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BUILDING RESEARCH NOTE 67

CENTRAL BUILDING RESEARCH INSTITUTE, INDIA

PRODUCTION OF CEMENT CLINKER USING FLY ASH

Introduction

Cement Clinker is produced by burning at clinkering temperature a raw mix consisting of a calcareous material and an argillaceous one. Typical of the calcareous and argillaceous materials used generally are limestone and clay respectively.

Fly ash is produced in large quantities at various thermal power stations in India. It compares well in chemical composition with clay used in the raw mix for the production of cement clinker (Table 1). Investigations carried out at C.B.R.I. have shown that it can be used in place of clay as a source of SiO_2 and Al_2O_3.

Table 1

Chemical Composition of Indian Fly Ashes and Clay.

Chemical Composition	Indian Fly ashes	Clay
SiO_2, per cent	46—62	60.48
Al_2O_3, per cent	19—28	17.79
Fe_2O_3, per cent	4—20	6.77
CaO, per cent	0.6—4	1.61
MgO, per cent	0.2—2	3.0
SO_3, per cent	traces—0.3	0.21

Raw Mix Proportions

The raw mix used for producing cement clinker can be prepared by intimately mixing together in dry state 35—40 per cent flyash (on ignited basis) and ground limestone 60—65 per cent, to supply CaO, by weight. The Al_2O_3/Fe_2O_3 ratio could vary between 0.66 to 2.50. Addition of Fe_2O_3 may be required to obtain the desired Al_2O_3/Fe_2O_3 ratio when fly ash having a low content of Fe_2O_3 is used.

Manufacturing Process

Semi-dry process is adopted for the production of cement clinker. Small nodules (diameter not exceeding 1.25cm) of the raw mix are prepared in a rotating pan pellerizer using a fine spray of water. Any other type of pelletizer can be used for preparing nodules using 10-14 per cent water in the raw mix. The nodules are fed into the rotary kiln and burnt at 1350°C to form clinker, which, on cooling, is ground with 4 per cent gypsum by weight to obtain cement.

Properties of Cement

The properties of cement obtained from clinker produced in a pilot plant rotary kiln are listed in Table 2. A photomicrograph of a section of the clinker showing C_3S, C_2S and interstitial phases is shown in the figure.

Table 2

Properties of Cement Obtained from Clinker Produced in a Pilot Plant Rotary Kiln.

Properties	Results	IS : 269-1967* requirements
1. Fineness : Specific surface (Blaine), cm^2/g	3421	2250 minimum
2. Soundness :		
(i) Le Chatelier test expansion, mm	1.5	10 maximum
(ii) Autoclave test expansion, %	0.112	0.8 maximum
3. Setting Time :		
(i) Initial, minutes	63	30 minimum
(ii) Final, minutes	113	600 maximum
4. Compressive strength of 1:3 Cement-Standard Sand (Single size) mortar.		
3 days, kg/cm^2	174.6	115 minimum
7 days, kg/cm^2	231.7	175 minimum
28 days, kg/cm^2	320.6	—

* IS : 269-1967 Specification for ordinary, rapid hardening and low heat Portland Cement (Second Revision).

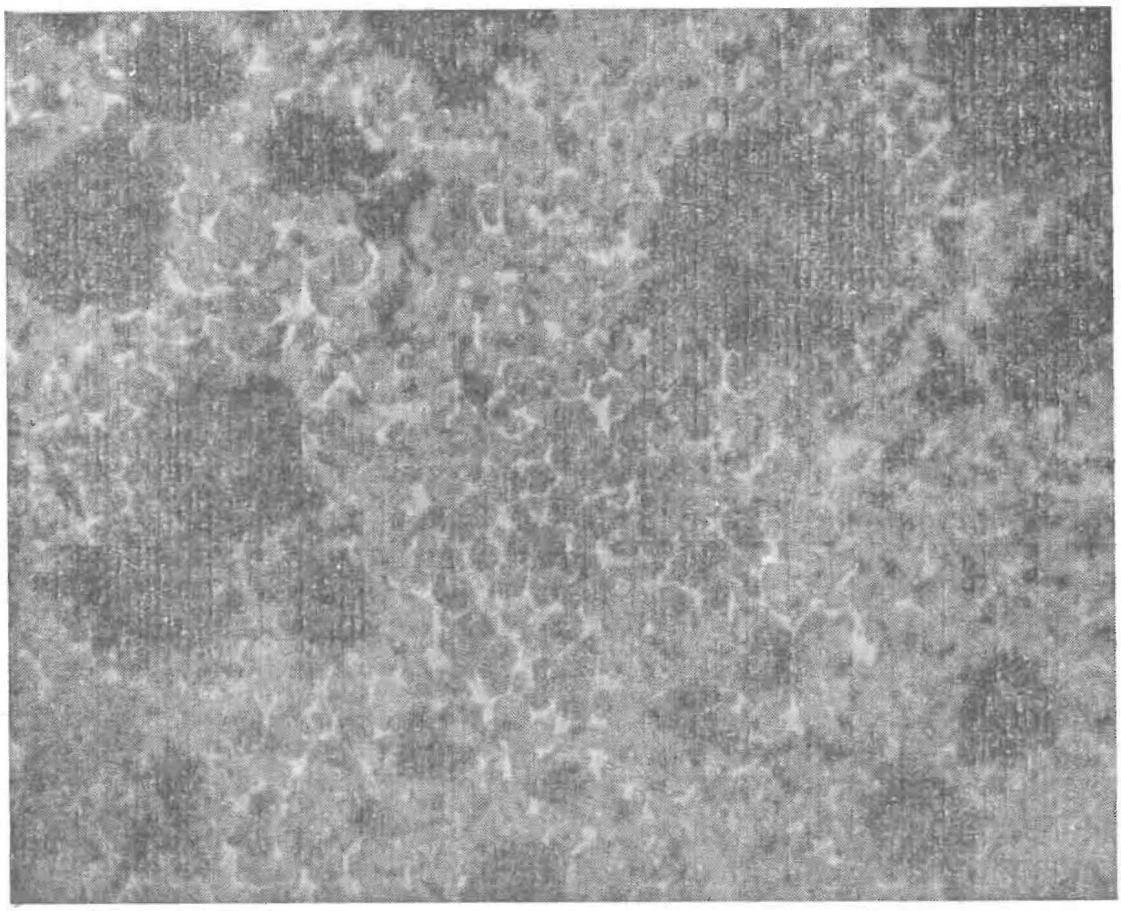
It can be seen that the cement developed high strength and conformed to all the specified requirements of Indiad Standard Specification for ordinary Portland Cement.

Advantages of Using Fly Ash in place of Clay

Use of fly ash in place of clay in the raw mix for producing cement clinker has followin advantages :

1. It enables production of high strength cement clinker at 1350°C instead of about 1450°C normally employed, thus bringing about a substantial saving in fuel consumption.
2. It enables production of Cement Clinker with MgO content of 6 per cent without causing unsoundness (as determined by autoclave test) in the final cement. In this way, it also helps in the utilization of magnesian limestone of marginally higher MgO content as a raw material.
3. It provides a profitable way of disposing off a large quantity of fly ash which is an industrial waste posing a serious problem of disposal.

The above mentioned advantages can be profitably exploited by cement works having limited resources of cement grade, high calcium limestone and located near thermal power stations producing fly ash.



A photomicrograph of a section of the clinker.

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