INGREDIENT OF PORTLAND CEMENT

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Abstract: Portland cement is the most common type of cement in general use around the world as a basic ingredient of concrete, mortar, stucco, and non-specialty grout. It was developed from other types of hydraulic lime in England in the early 19th century by Joseph Aspdin, and is usually made from limestone. It is a fine powder, produced by heating limestone and clay minerals in a kiln to form clinker, grinding the clinker, and adding 2 to 3 percent of gypsum. Several types of portland cement are available. The most common, called ordinary portland cement (OPC), is grey, but white Portland cement is also available. Its name is derived from its resemblance to Portland stone which was quarried on the Isle of Portland in Dorset, England. It was named by Joseph Aspdin who obtained a patent for it in 1824. However, his son William Aspdin is regarded as the inventor of "modern" portland cement due to his developments in the 1840s.

Portland cement (English: Portland - from the name of a peninsula in the United Kingdom), a water-resistant binder; building material. The composition consists mainly of calcium silicates. It is the most common type of cement. The mixture of clinker and gypsum (3-7%) is very soft. A certain amount (10-15%) of active mineral substance can be mixed into the mixture. According to the composition, properties and fields of application, Portland cement is divided into simple, quick-hardening, hydrophobic, sulfate-resistant, white, used in the production of asbestos-cement products, and others. The composition and quality of Portland cement mainly depends on the composition of clinker and how soft it feels. Its most important property is the ability to harden when exposed to water. This feature is determined by the brand, the brand of Portland cement produced in Uzbekistan ranges from 300 to 600 (the higher the brand, the higher the quality of the material).

The low cost and widespread availability of the limestone, shales, and other naturally-occurring materials used in portland cement make it one of the lowest-cost materials widely used over the last century. The most common use for portland cement is in the production of concrete. Concrete is a composite material consisting of aggregate (gravel and sand), cement, and water. Concrete produced from Portland cement is one of the world's most versatile construction materials, and has changed the world in almost every observable aspect. It is one of the most widely used substances on Earth, and as such, portland cement manufacturing is currently vital to the world's economy. It is one of the construction industry's largest cause of climate changing carbon dioxide emissions.

Portland cement clinker is made by heating, in a cement kiln, a mixture of raw materials to a calcining temperature of above 600 °C (1,112 °F) and then a fusion temperature, which is about 1,450 °C (2,640 °F) for modern cements, to sinter the materials into clinker.

The materials in cement clinker are alite, belite, tricalcium aluminate, and tetracalcium alumino ferrite. The aluminium, iron, and magnesium oxides are present as a flux allowing the calcium silicates to form at a lower temperature,[15] and contribute little to the strength. For special cements, such as low heat (LH) and sulfate resistant (SR) types, it is necessary to limit the amount of tricalcium aluminate ($3\ CaO{\cdot}Al_2O_3$) formed.

The major raw material for the clinker-making is usually limestone ($CaCO_3$) mixed with a second material containing clay as source of alumino-silicate. Normally, an impure limestone which contains clay or SiO_2 is used. The $CaCO_3$ content of these limestones can be as low as 80%. Secondary raw materials (materials in the raw mix other than limestone) depend on the purity of the limestone. Some of the materials used are clay, shale, sand, iron ore, bauxite, fly ash, and slag. When a cement kiln is fired by coal, the ash of the coal acts as a secondary raw material.

Typical constituents of portland clinker plus gypsum showing cement chemist notation (CCN)

Clinker	CCN	Mass
Tricalcium silicate $(CaO)_3 \cdot SiO_2$	C_3S	25–50%
Dicalcium silicate $(CaO)_2 \cdot SiO_2$	C_2S	20–45%
Tricalcium aluminate $(CaO)_3 \cdot Al_2O_3$	C_3A	5–12%
Tetracalcium aluminoferrite $(CaO)_4 \cdot Al_2O_3 \cdot Fe_2O_3$	C_4AF	6–12%
Gypsum $CaSO_4 \cdot 2\ H_2O$	$C\bar{S}H_2$	2–10%

Portland cement production includes two processes:

- Clinker production;
- Filling clinker with additives.
- First of all, the process is very complicated, and its implementation is associated with large funds and implementation costs. Because most of the total cost of Portland cement production (70-80%) is the cost of clinker.
- The following main technological operations are performed in the production of Portland cement clinker.
- limestone and clay are mined
- raw materials are prepared and ground
- fuel is prepared
- raw materials are burned

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