普通高等教育"十二五"规划教材

过程装备与控制工程专业英语

Professional English for Process Equipment and Control Engineering

◎ 王丰　李勤　刘翀　张光浩　编著

机械工业出版社
CHINA MACHINE PRESS

普通高等教育“十二五”规划教材

过程装备与控制工程专业英语

Professional English for Process Equipment and Control Engineering

王丰　李勤　刘翀　张光浩　编著

巴德纯　主审

机械工业出版社

本书分为课文、阅读和写作三大模块，素材全部改编自英文原版教材和科技资料。课文模块共20课，包括机械工程、控制工程及化工工程三大部分。每课由课文、专业术语、注释和练习组成；阅读模块包括扩展阅读和实用阅读两个部分，共10篇材料，每篇材料均给出主要术语；写作模块从实用角度出发，介绍了科技英语的特点、英语科技论文的结构以及英语科技论文的标题、摘要和关键词的写作技巧。书后附有专业术语总表。

本书取材新颖，专业条理清晰，专业内容覆盖全面，词汇量大，可读性好，文章体裁多样，实用性强，可作为高等院校过程装备与控制工程专业及相近专业本科生和研究生的专业英语教材，也可作为相关工程技术人员的专业英语读物。

图书在版编目（CIP）数据

过程装备与控制工程专业英语/王丰等编著．—北京：机械工业出版社，2013.8

普通高等教育“十二五”规划教材

ISBN 978-7-111-43359-0

Ⅰ.①过…　Ⅱ.①王…　Ⅲ.①化工过程—化工设备—英语—高等学校—教材②化工过程—过程控制—英语—高等学校—教材　Ⅳ.①H31

中国版本图书馆CIP数据核字（2013）第161667号

机械工业出版社（北京市百万庄大街22号　邮政编码100037）
策划编辑：刘小慧　责任编辑：刘小慧　丁昕祯　林　松
版式设计：常天培　责任校对：刘怡丹
封面设计：张　静　责任印制：李　洋
北京瑞德印刷有限公司印刷（三河市胜利装订厂装订）
2013年9月第1版第1次印刷
184mm×260mm · 11.75印张 · 285千字
标准书号：ISBN 978-7-111-43359-0
定价：23.00元

凡购本书，如有缺页、倒页、脱页，由本社发行部调换

电话服务	网络服务
社服务中心：（010）88361066	教材网：http：//www.cmpedu.com
销售一部：（010）68326294	机工官网：http：//www.cmpbook.com
销售二部：（010）88379649	机工官博：http：//weibo.com/cmp1952
读者购书热线：（010）88379203	**封面无防伪标均为盗版**

前言

对于工程技术人员而言，在当前国际化的知识经济时代，熟练运用专业英语来获取专业信息、了解国外学科最新发展动态、与国外同行进行合作交流的重要性日益凸显。因此，工科学生必须具备一定的专业英语能力，这样才能在求职中增加优势，并在未来的工作中获得较大的职业发展空间。

专业英语不同于基础英语，它隶属于科技英语，并与各自专业紧密结合，因此它既遵循科技英语的特点、语法体系及翻译方法，又具有极强的专业性，应在语言学习的同时促进学生对相关专业知识的加深理解和巩固。专业英语的最终目的是使学生完成从“学”到“用”的转变，实现综合能力的拓展和提高，因此还具有很强的实用性。在这一思想指导下，本书历经数年酝酿和准备，终于得以完成，并呈现出以下特点：

1）取材新颖。本书所用文章全部改编自近十年来的英文原版教材和科技资料。

2）专业条理清晰。“过程装备与控制工程”是一个较新的专业，涉及机械工程、控制工程及化工工程方向，属于新型交叉学科。本书充分体现了这一特点，紧密围绕机械工程、控制工程和化学工程三条主线来编写。

3）专业内容覆盖全面。在力求篇幅简洁，以适应专业英语学时普遍较少的现状，本书内容尽量涵盖过程装备与控制工程专业各主干学科的基本专业内容。

4）实用性强。为了使学生接触并熟悉不同体裁形式的文章，增强学生阅读各类科技文献的能力，除原版教材外，本书还选用了4篇实用文体的科技资料，分别涉及化工制备、设备维修、产品选购以及产品说明书。为了加强学生英语科技论文基本要素的写作能力，进而能够得心应手地运用英语完成科技论文的写作，以便在未来的工作中更好地展示科研成果，本书的第六部分（PART Ⅵ）系统地介绍了科技英语在词汇、语法、修辞等方面的特点，以及英语科技论文的基本架构、英语科技论文标题、摘要和关键词的写作技巧。

5）可读性好，方便自学。本书的所有文章都配有主要专业术语（Terminology）；注释（Notes）提供了疑难句的语法分析，并给出了参考译文，以此来反映科技英语的翻译方法，以供学生模仿和学习；练习（Exercises）中英译汉部分的内容取自与课文相同的素材，一方面可以作为课文内容的补充，而且也可以达到加强学生阅读和翻译能力的目的，段落中所涉及的术语列于该课术语的最后，以“*”符号示出。本书最后附有全书的专业术语总表，并注明术语首次出现的文章序号，以方便查询。

本书共分为6个部分。前3个部分（PART Ⅰ—PART Ⅲ）分别为关于机械工程、控制工程和化工工程的课文，共20课；第4部分（PART Ⅳ）和第5部分（PART Ⅴ）为阅读材料，分别为扩展阅读和实用阅读，共10篇材料；第6部分（PART Ⅵ）为科技英语写作，共5个主题，其中所有例词和例句均选自本书的文章，并以末尾处的上标形式注明该例词或例句所在文章序号，课文为字母L+课文号，阅读材料为字母RM+阅读材料号（术语总表中也采用此法标注）。本书的参考学时为40学时。由于各部分内容相互独立，因此可根据具体学时情况灵活选用，其余内容可供课外阅读使用。

本书由王丰负责素材遴选、统稿及定稿；第1、2、5、6部分由王丰编写，第3、4部分由李勤、刘翀、王丰编写，术语总表由张光浩整理。本书由东北大学巴德纯教授主审，他提出了很多宝贵意见，在此表示感谢。本书提供译文和电子课件，需要的教师可与机械工业出版社相关编辑联系。第1、2部分的课文译文和电子课件由张光浩、王丰完成，第3部分的译文和电子课件由刘翀完成。在本书的编写过程中，得到了机械工业出版社和沈阳工业大学与李福宝教授的大力支持，沈阳工业大学周磊老师也提出了很多宝贵意见，琚丽颖、沙嵬等同学为本书的录入做了大量的工作，在此一并表示感谢。

本书选用了参考文献中的部分内容和图表，实用阅读的内容取自互联网，在此向其作者致以衷心的感谢。由于过程装备与控制工程专业学科跨度大、专业领域广，书中难免出现不当之处，敬请读者提出宝贵意见。

王丰

于河北

Table of Contents

PART I MECHANICAL ENGINEERING

Lesson 1 Mechanical Properties and Their Measurements

1.1 STRENGTH

The resistance offered by a material on application of external force is called strength. Depending on the type of load applied, the strength could be tensile, compressive or shear. By application of load, the material is elastically deformed, which is called strain①. It can be defined as

$$\text{Strain} = \frac{\text{change in dimension}}{\text{original dimension}}$$

The resistance offered by the material is also referred to as stress which can then be defined as

$$\text{Stress} = \frac{\text{applied load}}{\text{area of cross section opposing the load}}$$

The deformation caused in a material is of two types, elastic and plastic. Elastic deformation is that part of the deformed material which when the applied load is removed, would spring back to its normal shape. Plastic deformation is on the other hand, permanently set in a material and cannot be regained.

Tensile strength is measured by a tensile test carried out on a universal testing machine. This involves the preparation of a test specimen as per standard shown in Fig. 1-1. The standard specimen is cylindrical in cross section with a diameter, d. The gauge length L is given by

$$L = 5.65\sqrt{d}$$

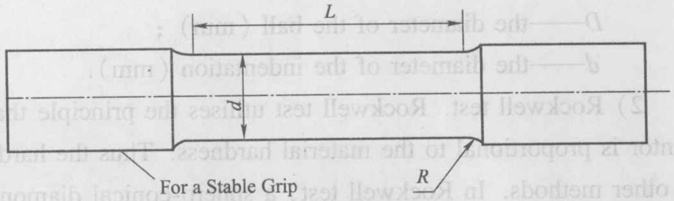

Fig. 1-1 Standard test specimen for tensile test

Then a uniformly increasing tensile load is applied on the specimen. As the load increases the specimen initially gets elastically elongated. On further elongation, the specimen starts necking at some point when the material goes beyond the elastic range. The reduced width of the specimen would further be reduced under the force of the load and finally develop fractures when the test is completed. During the test, a record is maintained of the load and the corresponding elongation. The stresses and strains are calculated from the data and plotted in a diagram as shown in Fig. 1-2.

It can be observed that there is a limit up to which the applied stress is directly proportional to the induced strain as represented by the linear portion of the curve②. The end of the linear portion is the yield point of the material above which the material starts plastically deforming. In the plastic region, there is a non-linear relationship between the stress and strain as evidenced by the bow-shaped portion of the curve. Finally, when the force of the applied load goes beyond the limit that can be borne by the material, the specimen breaks.

The stress at the elastic limit is called the yield strength. The maximum stress reached in a material before the fracture is termed as the ultimate strength. Similar tests can also be conducted for measuring the compression and shear strength.

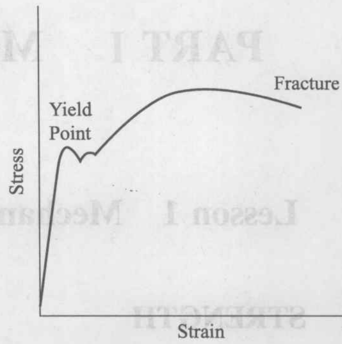

Fig. 1-2 Stress-strain diagram

1.2 HARDNESS

Hardness is a very important property since the manufacturing depends on it to a great extent. It is the resistance offered by a material to indentation. There are a number of indentation tests to measure the hardness of a material normally. These usually involve a ball, a cone or a pyramid of a harder material which is indented into the material under test with a specified load. The permanent indentation thus made is measured to give an indication of the hardness on the given scale for the tests.

The most commonly used tests are:

1) Brinell hardness test. Brinell hardness test where a sphere (usually of diameter 10 ± 0.01mm) made of steel or tungsten carbide is indented with a gradually applied load at right angles to the specimen surface and the indentation diameter made on the specimen measured. Then the Brinell hardness number, BHN is given by

$$BHN = \frac{2P}{\pi D\left[D - \sqrt{D^2 - d^2}\right]}$$

where P——the applied load in kg;

D——the diameter of the ball (mm);

d——the diameter of the indentation (mm).

2) Rockwell test. Rockwell test utilises the principle that the depth of penetration of the indentor is proportional to the material hardness. Thus the hardness measurement is faster compared to other methods. In Rockwell test, a sphero-conical diamond cone of 120° angle and a spherical apex of radius 0.2 mm is used to make the indentation and the depth of the indentation, t is used to calculate the hardness number.

The Rockwell hardness number (R) is given by

$$R = 100 - 500\,t$$

3) Vickers test. Besides, there are other tests available such as Vickers and Knoop hardness tests to measure hardness over a small area. In Vickers hardness test, a square base pyramid diamond indentor having 136° between the opposite faces is used. The Vickers hardness number (VHN) is calculated by

$$VHN = \frac{1.854L}{D^2}$$

where L——the applied load, in kg which is normally about 30 kg though provision up to 120 kg would be available on the testing machine for harder materials;

D——the average diagonal of the indentation in mm.

1.3 DUCTILITY

It is the measure of the amount of plastic deformation a material can undergo under tensile forces without fracture. In quantitative terms it is normally measured as the ratio of elongation of the material at fracture during the tensile test to the original length, expressed as a percentage. The final value of elongation obtained during the tensile test immediately after the fracture could be taken as the ductility. Since the elongation is dependent upon the gauge length chosen for the tensile test, the length needs to be specified along with the elongation values③. Alternatively, it may also be expressed as the ratio of reduction in cross-sectional area in the fractured specimen to the original cross-section area. This is independent of the gauge length and hence is a more convenient measure for ductility. It is also termed as the ability of a material to be drawn into wires since only ductile materials can be drawn into continuous wires without breaking in-between④. Brittleness is the property opposite to that of ductility.

1.4 TOUGHNESS

This is the property which signifies the amount of energy absorbed by a material at the time of fracture under impact loading. In short it is the capacity to take impact load⑤. It can be considered as the total area under the stress strain curve since it is an indication of the amount of work done on the material without causing fracture. Thus toughness can be considered as a parameter consisting of both strength and ductility.

Toughness of a material is measured by means of impact tests, where a notched bar prepared as per standard from the test material, is held in a vice and a weight is allowed to swing from a known height in such a way that it hits the notched bar in its path and breaks it⑥. Since the material has absorbed some amount of energy during its fracture, the swinging mass loses part of its energy and therefore will not be able to reach the same height from where it start, as shown in Fig. 1-3. The loss in height (h) multiplied by the weight represents the energy absorbed by the specimen during fracture, which can be directly measured from the indicator on the tester.

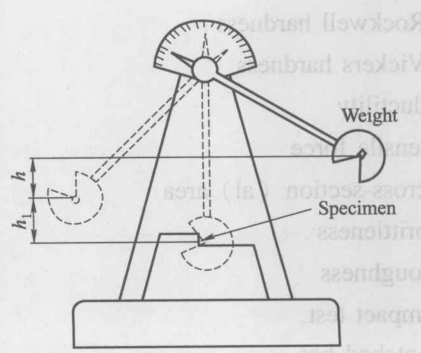

Fig. 1-3 Charpy impact testing machine

(Selected from: P N Rao, Manufacturing Technology-Foundry, Forming and Welding, China Machine Press & The McGraw-Hill companies, Inc., 2006)

Terminology

mechanical property	机械性能（特性）
strain	应变
stress	应力
elastic deformation	弹性变形
plastic deformation	塑性变形
tensile strength	抗拉强度
tensile test	拉伸（抗拉）试验
universal testing machine	万能试验机
specimen	样本（品），试样（件）
cross section	横截面
gauge length	标距长度
elongation	拉伸，延长；延伸率
elastic range	弹性范围
yield point	屈服点
elastic limit	弹性极限
yield strength	屈服强度
ultimate strength	极限强度
indentation	压痕，刻痕
indentation test	球印硬度试验；压痕试验
carbide	碳化物
tungsten	硬质合金，碳化钨
Brinell hardness	布氏硬度
Rockwell hardness	洛氏硬度
Vickers hardness	维氏硬度
ductility	塑性，延展性
tensile force	拉力
cross-section (al) area	截面积
brittleness	脆性
toughness	韧性
impact test	冲击试验
notched bar	凹口试杆，缺口试棒
Charpy impact testing machine	摆锤（单梁）式冲击试验机，夏比冲击试验机

Notes

1. By application of load, the material is elastically deformed, which is called strain.

句中，which 引导非限定性定语从句，代替前面整个句子的内容。全句可译为："通过

施加载荷，材料发生弹性变形，这叫做应变。”

2. It can be observed that there is a limit up to which the applied stress is directly proportional to the induced strain as represented by the linear portion of the curve.

句中，that 引导主语从句；which 引导限定性定语从句，修饰 limit；as 引导定语从句，对前述部分作补充说明。过去分词 applied 和 induced 作定语，分别修饰 stress 和 strain。短语（to be）directly proportional to 意为“与……成正比”；up to 意为“……以下，在……（范围，数值）以内”。全句可译为：“由此可见，该曲线有一个极限位置，在这个位置以下，所施加的应力与由此引起的应变成正比，正如曲线的直线部分所表示的那样。”

3. Since the elongation is dependent upon the gauge length chosen for the tensile test, the length needs to be specified along with the elongation values.

句中，过去分词短语 chosen for the tensile test 作后置定语，修饰 gauge length。短语（to be）dependent upon 意为“取决于”；along with 意为“除……之外”。全句可译为：“由于延伸率取决于为拉力试验而选择的标距长度，因此，除了延伸率之外还需要测定标距长度。”

4. It is also termed as the ability of a material to be drawn into wires since only ductile materials can be drawn into continuous wires without breaking in-between.

句中，不定式短语 to be drawn into wires 作后置定语，修饰 ability。term 意为“把……称为……，把……叫做……”；in-between 意为“在中间”。全句可译为：“由于只有塑性材料才能拉成连续的线材而不会在中间断裂，因此它也被称为将材料拉成线材的能力。”

5. In short it is the capacity to take impact load.

句中，短语 in short 为插入语，意为“总之；简言之；简单地说”。全句可译为：“简言之，它是指承受冲击载荷的能力。”

6. Toughness of a material is measured by means of impact tests, where a notched bar prepared as per standard from the test material, is held in a vice and a weight is allowed to swing from a known height in such a way that it hits the notched bar in its path and breaks it.

句中，where 引导非限定性定语从句，修饰 impact tests。在该从句中，过去分词短语 prepared as per standard from the test material 作后置定语，修饰第一个 notched bar；that 引导结果状语从句；第一个 it 指代的是 weight（重物，重锤），第二个 it 指代的是第二个 notched bar。短语 as per 意为“根据，按照”；in such a way that 意为“用这样的方式，以致……”。全句可译为：“通过冲击试验可测定材料的韧性。在冲击试验中，按照标准利用试验材料制成的凹口试杆夹持在虎钳上，并让重锤从已知的高度摆落，以便在其摆动轨迹上撞击凹口试杆，并使之断裂。”

Exercises

1. Answer the following questions according to the text.

1) What is called strain? What about stress?

2) What are the most commonly used hardness tests? What is the corresponding hardness number?

3) What is the difference between ductility and brittleness?

4) What can be considered as a parameter consisting of both strength and ductility?

2. Translate the following terms into English.

1）截面积 2）弹性变形 3）韧性 4）屈服强度 5）硬度试验

3. Translate the following terms from English into Chinese.

1）tensile test 2）Brinell hardness 3）plastic deformation 4）elastic limit 5）mechanical property

4. Translate the following sentences into English.

1）根据所施加载荷的类型，强度可分为抗拉强度、抗压强度或剪切强度。

2）抗拉强度可由在万能试验机上进行的拉力试验来测量。

3）材料断裂前的最大应力称为极限强度。

4）硬度是一个非常重要的特性，这是因为制造在很大程度上取决于它。

5. Translate the following paragraph from English into Chinese.

Manufacturing of a component is normally influenced by the mechanical and thermal properties of the work material. Also, the mechanical properties are affected by the manufacturing process employed. Either way the knowledge of mechanical properties of engineering materials is important to a manufacturing engineer.

Lesson 2 Metals

2.1 FERROUS METALS AND ALLOYS

2.1.1 Steel

Carbon steel is easily the most commonly used material in process plants despite its somewhat limited corrosion resistance. It is routinely used for most organic chemicals and neutral or basic aqueous solutions at moderate temperatures. It is also used routinely for the storage of concentrated sulfuric acid and caustic soda (up to 50 percent and 55℃). Because of its availability, low cost, and ease of fabrication steel is frequently used in services with corrosion rates of 0.13 to 0.5 mm/y, with added thickness (corrosion allowance) to assure the achievement of desired service life. Product quality requirements must be considered in such cases.

2.1.2 Cast Iron

Generally, cast iron is not a particularly strong or tough structural material, although it is one of the most economical materials and is widely used industrially.

Gray cast iron, low in cost and easy to cast into intricate shapes, contains carbon, silicon, manganese, and iron. Carbon (1.7 to 4.5 percent) is present as combined carbon and graphite; combined carbon is dispersed in the matrix as iron carbide (cementite), while free graphite occurs as thin flakes dispersed throughout the body of the metal. Various strengths of gray iron are produced by varying size, amount, and distribution of graphite.

Gray iron has outstanding damping properties—that is, ability to absorb vibration—as well as wear resistance①. However, gray iron is brittle, with poor resistance to impact and shock. Machinability is excellent.

With some important exceptions, gray-iron castings generally have corrosion resistance similar to that of carbon steel. They do resist atmospheric corrosion as well as attack by natural or neutral waters and neutral soils. However, dilute acids and acid-salt solutions will attack this material.

Ductile cast iron includes a group of materials with good strength, toughness, wear resistance, and machinability. This type of cast iron contains combined carbon and dispersed nodules of carbon. Composition is about the same as gray iron, with more carbon (3.7 percent) than malleable iron. The spheroidal graphite reduces the notch effect produced by graphite flakes, making the material more ductile②.

There are a number of grades of ductile iron; some have maximum toughness and machinability; others have maximum resistance to oxidation.

Generally, corrosion resistance is similar to gray iron. But ductile iron can be used at higher temperatures—up to 590℃ and sometimes even higher.

2.1.3 Stainless Steel

There are more than 70 standard types of stainless steel and many special alloys. These steels are produced in the wrought form and as cast alloys. Generally, all are iron-based, with 12 to 30 percent chromium, 0 to 22 percent nickel, and minor amounts of carbon, niobium (columbium), copper, molybdenum, selenium, tantalum, and titanium. These alloys are very popular in the process industries. They are heat- and corrosion-resistant, noncontaminating, and easily fabricated into complex shapes.

There are three groups of stainless alloys: martensitic, ferritic, and austenitic.

The martensitic alloys contain 12 to 20 percent chromium with controlled amounts of carbon and other additives. These alloys can be hardened by heat treatment, which can increase tensile strength from 550 to 1,380 MPa.

Corrosion resistance is inferior to that of austenitic stainless steels, and martensitic steels are generally used in mildly corrosive environments (atmospheric, fresh water, and organic exposures).

Ferritic stainless contains 15 to 30 percent Cr, with low carbon content (0.1 percent). The higher chromium content improves its corrosive resistance, The strength of ferritic stainless can be increased by cold working but not by heat treatment. Fairly ductile ferritic grades can be fabricated by all standard methods. They are fairly easy to machine. Welding is not a problem, although it requires skilled operators.

Corrosion resistance is rather good, although ferritic alloys are not good against reducing acids such as HCl. But mildly corrosive solutions and oxidizing media are handled without harm③.

Austenitic stainless steels are the most corrosion-resistant of the three groups. These steels contain 16 to 26 percent chromium and 6 to 22 percent nickel. Carbon is kept low (0.08 percent maximum) to minimize carbide precipitation. These alloys can be work-hardened, but heat treatment will not cause hardening. Tensile strength in the annealed condition is about 585 MPa, but work-hardening can increase this to 2,000 MPa. Austenitic stainless steels are tough and ductile.

They can be fabricated by all standard methods. But austenitic grades are not easy to machine. Rigid machines, heavy cuts, and high speeds are essential. Welding, however, is readily performed, although welding heat may cause chromium carbide precipitation, which depletes the alloy of some chromium and lowers its corrosion resistance in some specific environments, notably nitric acid④. The carbide precipitation can be eliminated by heat treatment (solution annealing). To avoid precipitation, special stainless steels stabilized with titanium, niobium, or tantalum have been developed. Another approach to the problem is the use of low-carbon steels, with 0.03 percent maximum carbon.

2.2 NONFERROUS METALS AND ALLOYS

2.2.1 Nickel and Nickel Alloys

Nickel is available in practically any mill form as well as in castings. It can be machined easily and joined by welding. Generally, oxidizing conditions favor corrosion, while reducing conditions retard attack⑤. Neutral alkaline solutions, seawater, and mild atmospheric conditions do not affect nickel. The metal is widely used for handling alkalies, particularly in concentrating, storing, and shipping high-purity caustic soda. Chlorinated solvents and phenol are often refined and stored in nickel to prevent product discoloration and contamination.

2.2.2 Copper and Copper Alloys

Copper and its alloys are widely used in chemical processing, particularly when heat and electrical conductivity are important factors. The thermal conductivity of copper is twice that of aluminum and 90 percent that of silver. A large number of copper alloys are available, including brasses (Cu-Zn), bronzes (Cu-Sn), and cupronickels.

Copper has excellent low-temperature properties and is used at −200℃. Brazing and soldering are common joining methods for copper, although welding, while difficult, is possible⑥. Generally, copper has high resistance to industrial and marine atmospheres, seawater, and alkalies. Oxidizing acids rapidly corrode copper. However, the alloys have somewhat different properties than commercial copper.

Brasses with up to 15 percent Zn are ductile but difficult to machine. Machinability improves with increasing zinc up to 36 percent Zn. Brasses with less than 20 percent Zn have corrosion resistance equivalent to that of copper but with better tensile strengths⑦. Brasses with 20 to 40 percent Zn have lower corrosion resistance and are subject to dezincification and stress corrosion cracking, especially when ammonia is present.

Bronzes are somewhat similar to brasses in mechanical properties and to high-zinc brasses in corrosion resistance (except that bronzes are not affected by stress cracking)⑧. Aluminum and silicon bronzes are very popular in the process industries because they combine good strength with corrosion resistance.

Cupronickels (10 to 30 percent Ni) have become very important as copper alloys. They have the highest corrosion resistance of all copper alloys and find application as heat-exchanger tubing. Resistance to seawater is particularly outstanding.

2.2.3 Titanium

Titanium has become increasingly important as a construction material. It is strong and of medium weight. Corrosion resistance is very superior in oxidizing and mild reducing media. Titanium is usually not bothered by impingement attack, crevice corrosion, and pitting attack in seawater. Its general resistance to seawater is excellent. Titanium is resistant to nitric acid at all concentrations except with red fuming nitric. The metal also resists ferric chloride, cupric chloride, and other hot chloride solutions. However, there are a number of disadvantages to titanium which have limited its use. Titanium is not easy to form, it has a high springback and tends to gall, and welding must be carried out in an inert atmosphere.

2.2.4 Zirconium

Zirconium was originally developed as a construction material for atomic reactors. Reactor-grade zirconium contains very little hafnium, which would alter zirconium's neutron-absorbing properties. Commercial-grade zirconium, for chemical process applications, however, contains 2.5 percent hafnium. Zirconium resembles titanium from a fabrication standpoint. All welding must be done under an inert atmosphere. Zirconium has excellent resistance to reducing environments. Oxidizing agents frequently cause accelerated attack. It resists all chlorides except ferric and cupric. Zirconium alloys should not be used in concentrations of sulfuric acid above about 70 percent. There are a number of alloys of titanium and zirconium, with mechanical properties superior to those of the pure metals. The zirconium alloys are referred to as Zircaloys.

(Selected from: Robert H. Perry & Don W. Green, Perry's Chemical Engineers' Handbook (Seventh Edition), Science Press & The McGraw-Hill Companies, Inc., 2001)

Terminology

ferrous metal	黑色金属
ferrous alloy	铁类合金
carbon steel	碳（素）钢
corrosion resistance	耐蚀性
aqueous solution	水溶液，含水溶剂
sulfuric acid	硫酸
caustic soda	氢氧化钠，烧碱
corrosion rate	腐蚀速率
corrosion allowance	允许腐蚀度
service life	有效寿命，使用期限
cast iron	铸铁，生铁
gray cast iron	灰（口）铸铁
cementite	渗碳体
damping	阻尼
casting	铸造；铸件

ductile (cast) iron	球墨铸铁
wear resistance	耐磨性
machinability	机械加工性能
malleable (cast) iron	可锻铸铁
notch effect	缺口效应
stainless steel	不锈钢
chromium	铬
nickel	镍
niobium	铌
tantalum	钽
titanium	钛
martensitic stainless steel	马氏体型不锈钢
ferritic stainless steel	铁素体型不锈钢
austenitic stainless steel	奥氏体型不锈钢
heat treatment	热处理
cold working	冷加工
weld	焊缝
welding	焊接
precipitation	析出，沉淀
nitric acid	硝酸
annealing	退火
nonferrous metal	有色金属
nonferrous alloy	有色（非铁）合金
alkaline solution	碱性溶液
solvent	溶剂
phenol	酚
conductivity	电导率
electrical conductivity	电导率
thermal conductivity	导热性，热导率
aluminum	铝
brass	黄铜
bronze	青铜
cupronickel	铜镍合金，白铜
brazing	硬（钎）焊，铜焊
soldering	软（钎）焊，锡焊
dezincification	失锌现象，除（脱）锌（作用）
stress corrosion	应力腐蚀
ammonia	氨（水）
impingement attack	浸蚀