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Investigation on Permeability Charecteristics of Phosphogypsum Based Concrete

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Abstract: *Concrete Permeability may be the most relevant property affecting its durability, especially under exposure to aggressive environment, as a permeability is an aspect of concrete performance that must be specified, designed for an monitored in the production of concrete. To determine the chloride permeability of concrete, many engineers have increasingly been using AASHTO T277, "Rapid determination of the chloride permeability of concrete". The main objective of this study is been to evaluate the permeability of concrete with phosphogypsum as admixture by using the "Rapid chloride chloride ion permeability teat(RCPT)" with all specifications confirming to ASTMC 1202 to evaluate the permeability of concrete with phosphogysum as admixture a series of tests were planned and performed. Replacement of cement by phosphorgypsum as 0%, 10%, 20% and 30% for water / powder ratio 0.50 of M_{25} grade concrete for every mix 3 cubes of size 150mmX150mmX150mm and 6 cylinders of size 95mm diameter and 50mm height were casted. Cubes were tested at 28 days after casting and the statistical data presented. 3 cylinders were tested at 28 days after casting and remaining 3 cylinders were tested at 90 days after casting. Based on the amount of charge passed in coulombs, Chloride ion permeability of the concrete may be defined as high, moderate, low and very low. The statistical data of chloride ion permeability at 28 days and 90 days is presented.*

Keywords: *chloride, Permeability, phosphogypsum,*

I. Introduction

The word 'pozzolana' was derived from pozzuolu, a town in Italy, a few miles from Naples and mount vacuous. The materials are of volcanic region containing various fragments of pumice, obsidian, feldspars, and quartz etc. The name 'Pozzolana' was first applied exclusively to this material. But the term has been extended later to diatomaceous earth, highly siliceous rocks and other artificial products. Thus, the pozzolanic materials are natural or artificial having nearly the same composition as that of volcanic tuffs or ash found at pozzuolu. Pozzolanic materials can be divided into two groups, namely i) Natural Pozzolana ii) Artificial pozzolanas. The natural pozzolanas are a) Clay and shale b) Opalineshales c) diatomaceous earth d) volcanic tuffs and e) pumicities. On the other hand a) Low calcium fly, ash b) High calcium fly ash c) silica fume d) surkhi are the artificial pozzolanas. MetaCem is made from purified kaolin. Most of the natural pozzolanas require grinding to a high degree of fineness to make them suitable for use in concrete except pumicities, which are normally in the finely divided form.With the advancement of technology and increased field application of concrete and mortars the strength, workability, durability and other characteristics of the ordinary concrete is continually undergoing modifications to make it more suitable for any situation. The growth in infrastructure sector led to scarcity of cement because of which the cost of cement increased incrementally. In India, the cost of cement increasing day to day. In order to combat the scarcity of cement and the increase in cost of concrete under these circumstances the use of recycled solid wastes, agricultural wastes, and industrial by-products like fly ash, blast furnace slag, silica fume, rise husk, phosphogypsum, etc. came into use. The use of abovementioned waste products with concrete in partial amounts replacing cement paved a role for

1. modifying the properties of the concrete,
2. controlling the concrete production cost
3. to overcome the scarcity of cement, and finally
4. the advantageous disposal of industrial wastes

II. Results And Discussions

II.1 Compressive Sterngth Of Phosphogypsum Concrete

The Compressive strength test were conducted on 15cmX15cmX15cm cubes of different Phosphogypsum concrete mixes at 28 days and results tabulated as follows.

Table 2.1 Variation of compressive strength with replacement of cement with Pohosphogypsum

S.No	% of Phoshogypsum	Compressive strength in MPa
1	0%	30.30
2	10%	32.43
3	20%	20.80
4	30%	16.10

II.2 Chgloride Ion Permeability Of Phosphogypsum Concrete

Chloride ion permeability tests were conducted on 95mmdiameter X50mm height cylindrical specimens at 28 days and 90 days the results tabulated as follows.

Table 2.2 Variation of Chloride ion permeability with replacement of cement with Phosphogypsum

S. No	% of Phosphogypsum	Chloride ion permeability in coulombs at 28 days	Chloride ion permeability in coulombs at 90 days
1	0%	3076	1834
2	10%	2775	1759
3	20%	2630	1648
4	30%	2426	1525

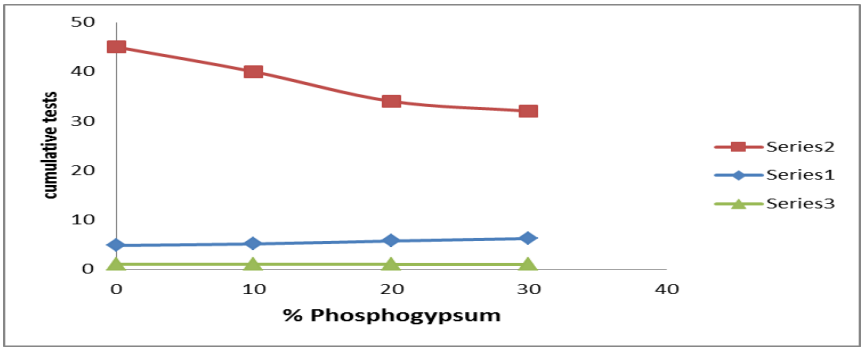

Fig. 2.1 Variation of Compressive Strength with Replacement of Phosphogypsum

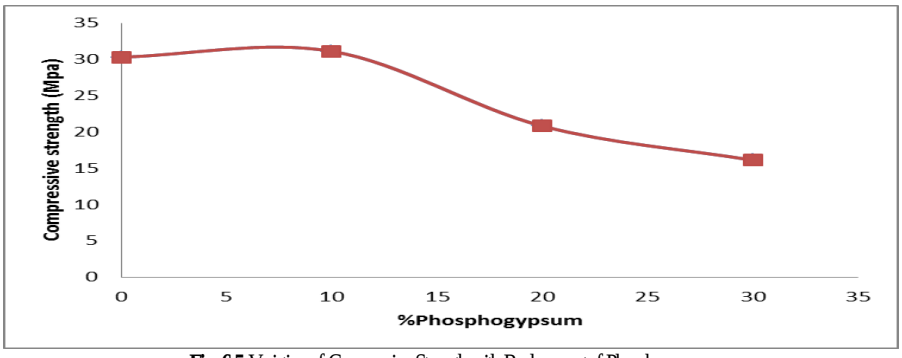

Fig. 6.5 Variation of Compressive Strength with Replacement of Phosphogypsum

III. Conclusion

Based on the results obtained from this study, the following Conclusions seems to be valid.

1. The increase in percentage replacement of cement with Phoshogypsum from 0% to 30% causes decrease in Slump value and Compaction factor value, but increase Vee-bee degree. This shows workability is reducing as percentage of Phosphogypsum increasing. However at 10% replacement of cement with Phosphogypsum the reduction in workability is very nominal. Hence, 10% replacement of cement with Phosphogypsum is suitable from workability point of view.
2. The increase in percentage replacement of cement with Phosphogypsum from 0% to 10% causes increase in compressive strength of concrete from 30.30MPa to 32.43MPa. Further increase in percentage replacement of cement with Phosphogypsum from 10% to 30% causes decrease in the compressive strength from 32.43MPa to 16.10MPa. Hence, 10% replacement of cement with Phosphogypsum is advisable from compressive strength point of view .
3. The increase in percentage replacement of cement with Phosphogypsum from 0% to 30% causes reduction in Chloride ion permeability from 3076 Coulombs to 2426 Coulombs, when tested for Chloride ion permeability at the age of 28 days

4. The increase in percentage replacement of cement with Phosphogypsum from 0% to 30% causes reduction in Chloride ion permeability from 1879 Coulombs to 1525 Coulombs, when tested for Chloride ion permeability at the age of 90 days.

Finally, it can conclude that though the permeability is reducing even upto 30% replacement of cement with Phophogypsum, Keeping the workability and compressive strength in mind,10% replacement of Phosphogypsum is recommended for use in M_{20} grade concrete. An industrial waste like Phosphogypsum impairs the strength development of calcined products and hence, it can be used in construction industry for preparation of concrete by replacing some quantity of cement, which is valuable ingredient of concrete to achieve economy.

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