English for Architectural Environment and Equipment Engineering

建筑环境与设备工程专业英语

主　编　张仙平
副主编　王凤坤

黄河水利出版社

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Yellow River Conservancy Press

内 容 提 要

本书是为建筑环境与设备工程专业学生编写的专业英语教材。全书共分九个单元，主要内容包括基础知识、热源及供热、通风、空气调节、制冷、流体机械、其他类别、常用专业术语、相关专业信息等。书中大部分文章节选自建筑环境与设备工程专业及相关专业基础学科的原版教材，内容力求科学性、知识性和语言的规范化，并由浅入深，循序渐进。每篇课文后均附有相关阅读材料，以扩大学生的阅读面，训练快速阅读能力。本书还系统地介绍了科技英语常用的语法知识和翻译技巧；提供了互联网上有关本专业的信息、主要国际学会的作用与使命、有关高等院校、主要国际国内刊物和国际会议等信息，以便学生查询相关专业文献及信息；精选出暖通空调各应用领域的常用专业词汇，便于学生查阅和掌握基本的专业词汇。

本书可作为建筑环境与设备工程专业及相关专业大学生的专业英语教材，也可供相关专业教师和工程技术人员参考。

图书在版编目(CIP)数据

建筑环境与设备工程专业英语/张仙平主编.
郑州：黄河水利出版社，2008.6
ISBN 978-7-80734-412-4

Ⅰ.建… Ⅱ.张… Ⅲ.①建筑工程-环境管理-英语-高等学校-教材②房屋建筑设备-英语-高等学校-教材
Ⅳ.H31

中国版本图书馆 CIP 数据核字(2008)第 051391 号

组稿编辑：王路平　电话：0371-66022212　E-mail：hhslwlp@126.com

出 版 社：黄河水利出版社
地址：河南省郑州市金水路 11 号　邮政编码：450003
发行单位：黄河水利出版社
发行部电话：0371-66026940、66020550、66028024、66022620(传真)
E-mail：hhslcbs@126.com
承印单位：黄河水利委员会印刷厂
开本：787 mm×1 092 mm　1/16
印张：11.5
字数：310 千字　印数：1—2 200
版次：2008 年 6 月第 1 版　印次：2008 年 6 月第 1 次印刷

定价：20.00 元

前　言

本书旨在使学生掌握基本的专业词汇，了解专业文献的写作形式，运用已学过的基础英语知识进行专业英语训练，培养学生科技专业英语的阅读能力，从而为学生毕业后继续深造或者从事科学研究等工作时能够顺利地阅读和翻译英文文献、进行国际学术交流打下良好的英语基础。

在内容安排上，本书将有关专业知识按单元分类进行介绍，在突出重点的同时，也兼顾了覆盖范围。全书分九个单元，大部分内容节选自建筑环境与设备工程专业及相关专业基础学科的原版教材，涉及到传热学、流体力学、供热、通风、空调、制冷、暖通空调新技术等相关知识。本书还提供了互联网上有关本专业的信息、主要国际学会的作用与使命、有关高等院校、主要国际国内刊物和国际会议等信息，以便于学生查询相关专业文献及信息。为了便于学生查阅和掌握基本的专业词汇，本书精选出了暖通空调各应用领域的常用专业词汇。每个单元后所附的翻译技巧，可以帮助学生熟悉科技英语文体的特点，掌握其翻译规律与方法，从而使学生在较短的时间内提高专业英语的阅读能力、理解能力和运用能力。

本书可作为建筑环境与设备工程专业及相关专业大学生的专业英语教材，也可作为相关专业教师和工程技术人员学习专业英语的参考书。

本书由张仙平任主编，王风坤任副主编。参加编写的人员为中原工学院王凤坤(Part Ⅰ的第1、2、3课，Part Ⅴ)、河南工程学院王迎辉(Part Ⅱ的第1、2、3课，Part Ⅶ的第1、2课)、河南工程学院张仙平(Part Ⅲ、Part Ⅳ)、中原工学院郑慧凡(Part Ⅶ的第3、4课，翻译技巧一、二、三、四)、河南工程学院薛永飞(Part Ⅱ的第4课，Part Ⅵ，翻译技巧五)、中原工学院李海军(Part Ⅰ的第4课，翻译技巧六、七，Part Ⅷ，Part Ⅸ)。

由于编者水平及经验有限，书中难免有漏误及不妥之处，敬请读者批评指正。

编　者

2007年8月

Contents

Part Ⅰ Basic Knowledge

Lesson 1 Characteristics of Fluids

[1] A fluid is a substance which may flow, that is, its constituent particles may continuously change their positions relative to one another. Moreover, it offers no lasting resistance to the displacement, however great, of one layer over another. This means that, if the fluid is at rest, no shear force (that is a force tangential to the surface on which it acts) can exist in it. A solid, on the other hand, can resist a shear force while at rest; the shear force may cause some displacement of one layer over another, but the material does not continue to move indefinitely. In a fluid, however, shear forces are possible only while relative movement between layers is actually taking place. A fluid is further distinguished from a solid in that a given amount of it owes its shape at any particular time to that of a vessel containing it, or to forces which in some way restrain its movement. ①

[2] The distinction between solids and fluids is usually clear, but there are some substances not easily classified. Some fluids, for example, do not flow easily: thick tar or pitch may at times appear to behave like a solid. A block of such a substance may be placed on the ground, although its flow would take place very slowly, yet over a period of time, perhaps several days, it would spread over the ground by the action of gravity, that is, its constituent particles would change their relative positions. ② On the other hand, certain solids may be made to "flow" when a sufficiently large force is applied. These are known as plastic solids.

[3] Even so, the essential difference between solids and fluids remains. Any fluid, no matter how "thick" or viscous it is, begins to flow, even it imperceptibly, under the action of the slightest net shear force. Moreover, a fluid continues to flow as long as such a force is applied. A solid, however, no matter how plastic it is, does not flow unless the net shear force on it exceeds a certain value. For forces less than this value the layers of the solid move over one another only by a certain amount, the more the layers are displaced from their original relative positions, however, the greater are the forces resisting the displacement. ③ Thus, if a steady force is applied, a state will be reached in which the forces resisting the movement of one layer over another balance the force applied and so no further movement of this kind can occur. ④ If the applied force is then removed, the resisting forces will tend to restore the solid body to its original shape.

[4] In a fluid, however, the forces opposing to movement of one layer over another exist only while the movement is taking place, and so static equilibrium between applied force and resistance to shear never occurs. Deformation of the fluid takes place continuously so long as

a shear force is applied. But if this applied force is removed the shearing movement subsides and, as there are then no forces tending to return the particles of fluid to their original relative positions, the fluid keeps its new shape. ⑤

[5] Fluids may be sub-divided into liquids and gases. A fixed amount of a liquid has a definite volume which varies only slightly with temperature and pressure. If the capacity of the containing vessel is greater than this definite volume, the liquid occupies only part of the container, and it forms an interface separating it from its own vapor, the atmosphere or any other gas present. ⑥

[6] On the other hand, a fixed amount of a gas, by itself in a container, will always expand until its volume equals that of the container. Only then can it be in equilibrium. In the analysis of the behavior of fluids, the most important difference between liquids and gases is that, whereas under ordinary conditions liquids are so difficult to compress that they may for most purposes be regarded as incompressible, gases may be compressed much more readily. Where conditions are such that an amount of gas undergoes a negligible change of volume, its behavior is similar to that of a liquid and it may then be regarded as incompressible. If, however, the change in volume is not negligible, the compressibility of the gas must be taken into account in examining its behavior.

[7] In considering the action of forces on fluids, one care either account for the behavior of each and every molecule of fluid in a given field of flow or simplify the problem by considering the average effects of the molecules in a given volume. In most problems in fluid dynamics the latter approach is possible, which means that the fluid can be regarded as a continuum, that is, a hypothetically continuous substance.

[8] The justification for treating a fluid as a continuum depends on the physical dimensions of the body immersed in the fluid and on the number of molecules in a given volume. Let us say that we are studying the flow of air past a sphere with a diameter of 1 cm. A continuum is said to prevail if the number of molecules in a volume much smaller than the sphere's is sufficiently great so that the average effects (pressure, density, and so on) within the volume either are constant or change smoothly with time. The number of molecules in a cubic meter of air at room temperature and sea-level pressure is about 10^{25}. Thus the number of molecules in a volume of 10^{-19} m^3 (about the size of a dust particle, which is very much smaller than the sphere) would be 10^6. This number of molecules is so large that the average effects within the micro-volume are indeed virtually constant. On the other hand, if the 1 cm sphere were at an altitude of 305 km, there would be only one chance in 10^8 of finding a molecule in the micro-volume, and the concept of an average condition would be meaningless. In this case, the continuum assumption would not be valid. It may thus be concluded that the assumption of a continuum is valid for fluid flow except in the rarest conditions, such as those encountered in outer space.

New Words, Expressions and Technical Terms

constituent [kən'stitjuənt] *n*.组分，要素；*a*.组成的
tangential [tæn'dʒenʃ(ə)l] *a*.切向的
restrain [ris'trein] *v*.限制，约束
equilibrium [ˌi:kwi'libriəm] *n*.平衡(状态)，均衡
interface ['intə(:)ˌfeis] *n*.相互关系，分界面
molecule ['mɔlikju:l] *n*.微小颗粒，分子
continuum [kən'tinjuəm] *n*.连续体

Notes

① A fluid…in that…, or to forces…: 句中 in that 引导的从句表示液体与固体的区别；第一个 it 指代固体，第二个 it 和 its 指代液体。

② A block of…, although…, yet…, that is…: 句中 A block of…作主语，may be placed 作谓语；although 引导状语从句；yet…从句对整句进行补充说明，that is…从句对它前面的句子进行补充说明。

③ For forces…, the more…, the greater…: 句中 the more…the more…句型表示越……越……。

④ Thus, if…, a state…in which…: 句中 if 引导状语从句表示假设某种情况；in which 引导的状语从句对 a state 进行修饰说明。

⑤ But if…, as…, the fluid…: 句中 if 引导状语从句表示假设某种情况；as 引导的从句进行进一步说明；the fluid 是句子的主语。

⑥ If…, the liquid…, and it forms…, the atmosphere…: 句中 If 引导状语从句；and 连接两个句子表示先后发生的动作；非限定性定语从句 the atmosphere…前面省略了 as，对前面句子进行补充说明。

Reading Material

Historical Development of Fluid Mechanics

[1] The science of fluid mechanics began with the need to control water for irrigation and navigation purposes in ancient China, Egypt, Mesopotamia, and India. Although these civilizations understood the nature of channel flow, there is no evidence that any quantitative relationships had been developed to guide them in their work. It was not until 250 B.C. that Archimedes discovered and recorded the principles of hydrostatics and buoyancy. In spite of the fact that the empirical understanding of hydrodynamics continued to improve with the development of fluid machinery, better sailing vessels, and more intricate canal systems, the fundamental principles of classical hydrodynamics were not founded until the seventeenth and eighteenth centuries. Newton, Daniel Bernoulli, and Leonhard Euler made the greatest

contributions to the founding of these principles.

[2] In the nineteenth century, two schools of thought arose in the treatment of fluid mechanics, one dealing with the theoretical and the other with practical aspects of fluid flow. Classical hydrodynamics, though a fascinating subject that appealed to mathematicians, was not applicable to many practical problems because the theory was based on inviscid fluids. The practicing engineers at that time needed design procedures that involved the flow of viscous fluids. Consequently, they developed empirical equations that were usable but narrow in scope. Thus, on the one hand, the mathematicians and physicists developed theories that in many cases could not be used by the engineers, and on the other hand, engineers used empirical equations that could not be used outside the limited range of application from which they were derived. In a sense, these two schools of thought have persisted to the present day, resulting in the mathematical field of hydrodynamics and the practical science of hydraulics.

[3] Near the beginning of the twentieth century, however, it was necessary to merge the general approach of the physicists and mathematicians with the experimental approach of the engineer to bring about significant advances in the understanding of flow processes. Osborne Reynolds' paper in 1883 on turbulence and later papers on the basic equations of liquid motion contributed immeasurably to the development of fluid mechanics. After the turn of the century, in 1904, Ludwing Prandtl proposed the concept of the boundary layer. In his short, convincing paper Prandtl, at a stroke, provided an essential link between ideal and real fluid motion for fluids with a small viscosity and provided the basis for much of modern fluid mechanics.

[4] The development of fluid mechanics in the twentieth century may be divided into four periods.

Low Speed Aerodynamics, 1900 ~ 1935

[5] The first development of fluid mechanics was closely associated with aeronautical science. Because of the stringent requirement on weight, one needs reliable theoretical prediction to practical problems. As a result, one has to combine the essential features of old hydrodynamics and hydraulics into one rational science of fluid mechanics. Some of the important developments in these periods are: (a) Prandtl's boundary layer theory, (b) Kutta-joukowski's wing theory to explain the phenomenon of air lift, (c) the theory of turbulent flow by von Kármán and others. In this period, the velocity of the fluid flow is low and the temperature difference in the flow is small. Consequently, we may neglect the compressibility effect of the fluid. Both the gas and the liquid may be treated by the same method of analysis. There is practically no difference in principle for hydrodynamics and aerodynamics.

Aerothermodynamics, 1935 ~ 1950

[6] The speed of the gas flow was gradually increased from subsonic to supersonic speed. The

compressibility effect of the gas is no longer negligible. We have to treat gas and liquid separately. For gasdynamics, we have to consider the mechanics of the flow simultaneously with the thermodynamics of the gas. Hence the term of aerothermodynamics was suggested for this new branch of fluid mechanics. In this field the most important parameter is the Mach number. However, the temperature range of the gas or air was still below 2 000 K and the air may be considered as an ideal gas with constant specific heat. The molecular structure has very little influence on the gas flow and we may use the same formula to deal with monatomic gas and polyatomic gas. Many new phenomena, such as shock wave, supersonic flow, etc., were analyzed in this period.

Physics of Fluid, 1950 ~ 1960

[7] This is the start of the space age. The speed of the flow and the temperature of the fluid are high enough so that we have to consider the interaction of mechanics of fluid with other theories of physics and that the molecular structure of the gas has a large influence on the fluid flow. We have to consider the influence on dissociation, ionization, and thermal radiation. New subjects such as aerothermochemistry, magnetogasdynamics, and plasma-dynamics, and radiation gasdynamics have been extensively studied. We have to deal with the whole physics of fluids.

New Era of Fluid Mechanics, 1960 and on

[8] In the above three periods, our main interests are still the flow of fluids which consists of liquid, gas, or plasma only. During the recent years, the interest of many technical developments is so broad that we have to deal with flow problems beyond those of fluid alone. For instance, we have to deal with the mixture of solid and fluid, the so-called two-phase flow. In many geological problems, the fluids behave partly as ordinary fluid and partly as solid. In the above three periods, we treat the fluid flow problems mainly recording to the principles of classical physics. In many new problems of fluid flow, we have to consider the principles beyond those of classical physics such as super-fluid for which the quantum effects are important even for macroscopic properties (quantum fluid mechanics); relativistic fluid mechanics in which the relativistic mechanics should be used because the velocity of the flow is no longer negligible in comparison with the speed of light. We are also interested in bio-fluid mechanics in which we study the interaction between the physical science of fluid flow and biological science. Modern developments in fluid mechanics, as in all fields, involve the use of high-speed computers in the solution of problems. Remarkable progress has been made in this area, and there is an increasing use of the computer in fluid dynamic design.

[9] It should be noted that even though we divide the development of modern fluid mechanics into the above four periods, there are overlaps in time for these periods as far as the study of various subjects are concerned. For instance, the study of turbulent flow of low speed fluid flow which was one of the major subjects in the first period is still a very active research subject at the present time and many basic problems are far from being solved yet.

Lesson 2 Basic Concepts of Thermodynamics

[1] Most applications of thermodynamics require that the system and its surroundings be defined. A thermodynamic system is defined as a region in space or a quantity of matter bounded by a closed surface. The surroundings include everything external to the system, and the system is separated from the surroundings by the system boundaries. These boundaries can be either movable or fixed; either real or imaginary.

[2] Two master concepts operate in any thermodynamic system, energy and entropy. Entropy (s) measures the molecular disorder of a given system. The more shuffled a system is, the greater its entropy. ① Conversely, an orderly or unmixed configuration is one of low entropy. Energy is the capacity for producing an effect, and can be categorized into either stored or transient forms. Stored forms of energy include:

thermal (internal) energy, u—the energy (possessed by a system) caused by the motion of the molecules and/or intermolecular forces; ②

potential energy, $P.\ E.$—the energy possessed by a system caused by the attractive forces existing between molecules, or the elevation of the system:

$$P.E. = mgz \tag{1-1}$$

where m = mass.

g = local acceleration of gravity.

z = elevation above a horizontal reference plane.

kinetic energy, $K.\ E.$—the energy possessed by a system caused by the velocity of the molecules:

$$K.E. = mv^2/2 \tag{1-2}$$

where m = mass.

v = velocity of the fluid streams crossing system boundaries.

chemical energy, E_c—energy possessed by the system caused by the arrangement of atoms composing the molecules.

nuclear (atomic) energy, E_a—energy possessed by the system from the cohesive forces holding protons and neutrons together as the atom's nucleus. ③

[3] Transient energy forms include:

heat, Q—the mechanism that transfers energy across the boundary of systems with differing temperatures, always in the direction of the lower temperature. ④

work—the mechanism that transfers energy across the boundary of systems with differing pressures (or force of any kind), always in the direction of the lower pressure; if the total effect produced in the system can be reduced to the raising of a weight, then nothing but work has crossed the boundary. ⑤ Mechanical or shaft work, W, is the energy delivered or absorbed by a mechanism, such as a turbine, air compressor or internal combustion engine.

Flow work is energy carried into or transmitted across the system boundary because a pumping process occurs somewhere outside the system, causing fluid to enter the system.[6] It can be more easily understood as the work done by the fluid just outside the system on the adjacent fluid entering the system to force or push it into the system.[7] Flow work also occurs as fluid leaves the system.

$$Flow\ Work\ (\text{per unit mass}) = pv \tag{1-3}$$

where p is the pressure and v is the specific volume, or the volume displaced per unit mass.

[4] A property of a system is any observable characteristic of the system. The state of a system is defined by listing its properties. The most common thermodynamic properties are: temperature (T), pressure (p) and specific volume (v) or density (ρ). Additional thermodynamic properties include entropy, stored forms of energy and enthalpy.Frequently, thermodynamic properties combine to form new properties. Enthalpy (h), a result of combining properties, is defined as:

$$h = u + pv \tag{1-4}$$

where u = internal energy.

p = pressure.

v = specific volume.

Each property in a given state has only one definite value, and any property always has the same value for a given state, regardless of how the substance arrived at that state.

[5] A process is a change in state that can be defined as any change in the properties of a system. A process is described by specifying the initial and final equilibrium states, the path (if identifiable) and the interactions that take place across system boundaries during the process. A cycle is a process, or more frequently, a series of processes wherein the initial and final states of the system are identical. Therefore, at the conclusion of a cycle all the properties have the same value they had at the beginning.

[6] A pure substance has a homogeneous and invariable chemical composition. It can exist in more than one phase, but the chemical composition is the same in all phases.

[7] If a substance exists as vapor at the saturation temperature, it is called saturated vapor. (Sometimes the term dry saturated vapor is used to emphasize that the quality is 100%)[8]. When the vapor is at a temperature greater than the saturation temperature, it is superheated vapor. The pressure and temperature of superheated vapor are independent properties, since the temperature can increase, while the pressure remains constant. Gases are highly superheated vapors.

New Words, Expressions and Technical Terms

thermodynamics [ˈθəːməudaiˈnæmiks] n.热力学

entropy [ˈentrəpi] n.熵(热力学函数)

shuffle [ˈʃʌfl] vt.搅乱，弄混

configuration [kənˌfigjuˈreiʃən] n.构造，结构

categorize [ˈkætigəraiz] v.把……分类

transient [ˈtrænziənt] a.(物) 瞬变的
thermal [ˈθəːməl] a.热的
elevation [ˌeliˈveiʃən] n.高度
acceleration [ækˌseləˈreiʃən] n.(物)加速度
kinetic [kaiˈnetik] a.动力学的，动力的
cohesive [kəuˈhiːsiv] a.内聚的
cohesive forces 内聚力
proton [ˈprəutɔn] n.质子
neutron [ˈnjuːtrɔn] n.中子
mechanism [ˈmekənizəm] n.机械装置，机械构造
shaft [ʃɑːft] n.轴
compressor [kəmˈpresə] n.压缩机，压气机
combustion [kəmˈbʌstʃən] n.燃烧
adjacent [əˈdʒeisənt] a.临近的，相连的
specific volume 比容
displace [disˈpleis] vi.排(水)
enthalpy [ˈenθælpi, enˈθælpi] n.焓
equilibrium [ˌiːkwiˈlibriəm] n.平衡，均衡
homogeneous [ˌhɔməuˈdʒiːnjəs] a.均匀的
saturation [ˌsætʃəˈreiʃən] n.饱和(态)
saturated [ˈsætʃəreitid] a.饱和的

Notes

① The more shuffled…, the greater… :是“越……越……”句型。

② …the motion of the molecules and/or intermolecular forces: 应理解为…the motion of the molecules and intermolecular forces 以及 …the motion of the molecules or intermolecular force。

③ energy possessed by the system from the cohesive forces holding protons and neutrons together as the atom’s nucleus: possessed by … forces 过去分词短语作定语修饰 energy; holding … as … 现在分词短语作定语修饰 cohesive forces。

④ … the mechanism that transfers … with … always in the direction of the lower temperature: that 引导的定语从句修饰 mechanism; with 短语修饰 systems; always …短语修饰 transfer。

⑤ … nothing but: 只有。

⑥ … a pumping process occurs somewhere outside the system, causing fluid to enter the system: causing… 现在分词短语作 a pumping process … the system 的结果状语。

⑦ … the work … on …: 对……做的功。

⑧ quality: 本文中意思为干度。

Reading Material

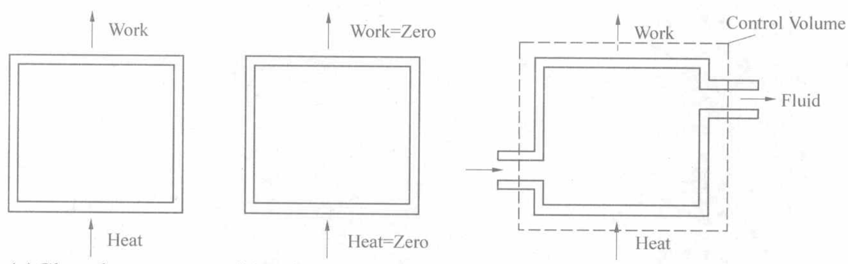
Thermodynamic Systems

[1] In the engineering world, objects normally are not isolated from one another. In most engineering problems many objects enter into a given problem. Some of these objects, all of these objects, or even additional ones may enter into a second problem. The nature of a problem and its solution are dependent on which objects are under consideration. Thus, it is necessary to specify which objects are under consideration in a particular situation. In thermodynamics this is done either by placing an imaginary envelope around the objects under consideration or by using an actual envelope if such exists. The term system refers to everything lying inside the envelope. The envelope, real or imaginary, is referred to as the boundaries of the system. It is essential that the boundaries of the system be specified very carefully. For example, when one is dealing with a gas in a cylinder where the boundaries are located on the outside of the cylinder, the system includes both the cylinder and its contained gas. On the other hand, when the boundaries are placed at the inner face of the cylinder, the system consists solely of the gas itself.

[2] When the boundaries of a system are such that it cannot exchange matter with the surroundings, the system is said to be a closed system (see Fig. 1-1(a)). The system, however, may exchange energy in the form of heat or work with the surroundings. The boundaries of a closed system may be rigid or may expand or contract, but the mass of a closed system cannot change. Hence, the term control mass sometimes is used for this type of system. When the energy crossing the boundaries of a closed system is zero or substantially so, the system may be treated as an isolated system (see Fig. 1-1(b)).

[3] In most engineering problems, matter, generally a fluid crosses the boundaries of a system in one or more places. Such a system is known as an open system (see Fig. 1-1(c)). The boundaries of an open system are so placed that their location does not change with time. Thus, the boundaries enclose a fixed volume, commonly known as the control volume.

[4] Sometimes a system may be a closed system at one moment and an open one the next. For example, consider the cylinder of an internal combustion engine with the boundaries at the inner walls. With the valves closed, the system is a closed one. However with either or both of the valves open, the system becomes an open system.



(a)Closed system (b)Isolated system (c)Open system

Fig. 1-1 Types of systems