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Comparative Study of OPC and PSC with Partial Replacement of Different Pozzuloic Materials

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ABSTRACT

In the present investigation an attempt is made to compare various compressive strengths of cement mortar cubes. Mathematical models were elaborated to predict the strength of mortar cubes with 10% partial replacement of cement by various types of mineral admixtures with and without super plasticizers. The strength of cubes with different types of cement (OPC, PSC) after 3,7,28 and 90 days with 28 days curing and also durability tests after 60 days, have been analysed to evaluate the effect of addition content, the time of curing and the type of cement on the changes in compressive strength. The test results of selected properties of binders and hardened mortar cubes with admixtures are also included. The analysis showed that mortar cubes with admixtures is characterized by advantageous applicable qualities.

The investigation revealed that use of waste materials like fly ash, micro silica, rice husk ash and ground granulated blast furnace slag, which are otherwise hazardous to the environment may be used as a partial replacement of cement, leading to economy and in addition by utilizing the industrial wastes in a useful manner the environmental pollution is also reduced to a great extent.

INTRODUCTION

The greatest challenge before the construction industry is to serve the two pressing needs of human society namely the protection of the environment and meeting the infrastructure requirement of our growing population and consequentially needs of industrialization [1] and urbanization in the past. The concrete industry has met these needs very well. However for a variety of reasons, the situation has been changed now.

The cement and concrete industries due to their large size are unquestionably feasible scope for economic and safe disposal of millions of tonnes of industrial by products such as fly ash, microsilica, slag, rice husk ash [2-4]. Due to their properties, by-products can be used in certain amount such as cement replacement material than in the practice today. In fact, these mixes replaced by 15% of by-products have shown high strength and durability at relatively early ages. This development has removed one of the strong objections to the use of high volume of by products in mortar cubes.

Therefore, it should be obvious that certain scale cement replacement with industrial by products is highly advantageous from the stand point of cost, economy, energy efficiency, durability and overall ecological and environmental benefits [3].

The advantageous in concrete technology method of construction and type of construction have paved the way to make the best use of locally available materials by judicious mix proportioning and proper workmanship so as to result in a construction industry satisfying the performance requirements. Proper design of mixes is intended to obtain such proportioning of ingredients that

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will produce of high durability during the designed life of a structure.

ADMIXTURES

This publication provides information on the types and functions of admixtures that have been, or are being, standardized in Europe for implementation in national standards in CEN member countries [6]. It also provides guidance on the circumstances when it may be necessary to specify an admixture to a concrete producer.

Admixtures are materials other than cement, aggregate and water that are added to concrete either before or during its mixing to alter its properties, such as workability, curing temperature range, set time or color. Some admixtures have been in use for a very long time, such as calcium chloride to provide a cold-weather setting concrete. Others are more recent and represent an area of expanding possibilities for increased performance. Not all admixtures are economical to employ on a particular project. Also, some characteristics of concrete, such as low absorption, can be achieved simply by consistently adhering to high quality concreting practices.

TYPES OF ADMIXTURES

Admixtures vary widely in chemical composition, and many perform more than one function. Two basic types of admixtures are available:
1) Mineral admixtures.
2) Chemical admixtures.

MINERAL ADMIXTURES

Mineral admixtures (fly ash, silica fume [SF], and slag) are usually added to concrete in larger amounts to enhance the workability of fresh concrete; to improve resistance of concrete to thermal cracking, alkali-aggregate expansion, and sulfate attack; and to enable a reduction in cement content.
(a) Fly Ash
(b) Silica Fume
(c) Ground Granulated Blast Furnace Slag
(d) Rice husk ash

CHEMICAL ADMIXTURES

Chemical admixtures are added to concrete in very small amounts mainly for the entrainment of air, reduction of water or cement content, plasticization of fresh concrete mixtures, or control of setting time.

Seven types of chemical admixtures are specified in ASTM C 494, and AASHTO M 194 [06], depending on their purpose or purposes in PCC [7]. Air entraining admixtures are specified in ASTM C 260 and AASHTO M 154[05]. General and physical requirements for each type of admixture are included in the specifications.
(a) Air-Entrainment agents.
(b) Water-Reducers.
(c) Set-Retarders.
(d) Accelerators.
(e) Superplasticizers.

TABLE: CHEMICAL COMPOSITION OF PORTLAND CEMENT

S.No.	Oxide	Percentage
1.	Lime, CaO	60-67
2.	Silica, $Si0_2$	17-25
3.	Alumina, AI2O3	3.0-8.0
4.	Iron oxide, Fe2O3	0.5-6.0
5.	Magnesia, MgO	0.1-4.0
6.	Sulphur trioxide, SO3	1.0-3.0
7.	Soda and / or Potash, Na_20+K_20	0.4-1.3
8.	Insoluble residue	2.0
9.	Loss on ignition	5.0

cr >; SiP_2 Silica ratio=- -- --------

Alumina Ratio: Alumina ratio is the ratio of Alumina to Ferric Oxide.

With a high value of this ratio we can have an alumina rich and ferric oxide free Portland. On the other hand for the iron ore, which contains no alumina, this ratio is practically zero.

Lime saturation factor: L.S.F has very high significance in the production of Portland cement. It is the ratio of the quantity of lime present by weight to that required by the acidic oxides (SiCo2, A1203, Fe203) to form the main mineralogical clinker compounds.
By Mathematical expression:

$$LSF = \frac{CaO - 0.7\ (SP_3)}{2.8SiO_2 + 1.5Al_2O_3 + 0.65Fe_2O_3}$$

The cause for the deduction of SO3 from the total lime percentage is due to the addition of gypsum during grinding of clinker, which is added to regulate the setting process of cement. The CaO derived from this addition of gypsum enters into the total lime percentage when determined analytically during chemical analysis of cement. The extra CaO induced in cement by addition of gypsum must therefore be subtracted from the total lime content. The actual extra CaO content is obtained by multiplying the quantity of SO3 obtained by the chemical analysis of cement by a factor 0.70.

BS 12-1978[09] specifies that the Portland cement shall have the L.S.F. corresponding to a high proportion of dicalcium silicate and also a value corresponding to a high proportion of tricalcium silicate. IS 296-1976 specifies the Lime saturation factor should not be greater than 1.02 and not less than 0.66. The Alumina ratio should not be less than 0.66.

The oxides present in the raw materials interact with each other to form a series of more complex compounds during fusion. The identification of the major compounds is largely based on Bogue R.H. (1995) [8] work and hence it is called "Bouge's compounds". The four compounds usually regarded as major compounds are listed in table no.2.2 as shown in below.

TABLE 2.2 BOUGE'S COMPONENTS

Name of compound	Formula	Abbreviated formula
Tri calcium silicate	$3Ca0.Si0_2$	C_3S
Di calcium silicate	$2Ca0.Si0_2$	C_2S
Tri Calcium aluminate	$3Ca0.Al_20_3$	c_3a
Tera calcium alumino ferrites	$4Ca0.Al_20_3.Fe_20_3$	C4AF

Bogue suggested equations for calculating the percentages of major compounds knowing the percentages of oxides present in raw materials. The equations are as follows.

$$C_3S=4.07(CaO)-7.6(SiO2)-6.72(Al2O3)-1.43(Fe2O3)-2.85(3aCaO.SiO_2)$$

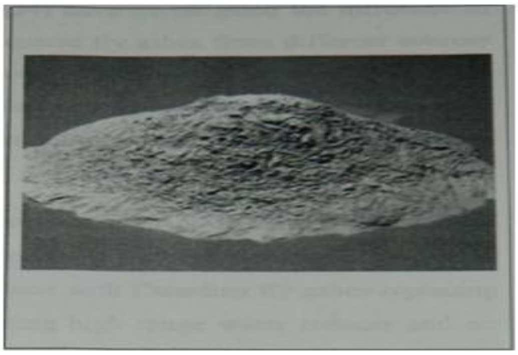
$$C_2S=2.87(Si0_2)-0.754\ (3Ca0.Si0_2)$$

$$C_3\ A = 2.65\ (A1_20_3) - 1.69\ (Fe_20_3)$$

$$C_4AF = 3.04\ (Fe_20_3)$$

FLY ASH

It is one of the by-products which will be coming burning coal to generate electric power. Two-thirds of the 55 million tonnes of fly ash produced in the U.S. in 1999 were sent to waste piles, with only 9 million tonnes used to make concrete. The carbon content of fly ash is a major concern. Class 'C' fly ash, most of which is produced in the west from lignite coal, contains little carbon. However, Class F fly ash, produced primarily from anthracite and bituminous coal, contains significant amounts of carbon. Class C and Class F material also differ from each other and from source to source with regard to strength, rate of strength gain, color and weather ability. Ensuring a consistent supply is a concern among concrete suppliers.



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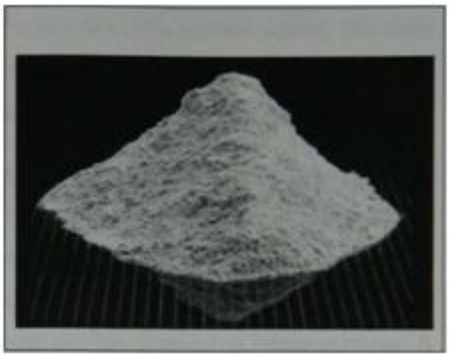
A number of studies were made in the past to investigate the effect of partial replacement of cement by fly ash on strength of concrete and other related aspects. Some of main investigations are presented here.

Maslehuddin et.al, 1989 [4], carried out investigation to evaluate the compressive strength development and corrosion-resisting characteristics of concrete mixes in which fly ash was used as an admixture and concluded that addition of fly ash as an admixture increases the early age compressive strength and long-term corrosion resisting characteristics of concrete.

SLAG

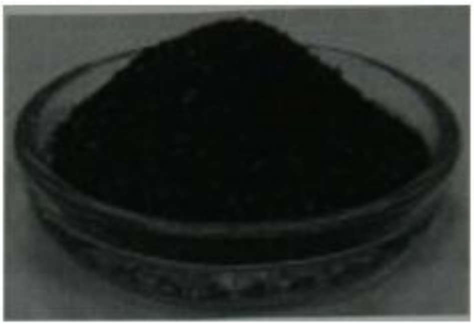
It is a by-product from production of both iron and steel, and ground iron slag from blast furnaces can be used for making concrete. About 12.4 million tonnes of blast furnace slag was used in the U.S. in 1999, of which 2 million tonnes were used in concrete.



In addition, another 1.1 million tonnes were imported for use by the construction industry. Because the demand for the product is rising while the supply is falling, new grinding plants are coming on line to process imported slag. The added energy used to ship and grind the slag makes it somewhat less energy-saving than fly ash, but far better than Portland cement. Some of main investigations are presented here.

RICE HUSK ASH

RHA is a by-product material obtained from the combustion of rice husk which consists of non-crystalline silicon dioxide with high specific surface area and high pozzolanic reactivity [9]. It is used as pozzolanic material in mortar and concrete, and has demonstrated Significant influence in improving the mechanical and durability properties of mortar and concrete. Some of main investigations are presented here.



Harunur Rashid, Md., Keramat Ali Molla, Md. and Tarif Iddin Ahmed, 2010 [16| evaluates the effects of using Rice Husk Ash (RHA) as a partial cement replacement material in mortar mixes. The mechanical properties investigated were the compressive strength and the porosity of mortar. The results showed that the strength and porosity of mortar incorporating RHA were better, up to 20% of cement replacement level.

SILICA FUME

Silica fume was once a cheap waste product but high demand has made it a high-cost admixture, used primarily for bridges and other structures where top weathering performance and high strength are needed. Concrete made from silica fume is expensive, however, not only because of the material cost, but because the powdery fineness of the fume makes it hard to handle. It is often turned into slurry before use.

When silica fume is added to concrete, it results in a significant change in the compressive strength of the

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mix. This is mainly due to the aggregate- paste bond improvement and enhanced microstructure. Some of main investigations are presented here.

QUALITY CONTROL

To insure the quality of concrete, every aspect of concrete production is must be monitored via.., from the uniformity of raw materials to proper batching and mixing procedures, transportation, placement, vibration and curing through to the proper testing of the hardened concrete. The weighing scales shall be regular!) calibrated and weighing of aggregates shall be within +2%; for cement and water+1%, water-binder ratio must be controlled.

For concrete incorporating pozzolanic materials in its constitution, the consideration of compressive strengths at 28 days is always conservative assessments of strength and there, designer must considered along with ZSdays, due to fact that structures are rarely loaded to its design strength is less than 3 months.

CURING CONDITION

As per IS:456-2000[22], the period of moist curing shall not be less than 10 days from the date the date of placement of concrete for flyash concrete this minimum lOdays of moist curing may be extended to 14 days. As per ACI 363 R [02], when selecting mix proportions, the type of curing anticipated should be considered along with test age and concrete gains strength as a function of maturity, which is usually defined as a function of time and curing temperature.

QUALITY ASSURANCE

As per IS: 456-2000 [12] the quality controls and assurance would involve quality audit of both the input as well as the output. Inputs are in the form of materials in concrete; workmanship in all stages of batching, mixing, transportation, placing, compaction and curing, and related equipment and plant resulting in the output in the form of concrete in place. The quality controls measures are both technical and organizational. ACI 363 R [2] recommends following phases of quality assurance for field applications of high strength concrete but this measure will be for normal strength concrete also.

1) Materials- it is desirable that the aggregates and Admixtures specified in the mixture be uniform and come from the same source for the entire duration of the project.

2) Control of operations- Effective co-ordination and control between supplier and contractor are critical to the operations.

3) Construction equipment-Project manager should advice the contract of equipment to present plans or description of the equipment for review of well in advance for start of placement.

4) Laboratory-ACI 363 and ASTM E329 [2] recommended detail specifications for specimen size, shape, type of mould, testing the apparatus, specimens preparations etc.,

5) Contingency plans- Plans need to develop to provide for alternate operations in case difficulty is experienced in the basis planning concept.

BENFITS AND USES

All cement substitutes have the dual benefit of replacing energy- intensive Portland cement, and of using material that would otherwise be land filled .In the case of blast-furnace slag, some waste product is imported, somewhat reducing its positive energy impact. Small percentages of fly ash or slag will reduce cost by replacing high cost Portland cement. As the percentages of substitutes rises and water content falls to control strength gain, super plasticizer additives and more precise control began to raise the cost.

Ground Granulated Blast Furnace Slag (GGBS)

In the production of cast iron, also called pig iron, if the slag is cooled slowly in air, the chemical components of slag are usually present in the form of crystalline melelite (C3 AS-C2 MS2 solid solution) [10], which does not react with at ordinary temperature. The granulated slag when finely ground and combined with Portland cement has been found to have excellent cementitious properties. GGBS has an inherent ability to reduce heat evolved during exothermic reaction of

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cement and water. It has been observed that GGBS has the largest potential to replace cement due it's in built cementitious property. Hence a high volume replacement of cement by GGBS is an attractive option; usually for every tones of pig iron produced about 1.0 to 1.5 tonnes of slag is discarded as a waste material. It is estimated that India alone produces about 8 million tone of slag every year. The disposal of such slag as a waste fill is a problem and may cause serious environmental hazard. Such that it is produced from Lanco steel plant, Sri Kalasatri. The physical and chemical properties of this cement are given in the table no.4.2 (d) below.

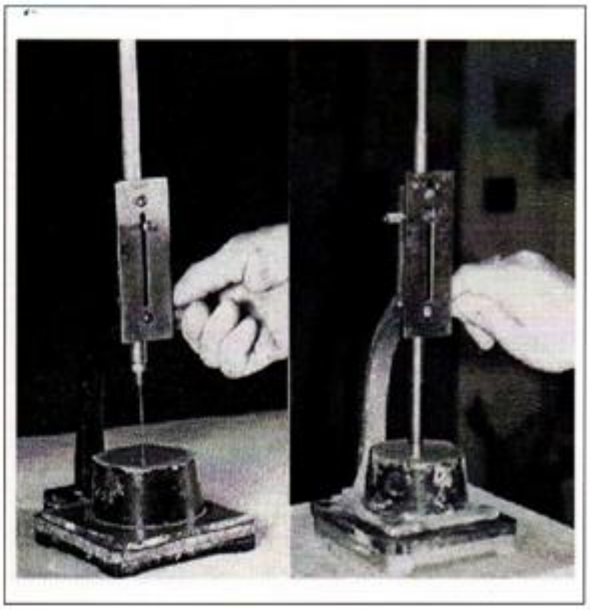
Table 4.2(d): The Physical and Chemical properties of GGBS

Sl. No.	Physical Characteristics	Properties of Slag used
1	Specific gravity	2.91
2	Fineness m^2/kg	330
3	Glass content percent	93
4	Bulk density Kg/m^3	1100
5	Color	Dull white

S. No.	Compound	Chemical Requirement (BS:6699)	Properties of Slag used
1	$Si0_2$	32-42	33.2
2	Al_20_3	7.16	18.3
3	CaO	32-45	41.0
4	Fe_20_3	0.1-1.5	1.3
5	MgO	14 max	11.6
6	$S0_3$	2.5 max	1.0
7	CaO/ $Si0_2$	1.4 max	1.23
8	Loss on ignition	3 max	0.5

EXPERIMENTAL PROCEDURE

Normal consistency, initial and final setting times are determined by Vicat's apparatus [11], which measure the resistance of cement paste of standa rd consistency to the penetration of the needle under total load of 300gms.



Vicat's apparatus confirming to IS 5513- 1976 [7] consists of a frame to which a movable rod having an indicator is attached which gives the depth of penetration. The rod weights 300gms and has diameter and length of 10mm and 50mm respectively. Vicat's mould is in the form of a cylinder and it can be split into two halves. Vicat's apparatus includes three attachments - plunger for determining normal consistency, square needle for initial setting time, and needle with annular collar for final setting time. Detailed experimental procedures adopted in the investigation are given in the following sub-sections.

CONSISTENCY

Normal consistency is the initial parameter of cement for determining other properties of cement. The normal consistency of a cement paste is defined as that consistency which will permit a Vicat plunger having 10mm diameter and 50mm length to penetrate to a depth of 33-35mm from top of the mould. The process is used to find out the percentage of water required to produce a paste of standard consistency.

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About 400g of cement with initially mixed with 28 percentage of mixing water. The paste prepared in the standard manner and filled into the Vicat mould within 3 to 5 minutes. The surface of the mould was smoothened, levelled and shaked to expel the air. A standard plunger, 10mm diameter, 50mm long, is attached and lowered gently to touch the surface of the paste in the test block and quickly released to sink into the paste by its own weight. The reading is noted by taking the depth of penetration of the plunger. The experiment was performed carefully away from vibrations and other disturbances. The test procedure was repeated by increasing the percentage of mixing water at 1 % increment until the reading was 5 to 7mm from the bottom of the mould.

INITIAL AND FINAL SETTING TIME

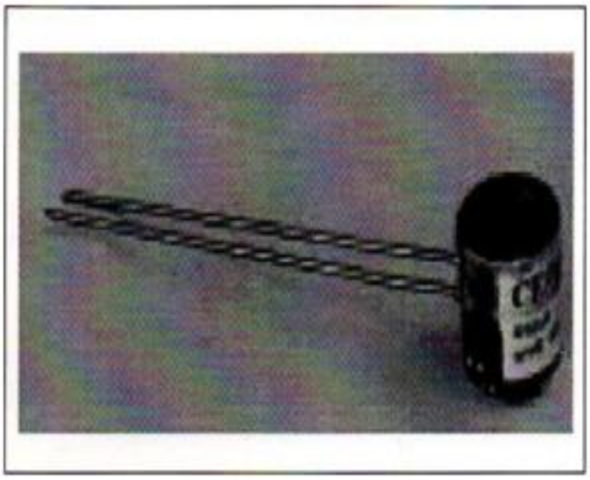
Initial setting time is regarded at time elapsed between the moment that the water is added to the cement, to the time that the paste starts losing its plasticity.

Final setting time is the time elapsed between the moment the water is added to the cement, and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain definite pressure.

About 300gms of cement was taken and mixed with 0.85 times of appropriate mixing water required to produce cement paste of standard consistency. The stopwatch was started at the instant the mixing water was added to the cement. The paste was filled into the Vicat mould in the specified manner within 3 to 5 minutes. The test was conducted at a room temperature of 27 ± 2°C at a relative humidity of 60%.

SOUNDNESS

Le-chatelier apparatus is used for the determination of soundness of cement (IS 5514:1969 [8]). It consists of a small split cylinder of spring brass of 0.5mm thickness, forming a mould 30mm high. On either side of the split are attached to indicators with pointed ends, the distance from these ends to the centre of the cylinder being 165mm. lOOg of cement was mixed with 0.78 times the water required for standard consistency in a standard manner and filled into the mould kept over a glass plate.



The mould was covered on the top with another glass plate. The mould was submerged into water at a temperature of 27 ± 2°C for 24 hours. The mould was taken out and the distance between the indicator points was measured. The mould was taken again submerged in water and by using the water heaters, the water was brought to boiling point within 25 to 35 minutes and the specimen was kept for 3 hours at boiling point. The mould was removed from water and was allowed to cool down as 27°C. The distance between the indicator points was measured again.

The difference between the two measurements represents the expansion or soundness of cement. This must not exceed 10mm for ordinary Portland cement. If, in any case, the expansion is more than 10mm the cement is said to be unsound and not suitable for construction activities [3].

COMPRESSIVE STRENGTH

The compressive strength of hardened cement is the most important of all the properties. Moulds for the cube specimens of 50cm face area are taken. The mould shall be sufficiently thick to prevent spreading and warping. The moulds are rigidly constructed in such a manner as facilitate the removal of the moulded specimen without damage. The moulds when assembled should conform to the following specifications.

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The internal dimensions of the mould shall be 70.6 mm (3-D). The angle between the adjacent interior faces, top and bottom planes of the mould shall be 90°. The interior faces of the moulds shall be plane. The height of the mould and the distance between opposite faces shall be 70.6mm. The angle between the adjacent interior faces and top and bottom planes of the mould shall be 90°. The interior faces of the mould shall be plane surfaces with a permissible variation of 0.15mm. The base plate is of such dimensions as to support the mould during filling without leakage. While assembling the mould, the joints between the halves of the mould were covered with a thin film of petroleum jelly and a similar coating of petroleum jelly shall be applied between the contact surface of the bottom of the mould and its base plate in order to ensure that no water escapes during vibration. The interior faces of the mould were treated with a thin coating of mould oil. The assembled mould has to place on the table.

ACID RESISTANCE TEST

The mortar cube specimens (of various samples) of size 7.07 cm were casted and after 28 day of water curing. The specimens were removed from the curing tank and allowed to dry for one day. The weights of mortar cube specimen were taken. The acid attack test on specimens was conducted by immersing the cubes in the acid water for 60 day after 28 day of curing. Hydrochloric acid (HCL) with pH of about 2 at 5% weight of water was added to water in which mortar cubes were stored. The was maintained throughout the period of 60 day. After 60 day of immersion, the mortar cubes were taken out of the acid water and the weights of cubes were recorded after wiping out the acid water on the surface of the cubes. Then, the specimens were tested for compressive strength duly following the procedure prescribed in IS 516:1959 [3]. The resistance of mortar cubes to acid attack was found by the loss of weight of specimens and the loss/variation of the compressive strengths on immersion of mortar cubes in acid water.

ALKALINITY RESISTANCE TEST

To determine the resistance of various mortar mixtures to alkaline attack, the residual compressive strength of mortar cubes size immersed in alkaline waters having 5% of sodium hydroxide (NaOH) by weight of water was found. The mortar cubes of size 7.07 cm size which were cured in water for 28 day were taken from the curing tanks and allowed to dry for one day. The weights of dry specimens were noted. Then the cubes were immersed in alkaline waters continuously for 60 day. The alkalinity of water was maintained same throughout the test period. After 60 day of immersion in alkaline water, the cubes were removed and the weights of cubes were taken after wiping out the water and grit from the surface of the specimens. The compressive strengths of cubes which were cured in water for 60 day was determined as per the procedure prescribed in IS 516:1959[2].

SULPHATE RESISTANCE TEST

The resistance of mortar cubes to sulphate attack was studied by determining the loss of compressive strength or variation in compressive strength of mortar cubes immersed in sulphate water having 5% of sodium sulphate (Na2S04) and 5% of magnesium sulphate (MgS04) by weight of water and those which are not immersed in sulphate water. The mortar cubes of 7.07 cm size after 28 day of water curing and dried for one day were immersed in 5% Na2S04 and 5% MgSC>4 added water for 60 day. The concentration of sulphate water was maintained throughout the period. After 60 day immersion period, the mortar cubes were removed

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from the sulphate waters and after wiping out the water and girt from the surface of cubes tested for compressive strength following procedure prescribed in IS 516:1959[2-3]. This type of accelerated test of finding out the loss of compressive strength for assessing sulphate resistance of mortar cubes was proposed by Mehta (1980) [4].

RESULTS AND DISCUSSIONS

The results of the present investigation are presented both in tabular and graphical forms. In order to facilitate the analysis, interpretation of the results is carried out at each phase of the experimental work. This interpretation of the results obtained is based on the current knowledge available in the literature as well as on the nature of result obtained. The significance of the result is assessed with reference to the standards specified by the relevant I S codes.

1. The averages of both the initial and final setting times of three cement samples prepared with PSC/OPC and compared with those of the cement specimen prepared with different admixtures. If the difference is less than 30 minutes, the change is considered to be negligible or insignificant and if it is more than 30 minutes, the change is considered to be significant.
2. The average compressive strength of at least three cubes prepared with PSC/OPC under consideration is compared with that of three similar cubes prepared with different admixtures. If the difference in the strength is less than 10%, it is considered to be insignificant and if it is greater than 10%, it is considered to be significant.
3. The average soundness test results of three samples prepared with PSC/OPC under consideration are compared with those with different admixtures. The unsoundness of the specific sample, made with admixtures, is significant if the result of Le-Chatelier's test is more than 10 mm.

Though all the samples made with different types of cements (i.e. PSC and OPC) by replacement of chemical and mineral admixtures either accelerate or retard significantly the setting process. The limits for significance criteria in setting times of all these samples under consideration are within the range of standards specified in IS 8112:1989[3], The IS code specifies initial setting time should not be less than 30 minutes and final setting time should not be more than 600 minutes.

Soundness test results of the samples made with different types of cements are presented in the Tables 5.1 to 5.2. The IS 269:1976[1] code specifies the limit for soundness as per the Le-Chatelier's test result should not be more than 10 mm for Ordinary Portland Cements. The Le-Chatelier's test results of soundness of different types of cements vary proportionately with the concentration of the cement.

Effect of different admixtures on Portland Slag Cement

Effect of admixtures without Superplasticizer.

The effect of different admixtures without superplasticizer on the Portland Slag Cement is presented in Table 5.1 and the graphical representation is presented in Fig 5.1(a), 5.1(c) and 5.1(d)

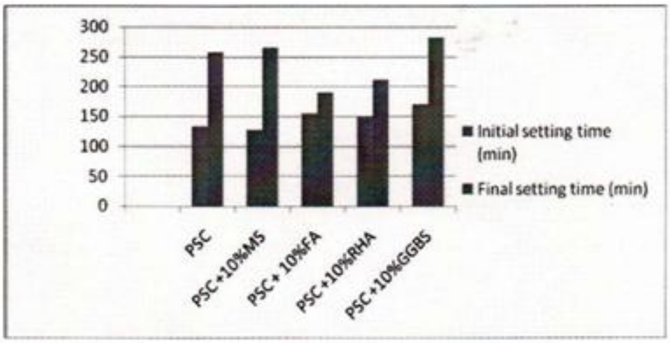

Fig. 5.1(a) Variation of initial and final setting times in the Portland slag cement with the replacement of different admixtures without superplasticizer

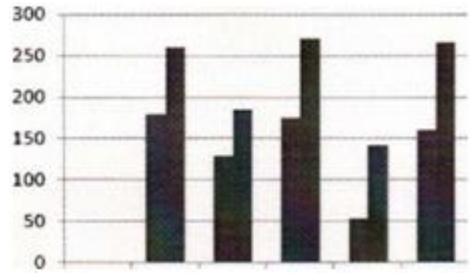

Fig. 5.1(b) Variation of initial and final setting times in the Portland slag cement with the replacement of different admixtures with superplasticizer

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Effect of different admixtures on Ordinary Portland Cement

Effect of admixtures without Superplasticizer.

The effects of different admixtures without superplasticizers on the Ordinary Portland Cement are presented in Table 5.2 and the graphical representation is illustrated in Fig 5.2(a)

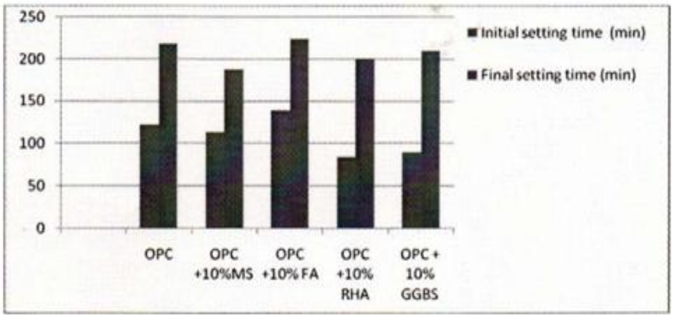

Fig.5.2 (a) Variation of initial and final setting times in the Ordinary Portland Cement with replacement of different admixtures with and without superplasticizer

CONCLUSION

Based on the results obtained in the present investigation in Chapter 5, the following conclusions can be drawn.

- PSC with 10% replacement of mineral admixtures like fly ash, ground granulated blast furnace slag, with superplasticizer retards the setting times significantly where as in the case of rice husk ash with and without superplasticizer accelerates both the initial and final setting times significantly.
- PSC with 10% replacement of all admixtures with and without SP the percentage change in compressive strength is meagre and further it is observed that the decrease in compressive strength is significant in the case of RHA with SP at lateral ages.
- Significant loss in compressive strength is observed in PSC and PSC with replacement of mineral admixtures with and without superplasticizer when the samples are tested in acid, alkali and sulphate solutions.
- OPC with 10% replacement of mineral admixtures like fly ash, ground granulated blast furnace slag and microsilica with superplasticizer retards final setting time significantly, where as in the case of rice husk ash with and without superplasticizer accelerates both the initial and final setting times significantly.
- OPC with 10% replacement of fly ash, ground granulated blast furnace slag and microsilica with and without superplasticizer the percentage change in compressive strength is decreased significantly and further, it is observed that this decrease in strength slightly increases at lateral days.
- OPC with 10% replacement of mineral admixtures like fly ash, ground granulated blast furnace slag, microsilica and rice husk ash with and without superplasticizer, the loss in compressive strength in Acid Test, alkali and sulphate test is significant.
- From the test analysis it can be inferred that the PSC in all the cases performing well than that of the OPC. Hence it is preferable to use PSC.

SCOPE FOR FURTHER STUDY

The following aspects can be taken up for further investigation.

1. Similar studies can be carried out on admixture cement concrete to analyze the effect of various chemical and mineral admixtures on the compressive strength with a special attention on the durability of concrete beyond 2-years.

2. The effect of other similar substances present in water, which are not covered in this research, on the setting properties of cement and strength of cement mortar can be investigated.

3. The effect of substances located at various places containing unique compounds can be studied to develop standards and limitations on the use of such admixtures in cement construction.

4. Similar studies can be carried out on other engineering properties of cement mortar like tensile strength and shear strength.

5. Formation of lattice structures of hydrated cement compounds need to be investigated to study the reasons

for changes occur due to mineral and chemical admixtures in cement mortar.

REFERENCES

[1]. Ramasamy,V.; Biswas,S. "Mechanical properties and durability of rice husk ash concrete"(Report), International Journal of Applied Engineering Research December 1, 2008.

[2]. Bayasi, Zing, Zhou, Jing, (1993) "Properties of Silica Fume Concrete and Mortar", ACI Materials Journal 90 (4) 349 - 356.

[3]. Venkatesh Babu DL, Nateshan SC. Investigations on silica fume concrete, The Indian concrete Journal, September 2004, pp. 57-60.

[4]. Khedr, S. A., Abou - Zeid, M. N., (1994) "Characteristics of Silica-Fume Concrete", Journal of Materials in Civil Engineering, ASCE 6 (3) 357 - 375.

[5]. Bhanja Santanu, and Sengupta, Bratish, (2003) "Optimum Silica Fume Content and its Mode of Action on Concrete," ACI Materials Journal, V (100), No. 5, pp. 407-412.

[6]. Sensualle GR , Strength development of concrete with rice husk ash, Cement and Concrete Composites 2006.

[7]. ACI234R – 96 "Guide for the use of silica fume in concrete" by ACI committee 234

[8]. Papayianni , G. Tsohos, N. Oikonomou, P. Mavria, "Influence of super plasticizer type and mix design parameters on the performance of them in concrete mixtures", Cement & Concrete Composite, Vol. 27, 2005, 217-222

[9]. V.Bhikshma, K.Nitturkar and Y.Venkatesham, "Investigations on mechanical properties of high strength silica fume concrete." Asian journal of civil engineering (building and housing) vol. 10, no. 3(2009) pp.335-346.

[10]. Aravindhan.C, Anand.N ,Prince Arulraj.G "Development of Self Compacting Concrete with Mineral and Chemical Admixtures – State of the Art" IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498, Vol.2, No.6, December 2012

[11]. Khayat, K.H., 1999. "Workability, Testing, and Performance of Self-Consolidating Concrete", ACI Materials Journal, 96(3): 346-353.

[12]. Hwang, C.L. and M.F. Hung, 2002. "Durability Consideration of Self-Consolidating Concrete", Proceedings of the First North American Conference on the Design and Use of Self-Consolidating Concrete, Hanley-Wood, LLC,Illinois, USA, pp: 343-348.