高等学校教材

建筑材料专业英语

ENGLISH ON CONSTRUCTION MATERIALS

樊云昌　姜　波
金树新　王淑平　编

中国铁道出版社

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建筑材料专业英语

(English on Construction Materials)

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中国铁道出版社
2002年·北京

(京)新登字 063 号

内 容 简 介

本书内容涉及水泥制造、基本成分及特性,混凝土的基本特性、检测技术,高性能混凝土,外加剂,建筑材料力学性能及其测试方法,以及常用的国际单位标准等知识,有利于提高学生的专业英语词汇量,并增强外文资料的阅读理解能力。

图书在版编目(CIP)数据

建筑材料专业英语/樊云昌等编 . -北京:中国铁道出版社,2001.12

ISBN 7-113-04431-X

Ⅰ.建… Ⅱ.樊… Ⅲ.建筑材料-英语 Ⅳ.H31

中国版本图书馆 CIP 数据核字(2001)第 080542 号

书　　名:建筑材料专业英语

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出版发行:中国铁道出版社(100054,北京市宣武区右安门西街 8 号)

策划编辑:李丽娟

责任编辑:李丽娟　编辑部电话:010-51873135

封面设计:蓝　晶

印　　刷:中国铁道出版社印刷厂

开　　本:850×1168　1/32　印张:6　字数:155 千

版　　本:2002 年 1 月第 1 版　2002 年 1 月第 1 次印刷

印　　数:1～3 000 册

书　　号:ISBN 7-113-04431-X/TU·682

定　　价:14.50 元

前　言

为适应我国材料科学与工程学科发展和教学的需要，我们根据国内一些院校无机非金属专业的教学特点，编写了这本《建筑材料专业英语》(English on Construction Materials)教材。本教材的使用对象为已学完基础英语的无机非金属专业建筑材料方向的学生，以在第5～7学期学习为宜。教学目的是以培养学生的专业英语阅读能力为主，使学生熟悉常见的专业词汇，并适当掌握建筑材料科技英语文章的结构及写作方法。本教材适合于40～60学时的教学安排，但任课老师可根据课时的多少和学生的实际接受能力，对教材内容进行适当的取舍。在选材上，编者从国外原版教科书和有关科技杂志中尽量多地选取基本专业知识方面的文章作为编写参考资料，以便学生在专业英语的学习过程中能够温故而知新，通过英语强化自己所学的专业知识。同时本教材也选编了部分较新的科技信息，这部分内容在英语阅读和专业知识掌握上均具有一定的难度。因而，本教材也可作为建筑材料专业方向的研究生和从事建筑材料研究开发的工程技术人员进一步提高专业英语阅读能力的参考读物，以及专业技术人员晋升高级职称的英语阅读材料。

本书内容丰富，涉及水泥制造、基本成分及特性，混凝土的基本特性、检测技术，高性能混凝土，外加剂，建筑材料力学性能及其测试方法，以及常用的国际单位标准

等知识。在汲取多种高等院校专业英语教材的优点和公共英语教学实践经验的基础上，本教材在内容的编排上采取了课堂讲授与课外阅读相结合的方式，利用课后的阅读材料加大了学生的阅读量，有利于提高学生的专业英语词汇量，并增强外文资料的阅读理解能力。编者对阅读材料中一些专业性很强的力学、矿物、物化等方面的词汇，在文中标出了其较准确的中文含义，以便于读者对这部分材料的阅读和理解。

在编写过程中，宋少民、刘娟红及苏振荣等同志为本书的选材和修改提出了许多宝贵的意见，谨在此深表谢意。

由于编者水平有限、资料收集不多，加之时间仓促，所编教材难免存在不少的缺点和错误，恳请读者提出宝贵的批评和建议。

编　　者

2001 年 7 月

CONTENTS

Unit 1

Cement Science (1)

Classification of Cements

Cements can be divided into the following categories:

1. Portland cements which can be subdivided into:

(a) Ordinary Portland cement.

(b) Rapid hardening Portland cement.

(c) Extra rapid hardening Portland cement.

(d) Portland blast-furnace cement.

(e) Low heat Portland cement.

(f) Sulphate resisting Portland cement.

(g) White Portland cement.

(h) Colored Portland cement.

2. Natural cements.

3. High alumina cement.

4. Supersulphated cement.

5. Special cements:

(a) Masonry cement.

(b) Trass cement.

(c) Expansive cement.

(d) Oil well cement.

(e) Jet set cement.

(f) Hydrophobic cement.

(g) Waterproof cement.

American Types of Cement

In America Portland cements are divided under the ASTM

(American Society for Testing Materials) Standards into the following types:

Type Ⅰ: For use in general concrete construction where the special properties specified for types Ⅱ, Ⅲ, Ⅳ and Ⅴ are not required.

Type Ⅱ: For use in general concrete construction exposed to moderate sulphate action, or where moderate heat of hydration is required.

Type Ⅲ: For use when high early strength is required.

Type Ⅳ: For use when low heat of hydration is required.

Type Ⅴ: For use when high sulphate resistance is required.

In addition, there are Type ⅠA, ⅡA and ⅢA which are exactly the same as Types Ⅰ, Ⅱ, and Ⅲ except that they have an air-entraining agent added.

The Manufacture and Delivery of Portland Cement

The principal raw materials used in the manufacture of cement are:

1. Argillaceous, or silicates of aluminum in the form of clays and shales.

2. Calcareous, or calcium carbonate, in the form of limestone, chalk and marl which is a mixture of clay and calcium carbonate.

The ingredients are mixed very roughly in the proportion of two parts of calcareous material to one part of argillaceous material. Limestone and shales have first to be crushed. They may then be ground in ball mills in a dry state or mixed in a wet state, the latter being preferable for the softer types of raw material and most commonly used by British manufacturers as it permits more accurate control of the ultimate composition . The dry powder, or in the case of the wet process the slurry, is then burnt in a rotary kiln at a tem-

perature between 1 400 ℃ to 1 500 ℃, pulverized coal, gas or oil being used as the fuel. In the wet process the chemical composition of the slurry can easily be checked and if necessary corrected before it is passed into the kiln.

The clinker obtained from the kilns is first cooled and then passed on to ball mills where gypsum is added and it is ground to the requisite fineness according to the class of the product. The finished product is generally stored in silos at the works before dispatch, but in terms of shortage it may be sent to the user straight from the mills, in which case it will still be hot when used. This has led to considerable controversy and hot cement has often rejected by the user. In fact, cement in a hot state can normally be used quite satisfactorily, as the aggregate and water are sufficient in bulk to reduce the temperature quickly to a safe value. Cement can be sent to the user in bulk containers or can be packed in drums, jute sacks or multiply paper bags, the last now being favored in British practice.

In British practice a bag of cement weighs 1 cwt (112 lb) giving 20 bags to the ton. In American practice a bag of cement contains 94 lb of cement giving 24 bags to the ton and a barrel contains 376 lb of cement giving 6 barrels to the ton.

Cement is normally assumed to weigh 90 lb per cu ft, although 82 lb per cu ft is perhaps a better average figure. It may weigh between 75 and 110 lb per cu ft according to its state of compaction. According to the ASTM specifications, cements which have been stored after testing and before delivery for more than 6 months in bulk or 3 months if in bags may be retested before use.

Compound Composition of Portland Cement

The constituents forming the raw materials used in the manufacture of Portland cements combine to form compounds in the

finished product, the following being the most important.

Compound	Chemical formula	Usual abbreviated designation
Tricalcium silicate	$3CaO \cdot SiO_2$	C_3S
Dicalcium silicate	$2CaO \cdot SiO_2$	C_2S
Tricalcium aluminate	$3CaO \cdot Al_2O_3$	C_3A
Tetracalcium alumino-ferrite	$4CaO \cdot Al_2O_3 . Fe_2O_3$	C_4AF

These compounds have been called Bogue compounds as it is largely due to him that they have been identified.

Bogue and others have given formulae by which the compound composition of cement can be calculated from the chemical analysis of the raw materials and the formulae adopted by the American Society for Testing Materials (ASTM) are as follows:

Amount of tricalcium silicate per cent

$= (4.07 \times \text{per cent } CaO) - (7.06 \times \text{per cent } SiO_2)$

$- (6.72 \times \text{per cent } Al_2O_3) - (1.43 \times \text{per cent } Fe2O_3)$

$- (2.85 \times \text{per cent } SO_3)$

Amount of dicalcium silicate per cent

$= (2.87 \times \text{per cent } SiO_2) - (0.754 \times \text{per cent } 3CaO \cdot SiO_2)$

Amount of tricalcium aluminate per cent

$= (2.65 \times \text{per cent } Al_2O_3) - (1.69 \times \text{per cent } Fe_2O_3)$

Amount of tetracalcium alumino-ferrite per cent

$= 3.04 \times \text{per cent } Fe_2O_3$

In addition, there may be present small amounts of gypsum, magnesium oxide, free lime and silicate in the form of glass.

A liquid is formed at the burning temperatures and this contains, in addition to other compounds, all the alumina and iron oxide present in the cement. The alumina and iron compounds present in the cement are formed by crystallization of this liquid on cooling. Some of the liquid may however form glass according to the condi-

tions in the kiln and the quantity of alumina and iron compounds formed will depend on the extent of this action. Variations in the kilning process therefore affect the properties of the cement. If glass is formed the quantities of alumina and iron compounds present will be reduced.

The C_3S and C_2S constituents form 70 to 80 per cent of all Portland cements, are the most stable and contribute most to the eventual strength and resistance of the concrete to corrosive salts, alkalis and acids. The C_3S hydrates more rapidly than the C_2S and it therefore contributes more to the early strength and the heat generated and therefore the rise in temperature. The contribution of the C_2S to strength takes place principally after 7 days and may continue for up to 1 year. The C_3A hydrates quickly and generates much heat. It makes only a small contribution to the strength principally within the first 24 hours and is the least stable of the four principal components of the cement. The C_4AF component is comparatively inactive and contributes little at any age to the strength or heat of hydration of the cement. It is more stable than the C_3A component but less stable than the C_3S and C_2S. The presence of glass increases the early strength and the heat generated. The C_3A is liable to decompose to hydroxides of calcium and aluminum on exposure to air and water and the ease with which it is attacked by salts and alkalis renders its presence undesirable for any hydraulic or marine works. The rates of heat evolution of the four principal compounds, if equal amounts are considered, would be in the following order: C_3A, C_3S, C_4AF and C_2S.

The difference in the properties of the various kinds of Portland cement arises from the relative proportion of the four principal compounds they possess and from the fineness to which the cement clin-

ker is ground. Thus rapid hardening Portland cement is ground finer than and may possess more C_3S and less C_2S than ordinary Portland cement. The difference for any one works is usually in the fineness of grinding. Sulphate-resisting cement is characterized by an exceptionally low percentage of C_3A and low heat cement should have a low percentage of C_3A and relatively more C_2S and less C_3S than ordinary Portland cement; it will therefore have a low rate gain of strength.

The compound compositions of cements of different manufacturers and in different countries can vary widely but an approximate idea of the relative proportions of the various compounds in the different kinds of Portland cement according to Lea is given in Table 1-1.

Table 1-1 Composition and compound of Portland cements

(After Lea)

Analysis: per cent	Rapid hardening	Normal	Low-heat	Sulphate resisting
Lime	64.5	63.1	60.0	64.0
Silica	20.7	20.6	22.5	24.4
Alumina	5.2	6.3	5.2	3.7
Iron oxide	2.9	3.6	4.6	3.0
Compounds: per cent				
Tricalcium silicate	50	40	25	40
Dicalcium silicate	21	30	45	40
Tricalcium aluminate	9	11	6	5
Iron compound	9	11	14	9

The salient point demonstrated by this table is the comparatively large variation in compound composition that can apply even with a very small variation in the chemical analysis of the raw materials.

Summary of Properties of the Principal Cements

The properties of cements can be summarized as in Table 1-2,

which is due to Lea.

Table 1-2 Properties of different cements

	Rate of strength development	Rate of heat evolution	Drying shrinkage	Resistance to cracking	Inherent resistance to chemical deterioration
Portland cements					
Rapid-hardening	High	High	Medium	Low	Low
Normal	Medium	Medium	Medium	Medium	Low
Low-heat	Low	Low	Somewhat higher	High	Medium
Sulphate-resisting	Low to medium	Low to medium	Medium	Medium	High
Cements containing blast-furnace slag					
Portland b.- f.slag	Medium	Medium	Medium	Medium	Medium
Supersulphate	Medium	Very low	Medium	Inadequate information	High
High alumina cement	Very high	Very high	Medium	Low	Very high
Pozzolanic cements	Low	Low to medium	Somewhat higher	High	High

New Words and Expressions

subdivide ['sʌbdi'vaid]
v. 细分,细区分,再划分
blast-furnace [blɑ:st'fə:nis]
n. 高炉,鼓风炉
supersulphated['su:pə(r)'sʌlfeitid]
adj. 富硫酸盐的,过硫化的
oil well 油井
alumina[ə'lju:minə]
n. 矾土;铝氧土,氧化铝
masonry['meisnri]
n. 砖石建筑,砌砖,砌块
hydrophobic[ˌhaidrə'fəbik]
adj. 憎水的
trass[træs]
n.[矿]火山灰,粗面凝灰岩
jet[dʒet]
n. 射流,喷气,喷射
waterproof['wɔ:təpru:f]
adj. 防水的,不透水的
sulphate['sʌlfeit]
n. 硫酸盐
air entraining agent 加气剂,引

气剂

argillaceous[ˌɑ:dʒi'leiʃəs]

adj. 泥质的,含粘土的

clay[klei]

n. 粘土

shale[ʃeil]

n. 页岩,油页岩

calcareous[kæl'kɛəriəs]

adj. 含钙的,石灰质的

calcium carbonate 碳酸钙

limestone['laimstəun]

n. 石灰石

chalk[tʃɔ:k]

n. 白垩,碳酸钙

marl[mɑ:l]

n. 泥灰石,泥灰岩

ingredient[in'gri:diənt]

n. 成分,组成部分,配料

roughly ['rʌfli]

adv. 概略地,粗糙地

ball mill 球磨机

slurry['slə:ri]

n. 泥浆

kiln[kiln]

n.(砖,石灰等的)窑,炉,

vt. 烧窑,在干燥炉中使……干燥

rotary cement kiln

回转式水泥窑

pulverize ['pʌlvəraiz)]

v. 研磨成粉

clinker['kliŋkə]

n. 水泥熟料,渣块

gypsum['dʒipsəm]

n. 石膏

requisite ['rekwizit]

adj. 必要的,所需要的

drum [drʌm]

n. 转筒,滚筒

jute[dʒu:t]sack[sæk]

黄麻袋,麻布袋

barrel['bær(ə)l]

n. 桶

cwt *abbr*. = hundredweight

英担(1/20 吨,英制为 112 磅,美制为 100 磅)

tricalcium[trai'kælsiəm]

n. 三钙

tricalcium silicate 硅酸三钙

dicalcium[dai'kælsiəm]

n. 二钙

dicalcium silicate 硅酸二钙

aluminate[ə'lju:mineit]

n. 铝酸盐

tetracalcium['tetrə'kælsiəm]

n. 四钙

aluminoferrite[əljuminəu'ferait]

n. 铁铝酸盐

formulae ['fɔ:mjulə](formula 的复数)

n. 公式,算式

magnesium[mæg'ni:ziəm]

n. 镁 (Mg)

crystallization[,kristəlai'zeiʃən]

n. 结晶

corrosive[kə'rəusiv]

adj. 侵蚀的,腐蚀性的

alkali['ælkəlai]

n. 碱,强碱

hydrate['haidreit]

v. 与水化合,水化

decompose[,di:kəm'pəuz]

n. 分解

v. 分解

aluminum[ə'lu:minəm]

n. 铝(Al)

hydraulic[hai'drɔ:lik]

adj. 水力的,用水的

marine[mə'ri:n]

adj. 海的,海产的

salient['seiljənt]

adj. 显著的,突出的,卓越的

lime[laim]

n. 生石灰,石灰

silica['silikə]

n. 硅石,二氧化硅,氧化硅

inherent[in'hiərənt]

adj. 固有的,先天的

deterioration[di,tiəriə'reiʃən]

n. 退化,变质

slag[slæg]

n. 矿渣,熔渣

pozzolanic[,pɔtsə'lɑ:nik]

adj. 火山灰质的

Exercises

1. For each of the incomplete sentences below you are to choose one answer (A, B, C, or D) that best completes the sentence, and fill the corresponding letter in the blank or blanks of each sentence.

(1) Cements can be divided into ____ categories.

A. 8 B. 7 C. 6 D. 5

(2) According to the ASTM specifications, cements which has been stored after testing and before delivery for more than ____ months in bulk or ____ months if in bags may be retested before use.

A. 3, 3　　B. 3, 6　　C. 6, 3　　D. 6, 6

(3) The ingredients are mixed very roughly in the proportion of ____ parts of calcareous material to ____ part of argillaceous material.

A. 1, 1　　B. 1, 2　　C. 2, 1　　D. 3, 1

(4) The latter being preferable for the softer types of raw material and most commonly used by British manufacturers ____ it permits more accurate control of the ultimate composition.

A. because　　B. if　　C. as　　D. though

(5) The clinker obtained from the kilns is first cooled and then passed on to ball mills where gypsum is added and it is ground to the requisite fineness ____ the class of the product.

A. in terms of　　B. according to

C. because of　　D. due to

(6) Cement is normally assumed to weigh 90 lb per cu ft, ____ 82 lb per cu ft is perhaps a better average figure.

A. although　　B. even if　　C. in fact　　D. though

(7) The alumina and iron compounds present in the cement are formed by crystallization of this liquid ____ cooling.

A. in　　B. on　　C. while　　D. at

(8) The C_3S hydrates more ____ than the C_2S and it therefore contributes more to the ____ strength and the heat generated and therefore the rise in temperature.

A. rapid, early　　B. slow, late

C. rapidly, early　　D. slowly, late

(9) Rapid hardening Portland cement is ground finer than and may possess ____ C_3S and ____ C_2S than ordinary Portland cement.

A. more, more　　B. more, less

C. less, more　　D. less, less

(10) The order of the stable of the four principal components of