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EFFECT OF QUALITY OF PHOSPHOGYPSUM ON CEMENT QUALITY

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ABSTRACT

This paper comprises the study of phosphogypsumcollecting from different sources and used in cement/concrete manufacturing. Phosphogypsum is a smooth powder of calcium sulphate content. Some filths like phosphatic and fluoride cannot be removed completely by normal washing or any chemical treatment. However, phosphogypsum, when heated at preeminent temperature, the impurities become inert. Results displays that with the use of sodium sulfate and ferrous sulfate activators, highest attainment of strength can be achieved. A correlation was established between hydration and chemically combined water. Microscopic studies revealed that formation of euhedral prismatic and rhombic shaped gypsum crystals govern high strength development in the anhydrite cement. Manufacture of anhydrite cement from phosphogypsum is suggested because of its lesser energy requirements than the traditional edifice materials.

Keywords : ***Phosphogypsum, cement, concrete, gypsum.***

Introduction: In India, over 100 million tons of left-over materials are produced annually from the agro-industrial processes. Fly ash, slag, phosphogypsum, fluorogypsum, red mud, lime sludges, and mining stakeouts are the dominant industrial wastes that demand serious attention to save the fast-deteriorating environment. Phosphogypsum, a waste product of phosphoric acid fertilizer, is produced up to 5.0 million tons/annum in India and not more than 10.0% is used at existing. Efforts have been thru in several realms to use phosphogypsum in making cement [1], gypsum plasters [2], building products [3],and binders [4].

Phosphogypsum is an important ingredient of cement/concrete. It is used in cement /concrete to increase its setting time. In cement manufacturing industries phospogypsum is collected from different sources and mixes with clinker after mortaring lime stone,

Phosphogypsum is an ironic source of calcium sulfate booming impurities of phosphates, fluorides, organic matter, and alkalies. These filths avert direct use of phosphogypsum in edifice materials due to their bad outcome on regular setting and hardening of cements along with calcined gypsum. It is, consequently, essential to beneficiate phosphogypsum to grow rid of inoffensive impurities. Various Processes grounded on washing, thermal, or chemical extraction have been studied by many workers in Japan [5], Germany [6] India [3] etc. These processes are operative in reducing the filths to a greater extent. However, these processes could not be approved commercially due to their high cost of beneficiation. Researches carried out by Simanovskaya[7], Gordashevskii and Broido[8], Berezovskii[9], Singh et al. [10] and Ostrowski[11] have shown that filths can be made sluggish by treating the phosphgypsum at high temperatures.

Experimental:

The process to get the Gypsum contains collection of residuals from various consignments and selected by quarter and coning method after crushing for testing purpose. The crushed sample is heated in oven while maintaining constant temperature for overnight to check percentage of water and after it, the new crushed sample is treated with HCl for ½ hours. After filtration residual is washed with Luke warm distilled water for the testing of SO_3, Na_2CO_3.

In determination of percentage of SO_3one gm of $BaCl_2$ powder is used. For the filtration, WM-42 paper is used. The temperature is extremely high (600-800^{0}C) for the experiment. The sample of Gypsum with chemical composition is cited in table 1.

Result & Discussion:

In the construction of concrete from phosphogypsum, the actions of filths, particularly P_2O_5 and F, play an important role. As per previous knowledge, these filths are of different types, in which first is water soluble bulkypercentage of P_2O_5 and F exist on

the surface of gypsum crystals and in the interstices of agglomerated crystals as H_3PO_4, $Ca(H_2PO_4)$. H_2O, NaF and Na_2SiF_6[12], second is a portion of P_2O_5 and F in the gypsum lattice which has arrived in to solid solution with gypsum by substitution of HPO_4^{--}, $FPO_3^{--}$and AlF_5^{--} ions for SO_4^{--} ions because these crystals have identical lattice parameter and belong to the analogous space group [13,14], and last is insoluble form as $Ca_3(PO_4)2$ and CaF_2[15].

Table 1 Chemical composition of phosphogypsum

Constituents	Contents (%)
P_2O_5	0.472
F	0.864
Organic matter	0.589
SiO_2 + insoluble in HCl	0.288
$Al_2O_3 + Fe_2O_3$	0.537
CaO	31.091
MgO	1.312
SO_3	43.207
Na_2O	0.293
Loss on ignition	18.376

The water-solublefilths of P_2O_5 and F can be effortlesslydetached from phosphogypsum by washing with regular tap water. However, the P_2O_5obstructed ($CaHPO_42H_2O$) in the gypsum crystals is rather difficult to be removed by reason of its low solubility 0.0286 g/100 cm^3 water @ 35°C. The strength of cement and calcined gypsum are unpleasantly affected by slow suspension of $CaHPO_42H_2O$ with

the progressive hydration. It has been detected that throughout the heating of phosphogypsum at high temperature, the contamination $CaHPO_4 2H_2O$ gets renewed into calcium pyrophosphate (CaP_2O_7) which is water insoluble and consequently harmless [16,17]. This was established by procurement the nonappearance of phosphate in the extract prepared by trembling the anhydrite prepared from phosphogypsum in saturated lime water for 4 h. Data demonstrates that with enhancement in calcination temperature, the standards of specific gravity, pH and specific surface area increased and that of $CaSO_4.2H_2O$ content reduced. The increase in pH values beyond 800°C is probably because of formation of free lime from the fractional disintegration of gypsum.In the natural gypsum sources, anhydrite gypsum can frequently be come across, so its effect on cement's quality parameters must be attentive on [18-20].

Table 2 comparative chart of samples(gypsum/phosphogypsum) collecting from different sources

Source	Type of Gypsum	% R. M.	% Purity	% P_2O_5	% I. R.	% SO_3 (Reported)
Sample 1	Mineral	3.76	85.69		5.31	39.86
Sample 2	Mineral	4.80	60.63		25.55	28.20
Sample 3	Chemical	13.60	92.12		1.32	42.88
Sample 4	Chemical	18.60	93.37		0.73	43.43
Sample 5	Chemical	22.00	92.08	0.482	1.85	42.83
Sample 6	Mineral	12.40	80.99	0.00	5.46	37.67
Sample 7	Mineral	18.00	56.54	0.00	28.38	26.30
Sample 8	Mineral	12.00	86.30	0.00	4.00	40.14
Sample 9	Mineral	15.20	64.07	0.00	23.00	29.80
Sample 10	Mineral	14.60	63.38	0.00	23.43	29.48

CONCLUSION

The cement quality is depending upon its constituent from which it produced. One of them gypsum/phosphogypsum is major component is responsible for setting time. The sample of gypsum is treated under various parameters of purity and various treatments are performed for the elimination filths. From the above table it is concluded that ratio of gypsum/Phosphogypsum is diverse on the basis of quality standard. The best quality of constituent required lesser in quantity than others. Presentinvestigation reveals that sample1 does not required any specific purification process and it is comparatively better than other sample for the manufacturing of concrete.

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