Properties of concrete by partially replacing cement with egg shell powder

S.Vijaya Bhaskar Reddy[1], K.Subhashini[2], T.Suresh[3]

[1]Prof & Head, [2,3]Assistant Professor
Department of civil Engineering CMR Technical campus-501401,
Hyderabad, Telangana India.

***Abstract*: Currently India has taken a major initiative on developing the infrastructure such as express highways, power projects and industrial structure etc., to meet the requirements of globalization, in the construction of building and other structure. Concrete plays the key role and a large quantum of concrete is being utilized in every construction practices. The egg shell usually which are disposed, is used as an alternate for the cement since the shell is made up of calcium. An egg shell is used in different combinations to find the feasibility of using the egg shells as an alternate to cement. Egg Shell powder replaces 0%, 5%, 10% and 15% of weight of cement.**

***Keywords*: Cement replacing material, Egg Shell powder, Compressive strength**

I. INTRODUCTION

Concrete is a mixture of different materials like binder (cement), fine aggregate, coarse aggregate and water. Use of concrete is very large so availability of natural material is reduced and there is no material which plays the role of this ideal material. So to fulfil the requirement of industries we have to replace fully or partially all the materials. In India number of waste materials is produced by different manufacturing companies, Thermal power plant, municipal solid wastes and other wastes. Solid as well as liquid waste management is one of the biggest problems of the whole world. During manufacturing of one tonnes Ordinary Portland Cement (OPC) we need about 1.1 tonnes of earth resources. Further during manufacturing of one tonnes of cement an equal amount of carbon dioxide is released in to the atmosphere which acts as a silent killer in the environment as various forms. In this backdrop, the search for cheaper substitute to OPC is a needful one. Egg shells are agricultural throw away objects produced from chick hatcheries, bakeries, fast food restaurants etc. which can damage the surroundings and as a result comprising ecological issues/contamination which would need appropriate treatment. Egg shell also creates some allergies when kept for longer time in garbage. Use of egg shell waste instead of natural lime to replace cement in concrete can have benefits like minimizing use of cement, conserving natural lime and utilizing waste material. The egg shell primarily contains calcium, magnesium carbonate and protein. Egg Shell Powder (ESP) is the fine grained powder with suitable proportion which is sieved to the required size before use with concrete/mortar.

NATURE OF EGG SHELL

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 chemical composition of Eggshell powder and cement were found to be similar. The main component of eggshell was calcium carbonate (around 51%).Eggshell consists of several mutually growing layers of CaCO3, the innermost layer-maxillary 3 layer grows on the outermost egg membrane and creates the base on which palisade layer constitutes the thickest part of the eggshell. The shell itself is about 95% CaCO3 (which is also the main ingredient in sea shells). The remaining 5% includes Magnesium, Aluminum, Phosphorous, Sodium, Potassium, Zinc, Iron, Copper, Ironic acid and Silica acid. Eggshell has a cellulosic structure and contains amino acids; thus, it is expected to be a good bio-sorbent and it was reported that large amounts of eggshells are produced in some countries, as waste products and disposed in landfills annually.

The Eggshell consists of several mutually growing layers of CaCO3, the innermost layer-maxillary 3 layer grows on the outermost egg membrane and creates the base on which palisade layer constitutes the thickest part of the eggshell. The top layer is a vertical layer covered by the organic cuticle. The eggshell primarily contains calcium, magnesium carbonate (lime) and protein. In many other countries, it is the accepted practice for eggshell to be dried and use as a source of calcium in animal feeds. The quality of lime in eggshell waste is influenced greatly by the extent of exposure to sunlight, raw water and harsh weather conditions. It is the fine grained powder with suitable proportion which is sieved to the required size before use with concrete/mortar.

Fig1. Egg shell powder

II. LITERATURE REVIEW

Karthick et al has conducted experiment by replacing the fine aggregate by egg shell. Here they had replaced the Eggshell up to 10%, 20%, 30%, 40% & 50%. They concluded that, the tensile strength, flexural strength was decreased with increasing egg shells percent. The tensile strength decreased from (2.36N/mm2) to (0.21 N/mm2) with increasing egg shell from (0 wt %) to (50 wt %).

Mahendra Prasad et al had done the research to investigate the workability and flexural strength of cement concrete containing silica fume and polypropylene fibers. Silica fume content used was 0%, 5%, 10% and 15% by replacement of equal weight of cement in concrete. Polypropylene fibers were added in 0%, 0.20%, 0.40% and 0.60% by volume fraction of concrete. Silica fume appeared to have an adverse effect on the workability of fiber concrete. It is observed from slump test results of PF0S0 to PF0.6S15 that there is continuous decrease in workability of concrete with increase in polypropylene fiber content. The increase in flexural strength was found to be around 40% with the use of polypropylene and silica fume compared to the reference concrete.

M.Divya and R.Nandhakumar Reduce and Reuse of the alternative materials is much important to sustain our energy resources. In the field of construction, the use of admixtures and re-utilization of available wastage materials is not a new one. But this article is deals with a study of Egg Shell Powder as a partial replacement of cement in concrete to make two advantages, to improve the strength as well as to reuse & reduce the egg shell wastage. Because the egg shell wastage is huge in our country around 2Lakh Tones per year. The various characteristics of ESP are examined and it is allowed to concrete as a partial replacement of cement. The various proportions such as 2.5, 5, and 7.5% are tried in this investigation and the strength achieved by ESP concrete is much better than a nominal concrete. Every admixture has its own strength in their dosage level; likewise there was a sharp decrease in the strength when the proportion of ESP is beyond the level of 5%.

Bandhavya G.B1, Sandeep K2, Bindhushree G. Currently India has taken a major initiative on developing the infrastructure such as express highways, power projects and industrial structure etc., to meet the requirements of globalization, in the construction of building and other structure. Concrete plays the key role and a large quantum of concrete is being utilized in every construction practices. The egg shell usually which are disposed, is used as an alternate for the cement since the shell is made up of calcium. An egg shell is used in different combinations to find the feasibility of using the egg shells as an alternate to cement.

Egg Shell powder replaces **0%,5%,10% and 15% of weight of cement**. Concrete is cast and compressive test and tensile tests were carried out to find the best combination which results in optimum percentage of strength.

Okonkwo et al has concluded in his research that Egg Shell ash can be used as an alternate for cement which resulted in higher compressive strength on lateritic soil. Constant Cement of 6 and 8 per cent added with the egg ash powder of 0-10 per cent at 2 per cent intervals shows increase in 35 per cent of compressive strength but fell short of the strength requirements the durability. Ultimately they found that soil-cement egg shell mixture can be used for road pavements.

Arash Barazesh et al carried out the experiment on the effect of eggshell powder on plasticity index in clay and expansive soils and reported that plasticity index of the soil can be improved by adding egg shell wastes with the clay soil and can be used in construction projects including earth canals and earth dams.

III. OBJECTIVES

To investigate the utilization of Industrial wastes as a replacement for cement in concrete and influence of this on the Strength of concretes made with different cement replacement levels with admixtures.

IV. EXPERIMENTAL WORK

The purpose of this research is to identify the factors that contribute to strength gain in ESP concrete specimen. This section summarizes design mix of concrete

MATERIALS USED

- Cement
- Sand
- Coarse aggregates
- Egg shell powder
- Water

Table 1: Physical Properties of Egg Shell Powder

Name	Physical Properties
Specific Gravity	0.85
Moisture content	1.18
Bulk Density (g/m^3)	0.8
Particle Density (g/m^3)	1.012
Porosity (%)	22.4
Surface area m^2/g	21.2

V. RESULTS AND DISCUSSION

The aim of the investigation is to analyze the effect of concrete with egg shell powder. In this study the effect of the ESP is studied on different percentages 0%, 5%, 10%, 15% using in concrete to find compressive strength and flexural strength split tensile strength.

PROPERTIES OF CONCRETE

The properties of concrete that is used in the investigation are obtained as follows.

Table 2 Tests on cement

NAME OF EXPERIMENTS	RESULTS
1.Specific gravity	2.67
2.Normal consistency	30%
3.Setting time (a)Initial setting time (b) Final setting time	 30 mins 10 hours

Table 3 Tests on aggregate

NAME OF EXPERIMENTS	RESULTS
1.Specific gravity	2.6
2.Impact value test	34.93%

Table 3: Tests on aggregate

Item	1 Days	7 Days	28 Days
compressive strength N/mm^2	26.68	39.05	49.6
Flexural strength N/mm^2	3.07	3.26	4.78
Split tensile strength N/mm^2	2.874	2.911	3.55

Fig 2. **Percentage of ESP with compressive strength**

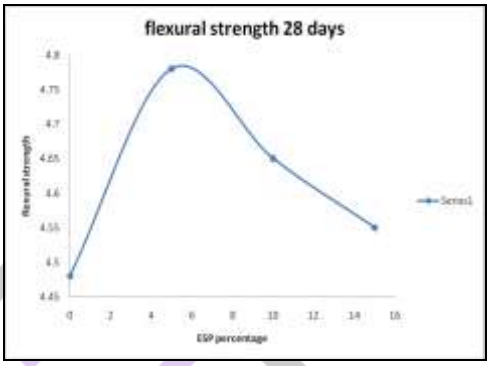

Fig 3. **Percentage of ESP with flexural strength**

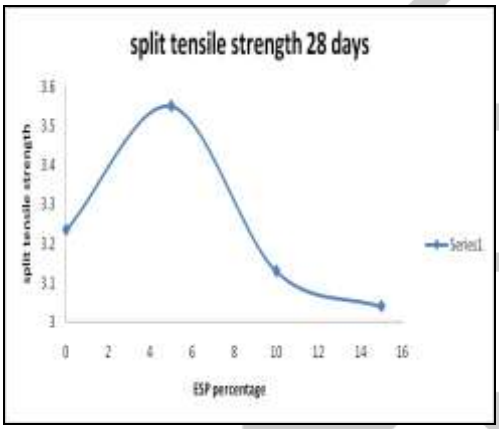

Fig 4. **Percentage of ESP with split tensile strength**

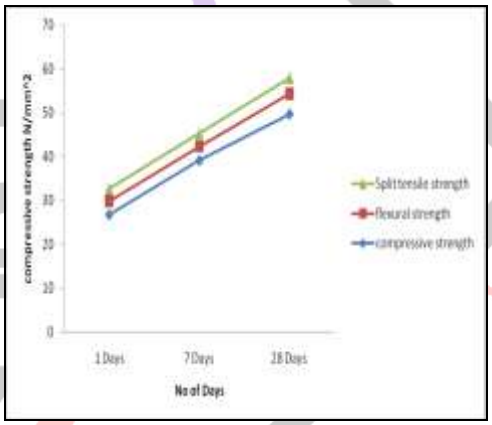

Fig 5. **Percentage of ESP with compressive strength**

VI. CONCLUSION

The data show the ESP can be replaced in place of cement. However, percentage ESP replacement has influence on concrete properties. The main points of this study are outlined below.

Compressive strength was higher than control concrete for 5 % ESP replacement at 7 and 28 days of curing ages. ESP replacements greater than 10 % had lower strength than control concrete. Split tensile strengths of ESP concretes were comparable with control concrete up to 10 **%** ESP replacement. However, concrete with 15 % ESP had lower split tensile strength than control concrete. As in compressive strength, addition of fly ash improved split tensile strength of 15 % ESP concrete.

The results demonstrated that, irrespective of ESP percentage replacement there was good relationship between compressive strength and split tensile strength. Absorption characteristics show that the initial 30 min absorption values for all the concretes were lower than limits commonly associated with good quality concrete. The maximum absorption observed was 1.87 % for 15 % ESP. The absorption decreased with decrease in permeable voids.

REFERENCES

[1] D.Gosika et.,al., 2014 , "Experimental Investigation of Egg Shell Powder as Partial Replacement with Cement in Concrete", Volume 14 Number 2 – Aug 2014 Dept of Civil Engineering, KSR College of Engineering, Tiruchengode, TamilNadu, India.
[2] Nilforoushan, Mohammed Reza, the Effect Of Micro Silica On Permea-bility And Chemical Durability of Concrete Used In The Corrosive Envi-ronment, Iran J. Chem and ChemEng, vol 24 ,No 2, 2005.
[3] Mohammed Razzaq, Ahmed NamahHadi, "Effect Of Egg Shells Powder On Some Mechanical And Physical Properties Of Natural Rubber", The Iraqi Journal For Mechanical And Material Engineering,Vol.12, No.3, 2012.
[4] Guemmadi, Z., Resheidat, M., Houari, H. and Toumi, B (2008) Optimal criteria of Algerian blended cement using limestone fines, Journal of Civil Engineering and Management; 14 (4): 269-275.
[5] Tsivilis S, Tsantilas J, Kakali G, Chaniotakis E, Sakellariou A (2003) The permeability of Portland limestone cement concrete, Cement and concrete research, 33: 1465-1471.
[6] Malhotra, V.M., and P.K. Mehta (2002) High-performance, High Volume fly ash concrete. Supplementary Cementing Materials for sustainable development, inc., Ottawa, Canada, 101pp.
[7] CEB-FIP (1989) Diagnosis and assessment of concrete structures – stateof art report. CEB Bull, 192: 83–85.