammar-school	/græmə/	trường trung học
granular	/grænjulə/	(thuộc) hạt, hình hạt
grant	/gra:nt/	sự nhường/ cấp cho, nhường, cho mượn, phong cho
graphite	/græfait/	than grafit
grateful	/greitf(u)l/	dễ chịu, khoan khóai
grater	/'greitə/	bàn xát, bàn mài
grating stage	/'gritiŋ steidz/	giai đoạn nghiền và mài qua lưới
gravity	/græviti/	tỷ trọng, trọng lượng, trọng lực, lực hút
grease	/gri:s/	bôi mỡ, tra dầu, dầu bôi trơn
greenish	/gri:niʃ/	hơi xanh
grief	/gri:f/	tai họa, đau khổ
grind (ground, ground)	/graind, graund/	nghiền, nghiền mịn
grip	/grip/	bắt, giữ chặt
grittiness	/'gritinis/	tình trạng có sạn, có hạt cứng
groove	/gru:v/	khía, rãnh, đường rãnh
groundnuts	/graundn^ts/	hạt lạc
group	/gru:p/	nhóm, tập hợp lại
grow (grew, grown)	/grou, gru:,groun/	phát triển, trồng trọt, sinh trưởng
guanine	/guanin/	guanin, $C_5H_5ON_5$
guillotine	/giləti:n/	máy xén, xén cắt
gymnosperm	/'dzimnəspə:m/	cây hạt trần

H

hammer	/hæmə/	cái búa, máy búa, thanh gõ/ đóng vào, gõ vào
hamster	/'hamstə/	chuột đồng
handle	/hændl/	tay cầm, tay quay/ điều khiển, vận hành, sử dụng
hard	/ha:d/	cứng, khó khăn, chăm chỉ
hardbound		đóng bìa cứng, giới hạn
harden	/ha:dən/	tôi luyện, làm cho cứng lại
hardness	/ha:dnis/	độ cứng
harm	/'ha:m/	có hại, gây hại
harmful	/ha:mful/	có hại, tác hại
harvest	/'ha:vist/	gặt hái, thu hoạch
hazard	/'hæzad/	nguy hiểm, rủi ro
heap	/hip/	đống, đụn
heat	/hi:t/	nhiệt, nóng/ đun nóng
apply h.		đun nóng, cung cấp nhiệt
helminth	/helminð/	giun sán
hence	/hens/	do đó, vì thế, kể từ đây
herewith	/hiə'wið/	kèm theo đây
heterogeneous	/,hetərou'dzi:njəs/	khác giống, dị thể
hexagon	/heksəgən/	hình 6 cạnh
hexagonal	/hek'sægənl/	(thuộc) hình 6 cạnh. 6 hướng khác nhau
hinge	/hindz/	khớp, nối, lắp
hold	/hould/	bao gồm, giữ lấy, định giá, nắm giữ
hold examinations		tiến hành tốt, tổ chức thi cử
holding capacity	/houldiŋkə'pæsiti/	sức chứa, dung lượng, thùng chứa
holder	/houldə/	giá đỡ, bệ, đui đèn
homogeneous	/,homə'dzi:niəs/	đồng thể, đồng nhất
homestead	/həumsted/	trang trại
hood	/hud/	nắp chụp, chụp hốt
hop	/hop/	hoa huplông

h. jack		hộp hoa huplông
horizontal	/,hori'zontl/	nằm ngang
hose	/houz/	ống mềm, ống dẫn bằng nhựa
hostel	/hostl/	nhà trọ
hot	/hot/	nóng, cay
household	/haushould/	người nội trợ
huge	/hju:dz/	to lớn, đồ sộ, khổng lồ
humidity	/hju:'miditi/	độ ẩm, bị ẩm
husk	/h∧sk/	vỏ trấu
hydraulic	/hai'drɔ:lik/	có nước, háo nước
hydrocarbon	/,haidrou'ka:bən/	hydrocacbon
hydrochloric acid	/,haidrɔ'klorik/	axit clohydric
hydrogen	/haidrədzən/	hydro, H
h. bromide	/broumaid/	bromua hydrro, HBr
hydrogenation	,haidroudzi'neiʃən	quá trình hydrogen hóa
hydrolysis	/hai'drolisis/	sự thủy phân
hydronium ion	/haidrouniəm/	ion H^+
hydroxide	/hai'droksaid/	hydroxyt
hydroxyl	/hai'droksil/	nhóm hydroxyn OH^-
hypha, pl. hyphae	/haifə, haifi:/	nấm, sợi nấm mốc

I

ice	/ais/	đá, đông thành đá
identify	/ai'dentifai/	xác định, nhận ra, phát hiện, đồng nhất hóa
ignore	/ig'nɔ:/	bác bỏ, phớt lờ
immaterial	/,imə'tiəriəl/	vô hình, phi vật chất, vụn vặt
immerse	/i'mə:s/	ngâm, nhúng chìm, ngập dịch
immiscible	/i'misibl/	không thể trộn lẫn vào nhau được
immunity	/'imju:niti/	sự miễn, được miễn
immunology	/'imju'noləgzi/	miễn dịch học
impact	/impækt/	sự va chạm, va đập, tác động
i. strength		độ bền va đập
impervious	/im'pə:viəs/	không thấm được
impregnate	/impregneit/	tẩm, thấm
impregrate	/'impregreit/	thấm, nhiễm, tiêm nhiễm, thụ tinh
improvement	/im'pru:vəmənt/	cải tiến, cải thiện, nâng chất lượng
impure	/im'pjuə/	không tinh khiết, có tạp chất
impurity	/im'pjuəriti/	độ tạp chất, độ không thuần khiết
inactive	/in'æktiv/	vô hoạt, vô tác dụng
inadequate provision	/inæ'dikwit prə'vizn/	đồ ăn uống không cấp đủ (không tương xứng)
include	/in'klu:d/	bao gồm, gồm có
income	/'inkəm/	thu nhập, doanh thu, lợi tức
increase	/in'kri:s/	tăng lên, nâng cao lên
incubation	/,inkju:'beiʃən/	nuôi cấy, duy trì trong tủ ấm
independent of	/,indi'pendənt/	không phụ thuộc vào, độc lập với
indicate	/indikeit/	chỉ ra, đo được, biểu thị
indicator	/indi'keitə/	chất chỉ thị, chỉ thị kế
indication	/,indi'keiʃn/	chỉ số, sự biểu thị, dấu hiệu
indigenous	/in'didzinəs/	bản xứ
indispensable	/,indis'pensəbl/	không thể thiếu được
industrial	/indstriəl/	(thuộc) công nghiệp
industry	/indəstri/	ngành công nghiệp
electronics i.		công nghiệp điện tử
instruments i.		công nghệ cơ khí chính xác
machine-building i.		Công nghệ chế tạo máy

inert	/i'nə:t/	khí trơ, không tác tụng
influence	/influəns/	ảnh hưởng, tác dụng, gây ra, có ảnh hưởng
infusible	/in'fju:zəbl/	tính không thể nóng chảy được
ingestion	/in'dzesʃn/	sự tiêu thụ thức ăn, thức ăn
ingredient	/in'gri:diənt/	thành phần, bộ phận, cấu tử
inherent	/in'hi:rnt/	vốn có, cố hữu, vốn thuộc về
inhibit	/in'hibit/	ức chế, kiềm chế, kìm hãm
inhibitor	/in'hibitə/	chất ức chế, chất kìm hãm
initial	/iniʃəl/	đầu tiên, thoạt tiên
initiate	/i'niʃiet/	bắt đầu, khởi đầu, khởi xướng
injection	/in'dzekʃən/	sự bơm, sự tiêm, sự phun
i. moulding		ống tiêm
injury	/indzəri/	sự làm hại, điều hại, vết thương/ làm hỏng
inlet	/inlet/	lối vào, cửa vào, lỗ lắp vào, vật lồng vào
inoculate	/i'nokjuleit/	cấy truyền vi sinh vật
inoculation	/i,nokju'leiʃn/	sự tiêm chủng, sự cấy truyền VSV
inorganic	/ino:'gænik/	(thuộc) hóa vô cơ
inseparable	/in'sepərəbl/	không thể phân tách được, không thể tách ra được
		vòng vào, gắn vào, đè lên
insert	/in'ʃə:t/	nhạt nhẽo, vô vị, không sinh động
insipid	/in'sipid/	
installation	/,instə'leiʃn/	sự lắp đặt, gá đặt thiết bị
institution	/,insti'tju:ʃn:/	thể chế, người quen thuộc
instrumentation	/,instrumen'teiʃn/	thiết bị đo, dụng cụ đo
insulate	/insjuleit/	phân lập, cô lập, ngăn cách, cách điện
insulating material		vật cách điện, chất cách điện
insulation	/,insjuleiʃn/	sự phân lập, sự phân cách, sự cách điện
insulator	/insjuleitə/	chất cách điện, cách nhiệt
insure	/in'ʃuə/	bảo đảm, bảo hiểm
integer	/intidzə/	nguyên, tổng thể, toàn bộ
integral	/intigrl/	tính nguyên, tính toàn bộ, tính tổng thể, cơ bản, tích phân
intend	/in'tend/	dự tính, có ý định
intensity	/in'tensiti/	lực, cường độ, độ mạnh
interaction	/,intə'rækʃən/	sự tương tác lẫn nhau, sự tác động qua lại
interchange	/'intətʃeindz/	trao đổi lẫn nhau, xen kẽ nhau
interferon	/,intə'firn/	chất kìm hãm (ức chế) sinh sản
intermediate	/,intəmi:diət/	bán sản phẩm, sản phẩm trung gian, sự hỗ trợ, làm môi giới
intermingling	/intə'miŋliŋ/	trộn lẫn, pha trộn
intermittent	/,intə'mitənt/	gián đoạn, chạy trục trặc, thỉnh thoảng lại ngừng, lúc có lúc không
inter-molecular	/,intəmou'lekjulə/	giữa phân tử
internal	/in'tə:nl/	bên trong, phía trong
interrelated	/,intəri'leitid/	quan hệ qua lại
interval	/intəvə l/	khoảng, khoảng cách, quãng, lúc ngừng
intimacy	/intiməsi/	trộn đều, trộn lẫn kỹ càng. đánh trộn đều
intimate	/intimit/	kỹ càng, xít, sát, cạnh, hoàn thành, kết thúc
introduce	/,intro'dju:s/	giới thiệu, đưa vào, mở đầu
invent	/in'vent/	sự kiện
invention	/in'venʃn/	phát minh, sáng chế
inventory	/invəntri/	tóm tắt, kiểm kê
pl. inventories		nguyên vật liệu cơ sở
invert	/in'və:t/	nghịch chuyển, chuyển đổi, đảo ngược, hai chiều, phản ứng theo hai chiều
inversion	/in'və:ʃən/	phép nghịch đảo
involve	/in'volv/	bao gồm, kéo theo
iodine	/aiədi:n/	Iod, I_2
ion	/aiən/	ion

iron	/aiən/	sắt, Fe / là
irradiation	/i,reidi'eiʃən/	chiếu xạ, bức xạ
isolate	/aisəleit/	phân lập, phân tách, loại trừ
isolation	/,aisə'leiʃn/	quá trình phân lập, phân loại
isoprene	/aisopren/	izopren
isotope	/aisoutoup/	chất đồng vị
insulin	/insjulin/	insulin, $C_{45}H_{69}O_{14}N_{11}S.\ 3H_2O$
italicize; -ise	/i'tælisaiz/	In nghiêng, viết nghiêng
ivory	/aivəri/	ngà vòi

J

jacket	/ 'dzækit/	vỏ ngoài, áo khóac, lớp tường lót
jam	/dzæm/	mứt nhừ, mứt quả nhừ
jar	/dza:/	bình, lọ cổ rộng
jelly	/dzeli/	thạch, gen, keo đông, bánh bằng mứt quả
joint	/dzoint/	liên kết, nối, tiếp xúc, khớp nối
journal	/dzə:nl/	tạp chí, báo chí
juice	/dzu:s/	nước ép quả, nước quả

K

keep within bounds	/baundz/	giữ lại bằng các liên kết,
keg	/keg/	bom đựng bia loại nhỏ 25 - 50 lít
kerosene	/kerəsi:n/	dầu hỏa, dầu lửa
ketene	/keti:n/	Ketôn
kettle	/ketl/	ấm đun nước, bình, thiết bị nấu bia
key	/ki:/	chìa khóa, mấu chốt
kiln	/kiln, kil/	tủ sấy, lò sấy
kind	/kaind/	loại giống
kinetic	/kai'netik/	động học, sự chuyển động
knead	/ni:d/	nhào trộn
know-how	/nou hau/	kinh nghiệm, bí quyết công nghệ, mức độ hiểu biết
knowledge	/'nolidz/	kiến thức, sự hiểu biết

L

laboratory, lab	/lə'borətəri/ /'læbərətəri/, /læb/	phòng thí nghiệm
labour	/'leibə/	lao động, công nhân, sức lao động
lactalbumin	/lækt'ælbjumin/	albumin của sữa
lactic	/læktik/	lactic, axit lactic
lactose	/læktous/	đường lactoza
laminate	/lamineit/	cán mỏng, dát mỏng
lamination		sự cán mỏng, sự dát mỏng
largely	/la:dzli/	một cách rộng lớn
latex	/lætəks/	latec, mủ cao su
latitude	/lætitju:d/	vĩ độ, miền vùng, bề rộng
lattice	/lætis/	mạng lưới, cách tử
lay down	/lei daun/	đặt nằm xuống, để xuống, hình thành lớp, tầng, màng
layer	/leiə/	
lead	/led/	chì, Pb/ bọc chì
lead	/li:d/	dẫn dắt, lãnh đạo, dây dẫn chính
leather	/'leđə/	da thuộc, vật liệu bằng da
leaven	/'levn/	men, làm lên men, pha trộn

length	/leŋð/	độ dài, chiều dài
level	/'levl/	mức độ, cấp, mức
liberate	/libəreit/	giải phóng, thóat ra, thả ra
liberation	/,libə'reiən/	sự giải phóng, sự thóat ra
lighting	/laitiŋ/	hệ thống chiếu sáng
lignite	/lignait/	than nâu
likelihood	/’laiklihud/	có thể đúng, có nhiều khả năng như vậy
lime	/laim/	vôi, hóa vôi, ngâm vôi
limitation	/limi'teiən/	sự hạn chế, sự giới hạn
limited	/limitid/	bị hạn chế, bị giới hạn
line	/lain/	dấu, ngấn. mốc. đường thẳng/ bọc, lót (lò)
line of study		hướng nghiên cứu, chuyên ngành
liquefy	/likwifai/	hóa lỏng, nóng chảy, dịch hóa
liquid	/likwid/	chất lỏng, lỏng
litmus	/litməs/	quỳ, giấy quỳ
litter	/li:tə/	lít
lixiviate	/lik’siveit/	ngâm chiết
load	/loud/	đường dẫn/ dẫn, dẫn tới, chứa
locomotion	/,loukə'məuʃn/	sự di động, sự di chuyển
loop	/lu:p/	quai, vòng, nút lưới, thắt vòng
loss	/lɔs/	sự mất mát, sự hao hụt
lower	/louə/	thấp hơn, hạ thấp, hạ xuống, làm nhỏ đi
lubricant	/lju:brikənt/	chất bôi trơn, dầu bôi trơn
lubricating	/lu:brikeitiŋ/	sự bôi trơn
lump	/lʌmp/	tảng, khối, cục, miếng
luster	/lʌstə/	ánh, ánh lên, long lanh

M

machine	/mə'ʃi:n/	máy móc, thiết bị
mixing m.		máy trộn
machinery	/mə'ʃi:nəri/	(thuộc) máy móc, thiết bị
made up (of)	/meid ^p/	làm bởi, chế tạo bởi
magnesia	/mæg'ni:ʃə/	magiê ôxit, MgO
magnesium	/mæg'ni:ziəm/	Magiê, Mg
magnify	/mægnifai/	khuyếch đại, phóng đại
main	/mein/	chính, chủ yếu
maintain	/men'tein/	bảo dưỡng, duy trì
major	/meidzə/	lớn, quan trọng, lớn hơn
malleability	/,mæliə'biliti/	tính rèn được, tính dẻo
malt	/mɔ:lt/	malt đại mạch, tạo malt
maganese	/,mæŋgə'ni:z/	Mangan, Mn
maggot	/'mægət/	con giòi, ý nghĩ kỳ quái
manifold	/mænifould/	đường ống phân phối/nhiều lần gấp đôi, đông đúc
manner	/'mænə(r)/	cách, lối, thói, kiểu
manslaughter	/’mæslotə/	tội ngộ sát, tội giết người
manufacture	/,mænju:'fæktʃə/	sản xuất, chế tạo/ sự chế tạo quá trình sản xuất, sản phẩm
manufacturer	/,mænju'fæktʃərə/	người sản xuất, người chế tạo
marine	/mə'ri:n/	(thuộc) biển, hải quân
mark	/ma:k/	dấu, chú ý, đánh dấu, điểm
market	/ma:kit/	thị trường, nơi tiêu thụ
marketable	/ma:kitəbl/	có thể tiêu thụ được, thích hợp để bán
marking	/ma:kiŋ/	sự đánh dấu, sự ghi nhãn, vết
marmalade	/ma:məleid/	mứt quả nghiền

married couple	/mærid k^pl/	cặp vợ chồng
mash	/mæʃ/	bột nhão, dịch hèm/ quá trình nấu, ngâm ủ
mask	/ma:sk/	mặt nạ, che đậy, ngụy trang, khung che, cửa chắn sáng
mass	/mæs/	khối, đống, số nhiều, đa số, chất thành đống
massecuite	/'mæsikjut/	khối đường ướt, khối bột nhão
mat	/mæt/	đệm lót, trải, lớp màng mốc
material	/mə'tiəril/	vật liệu, vật chất, chất liệu
mathematics	/,mæði'mætiks/	toán học
matter	/mætə/	chất, vật chất, vật liệu
mature	/mə'tju:ə/	chín, thành thục, chín mùi
maximum	/mæksiməm/	cực đại, trị số cực đại, tối đa
means; sg, i pl.	/min:z/	biện pháp, cách, phương tiện
measure	/mezə/	số đo, thước đo, độ đo/ đo
mechanization	/,mekənai'zeiʃn/	sự cơ khí hóa, cơ giới hóa
medicine	/'medsin/	thuốc men
mediterranean	/meditə'reinjən/	Địa trung hải, cách xa biển
medium, pl. media	/'mi:diəm/; /mi:diə/	số trung bình, môi trường, phương tiện, phương pháp vừa, trung bình
culture m.		môi trường nuôi cấy vi sinh vật
nutrient m.		môi trường dinh dưỡng VSV
meet (met)	/mi:t/	gặp gỡ, điểm gặp nhau, thoả mãn, đáp ứng
melamine	/'meləmi:n/	melamin
melt	/melt/	sự nấu chảy, sự tan chảy/ nấu chảy, nung chảy
member	/'membə/	phần, phần tử, bộ phận, chi tiết, cấu kiện
membrane	/'membrein/	màng, màng ngăn, màng chắn
merchant	/mə:tʃənt/	nhà buôn, lái buôn
mercury	/mə:kjuri/	thủy ngân, Hg
mere	/miə/	đốt, khúc, đoạn, phần
merely	/miəli/	chỉ, đơn thuần
mesocarp	/'mesouka:p/	cùi, cùi quả cọ để ép dầu
metal	/'metəl/	kim loại
metallic	/mi'tælik/	(thuộc) kim loại
metallurgy	/me'tələ:dzi/	ngành luyện kim
meter	/'mitə:/	đồng hồ đo
methane	/'meðein/	mêtan
metric	/'metrik/	hệ mét
microcline	/'maikrɔklain/	chuỗi nhỏ, xích nhỏ
microorganism	/'maikrou'ɔ:gəni-zəm/	vi sinh vật
micron	/maikrɔn/	micron. $=10^{-6}$ m
microscope	/maikrə'skoup/	kính hiển vi
microscopic (al)	/,maikrə'skɔpik (əl)/	(thuộc) kính hiển vi
milk	/milk/	sữa
skimmed	/skimd milk/	sữa khử bơ, sữa gầy
milky	/milki/	có sữa
millet	/milit/	kê
mineral	/'minərəl/	chất khóang, quặng
mineralogy	/,minə'rælədzi/	(thuộc) chất khóang, ngành luyện kim học
miscible	/'misibl/	hỗn tạp, có thể hòa trộn được
mite	/mait/	con mọt
mix	/miks/	trộn, nhào trộn
mixture	/'mikstʃə/	hỗn hợp, sự khuấy trộn sự nhào trộn
mobile	/mou'bail/	cơ động, linh động, lưu động, di chuyển
moderant	/'mɔdərənt/	sự điều hòa, bộ chống rung
moderate	/'mɔdəreit/	vừa phải, trung hòa, ôn hòa/ giảm tốc, chống rung
	/'mɔdərit/	

moderation	/,mɔdə'reiʃən/	sự chống rung động, sự giảm tốc, sự điều hòa
moderator	/mɔdə'reitə/	bộ tiết chế, bộ phận giảm tốc
modify	/'mɔdifai/	sửa đổi, biến đổi
modification of the strain		sự biến đổi chủng vi sinh vật
moist	/mɔist/	ẩm ướt, ẩm, ướt
moisture	/'mɔistʃə/	độ ẩm, hơi ẩm, sự ẩm ướt
molasses	/mə'læsiz/	nước mật, rỉ đường
mold	/mɔld/	nấm
m. mat		lớp màng mốc
molecular	/'mou'lekjulə/	(thuộc) phân tử
molecule	/'mɔlikju:l/	phân tử
mole	/moul/	mol, phân tử gam
molten	/moultən/	nóng chảy
molybdenum	/mɔ'libdinəm/	môlipđen, Mo
monopoly	/mə'nɔpəli/	sự độc quyền, sự lũng đoạn
mortar	/'mɔ:tə/	cái cối
grinding m.		cái cối nghiền, máy nghiền
mosses	/mɔsiz/	rêu
motion	/mouʃn/	sự chuyển động, sự vận động
motor	/'moutə/	động cơ, môtơ, có động cơ
mo(u)ld	/mould/	khuôn đúc, nấm mốc/ làm khuôn. dập khuôn, làm cho đất tơi
moulding	/mouldiŋ/	sự làm khuôn, sự ép theo khuôn, sự rót khuôn
mount	/məunt/	núi, đồi cao
move	/mu:v/	chuyển động, di chuyển, chuyển chỗ
multiple	/maltipl/	bội số, nhiều số, nhiều phần, phức
multiply	/maltiplai/	nhân, khuyếch đại, tăng cường, làm tăng lên
municipal	/mju'nisipl/	(thuộc) thành phố
municipality	/,mju:nisi'pæliti/	thị xã, thành phố, quận có chính quyền địa phương riêng
muscovite	/m^skəvait/	mutcovit, mica trắng
mutant	/'mjutənt/	tác nhân gây đột biến
mycelium	/mai'si:liəm/	thể sợi nấm, hệ sợi

N

nail	/neil/	cái đinh, móng vốt
native	/'neitiv/	tự nhiên, bẩm sinh
natural	/'nætʃrəl/	(thuộc) thiên nhiên, tự nhiên
n. gas		khí tự nhiên
nature	/'neitʃə/	thiên nhiên, bản chất, tính chất
necessity	/ni'sesiti/	sự cần thiết, bắt buộc phải có
neck	/nek/	cổ, ngõng (trục), chỗ thắt, chỗ hẹp/ uốn khúc, tiện ngấn, ren
neutralization	/,nju:trəlai'zeiʃn/	sự trung hòa, làm mất tác hại
neutralize	/nju:trəlaiz/	làm trung hòa
neutron	/nju:trɔn/	nơtron điện tử
nickel	/nikl/	niken, Ni, kền/ mạ kền
nitric	/'naitrik/	(thuộc) nitơ, có chứa nitơ
n. acid		axit nitric
nitrogen	/nait'rədzən/	Nitơ, N
node	/noud/	nút, mấu, đốt mắt, tiết điểm
nomenclature	/nou'menkləʧə/	danh pháp, thuật ngữ
non-elastic	/,nɔni'læstik/	không đàn hồi được
non-ferrous	/'nɔn'ferəs/	không phải sắt, không có sắt
non-metal	/'nɔn'metl/	không phải kim loại, phi kim loại, á kim

non-objectionable	/'nɔnəb'dzekʃnəbl/	không gây phản ứng, không gây khó chịu
note	/nout/	chú thích, ghi chú
nourishment	/'nʌriʃmənt/	sự nuôi dưỡng, thức ăn, thực phẩm
nozzle	/nɔzl/	vòi phun, miệng phun, ống phun, vòi
nuclear	/nju:kliə/	(thuộc) hạt nhân
nucleus, pl. nuclei	/nju:kliəs, nju:kliai/	hạt nhân, nhân, tâm các hạt nhân
numerical	/nju:'merikl/	(thuộc) số, bằng số
nutrient	/nju:triənt/	thức ăn, chất dinh dưỡng/ bổ, dinh dưỡng
nutrition	/nju:'triʃən/	sự nuôi dưỡng, sự dinh dưỡng, thức ăn

O

obligatory	/ɔ'bligətri/	bắt buộc, cưỡng bách, nghĩa vụ
observation	/əb'zə'veiʃn/	sự quan sát, sự quan trắc
observe	/əb'zə:v/	quan sát, theo dõi
obtain	/əb'tein/	đạt được, thu được / hiện hành
occlude	/ɔ'klu:d/	đút nút, bít, hút giữ, đậy nắp lại
occur	/ə'kə:/	xảy ra, xuất hiện, tồn tại
occurrence	/ə'karəns/	việc xảy ra, sự cố, sự xuất hiện
odo(u)r	/oudə/	mùi, mùi thơm, hương thơm
odo(u)rless	/oudəlis/	không có mùi, không có hương thơm
offer	/ɔfə/	đưa ra, đề nghị cung cấp, xuất hiện
oil	/ɔil/	dầu/ chế biến dầu
o. gas gas o.		khí dầu mỏ dầu gazoin
oily	/ɔili/	(thuộc) dầu, có dầu, trơn như dầu
oleic	/ɔliik/	dầu ôliu
o. acid		axit ôleic
oncogenic substance	/ɔŋkdzeinik sʌbstəns/	chất gây ung thư
operate	/ɔpəreit/	vận hành, thao tác, hoạt động, điều khiển
operation	/,ɔpə'reiʃən/	sự vận hành, sự hoạt động, sự điều khiển, nguyên công
opportunity	/,ɔpə'tju:niti/	cơ hội, thời cơ
opposite	/ɔpəzit/	đối nhau, ngược nhau, ngược lại
optical	/ɔptikl/	(thuộc) quang học, thị giác
optimal	/ɔptiməl/	tối ưu, thích hợp nhất, phù hợp nhất
optimum	/ɔptiməm/	điều kiện tối ưu
o. temperature		nhiệt độ tối ưu
orange	/'ɔrindz/	cây cam, quả cam, màu da cam
order	/ɔ:də/	dãy, chuỗi, thứ tự, trình tự, bộ, sự đặt hàng, đơn đặt hàng
ordinary	/ɔ:'dinəri/	thường, thông thường, bình thường
ore	/ɔ:/	quặng
organic	/ɔ:'gænik/	hữu cơ
organism	/ɔ:gənizm/	sinh vật, cơ thể, bộ phận cơ thể
origin	/'ɔridzin/	nguồn gốc, gốc, điểm xuất phát
original	/o'ridzinəl/	nguyên bản, bản gốc, ban đầu, nguồn gốc
o. yoghurt		sữa chua giống
oscillating wire	/' ɔsileitiŋ waiə/	máy cắt bằng lưới sắt
osmose, osmosis	/' ɔzmous/	sự thẩm thấu, thấm lọc
osmotolerance	/' ɔzmou'tələrəns/	khả năng chịu áp suất thẩm thấu cao

outbreak	/'autbreik/	sự bột phát, sự xuất hiện đột ngột, sự bùng nổ
outermost	/'autəməust/	phía ngoài cùng, phía xa nhất
outlet	/autlet/	lối thóat, lối ra, sự thóat nước
o. tube		ống ra, ống thóat
outline		phác thảo, phác họa, đề cương, đặc điểm chính, nguyên tắc chung
output	/autput/	công suất, lượng ra, sản lượng, sản phẩm, hiệu suất, sự sản xuất, tín hiệu ra, số liệu ra
outstrip	/aut'strip/	bỏ xa, vượt xa, có khả năng hơn
oval	/'ouvl/	hình ovan, có hình ovan, hình trứng
oven	/'ʌvn/	lò nung, lò đốt
overflow	/ouvəflou/ /,ouvə'flou/	sự tràn ra, dòng chảy tràn, ống tràn, phần tràn ra
overemphasize	/,ouvəremfəsaiz/	nhấn mạnh quá, quá nổi bật
overlay	/,ouvə'lei/	vật phủ (lên trên vật khác)/ che, phủ
ownership	/'ounəʃip/	quyền sở hữu
oxidation	/,ɔksi'deiʃən/	sự ôxi hóa
o. state		trạng thái ôxi hóa, mức độ ôxi hóa
oxide	/ɔksaid/	ôxyt
oxidize	/ɔksidaiz/	ôxi hóa
oxygen	/ɔksidzən/	Ôxy, O_2
ozone	/ɔzon/	ôzôn, O_3

P

paddy	/pædi/	lúa mạch, thóc
paint	/peint/	sơn, thuốc màu, thuốc vẽ/ sơn, quét, màu vẽ, tô vẽ
palatable	/'pælətəbl/	ngon
p. product		sản phẩm ngon miệng
palatability		vị ngon
palladium	/pə'leidiəm/	Paladi, Pd
palm kernel nuts	/pa:m kənəl nʌts/	hạt nhân cây cọ
paper	/'peipə/	giấy, gói giấy
paraffin	/pærəfin/	parafin/ phủ parafin
parasite	/'pærəsait/	ký sinh
partially	/pa:ʃəli/	một cách cục bộ, theo từng phần
particle	/'pa:tikl/	hạt, hạt nhỏ
particular	/pə'tikjulə/	đặc biệt, riêng biệt
pass out	/pa:s/	đi ra, thóat ra, chảy ra
passage	/'pæsidz/	sự đi qua, sự truyền qua, lối đi qua, lỗ rãnh
paste	/peist/	bột nhão, hồ bột/ dán (bằng hồ)
pasteurization	/pæstərai'zeiʃn/	sự diệt khuẩn theo phương pháp pasteur
pasty	/peisti/	sền sệt, nhão, bột chín
patent	/'peitənt, pætənt/	bằng sáng chế, đặc quyền chế tạo, có bằng sáng chế, được cấp bằng sáng chế
pathogenic	/pæðə'dzenik/	phát sinh bệnh, gây bệnh
paving	/'peiviŋ/	sự lát, sự phủ lên
p. brick		gạch lát đường
pearle	/pə:l/	hạt rời,viên, hạt nhỏ, rê, xay nghiền
peat	/pi:t/	(thuộc)than bùn
pectin	/pektin/	pectin
peeler	/'pi:lə/	máy gọt vỏ
penetrate	/penitreit/	xuyên qua, thấm qua, thâm nhập
peninsula	/pi'ninsjulə/	bán đảo
penny stack	/'peni stæk/	một đống lớn hình tròn
per	/pə/	theo, bằng, trên

per capita		theo đầu người
per cent		phần trăm
percentage	/pə'sentidz/	tỷ lệ phần trăm
perform	/pə'fɔ:m/	thực hiện, hoàn thành, trình bày
period	/'piəriəd/	thời kì, khoảng thời gian, chu kỳ
periodic	/,piəri'ɔdik/	(thuộc) chu kỳ, tuần hoàn, giai đoạn
perlocate	/,pə:lə'keit/	xuyên qua, thấm qua, đổ chảy ra
permanent	/'pə:mənənt/	lâu bền, vĩnh cửu, cố định, thường xuyên
permanganate	/pə:'mæŋgəmit/	pecmaganat, $KMnO_4$
permit	/pə'mit/	sự cho phép/ cho phép, thừa nhận
personnel	/,pə:sə'nel/	nhân sự, cá nhân, bản thân
pest	/pest/	bệnh dịch, người làm hại, vật làm hại
pestle	/pestle/	cái chày/ giã bằng chày
petrol	/petrəl/	xăng
petroleum	/pi'trouljəm/	dầu mỏ
p. oil		dầu mỏ
phase	/feiz/	pha, thời kì, giai đoạn
phenol	/fi:nɔl/	phenol
phenolphthalein	/,fi:nɔl'fðæliin/	phenolphtalein
phenomenon,	/.fi'nominən/	hiện tượng, chất liệu
pl. phenomena	/ -ə/	
phosphate	/fɔsfeit/	photphat/ photphat hóa
phosphide	/fɔsfaid/	photphit
phosphite	/fɔsfait/	photpho hóa
phosphorous	/fɔsfərəs/	muối photphát
phosphorus	/fɔsfərəs/	photpho, P
phosphoric	/fɔs'forik/	muối photphoric hóa trị 5
p. acid		axit photphoric, H_3PO_4
photographic	/,fout'əgræfik/	(thuộc) thuật chụp ảnh, như chụp ảnh
photometric (al)	/,foutou'metrik/	độ sáng, đo độ sáng
photosynthesis	/,foutou'sinðəsis/	quá trình quang hợp
physical	/fizikl/	(thuộc) vật lý
physics	/fiziks/	vật lý học
pier	/piə/	cầu tàu, bến tàu, cấu trúc bằng gỗ, sắt
pierce	/piəs/	đâm, chọc
pile	/pail/	chồng đống, lò phản ứng/ đóng cọc, chất đống
pinch	/pinʧ/	sự vát lại, sự thắt lại, hiệu ứng bóp
pipe	/paip/	ống, ống dẫn/ đặt đường ống, vận chuyển bằng ống
piping	/paipiŋ/	sự đặt đường ống, hệ thống đường ống
piston	/pistn/	pitông
place	/pleis/	nơi, địa điểm, vị trí/ để, đặt
plain	/plein/	đồng bằng, rõ rệt, đơn giản, không phụ gia
planar	/pleinə/	bằng phẳng, mặt phẳng, đồng bằng
plant	/pla:nt/	xưởng, nhà máy, máy móc, cây/ trồng, gieo
pilot-p.	/pailət/	xưởng sản xuất thí nghiệm (nhỏ)
plastic	/plæstik/	chất dẻo, sản phẩm nhựa dẻo, đồ nhựa
plate	/pleit/	tấm, bản, đĩa
p. glass		kính tấm, thủy tinh tấm
platinum	/plætinəm/	platin, bạch kim, Pt
plentiful	/plentiful/	phong phú, dồi dào
plot	/plɔt/	sơ đồ, biểu đồ, đồ thị/ lập đồ thị
plum	/plʌm/	cây mận, quả mận/ đá chèn
plunge	/plandz/	nhúng, nhấn chìm, làm nguội đột ngột
pocket money	/pɔkit/	tiền tiêu vặt

point	/pɔint/	điểm, mũi nhọn, chấm, dấu chấm
boiling p.		điểm sôi
freezing p.		điểm đóng băng
melting p.		điểm nóng chảy
starting p.		điểm khởi động, điểm xuất phát
poison	/pɔizn/	chất độc, độc tố/ gây độc, làm hỏng
poisonous	/pɔiznəs/	độc, có chất độc, ươn, thiu
polar	/poulə/	địa cực, cực
polish	/'pɔliʃ/	sự đánh bóng/ đánh bóng. mài nhẵn
pollute	/pə'lu:t/	làm bẩn, làm ô nhiễm, làm ôi thiu
pollution	/pə'lu:ʃn/	sự ô nhiễm, ự làm bẩn, sự thiu
polyamide	/,pɔli'æmaid/	polyamit
polyamine	/,poli'æmin/	poliamin
polybasic	/,pɔli'beisik/	đa chức
polymer	/'pɔlimə/	polyme
polymerization	/,pɔliməri'zeiʃən/	sự trùng hợp, sự polyme hóa
polymerize	/pɔliməraiz/	trùng hợp
polysulfide	/,pɔli'salfaid/	polysunfit
sodium p.		polysufit natri
popp	/pəp/	nổ bỏng
popcorn	/pəpcɔ:n/	bỏng ngô
porcelain	/'pɔ:slin/	(thuộc) đồ sứ, sứ
pore	/pɔ:/	lỗ, lỗ hổng, lỗ rỗ, bọt khí
porosity	/pɔ:'rositi/	tính xốp, độ xốp, rỗ/ tạo lỗ nhỏ
porous	/pɔ:rəs/	xốp, rỗ
porridge	/'pəridz/	cháo
porter	/pɔ:tə/	người khuân vác, một loại bia đen
portion	/pɔ:ʃən/	tỉ lệ, phần, phần chia
possess	/pə'zes/	có, chiếm hữu, chiếm đoạt
post-graduate	/'poust'grædjueit/	nghiên cứu sinh
potable	/pɔtəbl/	uống được
potash	/pɔtæ:ʃ/	kali cacbonat, K_2CO_3
potassium	/pə'tæsjəm/	Kali, K
potential	/pə'tenʃl/	(thuộc) thế, thế, điện áp, tiềm năng
pots	/pəts/	bình, hũ, lọ, vại
pound	/paund/	pao (=453,6g); đồng bảng Anh
pound		nghiền, giã
pour	/pɔ:/	rót, đổ đi, đổ ra
p. off		đổ bớt, rót bớt, vãi ra, đổ ra
powder	/paudə/	bột, bụi, thuốc nổ/ nghiền thành bột, rắc bột
powdery	/paudri/	dạng bột
power	/pauə/	lực, cường độ, công suất, năng lượng, khả năng, năng suất
p. demand	/'pauə di'ma:nd/	nhu cầu năng lượng, nhu cầu điện năng
p. station		trạm cấp điện
powerful	/pauəful/	mạnh, có công suất lớn
practice	/præktis/	thực hành, thực tiễn, kinh nghiệm
praise	/preiz/	khen ngợi, tán dương/ sự khen ngợi
precautionary	/pri'kosə:nəri/	sự lo trước, sự đề phòng, điều cảnh báo
precipitate	/pri'sipiteit/, /-tit/	kết tủa, lắng, lắng xuống
prefix	/pri:fiks/	tiền tố, đặt ở đằng trước, tiếp đầu ngữ
precipitation	/pri,sipi'teiʃn/	sự kết tủa, sự lắng xuống, sự tách ra
precise	/pri'sais/	đúng, chính xác, tỉ mỉ, nghiêm ngặt

predator	/'predətə/	thú ăn thịt
predict	/pri'dikt/	dự đoán, đoán trước, tiên đoán
predominate	/pri'dɔmineit/	chiếm ưu thế, trội hơn hẳn, xuất hiện
prefabricated	/'pri:'fæbrikeitid/	được chế tạo sơ bộ, được chế tạo sẵn, đúc sẵn
preferably	/prefərəbli/	thích hơn, ưa hơn
prefix	/pri:fiks/	tiền tố, tiếp đầu ngữ, tín hiệu mở
mono-; di-; tri-; tetra-; penta-; hexa; hepta-; octo-	/mɔnə; dai; trai; tetrə; pentə; heksə; heptə; ɔktou/	các tiếp đầu ngữ: 1, 2, 3, 4, 5, 6, 7, 8
preliminary	/pri'liminəri/	sơ bộ, thô, nguyên công
preparation	/,prepə'reiʃn/	sự chuẩn bị, sự điều chế, chế phẩm
prepare	/pri'peə/	chuẩn bị, điều chế
preserve	/pri'zə:v/	bảo quản, đóng hộp, lưu lại/ chất bảo quản
preserving industry		công nghiệp đồ hộp, CN bảo quản
press	/pres/	dập, nén, ép/ máy dập, máy nén, máy ép
p. in		nén, ép, ấn vào, in dấu lên
pressure	/'preʃə/	áp suất, áp lực, sức ép, sức nén
standard		áp suất không khí thông thường
parometric p.		
presumably	/pri'zju:məbli/	tương tự, có lẽ, khoảng chừng
presuppose	/,pri:sə'pouz/	giả thiết, phỏng đoán, giả định trước
prevalent	/'prevələnt/	thường thấy, thịnh hành
prevent	/pri'vent/	ngăn chặn, hạn chế, ngăn ngừa
price	/prais/	giá cả
prickly trunk	/'prikli truŋk/	thân cây đầy gai
primary	/praiməri/	cơ sở, chủ yếu, đầu tiên
primarily		thứ nhất, chủ yếu, đầu tiên
principally	/prin'səpəli/	chủ yếu, đại bộ phận
principle	/p'risipl/	quy luật, định luật, bản chất, nguyên tắc
problem	/p'robləm/	vấn đề, câu hỏi, vai trò, nhiệm vụ
procaryotic	/prə'kæri,outik/	thuộc loại tế bào procaryotic, tế bào nhân sơ
procedure	/prə'si:dzə/	quy trình sản xuất, quy trình, thủ tục
proceed	/prə'si:d/	thực hiện, quy trình, tiến hành, xảy ra, diễn ra
process	/prouses/	quá trình, quy trình
produce	/prə'dju:s/	sản xuất, sản phẩm, khai thác
producer	/prə'dju:sə/	người, nhà sản xuất, nơi sản xuất
gas p.		bình gaz, máy tạo gaz
product	/prɔdəkt/	sản phẩm, phần thu được
end p.		sản phẩm cuối cùng
final p.		sản phẩm cuối cùng, sản phẩm hoàn thành
finished p.		sản phẩm hoàn chỉnh
semifinished p.		bán sản phẩm
production	/prə'dakʃən/	quá trình sản xuất
large-scale p.		sản xuất lớn ở mức độ công nghiệp
profit	/prɔfit/	lợi nhuận, lợi ích, tận dụng, thuận lợi
progressive	/prə'gresiv/	lần lượt, tiến bộ, tốt hơn lên, từng bước, theo thứ tự
prolong	/prə'lɔŋ/	kéo dài ra
prominent	/prɔminənt/	đáng chú ý, nổi bật
promote	/prə'mout/	đẩy mạnh, xúc tiến, đề bạt, thăng cấp, tăng cường
promoter	/prə'moutə/	chất hoạt hóa, người được thăng cấp
proof	/pru:f/	bằng chứng, chứng cớ, thử thách, kiểm chứng, chứng minh
propagation	/,prɔpə'geiʃn/	sự nhân giống, cấy truyền, truyền bá, mở rộng
propane	/prɔpein/	propan
property	/prɔopəti/	tính chất

proportion	/prə'pɔ: ʃən/	tỷ lệ, phần, bộ phận
prosecute	/'prɔsikju:t/	kiện, khởi tố
protect	/prə'tekt/	chống lại, bảo vệ
protection	/prə'tekʃən/	quá trình bảo quản, quá trình chống lại, sự bảo vệ
protein	/proutii:n/	protein
protoplasm	/proutəplæzəm/	nguyên sinh chất
protozoan	/,prəutə'zəuən/	nguyên sinh động vật
prove	/pru:v/	thử nghiệm, chứng minh, chỉ ra, dẫn ra
provide with	/prə'vaid/	trang bị, cung cấp, kiếm ta, tạo ra
provided that	/prə'vaidid/	với điều kiện là
provision	/prə'vizən/	sự cung cấp, sự trang bị,
publish	/pʌbliʃ/	xuất bản, công bố, đăng
puffed rice	/pʌfd rais/	bánh ngọt từ gạo từng lớp, nở phồng đều
puffer	/pʌfə/	sự nở, phồng
pull, pulling	/pul/	lôi, kéo, hút, nút giật
pupl	/pʌpl/	CN giấy, CN gỗ, xenluloza, cặn bã
pulpy	/pʌlpi/	bột gỗ, bột giấy, bột nhão, thịt quả
pulse	/pʌls/	mạch, nhịp điệu
pump	/pʌmp/	cái bơm/ bơm
pungent	/pʌndzənt/	mùi hăng hắc, cay
purchase	/pə:tʃəs/	sự mua bán, đổi chác
purchasing power		sức mua bán
pure	/pjuə/	tinh khiết, nguyên chất, hoàn hảo
purification	/,pjurəfi'keiʃn/	sự làm sạch, sự lọc trong
purify	/pjuərifai/	làm sạch, làm trong, tinh chế
purpose	/pə:pəs/	mục đích, có ý định, kết quả
pyrite	/pairait/	pyrit

Q

qualitative	/kwɔlitətiv/	(thuộc) chất, phẩm chất, định tính
quadrill-ruled	/kwə'drilru:ld/	giấy kẻ ô vuông
quadrivalence	kwɔdri'væləns	hóa trị bốn
quantitative	/kwɔtitətiv/	(thuộc) số, số lượng, định lượng
quartz	/kwɔ:ts/	thạch anh
quench	/kwentʃ/	tắt, dập tắt, nhúng vào nước lạnh. làm nguội lạnh

R

radial	/'reidiəl/	(thuộc) tia, xuyên tâm, tỏa tròn
radiation	/,reidi'eiʃən/	sự bức xạ, sự tỏa ra
radioactive	/,reidiou'ækti/	phóng xạ
radiochemistry	/'reidiou'kemistri	hóa học phóng xạ
radium	/'reidiəm/	radi (Ra)
raise	/reiz/	nâng lên, tăng lên, thu góp
r. power		lực nâng
range	/reindz/	dãy hàng, phạm vi, lĩnh vực
rank	/ræŋk/	hàng dãy, hạng, loại/ sắp xếp
first rank		hạng một
rare	/reə/	hiếm, hiếm có, rất quí
rate	/reit/	tỉ lệ, tốc độ, đánh giá, ước lượng
ratio	/reiʃiou/	tỉ số, tỉ lệ
raw	/rɔ:/	thô, chưa gọt giũa, chưa chế biến
r. material		nguyên liệu thô, nguyên liệu ban đầu

ray	/rei/	tia, tỏa rọi
x- ray	/'altrə - vaiəlet/	tia X
ultra - violet rays		tia cực tím
rayon	/reiɔn/	tơ nhân tạo, lụa nhân tạo
reach	/ri:tʃ/	sự trải ra, tầm với, khoảng rộng/ đến, tới, trải ra
react	/ri'ækt/	phản ứng lại
reactant	/ri'æktənt/	chất phản ứng, chất tham gia phản ứng
reaction	/ri'æʃn/	sự phản ứng lại, sự phản tác dụng, phản ứng
r. product		sản phẩm của phản ứng
reactive	/ri'æktiv/	tác động trở lại, phản ứng lại
reactor	/ri:'æktə/	lò phản ứng, thiết bị phản ứng
batch r.		lò phản ứng gián đoạn
flow r.		lò phản ứng liên tục
reactivity	/riək'tiviti/	khả năng phản ứng, tính dễ phản ứng
readily	/redili/	sẵn sàng, dễ dàng, không khó khăn gì
reading	/ri:diŋ/	sự đọc, sự xem, số ghi
reagent	/ri'eidznt/	thuốc thử, chất phản ứng
realize	/riəlaiz/	thực hiện, thực hành, thấy rõ, thu được
reason	/ri:zn/	lí do, lẽ phải, suy luận
receiver	/ri'si:və/	người nhận, bình chứa, thùng chứa, thùng hứng
reciprocating motion	/ri'siprəkeitiŋ/	sự vận động qua lại kiểu pitong, sự chuyển động qua lại
recognize	/'rekəgnaiz/	nhận biết, nhận ra, công nhận
recombinant	/,rekəm'binənt/	tiếp hợp
record	/rekɔ:d/,/ri'kɔ:d/	ghi chép, băng nhạc / ghi băng
recover	/ri'kʌvə/	tái sinh, thu hồi, hồi phục
recoverable	/ri'kʌvərəbl/	có thể tái sinh được, có thể thu hồi được
recovery	/ri'kʌvəri/	sự hồi phục, sự tái sinh, sự thu hồi
rectangular	/re'ktæŋgjulə/	(thuộc) hình chữ nhật
recycle	/'ri:'saikl/	tuần hoàn lại, chu kỳ lặp lại
reddish	/rediʃ/	hơi đỏ, đo đỏ
red - hot		nóng đỏ / nung đỏ
redness	/rednis/	màu đỏ, màu đỏ hung
reduce	/ri'dju:s/	hạ, giảm, thu nhỏ, khử hoàn nguyên
refer (to)	/ri'fə:/	qui cho, chuyển tới, kể đến, liên quan đến
reference	/refrəns/	sự chuyển đến, để xem xét, tài liệu tham khảo
refine	/ri'fain/	lọc, lọc trong, tinh chế, tinh luyện
reflux	/ri:flʌks/	dòng ngược, sự chảy ngược
r. condenser		ống sinh hàn
refractory	/ri'fræktəri/	vật liệu chịu lửa, vật chịu nhiệt/ chịu lửa, khó cháy
refrigerate	/ri'fridzəreit/	làm lạnh, ướp lạnh, ướp đá
refuse	/refju:s/	đồ thừa, đồ thải, phế phẩm/ thải, từ chối
regain	/ri'gein/	sự thu hồi lại, sự giành lại, lượng thu hồi/ thu lại, thu hồi lại
regard	/re'ga:d/	sự chú ý, cái nhìn/ coi như, có liên quan
as regards		về phần, về cái gì/ có liên quan tới
regardless		không kể, không chú ý tới, bất chấp
regular	/'regjulə/	đều đặn, không thay đổi, cân đối, chính qui
regularly	/re'gjuləli/	đều đặn, thường xuyên
regulate	/'regjuleit/	điều chỉnh, điều tiết, điều hòa
regulating appliance		thiết bị điều chỉnh
related	/ri'leitid/	có liên hệ, có liên quan, có tương quan
relation	/ri'leiʃn/	mối quan hệ, mối tương quan, hệ thức

relationship	/ri'leiʃnʃip/	mối quan hệ, mối tương quan
relative	/relətiv/	tương đối, có liên quan
rely	/ri'lai/	dựa vào, tin vào
remain	/ri'mein/	cặn bã, đồ thừa, phần giữ lại
remainder	/ri'meində/	phần còn lại, chỗ còn lại, số dư
remove	/ri'muv/	loại bỏ, di chuyển, dời đi, tháo dỡ, tẩy trừ
rennet	/renit/	chất renin, chất làm đông sữa, enzim renin làm fomát
replace	/ri'pleis/	thay thế, thay vị trí, đặt lại chỗ cũ
report	/ri'pɔ:t/	bản báo cáo, bản tường trình
reproducibility	/,ri:prə'dju:sibiliti	tính sinh sản, tính sao chép, tái sản xuất
reproduction	/,ri:prə'dakʃn/	sự tái sản xuất, sự sinh sản, sự sao chép
require	/ri'kwaiə/	đòi hỏi, yêu cầu
requirement	/ri'kwaiəmənt/	sự đòi hỏi, nhu cầu, điều kiện cần thiết
research	/ri'sə:tʃ/	nghiên cứu, khảo sát/ sự nghiên cứu, sự khảo sát
r. institute		viện nghiên cứu
r. work		công việc nghiên cứu
researcher	/ri'sə:tʃə/	nhà nghiên cứu, người khảo sát
resemble	/ri'zembl/	giống với, tương tự như
reserve	/ri'zə:v/	sự dự trữ, vật dự trữ/ để dành, dự trữ
reservoir	/rezəvwa:/	thùng chứa, bể chứa, kho, nguồn
residue	/'rezidju:/	phần còn lại, phần sót lại, cặn bã, chất lắng cặn
resiliency	/ri'ziliənsi/	tính giãn nỡ, tính co giãn, tính bật nhảy
resin	/'rezin/	nhựa
resist	/ri'zist/	lớp bảo vệ chống ăn mòn/ kháng cự, chống lại
resistance	/ri'zistns/	sức cản, sức bền, tính chống lại, độ bền
resistant to	/ri'zistənt/	bền vững, chống đỡ được, có khả năng chống đỡ
resistive	/ri'zistiv/	chống lại, kháng lại, có điện trở
respiration	/,respə'reiʃən/	sự thở, sự hô hấp
responsive	/ris'pɔnsiv/	đáp lại, trả lời, nhạy, dễ phản ứng
rest	/rest/	sự nghỉ, điểm tựa, điểm tỳ, thanh đỡ; trạng thái tĩnh
restrain	/ri'strein/	kìm hãm, hạn chế, ngăn cản, làm chậm lại
restrict	/ri'strikt/	hạn chế, giới hạn, thu hẹp
result	/ri'zʌlt/	kết quả, do, bởi/ dẫn đến
r. from		gây bởi, có kết quả
resultant	/ri'zltənt/	vectơ tổng, hợp lực, kết quả, sản phẩm phản ứng
retain	/ri'tein/	giữ, cầm lại, ghi nhớ, vẫn duy trì
retard	/ri'ta:d/	làm chậm, trì hoãn, giải phóng ra
retort	/ri'tɔ:t/	bình chưng, bình cổ cong
reversible	/ri'və:sbəl/	thuận nghịch, nghịch đảo, có hành trình ngược
review	/ri'vju:/	sự xem xét, sự duyệt lại/ xét lại
revolutionary	/,revə'lu:ʃnəri/	cách mạng, nhà cách mạng
rice	/rais/	gạo, thóc lúa
rigid	/ridzid/	cứng, vững, rắn chắc, nghiêm khắc
rind	/raind/	vỏ cứng, vỏ ngoài cùng
ring	/riŋ/	vòng, vành, vòng cách, chuông/ lắp vòng, rung chuông
ripen	/raipən/	chín, chín muồi / làm cho chín
rise	/raiz/	tăng lên, dâng lên, nhô lên, lộ ra

roaster	/'roustə/	lò nướng, lò quay, rang
rock	/rɔk/	đá, tảng đá, nham thạch, bằng đá
rod	/rɔd/	que, đũa, thanh đòn
rodent	/'roudənt/	chuột bọ, loài gậm nhấm
roll	/roul/	cuộn, cuộn dây, con lăn, trục lăn, trụ xoay
roller	/roulə/	trục quay, con lăn, trục lăn, tang
roofing	/ru:fiŋ/	vật liệu lợp (mái), mái lợp, sự lợp mái
rotate	/rou'teit/	quay, quay tròn, lăn tròn, luân chuyển
rotational	/rou'teiʃnl/	quay tròn, lăn tròn, luân chuyển
rotor	/routə/	rôto, phần quay, cánh quạt
rough	/r^f/	thô nhám, xù xì, vật liệu thô
row	/rou/	dòng, dãy, hàng
rubber	/'rʌbə/	cao su / tráng cao su, bọc cao su
rubber like		giống cao su
rudimentary	/'rjudimentəri/	sơ đẳng, sơ khai, thô sơ
run (ran, run)	/rʌn, ræn/	chạy, hoạt động / hành trình, sự vận hành
running water		nước chảy liên tục, dòng nước
run into		đâm phải, đâm vào, chuyển thành
run out		chảy ra, hết, chảy kiệt, bơm hết
run off		chảy đi, cho chảy đi, đổ vào khuôn(kim loại), chạy trật (đường)
rupture	/rʌptʃə/	sự gãy, sự đứt, sự phá hủy, vết nứt, sự đánh thủng / nứt, làm gãy, phá hủy
rush	/rʌʃ/	sự cuốn đi, sự xuất hiện đột ngột

S

saccharine	/sækərin/	sacarin (đường nhân tạo)
safety	/seifti/	sự an toàn, tính an toàn
salable	/seiləbl/	dễ bán, dễ tiêu thụ, có thể bán được
salt	/sɔ:lt/	muối, ướp muối
salutation	,sælju:'teiʃən	sự chào hỏi
sample	/sa:mpəl/	mẫu thử, vật làm mẫu / lấy mẫu
sand	/sænd/	cát
saprophylic organisms	/'sæprə'filik/	VSV hoại sinh
satisfactory	/,sætis'fæktri/	làm thỏa mãn, làm đầy đủ
saturate	/sætʃəreit/	làm bão hòa, làm no
scale	/skeil/	phạm vi, thang đo, lớp cáu bẩn, thước tỷ lệ/ cân
on a large scale		trên một phạm vi rộng, mức độ lớn
full - scale	/ful skeil/	tỷ xích tự nhiên, kích thước, mức đo thực tế
scholarship	/skɔləʃip/	học bổng
school-leaving examination		kì thi tốt nghiệp
science	/saiəns/	khoa học
scientific	/,saiən'tifik/	(thuộc) khoa học
scientist	/saiəntist/	nhà khoa học
scone	/scɔ:n/	bánh nướng
scope	/skoup/	phạm vi, tầm mức/ tiếng gọi tắt một số khí cụ (microscope, telescope...)
scrape	/skreip/	tiếng rè, cạo, nạo gọt, kì cọ
s. off		cạo sạch, nạo sạch
scraper blade	skreipə bleid	lưỡi dao nạo, dao cạo

screen	/skri:n/	màn hình, mặt sàng, lưới sàng, màn chắn/ chắn lại, ngăn lại
seal	/si:l/	nút bịt kín, vòng bịt kín, mối hàn kín, con dấu/ gắn kín, gắn xi, đóng dấu
sealed	/si:ld/	được bịt kín, kín khít
mercury-sealed stirrer		máy khuấy được gắn kín bằng thủy ngân
seasame	/'sesəmi/	cây vừng, hạt vừng
season	/si:zn/	mùa, thời vụ / cho thêm gia vị, hồ bề mặt (vải)
secondary	/sekəndəri/	thứ yếu, thứ cấp, thứ sinh
section	/sekʃn/	sự chia cắt, mặt cắt, tiết diện, phần, đoạn, nhóm máy, đoạn cắt ra (làm mẫu)
cross - s.		mặt cắt ngang
secure	/sikjuə/	chắc chắn, an toàn
sediment	/,sedimənt/	cặn, cáu bẩn, chất lắng xuống
sedimentation	/,sedimən'teiʃn/	quá trình lắng, quá trình kết tủa
seed	/si:d/	hạt, hạt giống, nguyên nhân / kết thành hạt
seeded agar		thạch dạng hạt, thạch giống nuôi cấy vi sinh vật
sedimentary	/,sedi'mentəri	lắng cặn
segregation	/,segri'geiʃn/	sự tách riêng, sự chia tách, sự phân biệt, sự phân li
sein - netting	/'sein'netiŋ/	lưới đánh cá
select	/si'lekt/	lựa chọn, tuyển lựa / được lựa chọn
selection	/si'lekʃn/	sự lựa chọn, sự chọn lọc
semi-	/semi/	một nửa
semifinished product	/semi'finiʃ/	bán sản phẩm, sản phẩm nửa tinh chế
semi-water gas		khí ẩm, khí hỗn hợp với hơi nước
separate	/sepəreit/, /seprit/	chia tách, phân tách, riêng rẽ
separate out of		phân tách bởi, tách khí
separation	/sepə'reiʃən/	sự phân li, sự phân tách
series, pl. series	/siəri:z/	loạt, dãy, chuỗi, đợt/ nhóm cùng gốc
serve	/sə:v/	phục vụ, đáp ứng, thỏa mãn, hợp với
set	/set/	bộ, tập hợp, khuynh hướng/ để, đặt, gây ra, lắng
s. free	/set fri:/	trả lại tự do, giải phóng ra
s. in	/set in/	bắt đầu, đã ăn sâu vào
settle	/setl/	kết lắng, lắng xuống tĩnh lại
sewage	/sju:idz/	nước cống, nước thải
shade	/ʃeid/	sắc thái, một ít, chuyển dần màu
shaft	/ʃa:ft/	tay cầm, tia sáng, cuống, ống thông hơi, thân cột, trục, gióng, hố
shake (shook, shaken)	/ʃeik/	lắc, rung / sự lắc, sự rung
s. together		lắc liên tục
shallow	/'ʃælou/	nông, cạn
shape	/ʃeip/	hình dạng, khuôn mẫu, mô hình/ tạo hình, làm khuôn
share	/ʃeə/	phân chia / chia phần, góp phần
shatter	/ʃætə/	mảnh vỡ / đập vỡ, làm vỡ
shea-nuts	/ʃiə n^ts/	hạt cây có mỡ trắng
sheath	/ʃi:ð/	vỏ bọc, vỏ che, lớp bảo vệ, vách chắn / bọc, che phủ
sheave	/ʃi:v/	bánh xe có răng khía, rãnh
sheet	/ʃi:t/	tấm mỏng
shell	/'ʃel/	vỏ, mai, vỏ sò
shield	/ʃi:ld/	tấm chắn, tấm che, lá chắn, cái mộc
shiny	/ʃaini/	sáng bóng, chiếu sáng
shock	/ʃɔk/	sự đụng chạm mạnh, va chạm mạnh, sự đột biến, cú sốc
shot	/ʃɔt/	phần đóng góp, sự làm thử, tầm bắn, có tia, có vạch bắn

shovel	/ʃʌvl/	cái xẻng
sight	/sait/	thấy, trông thấy/ cửa quan sát
sight glass		kính nhìn, kính quan sát, cửa quan sát
sign	/sain/	dấu hiệu, kí hiệu, biểu hiện, ra hiệu
signature	/signitʃə/	ký tên
significant	/sig'nifikənt/	đầy ý nghĩa, có tính chất gợi ý, quan trọng
signify	/signifai/	biểu thị, biểu hiện, nghĩa là, có tầm quan trọng
silica	/silikə/	silic diôxyt (SiO_2)
silicate	/silikit; -eit/	silicat, muối silicat
aluminium s.		silicat nhôm ($Al_2(SiO_3)_3$)
silicon	/silikən/	silic (Si)
silver	/silvə/	bạc, (Ag)
single	/siŋgl/	đơn độc, chọn ra
sink	/siŋk/	bồn rửa, chậu rửa, ống thải nước
siphon	/saifən/	ống si phông /dẫn qua ống si phông
site	/sait/	vị trí, địa điểm, bãi đất
sit for an examination	/sit/	làm bài thi, đi thi
sitting	/saitiŋ/	sự chọn địa điểm/ lắp đặt, bố trí, phân bố
size	/saiz/	kích cỡ, khổ, độ lớn / định cỡ
sketch	/skeitʃ/	bản phác thảo, sơ đồ / phác họa
skill	/skil/	kỹ xảo, kỹ năng
skilled labour		lao động, thành thạo, lao động hoàn hảo
skim, skimmer	/skim/	lớp váng sữa, lớp bọt
slacken	/slækn/	nới lỏng, làm giãn, chùng lại
slice	/slais/	lát mỏng, vảy mỏng, lá mỏng / cắt mỏng, cắt lát
slight	/slait/	nhẹ, mỏng, yếu
slow down	/slou/	làm chậm, hạ xuống, giảm
sludge	/slədz/	bùn đặc, bùn quánh, nước thải
smooth	/smu:ð /	trơn, nhẵn bóng, bằng phẳng, êm, không va đập
soap	/soup/	xà phòng / rửa bằng xà phòng
soda	/soudə/	xút (Na_2CO_3)
s. ash	/soudə æʃ/	sô đa khan, Na_2CO_3 khô
sodium	/soudjəm/	natri, Na
s. bicarbonat		bicacbonat natri, $NaHCO_3$
s. bisufit		bisunfit natri, $NaHSO_3$
s. chloride		natri clorua, NaCl
s. hydroxide		hydrôxit natri, NaOH
soft	/sɔft/	nhẹ, mềm, từ từ, dịu
soften	/sɔfn/	làm mềm, làm dịu, làm nhạt
softening point		điểm nóng chảy, điểm chảy ra
soil	/sɔil/	đất đai, chất đất, chất bẩn / làm bẩn
solid	/sɔlid/	chất rắn, vật rắn, hình khối, cố định /cứng, chắc, đặc
solidification	/sə'lidifikeiʃn/	sự hóa cứng, sự hóa rắn, sự đông cứng
solidify	/sə'lidifai/	hóa cứng, hóa rắn
solubility	/,sɔlju:'biliti/	tính hòa tan, độ hòa tan
soluble	/sɔljubl/	dễ tan, tan được
solute	/sə'ljut/	chất tan
solution	/sə'ljuʃən/	dung dịch, nghiệm số, cách giải quyết
commercial s.		dung dịch kỹ thuật
solvent	/'sɔlvənt/	dung môi / làm hòa tan
soot	/sut/	muội than, mồ hóng
sorghum	/'sɔ:gəm/	lúa mạch
sound	/saund/	âm thanh, âm, que dò, vang lên, tốt, chắc chắn/thăm dò
s. casting		vệt đúc tốt, vật đúc chắc chắn

source	/sɔ:s/	nguồn, nguồn nước, mạch
space	/speis/	không gian, khoảng không, khoảng hở/ gian cách, chia cách
spark	/spa:k/	tia lửa/ đánh lửa, lóe lửa, phát ra tia lửa
special	/speʃəl/	đặc biệt, chuyên dụng, chuyên môn sâu
speciality	/speʃi'æliti/	chuyên môn, chuyên ngành hẹp
specialize	/speʃəlaiz/	chuyên môn hóa
species, pl. species	/spi:ʃi:z/	loại, hạng, loài
specific	/spi'sifik/	đặc trưng, đặc thù, riêng
s. gravity		trọng lượng riêng
s. heat		nhiệt dung riêng, tỷ nhiệt
speed	/spi:d/	tốc độ, vận tốc, độ phát sáng/ tăng tốc độ, chọn tốc độ
s. up		tăng tốc, tăng nhanh lên
spell	/spel/	báo hiệu, đợt, thời gian ngắn
sphaerotilus	/'sfæəroutiləs/	khối vi khuẩn hình cầu thể kim
spherical	/sferikl/	có hình cầu, có hình tròn
spirit	/spirit/	cồn, rượu, xăng, nhiên liệu lỏng
splinter	/'splintə/	mảnh vụn, đập nhỏ
split (split)	/split/	kẽ nứt, vết rạn, khoảng chia tách, miếng mỏng, sự tách ra/ tách ra, phân chia
spoilage	/'spəilidz/	làm hư hỏng, gây hỏng
spontaneous	/spon'teinjəs/	tự phát, tự sinh, hàng loạt
spore	/spɔ:/	bào tử
sporulation	/,spɔ:rju'leiʃn/	sự hình thành bào tử, sự tạo bào tử
spread	/spred/	dàn trải, trải ra
sprinkle	/spriŋkl/	bình tưới/ phun tưới, rắc rải, vẩy nước
sprout	/spraut/	mầm, chồi/ mọc mầm, đâm chồi
sputter	/spatə/	sự trào ra, sự sôi lên/ trào ra, bứt ra
square	/skweə/	hình vuông, thước đo góc, bình phương
squeeze	/skwi:z/	ép vào, xiết vào, xoắn chặt
stabilize	/steibilaiz/	làm ổn định, gia cố
stabilizer	/steibilaizə/	bộ ổn định, chất ổn định, để yên
stable	/steibl/	ổn định, bền vững, chắc
stack	/stæk/	dồn đống, chất thành đống
stage	/steidz/	đài, giàn, giá, mức, cấp/ dàn dựng
stainless	/steilis/	không rỉ, không có vết, không có đốm
stalk	/stɔ:k/	thân cuống
standardization	/,stændədai'-zeiʃn/	sự tiêu chuẩn hóa, định mức, sự chuẩn độ
standardize	/stændədaiz/	tiêu chuẩn hóa, định mức
standpoint	/stæn(d)pɔint/	lập trường, quan điểm, mặt, phương diện
stannic	/stænik/	(thuộc) thiếc IV
stannous	/stænəs/	(thuộc) thiếc II
starch	/sta:tʃ/	tinh bột / hồ bột
starchy	/sta:tʃi/	(thuộc) có bột
starter	/sta:tə/	bộ khởi động, động cơ khởi động/ bộ làm giống vi sinh vật, chất mồi
state	/steit/	trạng thái, tình trạng, giai đoạn/ công bố
s. of aggregation		trạng thái kết tụ, trạng thái tác dụng
stationary	/steiʃənəri/	tĩnh tại, dừng, không thay đổi
statistician	/,stæti'stiʃən/	chuyên viên thống kê
steady	/stedi/	ổn định, vững chắc, đều đặn
steam	/sti:m/	hơi nước/ xông hơi, xử lí bằng hơi
s. jacket		áo hơi
steamming	/sti:miŋ/	sự hóa hơi
steel	/sti:l/	thép, mũi khoan/ bọc thép
stepwise	/stepwaiəz/	như bậc thang, hình bậc thang

stiff	/'stif/	cứng, đủ cứng, cứng rắn
still	/stil/	nồi cất, thùng cất, yên tĩnh, không có ga
stimulate	/stimjuleit/	kích thích
stir	/stə:/	khuấy trộn, lắc trộn
stirrer	/stə:rə/	máy khuấy, máy trộn
stock	/stok/	nguyên liệu gốc, vật liệu gốc, phối liệu
s. solution		dung dịch chuẩn, dung dịch gốc
stopcock	/stɔpkɔk/	van đóng, vòi đóng
stopper	/stɔpə/	cái nút, chất gắn, chất ổn định, móc chặn
storage	/stɔ:ridz/	sự cất giữ, sự bảo quản, nhà kho
s. cell		ắc quy, ổ nhớ
store	/stɔ:/	sự cung cấp, hàng để cung cấp, kho/ cung cấp, lưu trữ
stout	/staut/	loại bia đen cao độ Porter
strain	/strein/	giống, nòi/ xiết, căng, lọc
strand	/strænd/	dải, băng
stratum, pl. strata	/streitəm/	tầng, lớp, tầng đất, địa tầng
straw	/strɔ:/	rơm, vật vô giá trị
stream	/stri:m/	dòng, luồng, dòng nước, tia chảy/ chảy, trôi, phun tia
strenous	/'strenjuəs/	tích cực, hăm hở, ráng sức
stress	/'stres/	đòi hỏi, nhấn mạnh, bắt buộc
stretch	/stretʃ/	căng ra
strike	/straik/	va chạm, kích động, lớp mạ lót/ nện, gõ, nghiền
striking	/straikiŋ/	đặc biệt, đặc sắc, quan trọng, đáng chú ý
stringent	/'strindzent/	chính xác, nghiêm, chặt chẽ
strip	/strip/	mảnh, dải, đường băng
strive	/straiv/	phấn đấu, nỗ lực, cố gắng
structural	/straktʃrl/	(thuộc)cấu trúc
structure	/straktʃə/	cấu trúc
stud	/stʌd/	đinh đầu to, núm cửa, đinh tán, khuy rời, vít cấy, chốt, đầu tiếp xúc, trụ nhỏ
subdivide	/,sʌbdi'vaid/	chia nhỏ ra
subdivision	/'sʌbdi,vizn/	sự chia nhỏ thêm, cấp phân loại phụ
subject	/sʌbdzikt/	chủ thể, chủ đề, đối tượng
	/səb'dzekt/	/lệ thuộc, bắt phải lệ thuộc
subscription	/səb'skripʃən/	sự quyên góp, sự ứng trước
substance	/sabstəns/	chất
substantial	/səb'stænʃəl/	thực chất, có thật, nội dung
substitute	/sʌbstịtu:t/	sự thay thế, chất thay thế/ thay thế
substratum, pl. -a	/sʌb'streitəm, -ə/	lớp dưới, lớp nền, chất gốc
subterranean	/,sʌbtə'reinjən/	dưới đất, ngầm
succeed	/sək'si:d/	thành công, kế tục
successive, -ly	/sək'sesiv, -li/	liên tục, kế tiếp, lần lượt
sucrose	/sju:krouz/	sacaroza, đường mía
suction	/sʌkʃən/	sự mút, sự hút
sudden	/sʌdən/	đột ngột
suffering	/'sʌfəriŋ/	sự đau khổ, sự chịu đựng
sufficient	/sə'fiʃənt/	số lượng đủ/ đủ, có khả năng
suffix	/sʌfiks/	hậu tố, tiếp vị ngữ
sugar	/ʃugə/	đường
suggest	/sə'dzest/	đoán, dự đoán, gợi ý
suitable	/sju:təbl/	thích hợp
sulphate, sulfate	/sʌlfit, -eit/	sunphat, sunphat hóa
sulphide, sulfide	/sʌlfaid/	sunfua

sulphite, sulfite	/sʌlfait/	sunfit
sulphur, sulfur	/sʌlfə/	lưu huỳnh, (S)/ xử lí bằng lưu huỳnh
sulphuric, sulfuric	/sʌlfjuərik/	sunfuric
s. acid		axit sunfuric (H_2SO_4)
sunflower	/sʌnf'lauə/	hạt, hoa hướng dương
superficial	/sju:pə'fisl/	(thuộc) bề mặt, ở phía trên mặt
superheated	/,sju:pə'hi:tid/	bị quá nhiệt, bị nung quá nhiệt
superior to	/sju'piəriə/	cao hơn, hoàn thiện hơn
supernatant	/'sju:pə'neitənt/	phần nổi trên bề mặt dịch
supplement	/sʌpplimənt/	phần bổ sung, phần phụ thêm/ phụ thêm, bổ sung
supernant liquid		chất lỏng trên bề mặt chất rắn
supply	/sə'plai/	sự cung cấp/ cung cấp
support	/sə'pɔ:t/	gối tựa, trụ đỡ, bệ đỡ. lớp nền/ giúp đỡ, tài trợ
supreme	/sju'pri:m/	tối cao, cao nhất, uy thế
surgical	/'sə:dzikəl/	(thuộc) phẫu thuật
surface	/sə:fis/	bề mặt, mặt ngoài, lớp phủ bề mặt, diện tích
surpass	/sə:'pa:s/	vượt hơn, trội hơn
surplus	/sə:pləs/	dư thừa
surround	/sə'raund/	vây quanh, bao quanh
survival	/sə'vaivəl/	sự sống sót
survive	/sə'vaiv/	sống sót
suspend	/səs'pend/	treo lơ lửng, hoãn, đình chỉ
suspension	/səs'penʃn/	sự treo, sự hoãn, sự đình chỉ
swell	/swel/	sự gợn sóng, sự phồng, sự trương nở
switch	/switʃ/	cầu dao, công tắc, cái chuyển mạch
s. on		đóng mạch
s. off		ngắt mạch
syllabus	/siləbəs/	đề cương bài học, kế hoạch học tập
symbiotic culture	/simbiɔ'tik/	nuôi cấy cộng sinh VSV
symposium, pl. symposia	/sim'pouziəm, -iə/	hội nghị các chuyên đề, hội thảo khoa học
synthesis, pl. -ses	/sinðəsis, -si:z/	sự tổng hợp
synthesize	/sinðəsaiz/	tổng hợp
synthetic	/sin'ðetik/	(thuộc) tổng hợp
syrup	/sirəp/	xiro, nước mật, nước đường đặc
system	/'sistim/	hệ, hệ thống, thiết bị, phương pháp, chế độ

T

tabular	/'tæbjulə (r)/	được sắp xếp thành bảng, lên danh sách
take place	/teik pleis/	xảy ra, diễn ra, đưa vào
t. up		sự kéo căng, guồng cuốn
tandem	/'tændəm/	xé, kéo
tank	/tæŋk/	thùng chứa, két, thùng to
tap	/tæp/	vòi nước, nút, dây nhánh/ phân nhánh
tap water		nước máy
tar	/ta:(r)/	nhựa đường, hắc in/ rải nhựa
taste	/teist/	có một vị, vị/ nếm
tasteless	/teistlis/	không có vị
technical	/teknikl/	(thuộc) kỹ thuật
t. school		trường kỹ thuật
technician	/tek'niʃn/	kỹ thuật viên
technique	/tek,ni:k/	kỹ thuật, phương pháp kỹ thuật
technologist	/tek'nolədzist/	nhà công nghệ, nhà kỹ thuật, kỹ sư công nghệ
technology	/tek'nɔlədzi/	công nghệ học, công nghệ

tedious	/'ti:djəs/	nhạt nhẽo, thiếu hấp dẫn, chán, quá chậm/ quá dài
temperature	/tempritʃə/	nhiệt độ
temporarily	/tempərərili/	một cách tạm thời, nhất thời
tenacity	/ti'næsiti/	tính dai, độ dai, độ bền, tính bám chắc
tend	/tend/	xu hướng, hướng tới
tensile	/tensail/	căng giãn, kéo căng, chịu căng
t. strength	/streŋð/	sức căng
term	/tə:m/	hạn kì, giới hạn, điều kiện
in term of		trong giới hạn, nhờ có
terminate	/tə:mineit/	kết thúc
test	/test/	sự kiểm tra, sự thử nghiệm, thuốc thử/ kiểm tra, phân tích
put to test		lắp đặt để kiểm tra, thẩm tra lại
test-tube		ống thử, ống nghiệm
testimonial	/,testi'mounjəl/	giấy chứng nhận, chứng chỉ
tetrahedral	/'tetrə'hedrəl/	(thuộc) tứ diện, bốn mặt
tetrahedron	/'tetrə'hedrən/	khối tứ diện, khối bốn mặt
tetrasulfide	/'tetrə'salfaid/	tetra sulfit
sodium t.		tetrasulfit natri
textiles	/tekstailz/	hàng dệt, sản phẩm dệt
theaceas	/ti:si:s/	tủ đựng chè
theoretical	/ðiə'retikəl/	(thuộc) lý thuyết, thuyết
thermal	/ðə:m(ə)l/	(thuộc) nhiệt
thermic	/ðə:mik/	(thuộc) nhiệt
thermometer	/ðə'mɔmitə/	nhiệt kế
thermoplastic	/ðə:mɔ'plæstik	nhựa dẻo nóng/ co giãn theo nhiệt độ
thermosetting	/'ðə:mou'setiŋ	nhiệt hóa rắn, đông đặc theo nhiệt
t. resin		nhựa hóa rắn do nhiệt, nhựa chịu nhiệt
thesis, pl. theses	/ði:sis/,/ði:si:z/	luận án, luận văn
thick	/ðik/	dày
thin	/ðin/	mỏng
Thiokol	/ðaiɔkɔl/	Thiokol
thorium	/ðɔ:riəm/	thori
thorough	/ðarə/	hoàn toàn, kỹ lưỡng
threat	/ðret/	sự đe dọa
three-way cock	/ðri: wei/	van ba ngả, ba chiều
throw (threw, thrown)	/ðrou,ðru:, ðroun/	ném, đẩy vào
thresh	/ðreʃ/	đập lúa, tuốt lúa
tight	/tait/	chặt, nắm chặt, chặt chẽ, kín, sít
tighten	/taitn/	chặt, căng, khít lại, siết chặt, căng ra
tin		hộp thiếc, thiếc (Sn)
tint		sắc độ, độ màu
tire (tyre)	/taiə/	lốp, vành đai
tissue	/tisju:/	vải, giấy lụa
titrate	/tai'treit/	chuẩn độ
titration	/tai'treiʃn/	sự chuẩn độ
ton	/tʌn/	tấn
tool	/tu:l/	dụng cụ, đồ nghề
top	/tɔp/	đỉnh, chóp
tosse	/tɔs/	làm bông ra, làm tơi ra
total	/toutl/	tổng, tổng cộng
toughly	/tʌfli/	dai, bền, cứng cỏi, gay go
toughness	/tʌfnis/	trạng thái dai, độ dai
tower	/tauə/	tháp, chòi
trace	/treis/	vết, dấu vết, nét

trade	/treid/	buôn bán, trao đổi
tracer	/treisə/	đánh dấu, chất đánh dấu
trample	/'træmpl/	dẫm, đạp, chà
transfer	/træns'fə:/	sự di chuyển, sự dời chỗ, sự cấy, sao lại
transform	/trænsfɔ:m/	phép biến đổi, sự cải tạo/ biến đổi
transition	/trænsiʃn/	sự đồng hóan
translate	/træn:s'leit/	dịch chuyển, chuyển đổi, sự truyền lại, phiên dịch
translation	/træn:s'leiʃn/	sự dịch mã
transparent	/træn'speərənt	trong suốt
transport	/trænspɔ:t/	sự chuyên chở, sự mang
transportable	/træns'pɔ:təbl	chuyên chở được
trashplate	/træʃpleit/	rác rưởi, cặn bã
traverse	/trævə:s/	sự đi ngang qua, sự vắt qua, thanh ngang
treasurer	/trezərə/	thủ quỹ, thủ kho
treat	/tri:t/	xử lí, gia công
treatment	/tri:tmənt/	sự xử lí, sự gia công
treiler	/treilə/	xe rơ moóc
trigger off	/'trigə/	gây ra, gây nên
triple	/tripl/	ba lần, gấp ba, ba phần
tube	/tju:b/	ống, đèn ống/ làm ống
tubing	/tju:biŋ/	hệ thống ống, đường ống, sự lắp ống
tubular	/tjubjulə/	có dạng ống
tungsten	/tæŋstən/	wonfram, (W)
turbidity	/tə:'biditi/	tính đục, độ đục
turbine	/tə:bin/	tuốc bin
turn on	/tə:n/	bật lên
t. off		tắt đi
type	/taip/	kiểu, mẫu/ đánh máy

U

ultimately	/'ʌltimitli/	cuối cùng, sau chót
unaffected	/'ʌnə'fektid/	không bị ảnh hưởng
uncoordinate	/ʌnkəu'ɔ:din-eit/	không đồng bộ, không ngang hàng
undergo	/ˌʌndə'gou/	trải qua, chịu đựng
undergraduate	/ˌʌndə'grædjut/	sinh viên đại học
underneath	/ˌʌndə'ni:ð/	bên dưới, dưới
unicellular	/'ju:ni'seljulə/	đơn bào
uniform	/ju:nifɔ:m/	bộ đồng phục/ đồng dạng, một kiểu, đồng nhất
unit	/ju:nit/	thiết bị, đơn vị, khối, tổ, đơn nguyên
power u.		bộ nguồn, máy phát lực, đơn vị công suất
uninterrupted	/'ʌn,intə'raptid/	không bị ngắt, không bị gián đoạn
universal	/ˌjuni'və:sl/	vạn năng, thông dụng. (thuộc) vũ trụ
unstable	/'ʌn'steibl/	không ổn định, không chắc, không bền
ultraviolet	/'ʌltrə'vaiəlit/	tia cực tím
underground	/ˌʌndə'graund/	dưới đất
undoubtedly	/'ʌn'dautidli/	một cách rõ ràng, chắc chắn
unleavened	/ʌn'levnd/	không dùng men, không nở
upheaval	/ʌp'hi:vl/	sự nổi lên, sự dâng lên đột ngột, sự nâng
upper	/ʌpə/	trên cao, thượng
uranium	/juə'reiniəm/	urani, (Ur)
u. pile		lò phản ứng uranium

urea	/juəriə/	ure
urine	/juərrin/	urin, nước tiểu
usage	/ju:zidz/	cách sử dụng, cách dùng
use	/ju:s/; /ju:z/	cách dùng/ sử dụng
u. up		tận dụng, dùng cho tới hết
utilize	/ju:tilaiz/	dùng, sử dụng

V

vacation	/və'keiʃən/	sự bỏ trống, sự bỏ, nghỉ hè
vacuum	/vækjuəm/	chân không
value	/vælju:/	giá trị
valve	/vælv/	van/ lắp van
vanadium	/və'neidjəm/	vanadi, (Va)
vanish	/væniʃ/	biến mất, triệt tiêu
vapo(u)r	/veipə/	hơi, hơi nước
vapo(u)rization	/,veipərai'zeiʃn/	sự hóa hơi, sự bốc hơi
variant	/veəriənt/	biến thể, khác nhau/ biến đổi
variation	/,veəri'eiʃən/	sự khác nhau, sự biến đổi
variety	/və'raiəti/	sự đa dạng
vary	/veəri/	làm cho khác nhau, thay đổi
vast	/va:st/	rộng lớn, khoảng rộng bao la
vat	/væt/	bể, thùng, chum
settling v.		bể lắng, thùng lắng
vegetable	/vedzitəbl/	rau, thực vật, mầm mống sinh sản
vegetative	/vedziteitiv/	sinh dưỡng, thực vật
velocity	/vi'lositi/	tốc độ, vận tốc
vent	/vent/	lỗ, lỗ thóat, lỗ thông, lỗ phun/ thông hơi, thóang khí
ventilation	/,venti'leiʃən/	sự quạt, sự thông gió, sự thóang khí
verify	/verifai/	kiểm tra, thử nghiệm, kiểm định
versatility	/,və:sə'tiliti/	tính linh hoạt, tính hay thay đổi
versus	/'və:səs/	chống lại
vertical	/və:tikl/	đường thẳng đứng, mặt thẳng đứng/ thẳng đứng
vesicular	/vesikjulə/	(thuộc) túi, bọng
vessel	/vesl/	bình, lọ chậu, thùng
via	/vaiə/	qua, theo đường, theo
vice-chancellor	/'vais'tʃa:nsələ/	phó hiệu trưởng
vice versa	/vaisi'və:sə/	ngược lại, trái lại
vicinity	/vi'siniti, vai's-/	sự tiếp cận, vùng lân cận
view	/vju:/	sự nhìn, tầm nhìn, hình chiếu/ xem
vigorous	/vigərəs/	mạnh mẽ, mãnh liệt
vinegar	/vinigə/	dấm
violently	/vaiələntli/	một cách mãnh liệt, mạnh mẽ
violet	/vaiəlit/	màu tím
viscous	/viskəs/	sền sệt, nhớt, lầy nhầy
visible	/vizibl/	có thể trông thấy, thấy được
volatile	/vɔlətail/	dễ bay hơi, chất dễ bay hơi
volatility	/vɔlə'tiliti/	tính dễ bay hơi
volatilize	/vɔlətilaiz/	bay hơi, làm bay hơi
volume	/vɔljum/	thể tích, dung tích, khối lượng
volumetric	/,vɔlju'metrik/	(thuộc) thể tích, đo thể tích
vulcanize	/valkənaiz/	lưu hóa

W

wage	/weidz/	tiền lương tuần, hậu quả, tiến hành

ware	/weə/	đồ vật chế tạo, hàng hóa
warm	/wɔ:m/	ấm, hiểm yếu/ làm cho ấm
wash	/wɔʃ/	rửa, giặt
w. bottle		chai rửa
waste	/weist/	phế liệu, chất thải, lãng phí, bị tàn phá
w.-heat boiler		nồi hơi dùng nhiệt thải ra
water	/wɔ:tə/	nước
w. gas		khí chứa nước
w. glass		thủy tinh lỏng, bình đo, bình đong
watery	/wɔ:təri/	ướt, đẫm nước, sũng nước
wave	/weiv/	sóng/ uốn sóng, gợn sóng
wax	/wəks/	sáp, parafin/ bôi sáp
weaning food	/'wi:niŋ/	bột trẻ em sau cai sữa
weavebasket	/wivbəskit/	rổ đan bằng tre, lưới
weight	/weit/	khối lượng, độ nặng, cân đong
weld	/weld/	mối hàn/ hàn kim loại
welfare	/welfeə/	phúc lợi, chăm sóc
wet	/wet/	ướt, ẩm ướt
whereas	/weə'ræz/	nhưng trái lại, trong khi mà, còn
whey	/wei/	nước sữa trong (sau khi tách protein)
wheying	/weiiŋ/	nước sữa, tách nước trong khỏi sữa
wholesome	/'houlsəm/	bổ ích, lành mạnh, không độc, khỏe mạnh
wide	/waid/	rộng
widespread	/waidspred/	trải rộng, chung nhất
widow	/widou/	quả phụ
width	/widθ/	độ rộng, chiều rộng
willing	/wiliŋ/	bằng lòng, sẵn sàng
winnow	/'winəu/	quạt
wire	/waiə/	dây, dây thép/ buộc bằng dây thép
withdraw	/wiθ'drɔ:/	lấy ra, rút ra, thu hồi, hủy bỏ
withstand	/wiθ'stænd/	chống lại, chịu đựng
works	/wə:ks/	các công việc, phân xưởng, xưởng
wort	/wə:t/	dịch hèm, dịch đường hóa cho sản xuất bia, dịch malt
woven	/wəuvn/	sàng đan

Y

yeast	/ji:st/	nấm men
yield	/ji:ld/	sản lượng, năng suất, hiệu suất
yogurt lay (youghurt)	/'jɔgə:t lei/	lớp sữa chua

Z

zinc	/ziŋk/	kẽm
zincate	/ziŋkeit; -kit/	muỗi kẽm

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