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Investigation work on Replacing cement partially by different amounts of Phosphogypsum In Cement With Different Water Cement Ratio

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Abstract : Phosphogypsum is strong in the production of phosphoric acid, which is a major component of many fertilizers, the chemical industry. To protect the environment, many efforts are being made to use a variety of solid waste to use it in concrete production. . Another way to replace industrial-derived materials with solid industrial waste. The current report deals with an investigation with compressive, flexural testing, tensile testing is done when the partial amount of phosphogypsum is replaced concrète using 0%, 5%, 10%, 15%, and 20%, 25% with a water-tight seal 0.45 and 0.50. After completion of the work following the conclusions is drawn. The cement was restored by 5% and 10% phosphogypsum for 28 days the compressive strength increased by 7% and 4% compared to conventional concrète. Cement is replaced by 5% phosphogypsum for 28 days Tensile strength is increased by 25% compared to conventional concrète. Cement replaced by 5% and 10% phosphogypsum for 28 days Flexural strength is almost the same compared to a conventional concrète.

Keywords-Phosphogypsum,solid wastes,partial replacement, water-binder ratio.

1. INTRODUCTION

GENERAL

Now each day with the advanced cement of technology and increased field application of concrete and mortars the strength, workability, durability, and other characteristics of the standard concrete is continually undergoing modifications to form it more suitable for any situation. The expansion in the infrastructure sector led to the scarcity of cement due to which the value of cement increased incrementally. In India, the value of cement during 1995 was around Rs. 1.25/kg and in now day 2021the worth increased approximately sixfold and increasing till. The demand for cement is more. Thanks to this construction cost of the structure are increases. to beat the scarcity of cement and reduce the value of concrete under these circumstances the utilization of solid wastes, agricultural wastes, and industrial by-products like ash, furnace slag, silica fume, rice husk, phosphogypsum, etc. came into use. The utilization of the above-mentioned waste products with concrete in partial amounts replacing cement paved a task for Enhancing concrete properties,

2)To control the cost of concrete,

3)The advantageous disposal of commercial wastes,

4) To protect the environment.

The use of particular waste is going to be economically advantageous usually at the place of abundant availability and production. Much of the literature is out there on the utilization of ash, furnace slag, silica fume, rice husk, etc. in the manufacture of cement concrete. However, the literature on the utilization of phosphogypsum in partial replacement of cement in concrete shows more application in the construction area. this report specializes in the use of phosphogypsum in the partial replacement of cement of fly ash, blast furnace slag, silica fume, rice husk, etc. in the manufacture of cement concrete. However, the literature on the use of phosphogypsum in partial replacement of cement in concrete shows more application in the construction area. This report focuses on the use of phosphogypsum in the partial replacement of cement in concrete.

PHOPHOGYPSUM

After the reaction of the sulphuric-acid on phosphate rock, the Phosphogypsum is a by-product in the wet process. India the bulk of phosphogypsum is produced by the dehydrating process thanks to its simplicity operational and lower as compared to other processes. The annual production of phosphogypsum from one dozen phosphoric acid and fertilizers is of the order of approximately five million tons. Fly ash is the first largest pollutant and phosphogypsum is the second largest. At present, in India, only about 12% of phosphogypsum is being utilized from the massive amount produced. The proper utilization of phosphogypsum is

required to unravel environmental and disposal problems. Considerable efforts are being taken worldwide to utilize natural waste and by-products as supplementary cementing materials to improve the properties of cement concrete.

Fig.1. Phosphogypsum

Currently every year about 100 million phosphoric acid yields. While most of the remainder of the planet checked out phosphogypsum as a valuable staple and developed a process to utilize it in chemical manufacture and building products, India blessed with abundant low-cost natural gypsum piled the phosphogypsum up rather than bear the additional expense of utilizing it as a raw material. It should be noted that in most of this point period the first reason phosphogypsum wasn't used for construction products in India was that it contained small quantities of silica, fluorine, and phosphate (P205) as impurities and fuel was required to dry it before it might be processed for a few applications as a substitute for natural gypsum, which is a material of higher purity. However, these impurities impair the strength development of calcined products. The generation of phosphogypsum poses various environmental as well as storage problems. Phosphogypsum is typically deposited within the open areas or dumped into a river or sea. The lack of consumption possibility of phosphogypsum causes landfill Problem and environmental pollution. Therefore, it will be worth it if phosphogypsum will be used.

EXPERIMENTAL PROGRAM

2.1 Cement The cement used was Birla Cement Ordinary Portland cement (53-grade cement). The cement was procured from local markets and in one lot to maintain uniformity throughout the investigation.The different properties of cement are: specific gravity-3.15, normal consistency-27.5%, fineness-3%, initial setting time-40minutes, and final setting time- 470 minutes.

2.2 Fine Aggregates The available sand confirming to IS 383:1970 is employed as fine aggregate within the present investigation. According to IS 2386-1963, the specific gravity noted was 2.86.

2.3 Coarse Aggregate Locally available in market coarse aggregate was chosen. 20mm is the highest nominal size of coarse aggregate. About the total volume of concrete, the major part meaning 70-75% is occupied by aggregates. They work as an economical space filler and give a rigid skeleton structure to concrete. 2.8 was noted as Specific gravity.

2.4 Water For various operations like curing and mixing tap water was used.

2.5 Phosphogypsum- From HiTech agro-industries, Pune in Maharashtra State, INDIA collection of Phosphogypsum with specific gravity 3.15 was gravity obtained w. The chemical composition of phosphogypsum is as follows.

Table 1- Chemical composition of phosphogypsum

Chemical Constitution	percentage
CaO	31.2
SiO2	3.92
SO3	42.3
R2O3	3.6
MgO	0.49
Phosphate, Floride	18.49

3. MIX TEST RESULTS -CEMENT -PHOSPHOGYPSUM

3.1. Normal Consistency-

The normal consistency was conducted as per IS 4031-1988. It was observed that phosphogypsum provides additional stiffness to the paste and therefore it had been required to feature water for desired penetration of Vicats plunger. However, for 5% replacement of raw phosphogypsum, the normal consistency is very on the brink of standard value and for further addition of phosphogypsum, the value increased beyond the limit specified in IS:12269-1987 i.e. 30% as per Indian standards. The normal consistency results are tabulated in the table below

Table 2: Normal consistency of cement and cement % replacement of cement Normal consistency

% Replacement of cement	Normal Consistency
0	27.6
5	29.6
10	32.8

15	33.4
20	35.7
25	36.3

3.2. Setting time-The setting time was conducted as per IS:4031-1988. For Ordinary Portland Cement, it was observed that small replacement of for 5% replacement of cement with raw of impure phosphogypsum there was an increase in time above the standard value for as specified in IS:12269-1987.

Table 3: Setting time of cement and cement-phosphogypsum mixes-

% replacement of cement	Initial setting time (min)	Final setting time (min)
0	35	470
5	112	610
10	190	677
15	244	950
20	288	970
25	290	975

3. Soundness Test -As per theIS: 4031-1988 test of the soundness of cement was performed. After replacing the cement to measure the soundness of the paste is very important. The test results are presented in the table below. It was observed that even after maximum replacing of 25% of cement has zero contribution to unsound paste.

Table 4: Soundness of cement and cement – phosphogypsum mixes

% Replacement of cement	soundness
0	0.55
5	1
10	3
15	6
20	8.6
25	9

4. Mixture Proportioning

As per IS 10262- 1982 the mix proportion was done. For the OPC control mixtures, the target strength is 31.6 Mpa(M25) , the total binder content is 437.77 kg/m3, fine aggregate is 749.76 kg/m3, and coarse aggregate 1164.76 kg/m3 for the water to binder ratio as 0.45. And the total binder content is 394 kg/m3, fine aggregate is 761.12 kg/m3, and coarse aggregate 1181.88 kg/m3 for the water to binder ratio as 0.50. For both binder ration 0f 0.45 and 0.50, the cement is replaced by phosphogypsum for 5%,10%,15% and 25% .Moulds used for casting are Cube, Beam, and Cylindrical. Compaction of concrete is done in three layers with a 16mm rod with 25 strokes for each layer. The left-behind concrete is allowed to set for 24 hours before demoulding of cubes and place in the curing tank. The curing Period for concrete cubes for a compression test is 7 and 28 days and that for flexural and tensile test for beam and cylinder is 28 days.

5 Expected Outcomes

After the experimental data, the Result was taken from all the tests performed of materials cement and cement +phosphogypsum also referring to various research papers. Following are some conclusions made,

1.] To create a good and hardened concrete to balance the economy we need to find out at what percentage part of ordinary Portland cement can be replaced with phosphogypsum.
2.]There an increase in setting time, standard consistency, but soundness property was not affected after Partial replacement of cement by phosphogypsum.
3.]Compressive Strength and tensile strength had increased by replacing 10% of cement with phosphogypsum at 28 days for different water binder ratios. BUT after a further increase in replacement, there was a decrease in compression and tension strength.
4.]Environmental hazards are reduced by using Partially replaced Pg
5.]produces economical and eco-friendly concrete.

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