NOW TRY IN ENGLISH CLIL

Portland cement

The chief ingredient in cement paste is Portland cement. It is a hydraulic cement and is the binding agent in Portland cement concrete (PCC). It hardens into a solid mass when combined with water. It forms PCC if interspersed in an aggregate matrix. Portland cement has been used for over 175 years and the results have always been positive and satisfying. Portland cement is a complex substance. Its mechanisms and interactions have not yet been explored. In the table below there are the definitions provided by ASTM C 125 and the Portland Cement Association (PCA).

Hydraulic Cement	An inorganic material or a mixture of inorganic materials that sets and develops strength by chemical reaction with water by formation of hydrates; capable of doing so under water.
Portland Cement	A hydraulic cement composed primarily of hydraulic calcium silicates.

Background

The use of cements (both hydraulic and non-hydraulic) goes back many thousands of years. Ancient Egyptian used cement. But it was in the 19th century that Portland cement firstly occoured. Joseph Aspdin took out a patent on a hydraulic cement in 1824. He called this kind a cement «Portland» cement. He named the cement "Portland" because it produced a concrete similar in colour to a natural limestone found on the Isle of Portland, a peninsula in the English Channel. Today the name «Portland cement» is recognized as a trade name for a type of material.
Today about 1.56 billion tonnes of Portland cement are produced each year. In fact it is the most widely used building material in the world. Each year Annual global around 3.8 million cubic meters (5 billion cubic yards) are produced. In the U.SA, rigid pavements Portland cement and Portland cement concrete are for rigid pavements.

Manufacturing

There are several variations of commercially manufactured Portland cement on the market but they have many of the same basic raw materials and chemical components. Calcium, silica, alumina and iron are the chief chemical components of Portland cement. Calcium is derived from limestone and chalk. Silica, alumina and iron come from the sands, clays and iron ore sources. Shale, shells and industrial by-products such as mill scale are other raw materials.

These materials are processed and heated in a kiln to about 1400 to 1600°C. At this temperature range the materials form calcium silicates. This heated substance, called «clinker» has the form of small gray-black pellets about 12.5 mm (0.5 inches) in diameter. Clinker is then cooled and pulverized into a fine powder that almost completely passes through a 0.075 mm (No. 200) sieve. Then it is fortified with a small amount of gypsum. In the end Portland cement is produced. This process is perfectly illustrated on the website of The Portland Cement Association (PCA).

Chemical properties

Portland cement's chemical properties determine its physical properties. Therefore, a basic understanding of Portland cement chemistry is necessary to understand how and why it behaves as it does. The table describes the basic chemical composition of a typical Portland cement and how it hydrates.

Chemical Name	Chemical Formula	Shorthand Notation	Percent by Weight
Tricalcium Silicate	$3CaO \times SiO_2$	C_3S	50
Dicalcium Silicate	$2CaO \times SiO_2$	C_2S	25
Tricalcium Aluminate	$3CaO \times Al_2O_3$	C_3A	12
Tetracalcium Aluminoferrite	$4CaO \times Al_2O_3 \times Fe_2O_3$	C_4AF	8
Gypsum	$CaSO_4 \times H^2O$	CSH_2	3.5

Main constituents in a typical Portland cement

Activities

True (T) or False (F)?

T F 1) Portland cement is the chief ingredient in cement paste.

T F 2) Portland cement is a hydraulic cement that, when combined with water, hardens into a solid mass.

T F 3) Portland cement when interspersed in an aggregate matrix it forms PCC.

T F 4) In the U.S., rigid pavements are the largest single use of Portland cement and Portland cement concrete

T F 5) The chief chemical components of Portland cement are calcium, silica, alumina and iron.

T F 6) Portland cements rarely are for pavement applications.

Tick the correct answer

1) The first occurrence of «Portland cement» came:
a) about in the 17th century.
b) about in the 18th century.
c) about in the 19th century.

2) Joseph Aspdin took out a patent on a hydraulic cement that he coined «Portland» cement:
a) in 1724.
b) in 1824.
c) in 1924.

3) Portland cement is the most widely used building material in the world with:
a) about 2.56 billion tonnes produced each year.
b) about 1.56 billion tonnes produced each year.
c) about 3.56 billion tonnes produced each year.

4) The basic manufacturing process heats these materials in a kiln to:
a) about 1400 to 1600°C.
b) about 1500 to 1700°C.
c) about 1700 to 1800°C.

Complete the sentences with correct word

1) Hydraulic Cement is an inorganic material or a mixture of inorganic materials that sets and develops strength by chemical reaction with …….. by formation of hydrates; capable of doing so under water.
2) Portland cement is a …….. cement composed primarily of hydraulic calcium silicates.
3) Aspdin named the cement because it produced a …….. that resembled the colour of the natural limestone quarried on the Isle of Portland.
4) Clinker is cooled and pulverized into a fine powder that almost completely passes through a 0.075 mm (No. 200) sieve and fortified with a small amount of …….. .

Keys

True (T) or False (F)?

~~T~~ F 1) Portland cement is the chief ingredient in cement paste.

~~T~~ F 2) Portland cement is a hydraulic cement that, when combined with water, hardens into a solid mass.

~~T~~ F 3) Portland cement when interspersed in an aggregate matrix it forms PCC.

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Complete the sentences with correct word

1) Hydraulic Cement is an inorganic material or a mixture of inorganic materials that sets and develops strength by chemical reaction with WATER by formation of hydrates; capable of doing so under water.
2) Portland cement is a HYDRAULIC cement composed primarily of hydraulic calcium silicates.
3) Aspdin named the cement because it produced a CONCRETE that resembled the colour of the natural limestone quarried on the Isle of Portland.
4) Clinker is cooled and pulverized into a fine powder that almost completely passes through a 0.075 mm (No. 200) sieve and fortified with a small amount of GYPSUM .