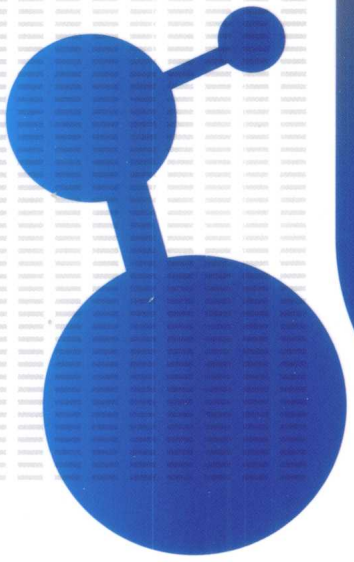
中国石油和化学工业行业规划教材

高职高专化工技术类



化工专业英语

Specialized English for Chemical Industry

刘庆文 主编　　谢 红 主审

化学工业出版社

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·北京·

本教材是为了提高化工技术类专业学生化工英语信息获取能力和信息产出能力，培养与职业能力结构要求相一致的高素质技能型人才而编写的。

本教材涉及化工产品生产、健康、安全、环境和质量等方面的内容。材料来源于英文原版书籍、杂志和英文化工方面的相关网站。由五个模块20个单元组成，每个单元由课文、难点注释、词汇表、课后练习和阅读材料组成。课文主要内容为：化工生产模块、职业健康和卫生模块、化工安全模块、环境保护模块和质量模块。书后附有总词汇表、化学化工常用构词、常见有机基团和常用化工产品英文缩写。

本教材突出实用、够用和好用特点，语言精练、图文并茂、操作性强、覆盖面广、难度适中，可作为高职高专化工技术类专业英语教材，也可作为从事化工产品生产工作人员的参考书。

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序

2006年11月教育部颁布了《关于全面提高高等职业教育教学质量的若干意见》（教高［2006］16号）文件，文件中明确了课程建设与改革是提高教学质量的核心，也是教学改革的重点和难点。文件要求各高等职业院校应积极与行业企业合作开发课程，根据技术领域和职业岗位（群）的任职要求，参照相关的职业资格标准，改革课程体系和教学内容；要建立突出职业能力培养的课程标准，规范课程教学的基本要求，提高课程教学质量；要改革教学方法和手段，融“教、学、做”为一体，强化学生能力的培养；要加强教材建设，与行业企业共同开发紧密结合生产实际的实训教材，并确保优质教材进课堂。

自文件颁布以来，在我国掀起了新的一轮高职高专教育教学改革热潮，以工作过程系统化重构高职高专课程体系，以项目化课程教学法改革传统学科传授教学法，取得了丰硕的成果。学生学习的兴趣、学习动力、自觉性、主动性、自信心、主体性和专业能力、自学能力、创新能力、团队合作能力、与人交流能力、计划策划能力、信息获取与加工能力等都得到明显提高，学生对复杂专业知识的把握情况也显著改善。项目化课程教学改革完全符合教育部的十六号文件精神。项目化课程教学改革遵循的八大原则更是体现了当今先进的高等职业教育观念。这八大原则是：①课程教学应进行整体教学设计；②课程内容是职业活动导向、工作过程导向，而不是学科知识的逻辑推演导向；③课程教学突出能力目标，而不仅仅是突出知识目标；④课程内容的载体主要是项目和任务，而不是语言、文字、图形、公式；⑤能力的训练过程必须精心设计，反复训练，而不是在讲完系统的知识之后，举几个知识的应用例子；⑥学生是课程教学过程中的主体；⑦课程的内容和教学过程应当“做、学、教”一体化，“实践、知识、理论”一体化；⑧注意在课程教学中渗透八大职业核心能力（外语应用能力、与人合作能力、与人交流能力、信息处理能力、数字应用能力、解决问题能力、自我学习和创新革新能力）的培养。

全国化工高等职业教育教学指导委员会（简称全国化工高职教指委）化工技术类专业委员会于2002年组织全国石油与化工各职业院校教师编写了第一套高职高专化工技术类专业规划教材，解决了当时高职院校化工技术类专业无教材的困难。然而，随着科学技术的进步，产业结构的调整，劳动效率的提高，信息技术的应用，劳动密集型生产已向资本密集型和技术密集型转变。特别是近年来的项目化课程教学改革的开展，原来的教材已不适应高等职业教育教学改革的需要。为此，全国化工高职教指委化工技术类专业委员会于2008年9月在常州工程职业技术学院启动了第二轮规划教材编写工作。教指委根据教育部教高［2006］16号文件的精神，吸收了先进的高职高专教育教学改

革理念，进行了企业调研、座谈，针对岗位（群），聘请企业职业专家进行工作任务分析，进而确定典型工作任务，组织课程专家按照职业成长规律和认知规律，用工作过程系统化的开发方法，重构化工技术类专业课程体系，制定课程标准，进行了教学情境设计，聘请企业一线技术专家作为教材编写的顾问和副主审，在全国石油和化工高职高专院校公开征集编写思路，组织高职教育领域的课程专家对应征的编写方案进行答辩，最终在全国范围内选拔出从事石油与化工职业教育的优秀骨干教师编写本套教材。

本套新教材的特点：

1. 体现工学结合的内涵要求；
2. 基本体现化工生产的工作过程；
3. 突出能力目标，重在培养学生的做事能力，强调知识的应用；
4. 便于项目化和任务驱动教学法的实施；
5. 注意培养学生的八大职业核心能力；
6. 反映当今的新技术、新材料、新设备和新工艺。

本轮建设的全套教材能满足化工技术类专业主干课程教学需求，能满足各个化工技术类专业方向课程教学需要，也能满足全国石油与化工高职院校根据地方经济发展和支柱产业需求设置的化工技术类专业选修课程教学要求。

本轮化工技术类专业的教材编写工作得到了许多化工生产一线企业行业专家、高等职业院校的领导和教育教学专家的指导，在此向所有对高等职业教育改革给予热情支持的人士表示衷心的感谢！

我们所做的工作仅是探索和创新的开始，还有许多的课题有待进一步研究，我们期待各界专家和读者提出宝贵意见！

全国化工高等职业教育教学指导委员会
化工技术类专业委员会
2009 年 6 月

前言

高等职业教育化工技术类专业是为应用化工、有机化工、精细化工和石油化工领域培养高素质技能型专门人才。毕业生不仅要具备化工产品生产、健康、安全、环境和质量等方面的职业能力，还应具备与职业能力结构要求相一致的化工英语信息获取能力和信息产出能力，为此全国化工高等职业教育教学指导委员会、化学工业出版社组织编写了本教材。

本教材材料来源于英文原版书籍、杂志和英文化工方面的相关网站。由五个模块20个单元组成，每个单元由课文、词汇表、难点注释、课后练习和阅读材料组成。课文主要内容为：化工生产模块、职业健康和卫生模块、化工安全模块、环境保护模块和质量模块。书后附有总词汇表、化学化工常用构词、常见有机基团和常用化工产品英文缩写。

本教材具有实用、够用和好用特点，语言精练、操作性强、覆盖面广、难度适中，可作为高职高专化工技术类专业英语教材，也可作为从事化工产品生产工作人员的参考书。

为方便教学，本书配有课文和阅读材料的中文翻译，以及课后练习的配套答案，使用本教材的学校可以与化学工业出版社联系（cipedu@163.com），免费索取。

本教材由天津渤海职业技术学院刘庆文担任主编，天津碱厂谢红主审。其中第1～3单元由滨州学院贾冬梅编写，第5单元、第8～10单元由常州工程职业技术学院张启蒙编写，第4单元、第7单元、第11～13单元由刘庆文编写，第14～17单元由天津渤海职业技术学院崔迎编写，第6单元、第18～20单元由武汉软件工程职业学院孙蓉编写，全书由刘庆文统稿。

本书在编写过程中，天津渤海职业技术学院杨永杰教授给予热情帮助和指导，提出了建设性意见，在此表示衷心感谢。

本书虽经多次校对，但限于编者水平，书中不足之处在所难免，恳请广大读者指正。

编者

2010年4月30日

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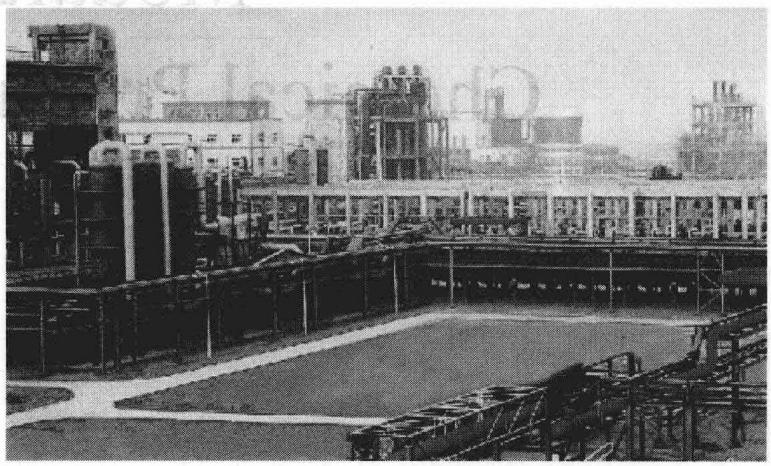
Module One
Chemical Production

Unit One

Production of Sodium Carbonate

Sodium carbonate (also known as washing soda, soda crystals or soda ash), Na_2CO_3, is a sodium salt of carbonic acid. It most commonly occurs as a crystalline heptahydrate, which readily effloresces to form a white powder, the monohydrate; and is domestically well known for its



everyday use as a water softener.[1] It has a cooling alkaline taste, and can be extracted from the ashes of many plants. It is synthetically produced in large quantities from table salt in a process known as the Solvay process.

Uses

The manufacture of glass is the most important use of sodium carbonate. When it is combined with sand (SiO_2) and calcium carbonate ($CaCO_3$) and heated to very high temperatures, then cooled very rapidly, glass is produced.[2] This type of glass is known as soda lime glass.

Sodium carbonate is also used as a relatively strong base in various settings. For example, sodium carbonate is used as a pH regulator to maintain stable alkaline conditions necessary for the action of the majority of developing agents. It is a common additive in municipal pools used to neutralize the acidic effects of chlorine and raise pH. In chemistry, it is often used as an electrolyte. Additionally, unlike chloride ions which form chlorine gas, carbonate ions are not corrosive to the anodes. It is also used as a primary standard for acid-base titrations because it is

solid and air-stable, making it easy to weigh accurately.

Production

Solvay process: In 1861, the Belgian industrial chemist Ernest Solvay developed a method to convert sodium chloride to sodium carbonate using ammonia. The Solvay process centered around a large hollow tower. At the bottom, calcium carbonate (limestone) was heated to release carbon dioxide:

$$CaCO_3 \longrightarrow CaO + CO_2$$

At the top, a concentrated solution of sodium chloride and ammonia entered the tower. As the carbon dioxide bubbled up through it, sodium bicarbonate precipitated:

$$NaCl + NH_3 + CO_2 + H_2O \longrightarrow NaHCO_3 + NH_4Cl$$

The sodium bicarbonate was then converted to sodium carbonate by heating it, releasing water and carbon dioxide:

$$2\ NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$$

Meanwhile, the ammonia was regenerated from the ammonium chloride byproduct by treating it with the lime (calcium hydroxide) left over from carbon dioxide generation:

$$CaO + H_2O \longrightarrow Ca(OH)_2$$

$$Ca(OH)_2 + 2\ NH_4Cl \longrightarrow CaCl_2 + 2\ NH_3 + 2\ H_2O$$

Because the Solvay process recycles its ammonia, it consumes only brine and limestone, and has calcium chloride as its only waste product. This made it substantially more economical than the Leblanc process, and it soon came to dominate world sodium carbonate production. By 1900, 90% of sodium carbonate was produced by the Solvay process, and the last Leblanc process plant closed in the early 1920s.

Hou's process: Developed by a Chinese chemist Hou Debang in 1930s, the first few steps are the same as the Solvay process. However, instead of treating the remaining solution with lime, carbon dioxide and ammonia are pumped into the solution, then sodium chloride is added until the solution saturates at 40°C. Next, the solution is cooled to 10°C. Ammonium chloride precipitates and is removed by filtration, and the solution is recycled to produce more sodium carbonate.[3] Hou's process eliminates the production of calcium chloride and the byproduct ammonium chloride can be refined or used as a fertilizer.

New Words

alkaline ['ælkəlin] *a.* 碱性的，含碱的
ammonia [ə'məunjə] *n.* 氨，氨水
anode ['æn,əud] *n.* 阳极
bicarbonate [bai'ka:bənit] *n.* 碳酸氢盐
brine [brain] *n.* 卤水，海水，盐水
calcium ['kælsiəm] *n.* 钙
carbonate ['ka:bəneit] *n.* 碳酸盐
chloride ['klɔ:raid] *n.* 氯化物

chlorine ['klɔ:ri:n] *n.* 氯，氯气
crystalline ['kristəlin] *a.* 水晶的，似水晶的，结晶质的
dioxide [dai'ɔksaid] *n.* 二氧化物
effloresces [ˌeflɔ:'res] *vi.* 开花，风化
electrolyte [i'lektrəˌlait] *n.* 电解液，电解质
fertilizer ['fə:tilaizə] *n.* 肥料
filtration [fil'treiʃən] *n.* 过滤，筛选
heptahydrate [heptə'haidreit] *n.* 七水混合物
hydroxide [hai'drɔksaid] *n.* 氢氧化物
limestone ['laimˌstəun] *n.* 石灰石
monohydrate [ˌmɔnəu'haidreit] *n.* 一水合物
neutralize ['nu:trəˌlaiz] *vt.* 使失效，中和
precipitate [pri'sipiteit] *vi.* 沉淀
saturate ['sætʃəreit] *vt.* 浸湿，浸透，使饱和
soda ['səudə] *n.* 苏打，纯碱
sodium ['səudi:əm] *n.* 钠
titration [tai'treiʃən] *n.* 滴定

Notes

1. It most commonly occurs as a crystalline heptahydrate, which readily effloresces to form a white powder, the monohydrate; and is domestically well known for its everyday use as a water softener.

本句为并列谓语结构，and 连接了谓语动词 occurs 和 is well known...as，定语从句 which ... powder 修饰 heptahydrate。本句可译为：碳酸钠通常以七水结晶形式存在，很容易风化变为白色的一水合物粉末。它也是人们熟知的家庭日常用水软化剂。

2. When it is combined with sand (SiO_2) and calcium carbonate ($CaCO_3$) and heated to very high temperatures, then cooled very rapidly, glass is produced.

When 引导时间状语，该从句中有两个并列成分：介词 with 的并列宾语 sand 和 calcium carbonate，it 的并列谓语动词 heated to (省略了 is)。此句可译为：当碳酸钠与沙子和碳酸钙混合在一起，加热到很高的温度，然后快速冷却时，就产生了玻璃。

3. Ammonium chloride precipitates and is removed by filtration, and the solution is recycled to produce more sodium carbonate.

此句为并列句，前一分句又并列了谓语动词 precipitates 和 is removed。可译为：氯化铵生成沉淀，过滤除去。溶液循环使用以便生产更多的碳酸钠。

Exercises

1. Translate the expressions.
   (1) 过滤操作
   (2) 酸碱滴定
   (3) 索尔韦法

(4) 浓缩液

(5) 氯化铵副产品

(6) sodium bicarbonate

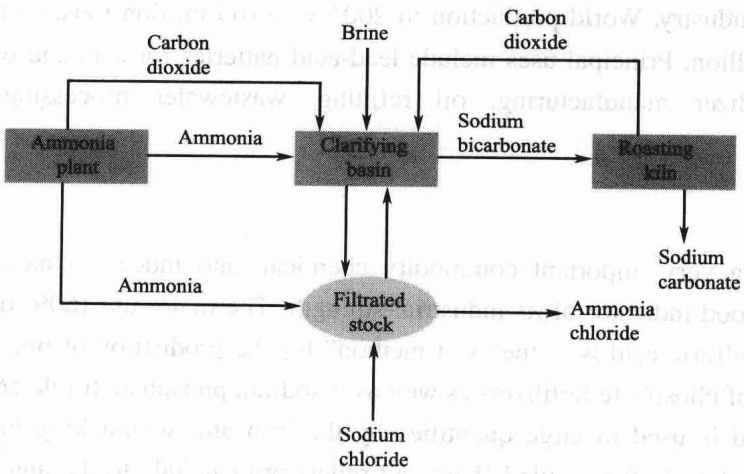
(7) primary standard

(8) acidic effects

(9) soda lime glass

(10) in various settings

2. Translate the names of the soda ash production.



3. Sentence scramble.

(1) 碳酸钠通常以七个结晶水的晶体存在。

sodium carbonate, as, commonly, crystalline, occurs, a, heptahydrate

(2) 碳酸氢钠加热转换为碳酸钠，并释放水和二氧化碳。

was, releasing, the, carbon dioxide, water, and, heating, it, by, sodium carbonate, sodium bicarbonate, converted to

(3) 因为易于准确称量，碳酸钠用作酸碱滴定的基准物。

sodium carbonate, is, it, as, accurately, weigh, to, easy, accurately, acid-base, for, titrations, primary standard, because, used, is

(4) 侯氏法非常经济，很快在世界碳酸钠生产中占据主导地位。

substantially, Hou's process, it, and, soon, is, economical, to, came, world, production, dominate, sodium carbonate

(5) 碳酸钠最重要的用途是生产玻璃。

glass, the, use, important, is, of, sodium, carbonate, manufacture, the, of, most

4. Make use of the following key words to write down a essay.

纯碱是碳酸钠的商品名称。它是生产玻璃、去污剂和其他工业产品的基本原料。有两种基本的纯碱：天然纯碱和合成纯碱。天然纯碱存在于含碳酸钠的盐液和地壳中。合成纯碱使用几种不同的化学方法生产。

sodium-carbonate-bearing, soda ash, essential raw material, synthetic, brines, detergents,

sodium carbonate, two varieties of, natural, chemical processes

Reading Material

Production of Sulfuric Acid

Sulfuric acid, (or sulphuric acid in British English) H_2SO_4, is a strong mineral acid. It is soluble in water at all concentrations. Sulfuric acid has many applications, and is one of the top products of the chemical industry. World production in 2001 was 165 million tons, with an approximate value of US$8 billion. Principal uses include lead-acid batteries for cars and other vehicles, ore processing, fertilizer manufacturing, oil refining, wastewater processing, and chemical synthesis.

Uses

Sulfuric acid is a very important commodity chemical, and indeed, a nation's sulfuric acid production is a good indicator of its industrial strength. The major use (60% of total production worldwide) for sulfuric acid is in the "wet method" for the production of phosphoric acid, used for manufacture of phosphate fertilizers as well as trisodium phosphate for detergents.

Sulfuric acid is used in large quantities by the iron and steelmaking industry to remove oxidation, rust and scale from rolled sheet and billets prior to sale to the automobile and white goods industry. Another important use for sulfuric acid is for the manufacture of aluminum sulfate, also known as paper maker's alum. Sulfuric acid is also used as a general dehydrating agent in its concentrated form.

Manufacture

Sulfuric acid is produced from sulfur, oxygen and water via the conventional contact process or the wet sulfuric acid process.

Contact process

In the first step, sulfur is burned to produce sulfur dioxide.

$$S(s) + O_2(g) \longrightarrow SO_2(g)$$

This is then oxidized to sulfur trioxide using oxygen in the presence of a vanadium(V) oxide catalyst.

$$2\,SO_2(g) + O_2(g) \longrightarrow 2\,SO_3(g) \text{ (in presence of } V_2O_5)$$

The sulfur trioxide is absorbed into 97%~98% H_2SO_4 to form oleum ($H_2S_2O_7$), also known as fuming sulfuric acid. The oleum is then diluted with water to form concentrated sulfuric acid.

$$H_2SO_4(l) + SO_3 \longrightarrow H_2S_2O_7(l)$$

$$H_2S_2O_7(l) + H_2O(l) \longrightarrow 2H_2SO_4(l)$$

Note that directly dissolving SO_3 in water is not practical due to the highly exothermic nature of the reaction between sulfur trioxide and water. The reaction forms a corrosive aerosol

that is very difficult to separate, instead of a liquid.

$$SO_3(g) + H_2O(l) \longrightarrow H_2SO_4(l)$$

Wet sulfuric acid process

In the first step, sulfur is burned to produce sulfur dioxide:

$$S(s) + O_2(g) \longrightarrow SO_2(g)$$

or, alternatively, hydrogen sulfide (H_2S) gas is incinerated to SO_2 gas:

$$2H_2S + 3O_2 \longrightarrow 2H_2O + 2SO_2 \ (-518\ kJ/mol)$$

This is then oxidized to sulfur trioxide using oxygen with vanadium(Ⅴ) oxide as catalyst.

$$2SO_2 + O_2 \longrightarrow 2SO_3 \ (-99kJ/mol)$$

The sulfur trioxide is hydrated into sulfuric acid H_2SO_4:

$$SO_3 + H_2O \longrightarrow H_2SO_4(g) \ (-101kJ/mol)$$

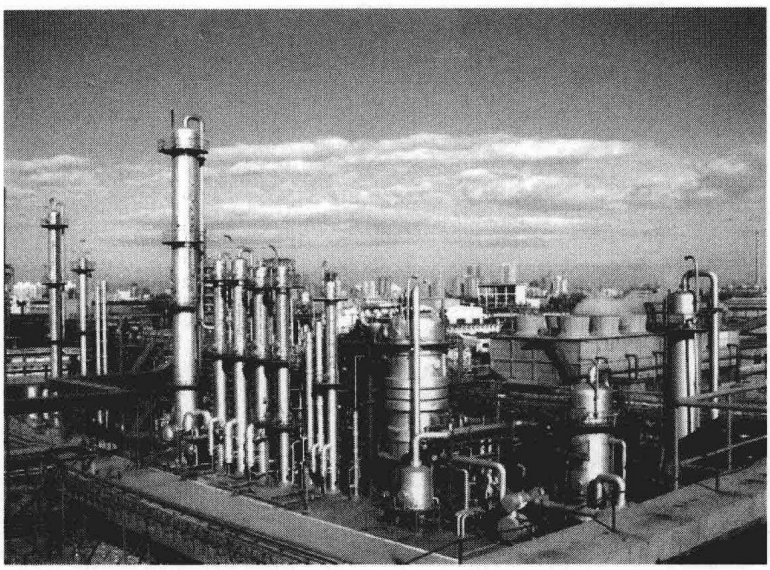
The last step is the condensation of the sulfuric acid to liquid 97%～98% H_2SO_4:

$$H_2SO_4(g) \longrightarrow H_2SO_4(l) \ (-69kJ/mol)$$

Unit Two

Production of Polyethylene

Polyethylene is a thermoplastic polymer consisting of long chains of the monomer ethylene. The name is abbreviated to PE in a manner similar to that by which other polymers like polypropylene and polystyrene are shortened to PP and PS respectively. [1]



The ethylene molecule C_2H_4 is $CH_2 = CH_2$. Two CH_2 groups connected by a double bond, thus: Polyethylene contains the chemical elements carbon and hydrogen.

Polyethylene is resistant to water, acids, alkalies, and most solvents. Its many applications include films or sheets for packaging, shower curtains, unbreakable bottles, pipes, pails, drinking glasses, and insulation for wire and cable.

Classification

Polyethylene is classified into several different categories based mostly on its density and branching. They are ultra high molecular weight polyethylene, ultra low molecular weight polyethylene, high molecular weight polyethylene, high density polyethylene, high density cross-linked polyethylene, cross-linked polyethylene, medium density polyethylene, linear low