STRENGTH, DURABILITY AND PROPERTIES OF CONCRETE BY USING FLY ASH, RICE HUSK ASH AND EGG SHELL POWDER AS PARTIAL REPLACEMENT OF CEMENT

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ABSTRACT

Concrete is always expected to be stronger and more durable than in the past while being cost and energy efficient. Moreover the major advantages that concrete possesses over the construction materials have to be conserved. The possibility of being fabricated practically anywhere, the ability to make the form imposed by the shape of a mould and a low cost of

components and manufacture. These factors have driven advances in improving the performance of concrete over years and continue to do so the need for improving the performance of concrete and concern for the environmental impact arising from the continually increasing demand for concrete has lead the growing use of alternative material components.

An experimental investigation will be conducted to study the properties of concrete containing Fly ash, Rice Husk ash and Egg shell powder as a partial replacement of cement in the concrete mix design. Various Strength tests compressive strength, split tensile strength, flexural strength and durability of concrete by varying proportions of RHA and ESP with constant variation 5% of FA. The experimental trials used for this study are 0%FA+0%RHA+0%ESP,5%FA+0%RHA+0%ESP, 5%FA+5%RHA+5%ESP, 5%FA+10%RHA+10%ESP, 5%FA+15%RHA+15%ESP by weight of cement for M30 grade concrete . The obtained results will be compared with the conventional concrete, there by knowing the changes in the properties of concrete containing FA, RHA, and ESP as partial replacement of cement.

Key words: Fly ash, Rice husk ash, Egg shell powder, compressive strength, split tensile strength, flexural strength, durability.

1.INTRODUCTION

Earlier works on the combination concrete conducted by scholars have led us to the point that the egg shell powder can be used as a supplement for industrial lime. In their article "Effect of Eggshell powder on the Stabilizing Potential of Lime on an Expansive Clay soil" by O. O. Amu, A. B. Fajobi and B.O. Oke Department of Civil Engineering, Obafemi Awolowo University, Ileife, Nigeria have come to the conclusion that the 4% ESP + 3% lime as the optimal percentage of lime Egg shell Powder Combination. There were also studies on using Egg Shell Powder in wall tile materials. Egg Shell Powder is rich in CaCo3.

Based on the researches conducted by M. N. Frere, J. N. F. Holanda in their article "Characterization of avian eggshell waste aiming its use in a ceramic wall tile paste". Opine that the eggshell rich in CaCo3 can be used as an alternative raw material in the production of wall tile material. World over 500 millions tons of rice is harvested. Of which 20% is rice husk which is a threat to the environment.

To reduce the pollution various tests are conducted to find out whether these matters can be converted into some useful material. Feng Qingfe et al in their article "Concrete with Highly Active Rice Husk Ash" have studied the strength, pore volume and pore distribution of the concrete using Rice Husk Ash. These Studies prompts think and investigate the possibility of using Egg Shell Powder, Rice Husk Ash and Fly Ash as partial replacement in the conventional Concrete.

2.LITERATURE REVIEW

AmarnathYerramala studied the Properties of concrete with eggshell powder as cement replacement.
D.Gowsika et al experimentally investigated the Egg Shell Powder as Partial Replacement with Cement in Concrete.
Praveen Kumar R et al experimentally investigated the Partial Replacement of Cement with Egg Shell Powder.
Lau yih bling conducted the investigation in egg albumen and reported that foamed concrete were prepared by egg albumen which has reduce the cost and time of project.
Amu et al carried out the experiment and stated that common salt with egg shell on lateritic soil obtaining a good

compliment for egg shell as a useful stabilizer for road works.

Dinesh et al has conducted the experiment by replacing fine aggregate by rice husk ash and egg shell powder.

Jayasankar et al has investigated the experiment by partially replacing cement with flyash and egg shell powder.

Karthick et al has conducted experiment by replacing the fine aggregate by egg shell. Here they had replaced the Egg shell up to 10%, 20%, 30%, 40% & 50%.

Mahendra Prasad et al had done the research to investigate the workability and flexural strength of cement concrete containing silica fume and polypropylene fibers.

Praveen Kumar et al has investigated the combination of Egg shell with silica fumes are used in different combinations to find the feasibility of using Egg shell as an alternate to cement.

3.MATERIALS

Cement:

Ordinary Portland cement of 53 grade from the local market was used and tested for physical and chemical properties as per IS: 4031 – 1988and found to be conforming to various specifications as per IS: 12269-1987. For this study jaypee cement of OPC 53 Grade was collected from Rama Krishna iron and cement, Door No 3-14-24/4, Kuc Road, Hanamkonda, Warangal - 506001, Near Sai Baba Temple, Yadava Nagar.

Fine Aggregates

In the present investigation fine aggregate is natural sand from local market is used. The physical properties of fine aggregate like specific gravity, bulk density, gradation and fineness modulus are tested in accordance with IS :2386.

For this study sand is collected from Bhavana Metal & Sand Suppliers, Kakatiya University Bypass Rd, University First Gate, Pedhammagadha Road, Kakatiya University, Hanamkonda, Telangana 506001

Coarse Aggregate

The crushed coarse aggregate of 12.5 mm maximum size rounded obtained from the local crushing plant, Robo silicon, keeseragutta; Hyderabad is used in the present study. The physical properties of coarse aggregate like specific gravity, bulk density, gradation and fineness modulus are tested in accordance with IS ; 2386.

For this study Coarse aggregates are collected from Bhavana Metal & Sand Suppliers, Kakatiya University Bypass Rd, University First Gate, Pedhammagadha Road, Kakatiya University, Hanamkonda, Telangana 506001

Fly ash

Fly ash, also known as "pulverised fuel ash" in the United Kingdom, is a coal combustion product that is composed of the particulates(fine particles of burned fuel) that are driven out of coal-fired boilers together with the flue gases. Ash that falls to the bottom of the boiler is called bottom ash. In modern coal-fired power plants, fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys. Together with bottom ash removed from the bottom of the boiler, it is known as coal ash. Depending upon the source and composition 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), aluminium oxide (Al_2O_3) and calcium oxide (CaO), the main mineral compounds in coal-bearing rock strata.

RICE HUSK ASH

Rice husk ash is used in concrete construction as an alternative of cement. The types, properties, advantages and uses of rice husk in construction is discussed. The rice paddy milling industries give the by-product rice husk. Due to the increasing rate of environmental pollution and the consideration of sustainability factor have made the idea of utilizing rice husk.The reasons behind the usage of rice husk as an alternative for cement in concrete manufacturing are explained in the following sections.To have a proper idea on the performance of rice husk in concrete, a detailed study on its properties must be done.About 100 million tons of rice paddy manufacture by-products are obtained around the world. They have a very low bulk density of 90 to 150kg/m^3. This results in a greater value of dry volume.

EGG SHELL POWDER

The eggshell also creates some allergies, when kept long time in garbage and disposal of eggshell also one the biggest problem. It also create undesirable smell which can cause irritation. The main ingredient in eggshells is calcium carbonate(the same brittle white stuff that chalk, limestone, cave stalactites, sea shells, coral, and pearls are made). The shell itself is about 95% CaCO3 (which is also the main ingredient in sea shells). The remaining 5% includes Magnesium, Aluminium, Phosphorous, Sodium, Potassium, Zinc, Iron, Copper, Ironic acid and Silica acid. Eggshell has a cellulosic structure and contains amino acids.

WATER:

Fresh and clean water is used for casting and curing of specimen. The water is relatively free from organic matters, silt, oil, sugar, chloride and acidic material as per requirements of Indian standard. Combining water with a cementitious material forms a cement paste by the process

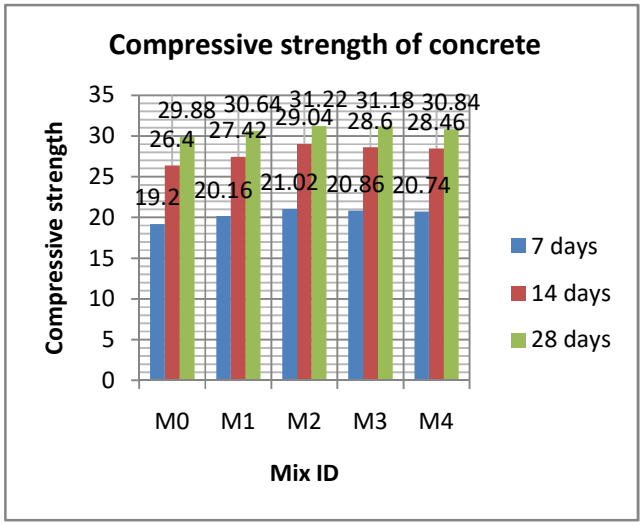
of hydration. A cement paste glues the aggregate together fills voids within it, and makes floor freely.

4.RESULTS

Compressive strength

s.no	%FA+%RHA+%ESP (Mix ID)	compressive strength		
		7 days	14 days	28 days
1	0%FA+0%RHA+0%ESP (M0)	19.2	26.4	29.88
2	5%FA+0%RHA+0%ESP (M1)	20.16	27.42	30.64
3	5%FA+5%RHA+5%ESP (M2)	21.02	29.04	31.22
4	5%FA+10%RHA+10%ESP (M3)	20.86	28.6	31.18
5	5%FA+15%RHA+15%ESP (M4)	20.74	28.46	30.84

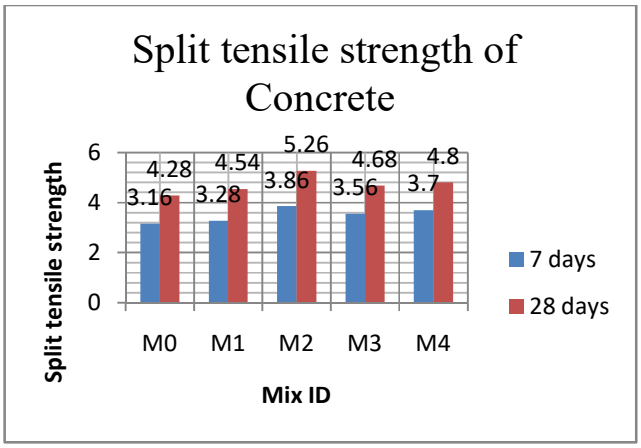
Compressive Strength of concrete



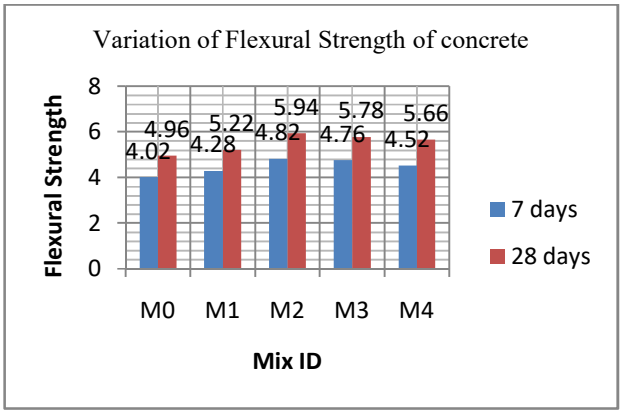
Split tensile strength

s.no	%FA+%RHA+%ESP (Mix ID)	Split tensile strength	
		7 days	28 days
1	0%FA+0%RHA+0%ESP (M0)	3.16	4.28
2	5%FA+0%RHA+0%ESP (M1)	3.28	4.54
3	5%FA+5%RHA+5%ESP (M2)	3.86	5.26
4	5%FA+10%RHA+10%ESP (M3)	3.56	4.68
5	5%FA+15%RHA+15%ESP (M4)	3.7	4.8

Split tensile strength of concrete

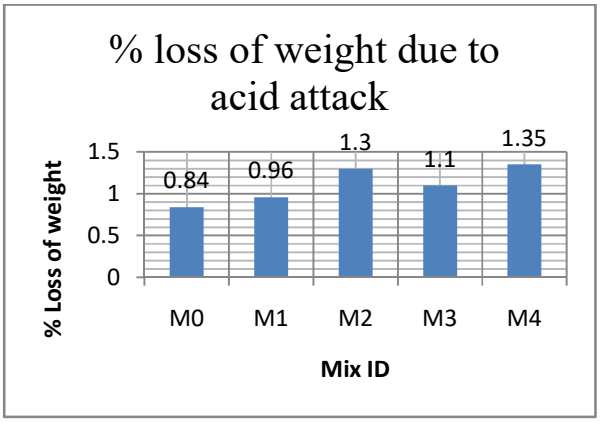


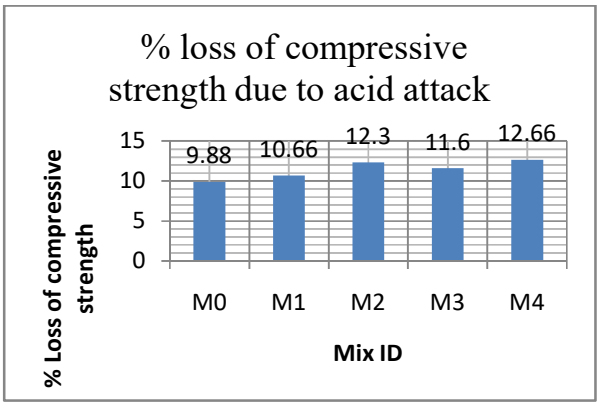
Flexural strength



Variation of Flexural strength of concrete

S.no	%FA+%RHA+%ESP (Mix ID)	Flexural strength of concrete	
		7 days	28 days
1	0%FA+0%RHA+0%ESP (M0)	4.02	4.96
2	5%FA+0%RHA+0%ESP (M1)	4.28	5.22
3	5%FA+5%RHA+5%ESP (M2)	4.82	5.94
4	5%FA+10%RHA+10%ESP (M3)	4.76	5.78
5	5%FA+15%RHA+15%ESP (M4)	4.52	5.66





DURABILITY

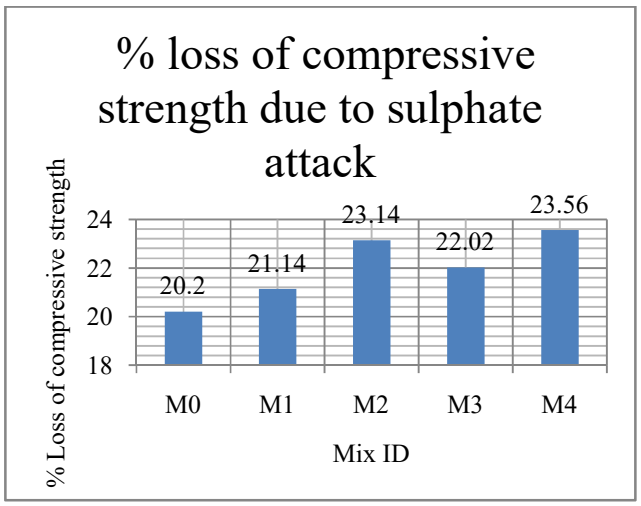
Acid Attack

Sl. no	% SF+%MD (Mix ID)	Initial weight of cube after 28days curing in grams	Final weight of cubes after 90days curing in grams	% loss of weight due to acid attack	Compressive strength of cube after 28days curing	Compressive strength of cubes after 90days curing	% loss of compressive strength due to acid attack
1	0%FA+0%RHA+0%ESP (M0)	2365	2345	0.84	29.88	26.93	9.88
2	5%FA+0%RHA+0%ESP (M1)	2340	2318	0.96	30.64	27.37	10.66
3	5%FA+5%RHA+5%ESP (M2)	2394	2363	1.3	31.22	27.38	12.3
4	5%FA+10%RHA+10%ESP (M3)	2330	2304	1.1	31.18	27.56	11.6
5	5%FA+15%RHA+15%ESP (M4)	2286	2255	1.35	30.84	26.94	12.66

SULPHATE ATTACK

Sl. no	%FA+%RHA+%ESP (Mix ID)	Compressive strength of cube after 28days curing	Compressive strength of cubes after 90days curing	% loss of compressive strength due to sulphate attack
1	0%FA+0%RHA+0%ESP (M0)	29.88	23.84	20.2
2	5%FA+0%RHA+0%ESP (M1)	30.64	24.16	21.14
3	5%FA+5%RHA+5%ESP (M2)	31.22	24	23.14
4	5%FA+10%RHA+10%ESP (M3)	31.18	24.31	22.02
5	5%FA+15%RHA+15%ESP (M4)	30.84	23.57	23.56

Sulphate Attack Test



5.CONCLUSIONS

From this study the following conclusions were made

1. By using fly ash, Rice husk ash and egg shell powder in concrete will reduces the cost of construction and increases the strength for certain percentage of replacement of cement.
2. The value of slump decreases with increase in the percentage of fly ash, Rice husk ash and egg shell powder from M0 Mix to M4 mix.
3. The value of compaction factor decreases with increase in the percentage of fly ash, Rice husk ash and egg shell powder from M0 Mix to M4 mix.
4. The optimal value (maximum value) of compressive strength was observed at 5%FA+5%RHA+5%ESP (M2) for 7days, 14 days and 28 days. After 5%FA+5%RHA+5%ESP (M2) the compressive strength of concrete decreases.
5. The optimal value (maximum value) of split tensile and flexural strength was observed at 5%FA+5%RHA+5%ESP (M2) for 7days, 14 days and 28 days. After 5%FA+5%RHA+5%ESP (M2) the compressive strength of concrete decreases.
6. Addition of fly ash, Rice husk ash and egg shell has resulted in enhanced early strength and ultimate strength of concrete.
7. The partial replacement of cement results in reduction in the emission of green gases.
8. The easy availability of fly ash, Rice husk ash and egg shell and their lesser cost affects in cheaper economy.

6.REFERENCES

AmarnathYerramala, ìProperties of concrete with eggshell powder as cement replacementî, The Indian Concrete Journal October 2014.

D.Gowsika, experimental Investigation of Egg Shell Powder as Partial Replacement with Cement in Concrete, International Journal of Engineering Trends and Technology (IJETT) ñ Volume 14 Number 2 ñ Aug 2014.

M.O.A. Mtallib and A. Rabiu, ìEffects Of Eggshells Ash On The Setting Time OfCementî, Vol 3, 12 January 2011.

Isaac O. Igwe, Genevive C. Onuegbu,î Studies on Properties of Egg Shell and Fish Bone Powder Filled Polypropylene ì, American Journal of Polymer Science 2012, 2(4): 56-61.

Praveen Kumar R, ìExperimental Study on Partial Replacement of Cement with Egg Shell Powderî, International journal of innovations in engineering and technology, Volume 5, ISSN: 2319-1058.

Dinesh.N, Ramesh Kumar.R, Arunachalam, Chandrasekhar, Gautam.P (2001), ëPartial Replacement of Fine Aggregate by Rice husk ash and Eggshell Powderí, International Journal of Innovative Science and research, Vol.3, Issue 1, pp.1-17.

Jayasankar.R, Mahindran.N, Ilangovan.R (2010), ëStudies on Concrete Using Fly Ash, Rice Husk Ash and Egg Shell Powderí, International Journal of Civil and Structural Engineering, Vol. 1, Issue No 3, pp. 362-373.

J.Karthick, R.Jeyanthi, M.Petchiyammal (2012), ëExperimental Study on Usage of Egg Shell as Partial Replacement for Sand in Concreteí, International Journal of Advanced Research in Education Technology, Vol.1, Issue 1, pp. 7-11.

M. Sivakumar, Dr. N. Mahendran, Strength And Permeability Properties Of Concrete Using Fly Ash (Fa), Rise Husk Ash (Rha) And Egg Shell Powder (Esp), Journal Of Theoretical And Applied Information Technology vol. 66