An Experimental investigation to check the effect of Egg shell powder and Rice husk ash on property of concrete

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Abstract:- Concrete has been accepted for its long-lasting and dependable nature. In addition to durability and dependability, concrete also has superior energy performance, is flexible in design, affordable, and relatively environmentally friendly. It can be expected that concrete will be needed to increase industrialization and urbanization while protecting the environment .Concrete can also be produced in ways that are environmentally friendly and architecturally moldable in esthetically pleasing forms. Unfortunately, India is not self sufficient in the production of cement, the main ingredient of concrete and the demand for exceeds the supply and makes the construction activities very costlier. Hence the entire construction industry is in search of an effective the waste product that would considerably minimize the use of cements and ultimately reduces the construction cost. The use of waste -products is an environmental friendly, method of disposal of large quantities of materials that would otherwise pollute land, water and air. In this investigation we use some cementing materials like Rice husk ash (RHA) and Egg shell powder (ESP) as a replacement of cement and found that the strength parameters of concrete (Compressive and Flexural) at different replacement levels at 7, 14 and 28 days of curing for M-25 grade is greater as compare to control concrete.

Keywords-*Concrete, Egg shell powder (ESP), Rice Husk Ash (RHA).*

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1. Introduction

1.1 Rice husk ash

In rice mill during the milling of paddy near about 78 % of weight is received as rice, broken rice and bran. The rest 22 % of the weight of paddy is received as husk. This husk is also used as fuel in the rice mills for the boilers for processing paddy and also used in a small power plants for producing energy. Rice husk contains about 75 % organic volatile matter which burns up and the balance 25 % of the weight of this husk is converted into ash during the firing process, which is known as rice husk ash (RHA). For making rice husk ash rice husk is burnt approximately 48 hours under uncontrolled combustion process. The burning temperature is within the range of 600 to 850 C^0. The ash obtained is ground in a ball mill near about for 30 minutes and color of rice husk ash is seen as grey. This RHA contains around 85%-90% amorphous silica. India is a major rice producing country, about 20 million tons of RHA is produced annually. This RHA is a great environment threat causing damage to the land and the surrounding area in which it is dumped. Lots of ways are being thought of for disposing it by making commercial use of this RHA. In the present investigation, Portland cement was replaced by rice husk ash at various percentages to study compressive and flexural strength.

(1P.Padma Rao, 2A.Pradhan Kumar, 3B.Bhaskar Singh, A Study on Use of Rice Husk Ash in Concrete, International Journal of Education and applied research Vol. 4, Issue Spl-2, Jan - June 2014)

1.2 Egg shell powder

It is estimated that roughly 90 million tones of hen egg are generated throughout the world every year. In India 77.7 billion eggs are produced in the year 2010-2011. Tamil Nadu having share of around 20 %, is ranked second with almost 2,000 core eggs created in the state every year. The next in the list of prominent egg producing states in India comprise Maharashtra, Haryana, Punjab and West Bengal.
(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 Technologyvol. 66 No.2.)

Eggshell is generally thrown away as a waste. The egg shell also creates some allergies when kept for a longer time in garbage. Disposal is a problem. It creates 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 of). The shell itself is about 95% $CaCO_3$ (which is also the main ingredient in sea shells). The remaining 5% includes Magnesium, Aluminum, Phosphorous, Sodium, Potassium, Zinc, Iron and Copper, **(Chirag J. Shah, Vyom B. Pathak, Rushabh A. Shah ,A Study of Future Trend for Sustainable Development by Incorporation of Supplementary Cementitious Materials, International Journal of Inventive Engineering and Sciences (IJIES) ISSN: 2319–9598, Volume-1, Issue-11, October 2013)**

3. Physical property of Cement, RHA and ESP

Material	Specific gravity	Finesse modules/ Finesse (%)
Cement	3.10	1%
Rice husk ash	1.98	1.6%
Egg shell powder	1.89	4.1%

(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 Technologyvol. 66 No.2.)

4. Chemical Analysis

Table 1: Chemical Analysis for Cement

SiO_2	21.3
CaO	63.14
Fe_20_3	3.77
Al_20_3	5.41
MgO	1.2
Na_2O	0.56
K_2O	0.67

Table 2: Chemical Analysis for Rice Husk Ash

SiO_2	92.89
Fe_2O_3	0.43
Al_2O_3	0.18
CaO	1.03
MgO	0.35
SO_3	0.1
$Al_2O_3 + Fe_2O_3$	0.61
Na_2O	3.56
K_2O	0.72

Table 3: Chemical Analysis for Egg Shell Powder

CaO	50.7
SiO_2	0.09
Al_2O_3	0.03
MgO	0.01
Fe_2O_3	0.02
Na_2O	0.19
P_2O_5	0.24
SrO	0.13
NiO	0.001
SO_3	0.57
Cl	0.219

(Jayasankar.R [1] , Mahindran.N [2] , Ilangovan.R [3], Studies on Concrete using Fly Ash, Rice Husk Ash and Egg Shell Powder, international journal of civil and structural engineering Volume 1, no 3, 2010.)

5. Mix proportion

Mix proportion for M25 grade concrete for tested material as follows:

Table 4: Concrete mix proportion

Sr. No.	Material	Quantity	Proportion
1	Cement	430.5 kg/m3	1
2	Sand	468 kg/m3	1.21
3	Coarse aggregate	1245.5 kg/m3	2.97
4	Water	---	0.43

6. Combination of materials

Table 4: Cement+RHS+ESP

Sr. No	Mix designation	Cement (%)	RHS (%)	ESP (%)
1	Mx_0	100	0	0
2	Mx_1	90	5	5
3	Mx_2	85	7.5	5
4	Mx_3	80	10	5
5	Mx_4	70	15	5
6	Mx_5	60	20	5

7. Test on hardened concrete

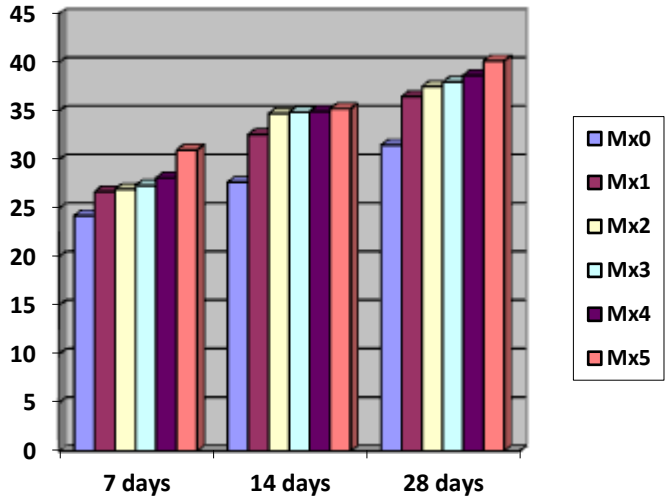
Tests were done as per following codes of Bureau of Indian Standards. The test for compressive strength on cubes were measured at 7, 14 and 28 days of curing as per IS : 516 1959, test for flexural strength on beam was measured at 28 days of curing as per IS: 516 1959 and test for split tensile strength on cylinder was measured at 28 days of curing as per IS : 5816 1999.

7.1. Compressive Strength Test

Concrete cube of 150 x 150 x 150 mm dimensions were cast for testing compressive strength. Vibration was given to the moulds using table vibrator. After 24 hours the cubes placed in curing tank for 7, 14 and 28 days curing. After curing these cubes were tested on digital compression testing machine as per I.S. 516-1959.

Table 5: Test results for Compressive strength

Sr. No.	Mix designation	Compression test after no. Of days (Mpa)		
		7 days	14 days	28 days
1	Mx_0	24.23	27.68	31.51
2	Mx_1	26.70	32.60	36.49
3	Mx_2	26.96	34.74	37.53
4	Mx_3	27.34	34.88	37.98
5	Mx_4	28.12	34.96	38.67
6	Mx_5	31.00	35.24	40.18



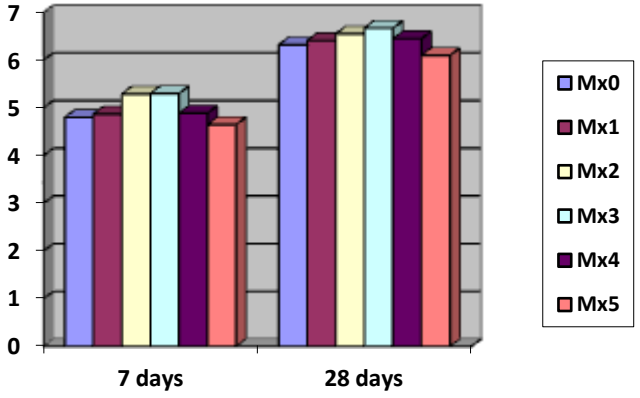
Graph 1: Compressive Strength of Concrete

7.3. Flexural Strength of Concrete

Flexural tensile strength by means of beam specimens of concrete. Beams were investigated after 7and 28 days of curing for Flexural Strength. It was seen that highest flexural strength was attained at Mx_3. and thereafter at Mx4, the flexural strength is decrease.

Table 6: Test results for Flexural Strength

Sr. No.	Mix designation	. Flexural Strength test after no. Of days (Mpa)	
		7 days	28 days
1	Mx_0	4.80	6.32
2	Mx_1	4.87	6.41
3	Mx_2	5.29	6.55
4	Mx_3	5.30	6.67
5	Mx_4	4.89	6.45
6	Mx_5	4.65	6.1



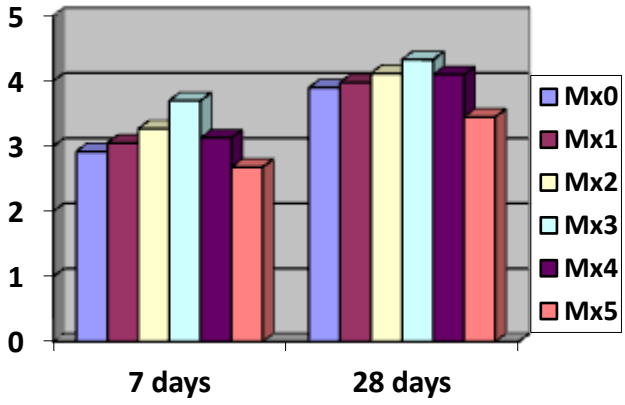
Graph 2: Flexural Strength of Concrete

7.2. Splitting Tensile Strength of Concrete

The splitting tensile strengths of concrete after 7 and 28 days of curing the splitting tensile strength value boosts Mx_1 to Mx_3. and then at Mx4, the splitting tensile strength is decrease.

Table 7: Test results for Splitting Tensile Strength

Sr. No.	Mix designation	Splitting Tensile Strength test after no. Of days (Mpa)	
		7 days	28 days
1	Mx_0	2.92	3.90
2	Mx_1	3.05	3.98
3	Mx_2	3.27	4.12
4	Mx_3	3.70	4.33
5	Mx_4	3.13	4.1
6	Mx_5	2.68	3.45



Graph 3: Splitting Tensile Strength of Concrete.

8. Conclusions

Based on the Results presented above, the following conclusions can be drawn:

1. Rice husk ash (RHA) contains 87.68 – 91 % silica and Egg shell powder contains 93.70% calcium carbonate.
2. Based on the results of these works it can be concluded that RHA and ESP mixed cubes has equal strength with that of conventional concrete cubes.
3. Compressive and tensile strength improves with the increase in the percentage of Rice Husk Ash and Egg shell powder of 7 and 28 days curing.
4. Better mechanical and physical properties of concrete can be obtained with the replacement of cement with rice husk ash and Egg shell powder in Mx_4 mix

References

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[4] (1P.Padma Rao, 2A.Pradhan Kumar, 3B.Bhaskar Singh, A Study on Use of Rice Husk Ash in Concrete, International Journal of Education and applied research Vol. 4, Issue Spl-2, Jan - June 2014)