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A review of utilization of Egg Shell Waste In Concrete and Soil Stabilization

KEYWORDS: waste utilization, egg shell waste, Supplementary Cementations Material, Physical Properties.

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ABSTRACT The current paper deals with a state of art review on utilization of the egg shell waste in civil engineering practice. This has two fold approach: the first being the disposal of waste and second being the improvement in the physical properties of engineering materials like soil and cement/concrete. The review suggests that very little research is focused on utilization in concrete & utilization in soil. The chemical compositions of these food industry wastes are almost similar to that of Ordinary Portland cement. Major part of chemical composition is govern by calcium oxide(lime).So it has good expectation that it behave well in construction industry.

I. INTRODUCTION

Many researchers have made attempts to use the waste materials to reduce the disposal problems and to improve the mechanical properties of concrete. Fly ash, silica fume, Pozzocrete, Quartz Sand, egg shell powder etc.are some of the waste materials used for making concrete more durable. Eggshells are a food industry waste materials generated from chick hatcheries, bakeries; fast food restaurants among others which can litter the environment and consequently constituting environmental problems/pollution which would require proper handling.

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.. India, currently ranks fourth in world in egg production with an annual production of 17,32,500 tons of egg. By taking 11% of the weight, nearly it comes around 2,50,000 tons of eggshell waste is created. This material goes as a waste and leads to pollution since it favours microbial action [S.Sasikumar].

TABLE 1 : Production of Egg shell in Gujarat (Estimated quantities)

Name of city	Yearly production(tons)
Ahmedabad	525
Surat	518
Baroda	433
Rajkot	412
bhavnagar	354

TABLE 2 : Physical Properties of Egg shell (R. Bhaumik, N. K. Mondal, B. Das)

Constituents	Value
Ph	6.59
Electrical conductance (mS)	0.1
Specific gravity	0.846
Moisture content	1.17
Particle size	150-350 micro-meter
Bulk Density (g/m3)	0.802

The shell itself is about 95% CaCO3 .The remaining 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.

Table3: Chemical Analysis for Egg Shell Powder [Jayasankar, 2010].

% Replacment	ESP & GGBS(50/50) 7 days	ESP & GGBS(50/50) 28 days	ESP & SDA(50/50) 7 days	ESP & SDA(50/50) 28 days
0	24.71	36.67	24.71	36.67
5	23.33	37.12	26.25	38.2
10	25.8	39.61	23.11	35.12
15	24.1	35.4	24.3	32.19
20	22.17	30.7	20.7	29.51
25	18.54	27	18.21	26.3

Egg shells powder is obtained from the egg shells that they were collected and dried by exposed to sun for (3) days, and they were milled by electrical mill, the set of sieves were employed to get on egg shells powder by the suitable size.

Aim of Research is to accelerate utilization of Egg shell on locally developed technologies. Where the communities should be encouraged to deliver them at collection points for onward delivery to a central point where they can be processed into the various products. This will create employment, increase returns from poultry production and minimize environmental pollution.

II. EGG SHELL UTILIZATION IN CONCRETE

- **K. UMA SHANKAR J& H. V. BALAJI** made their research on combinations of such supplementary materials.
- Combination of Materials taken under study was
- Cement + Egg Shell Powder + slag
- Cement + Egg Shell Powder + Sawdust ash

In research he conclude that strength can be maximized up to 10% in case of egg shell powder and slag combination replaced by cement up to 5%.

In case of egg shell powder and saw dust ash combination maximum strength can be achieved if it is replaced by 10%.

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Table3: Compressive strength result for fraction up to 25%
(K. UMA SHANKAR J).

% Replacement	ESP & GGBS(50/50) 7 days	28 days	ESP & SDA(50/50) 7 days	28 days
0	24.71	36.67	24.71	36.67
5	23.33	37.12	26.25	38.2
10	25.8	39.61	23.11	35.12
15	24.1	35.4	24.3	32.19
20	22.17	30.7	20.7	29.51
25	18.54	27	18.21	26.3

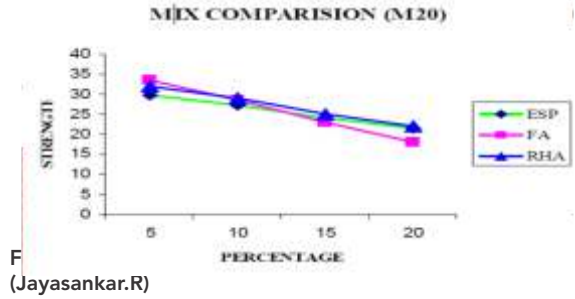
Jayasankar.R, Mahindran.N, Ilangovan.R investigate actual physibility of combination of
(Cement + Fly ash, Cement + RHA, Cement + ESP)

As well combination of (Cement + Fly ash + RHA, Cement + Fly ash + ESP, Cement + RHA + ESP).

Table4: Schedule of casting and combination mix. (Jayasankar.R)

All strength in N/mm²	M20	M25	M30	TOTAL
Control Concrete	9	9	9	27
Cement+flyash Cement+RHA* Cement+ESP**	36	36	36	108
Cement+flyash+RHA Cement+flyash+ESP Cement+RHA+ESP	36	36	36	108
Cement+flyash+RHA+ESP	12	12	12	36

Among all combinations (Cement+ FA) has maximum strength at 5 % replacement by cement.(Cement+RHA) has maximum strength at 20 % replacement.



F
(Jayasankar.R)

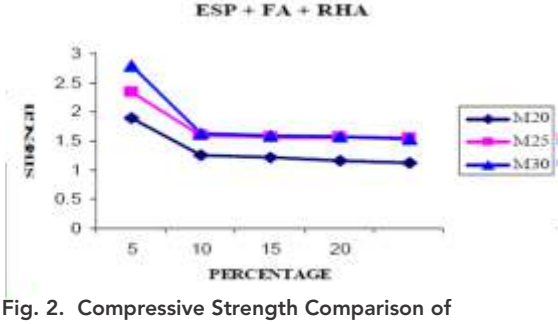


Fig. 2. Compressive Strength Comparison of (ESP+FA+RHA) for Different grades (Jayasankar.R)

RHA, Fly ash and ESP mixed cubes has equal strength with that of conventional concrete cubes in certain Categories. M20 and M25 cubes takes equal load compared to conventional concrete. And M30 grade concrete's load carrying capacity is slightly decreased. Therefore it can be concluded that RHA, Fly ash and ESP mixed cubes when added with the grades above M25 may results in the decrease of the strength level.

III. EGG SHELL UTILIZATION AS SOIL STABILIZATION

Earlier works on the combination concrete led 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, Nigeria have come to the conclusion that the 4%ESP + 3% lime as the optimal percentage of lime Egg shell Powder Combination in Expansive Clay Soil.

Eggshell powder has not been used as a stabilizing material in most parts of the world. However, it could be a Replacement for soil stabilization.

A. J. Olarewaju, M. O. Balogun, and S. O. Akinlolu Study actual suitability of egg shell waste as soil filler material.
From study, eggshell powder mixed with lateritic soil has been found to possess low binding properties, it can be used to significantly improve the strength of soil to be used as a sub grade where very high performance is not necessary. It could serve as a fair replacement for use as stabilizers for sub grade but not for base and sub base.
It can be seen that soil studied (lateritic soil) belongs to A-2-6 (4) group under the granular materials according to the AASHTO rating; i.e., it is regarded as good sub-grade soil. The soil sample is classified as a silty or clayey gravel and sandy soil according to AASHTO classification system. According to Casagrande soil classification, lateritic soil without stabilization is classified as inorganic clay of medium plasticity. It can be seen that both eggshell powder and cement significantly increased the optimum moisture content and maximum dry density of the soil. An 8% eggshell stabilized lateritic soil possesses close optimum moisture content and maximum dry density properties as 2% cement stabilized lateritic soil. California Bearing Ratio reveals that 8% eggshell-stabilized lateritic soil compares favorably with 2% cement stabilized lateritic soil.

Muthu Kumar M, Tamilarasan V S, Tamilnadu, India.
Made their effort to use egg shell as soil filler material during their study they found liquid limit value was decreased gradually when the eggshell powder was added from 0.5% to 5.5% at an interval of 0.5% to the soil. The gradual Decrease in the value of liquid limit was due to the porous

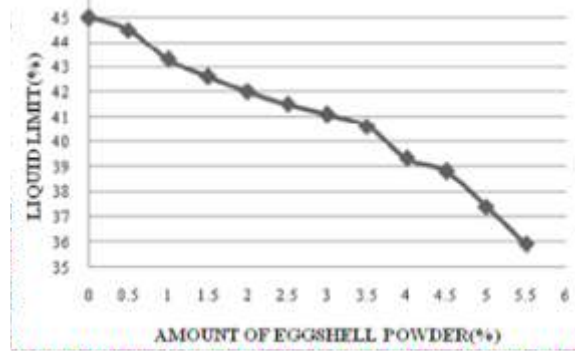


Fig.4 Variation of Plastic limit with the addition of eggshell powder (Muthu Kumar M)

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IV. EGG SHELL UTILIZATION IN NATURAL RUBBER.

Jayasankar et al, 2010, studied effect of egg shells powder on some mechanical and physical properties of natural rubber was investigated

Main objectives of his work was to investigate Use of a egg shells powder for improvement the mechanical and physical properties of polymer instead of traditional material, with a consequent reduction in cost.

Based on his work, following conclusions can be deduced:-

1). The tensile strength, elongation and resilience were decreased with increasing eggshells powder percent. The tensile strength decreased from (22.4 MPa) to (9.7 MPa) with increasing ESP from (5 wt %) to (25 wt%).

2). The modulus of elasticity, hardness and specific gravity were increased with increasing ESP. The hardness was increased from (36.9 IRHD) to (58.3 IRHD) with increasing ESP from (5 wt%) to (25 wt %).

V. EGG SHELL UTILIZATION AS MISCELLANEOUS.

Egg Shell Powder is rich in CaCo3. Based on the researches conducted by M. N. Freire, 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.

VI . CONCLUSION

1) According to researchers it is advisable to replace egg Shell powder with Cement up to 10 % by achieving Same strength. In case higher replacement up to 20%, there is a problem of bleeding, micro cracks and
Segregation. The cure is to add some other binder Material with good proportion as silica fume orPolyester fiber.

2) Study on soil shows Egg shell can utilize as a useful soil stabilizing material. By using the Eggshell powder as a soil stabilizer, we can minimize the waste disposal problem of eggshell. The optimum usage of eggshell powder added to the soil was 3% for best results.

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