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ALIEN PROPERTY CUSTODIAN

HYDRAULIC CEMENT

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This invention relates to a process for producing a high-grade hydraulic cement.

We know already that hydraulic cements which contain alumina and iron in approximately stocchiometric proportions are to be considered as especially high-grade products, because they are distinguished by little liability to shrink, great resistiveness to chemical attacks connected with high strength properties and the production of insignificant heat of hydration in setting. However the manufacture of such cements is in practice subject to considerable difficulties, inasmuch as with a determined content of sesquioxides within narrow limits, the adjustment of the low

$$\frac{Al_2O_3}{Fe_2O_3}$$

modulus required for Ferrari cements is only obtainable with the use of rare materials of specific composition.

Now we have found it advantageous to combine the production of such high-grade cements with an especial process of recovering alumina. Especially adapted for this purpose is the method of solubilizing the raw materials with lime, whereby we are also enabled to utilize materials relatively poor in alumina and rich in silica, viz. in such a manner that the raw materials are heated with lime so as to transform the alumina into calcium aluminates. The calcium aluminates contained in the partly solubilized material are then dissolved in water or aqueous liquids and the alumina is separated from these solutions by well-known means.

On lixiviating the solubilized materials with water a residue is left showing approximately the following composition:

	Per cent
SiO_2	24
Fe_2O_3	7
Al_2O_3	3
CaO	63

This residue is excellently adapted for producing the desired high-grade Ferrari cements so that now, without relying upon especial and possibly rare raw materials the desired low alumina modulus can be adjusted. For instance, by admixing the residue of such lixiviation to a normal raw Portland cement mixture containing about 78% $CaCO_3$, in a combining ratio of 1:1, after calcining the most valuable Ferrari cement containing alumina and iron in nearly stocchiometric proportions is obtained which is especially important for road-building. When proceeding in this manner not only the stores of high-grade limestone are saved, but moreover no pyrite roasting products or other iron ores are needed which otherwise are required for making Ferrai cement.

Example

1000 kilograms of a raw material having the following composition:

	Per cent
Calcining loss	9.5
SiO_2	37.8
Fe_2O_3	16.6
Al_2O_3	30.2
CaO	3.4

were sintered in a rotary furnace at about 1400° C. with 1710 kilograms of limestone containing 97% $CaCO_3$. The finely comminuted calcined product was treated with about 120 cubic meters of water. The residue amounting to 1540 kilograms (calculated as dry material) was mixed with about the same weight of powdered raw Portland cement mixture having the following approximate composition:

	Per cent
Calcining loss	34.6
SiO_2	13.5
Fe_2O_3	1.9
Al_2O_3	3.9
CaO	42.7

After calcining in the well known manner a hydraulic cement having the following properties was obtained:

		Per cent
Analysis:	SiO_2	20.4
	Fe_2O_3	6.3
	Al_2O_3	5.7
	CaO	65.2
	MgO	1.1
	SO_3	0.9
Hydraulic modulus		2.01
Silicate modulus		1.70
Alumina modulus		0.90

Setting period, beginning 3¾ hours ending 5½ hours

Standard strengths (earth-moist material)

	1 day	3 days [1]	7 days [1]	28 days [1]	28 days [2]
Compression	190	428	507	588	673
Tension	23	30	36	40	49

[1] Water storing.
[2] Mixed storing.

Bending-tension and compression strength (plastic)

Bending tension	27	51	67	83	76
Compression	93	256	347	495	512

Shrinkage after 28 days: −0.24.

From the calcium aluminate solution, for instance, a mixture of calcium carbonate and hydrated alumina may be precipitated by carbon dioxide, which mixture may be used as such for making alumina cement, or the calcium carbonate may be separated and from the remaining product pure alumina may be recovered.

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