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INNOVATIVE CONSTRUCTION MATERIALS & EFFECT OF ADMIXTURES ON THEIR PROPERTIES

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ABSTRACT

The main aim of this project is to check the effects of adding Rice Husk Ash (RHA) in the Ordinary Portland Cement, and to check what is the optimum amount of RHA that can be used in cement mortar without any kind of compromise in the strength of mortar. So this project is a study of performance of cement mortar by biased replacement of cement with the Rice Husk Ash. The maximum amount of replacement of Rice Husk Ash in cement is also calculated in this project. Effects of RHA on setting time of mortar is also computed Extensive hard work are being taken globally to utilize natural waste and by product as supplementary cementing materials to improve the properties of cement concrete. Rice husk ash (RHA) and Fly ash (FA) with using Steel slag is such Innovative Construction Materials. The detailed experimental investigation is doing to study the effect of partial replacement of cement by FA, RHA with using Steel slag in concrete. In this research work started proportion form 22% FA and 8% RHA mix together in concrete by replacement of cement last proportion taken 19% FA and 11% RHA, with gradual increase of RHA and simultaneously gradual decrease of FA and to improve the strength of concrete steel slag was added. The purpose of this research is to study the effects of mineral admixture on the mechanical properties compressive strength(7days,14 days,28 days ,90 days) flexural tensile strength, splitting tensile strengths at age of 7 days, 28 days and also comparative study of properties of uncontrolled RHA and controlled RHA in cement mortar. In this research presents a review of the properties of cement concrete including workability, setting time by using mineral admixtures fly ash (FA), steel slag (SS) and rice husk ash (RHA). Comparison of normal and high-strength concrete in which cement has been partially supplemented by mineral admixture has been considered. It has been concluded that mineral admixtures may be categorized into two groups: chemically active mineral admixtures and micro filler mineral admixtures. Chemically active mineral admixtures decrease workability and setting time of concrete but increase the heat of hydration and reactivity. On the other hand, micro filler mineral admixtures increase workability and setting time of concrete but decrease the heat of hydration and reactivity. In general, small particle size and higher specific surface area of mineral admixture are favorable to produce highly dense and impermeable concrete; however, they cause low workability and demand more water which may be offset by adding effective super plasticizer.

1. INTRODUCTION

General

In the early era, construction work was mostly carried out with assist of mudstone from industry. Fly ash is a by-product of burned coal from power station and rice husk ash is the by product of burned rice husk at higher temperature from paper plant artificial fibers are commonly used nowadays in order to improve the mechanical properties of concrete. In the last few years the use of waste material as a replacement of cement in the cement mortar and concrete become very popular in our country. Use of waste products like Rice Husk Ash (RHA), Fly Ash, Blast Furnace Slag etc. helps in saving the environment because their disposal requires large amount of money and land. Rice husk ash is a waste that is obtained from the separating the paddy from its cover and then burning it. It is used as a replacement of cement in cement mortar and also in cement concrete In general, small particle size and higher specific surface area of mineral admixture are favorable to produce highly dense and impermeable concrete; however, they cause low workability and demand more water which may be offset by adding effective super plasticizer. There is great need to conserve all the natural resources. The various steps to be adopted in the direction that includes minimization of production of energy consuming materials and heavy utilization of industrial by-products. Concrete can be produce using such materials like fly ash, slag and silica fumes. Some of these

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material can be used as replacement for cement. Ultimately it results in the reduction of the cost manufacturing of concrete and reduces environmental pollution. This study shows that materials used in this experiment are suitable for cement concrete - This research investigates on analyzing the effects of use of mineral admixtures in the mechanical properties of concrete.

Constituent Materials Used

The constituent materials used are cement, fine aggregate, coarse aggregate, stone dust and water. The recommended materials have been described below.

***Cement*: -** Various types of cement can be used in concrete with stone dust. The cement should be fresh, free from foreign matters and of uniform consistency. Usually ordinary Portland cement is used in normal conditions.

Fine Aggregate: - The most common fine aggregate used in concrete is sand. The sand should be clean, hard, strong and free from organic impurities and deleterious substances. It should be capable of producing a sufficiently workable mix with a minimum water-cement ratio.

Coarse Aggregate: - The aggregates are formed due to natural disintegration of rocks or by artificial crushing of the rock or gravels. The properties o coarse aggregate are chemical and mineral composition, spectrographic description, specific gravity, hardness, strength, physical and chemical stability, pore structure and color. Some other properties of the aggregate not possessed by the parent rocks are particle size and shape, surface texture and absorption etc. All these properties may have a considerable effect on the quality of concrete in fresh and hardened states.

Fly Ash

Fly ash is also known as flue-ash, is one of the residues generated in combustion and comprises the fine particles that rise with the flue gases. Ash that does not rise is called bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO_2) (both amorphous and crystalline) and calcium oxide (CaO)**.**

Fly ash is the most widely Pozzolanic material in the world. Its composition depends upon

I. Type of fuel burnt
II. Load on boiler
III. Type of precipitator or separator

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2. Fly Ash Contains

I.	Oxides of silicon (SiO_2)	30-60 %
II.	Oxides of calcium (CaO)	1-7 %
III.	Oxides of aluminum Al_2O_3	15-30 %
IV.	Unburrent fuel (Carbon)	Up to 30 %
V.	Oxides of magnesium (MgO)	small %
VI.	Oxides of sulphur (SO_2)	small %
Carbon content in fly ash should be as low as possible.		

Characteristic of fly ashes connected by different collectors.
Fly ash collected by Electrostatic precipitator (ESP Causes with specific surface 350 to 500 m^3/kg. ESP fly ash collected in chamber I & II is coarse with non spherical surface (particles) showing longer ignition are called as coal ash & not fly ash & not suitable for use as a pozzolana & does not reduce water demand.
2. Fly ash collected by cyclone separator is comparatively coarse and may contain longer amount of unburnt fuel.

Chemistry Of Fly Ash In Concrete
There is no direct relation of chemistry of fly ash and properties of concrete. Most of the properties of fly ash is concrete is determined by the two parameters

- Fly ash mineralogy
- Particle size distribution.

Fly Ash Particle Size
Particle size of fly ash is between 1 to 100 microns.
Av. size of fly ash particles = 20 micron

Influence of size of particles in fly ash on strength.

- Particle size < 10 (micron) are highly reactive & present in more than 40% by wt of fly ash and are responsible for early age strength (7-28 days)
- Particle size > 45 micron are coarse particles and becomes non reactive and present in less than 15 to 20% by wt of fly ash and becomes inert after 1 years & act as same.
- Particle size b/w 10-45 micron are slowly reactive b/w 28 days to 1 years.
- Modern furnace generally (module fly ash which contains 1.0-1.5% of carbon in the form of microspores large non-reactive spherical particles and one high (80-90%) of glass which have good reactivity.

3. TEST PERFORMED ON RICE HUSK ASH

Sieving Conducted On Rha
A sieve analysis was conducted on rice husk ash. Ash passing 150 micron sieve and retaining on pan was taken for the replacement of cement. Fine particles of rice husk ash are taken because it is being used as a pozzolonioc

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material. Fine fineness of pozzolana had a greater pozzolonioc reaction and the smaller particles will also fill the voids of mortar mix thus increasing the compressive strength.

Burning Of Rice Husk

Rice husk was burned in a pan using a small amount of paper a continuous supply of air was passed using mouth blowing so to allow complete burning of husk. And the same sieving was conducted to get uncontrolled ash.

4. TEST PERFORMED ON MORTAR CUBE

Compressive Testing On Mortar Cubes

Cement is replaced by the mineral admixtures. The methodology of the work is given below:-

- 6 beams,6 cylinders and 12cubesof M30 grade using the minerals admixtures are casted(fly ash 22%, rice husk ash8%).
- 6 beams,6 cylinders and 12cubesof M30 grade using the minerals admixtures are casted (fly ash 21%, rice husk ash9%).
- 6 beams,6 cylinders and 12cubesof M30 grade using the minerals admixtures are casted (fly ash 20%, rice husk ash 10%).
- 6 beams,6 cylinders and 12cubesof M30 grade using the minerals admixtures are casted (fly ash 19%, rice husk ash11%)
- 6 beams,6 cylinders and 12cubesof M30 grade using the minerals admixtures are casted rice husk ash 6.5%, fly ash 6.5%, Steelslag12%).

Flexural test is to be used to determine the flexural strength of concrete by using minerals admixture.

Split tensile test is to be used to determine the (modulus of rupture) split tensile strength of concrete.

5. RESULT ANAYLSIS

Test On Cement

Tests	Value
Specific gravity of cement	3.14
Initial setting time of cement	50 minute
Final setting time of cement	195minute

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Zoning Of Sand

Zoning of sand was conducted according to IS: 383(1970). The zones are divided in to four groups as shown below

Sieve sizes	Zone 1	Zone2	Zone3	Zone4
10mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

Sieves	Wt. Retained	Wt. Retained	Cumulative	Cumulative wt.
10 mm	0	0	0	100
4.75 mm	60	5	5	95
2.36 mm	175	14.58	19.58	80.42
1.18 mm	124	10.33	29.91	70.09
600 micron	106	8.83	38.74	61.26
300 micron	252	21.00	59.74	40.26
150 micron	365	30.41	90.25	9.85

So on comparing the values of cumulative wt. passing we concluded that the sand we are using is of zone 2. According to Indian standards zone 2 and zone 3 sand is most desirable for construction

Test On Coarse Aggregates

Tests	Value
Specific gravity of coarse aggregates	2.61
Apparent specific gravity	2.60
Water absorption value	1.0095

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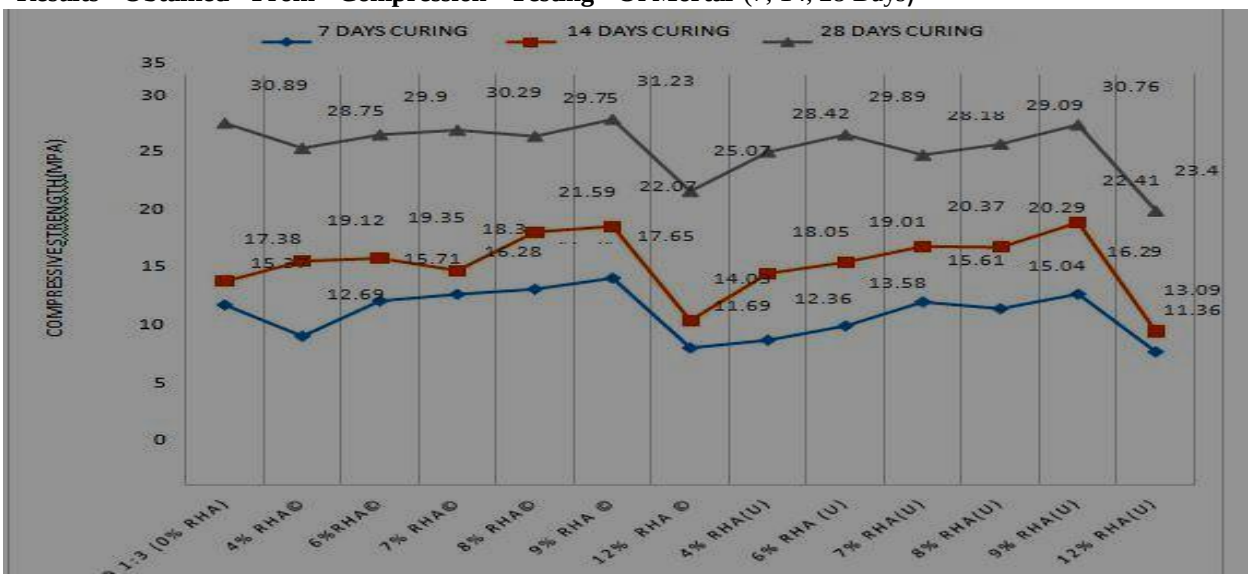
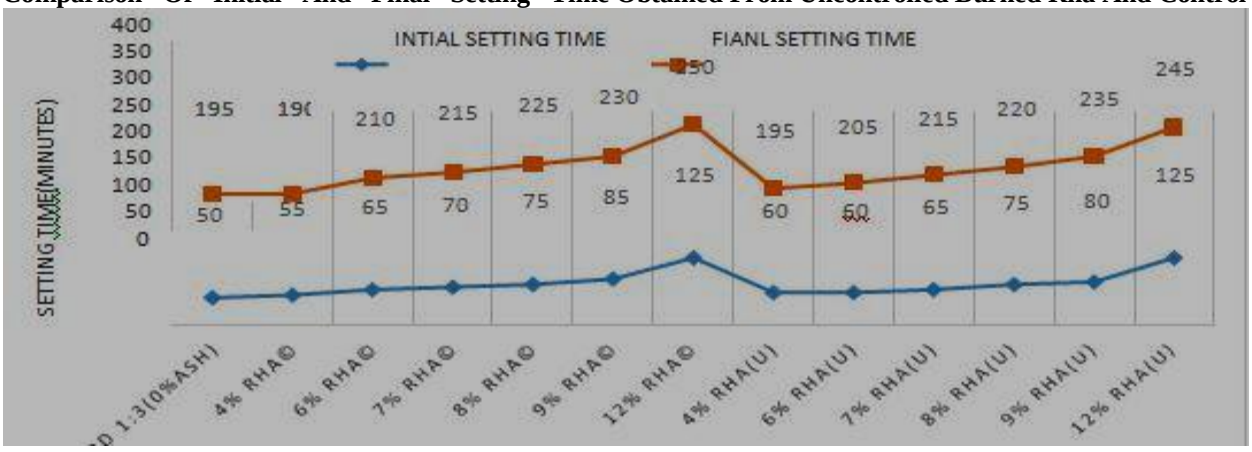
Test On Fine Aggregates

Tests	Value
Specific gravity of fine aggregate	2.59
Apparent specific gravity	2.62
Water absorption value	0.40

Results Obtained From Compression Testing Of Mortar (7, 14, 28 Days)



Comparison Of Initial And Final Setting Time Obtained From Uncontrolled Burned Rha And Control



6. DISCUSSION OF RESULTS

Results obtained by the use of controlled burned ash are somehow better than that of results obtained from the uncontrolled burned ash. However the results does not differ that much. The difference between the results obtained were 1-2 MPa in most of the samples. The use of uncontrolled RHA is also not suitable because burning of rice husk

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is not easy and also more cost & time will be consumed. But for better results and for saving time use of controlled burned ash is more preferable.

7. EFFECT ON COMPRESSIVE STRENGTH

Using rice husk ash up to an optimum level of 9% results in good compressive strength of cement mortar. Firstly there was a rapid increase in strength of the mortar when percentage varied from 4%-9%, after 9% when 12% rice husk ash was used a downfall in the strength was observed. Using ash up to 9% will give good results without compromising compressive strength.

8. EFFECT ON SETTING TIME

Initial setting time increased with the increase in percentage of ash whether that's burned under controlled condition or burned under uncontrolled condition. In case of final setting time, it is not affected by the lower percentages of the ash but as soon as percentage increases final setting time also increases. So both initial and final setting time will be enhanced by adding RHA and increase will depend solely on percentage of RHA added.

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