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A Study on Effect on Strength and Durability with Coconut Shell Ash and Egg Shell Ash in M40 Grade Concrete

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***Abstract*— The present research aims to investigate the use of Egg Shell Powder (ESP) and Coconut Shell Ash (CSA) as alternate materials, in the formation of a specific concrete and using these materials, design a concrete mix of grade M 40, which then compared with Standard Concrete of same grade against its Strength and Durability. Partial cement and sand replacement – ESP and CSA replaced @ 5%, 10%, 15%, 20%, 25% and 30% by weight of cement.**

***Index Terms*— Concrete, Strength, Durability, Eggshell Powder, coconut shell ash.**

I. INTRODUCTION

For improving the properties of fresh concrete and harden concrete various engineer and scientist are trying to search a material which give equal strength to concrete and we called it spare(Additional) material which enhance the properties of harden as well as in fresh concrete. There are various purposes of applying additional materials as a substitute to Sand and other components in concrete – first is the financial saving obtained by replacing a considerable part of the sand or other ingredients with these materials and second is an improvement in the properties of concrete.

A. Alternate Materials used in Concrete formation as part of this Study

a) Egg Shell Powder (ESP) – The egg shell powder obtained from the waste egg shells of chicken (poultry waste), which throw away in open ground by user. These egg shells are treated as waste and their accumulation in landfills attracts vermin due to attached membrane and causes environment pollution, indirectly affects the human health. Since, these egg shells are rich source of calcium carbonate (CaCO3); so, use of egg shell waste instead of natural lime to replace cement in concrete can have benefits like minimizing use of cement, saving lime and utilizing waste material in a meaningful purpose.

b) Coconut shell ash (CSA) - Coconut shell ash is agricultural waste. The waste is produced in abundance globally and poses risk to health as well as environment. Thus their effective, conducive and eco-friendly utilization has always been a. challenge for scientific application.

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II. SCOPE OF WORK WITH OBJECTIVES

The main scope of work is to find the suitable type of green concrete (a concrete which uses waste material as at least one of its components), made by using ESP and CSA, which can be use as sustainable construction material in future and also it should be quite suitable for concrete works where strength and durability are important aspects of sustainability.

The main objectives of the present study are as follows –

- To find the feasibility of using ESP as an alternate to cement and CSA as an alternate to sand in standard concrete formation.
- To study and test the strength i.e. compressive strength of concrete.
- To identify the proper percentage of alternate materials required for concrete formation in order to improve the hardened properties i.e. strength and durability.
- To study and test the durability of concrete.
- To compare the concrete made with combination of egg shell powder and CSA finer with the conventional concrete.

III. LITERATURE SURVEY

- **Anviti Bhartiya et.al (2018)** studied M-20 grade concrete tested for compressive strength. Egg shell powder + coconut shell ash are varies up to 13% (0%, 5%, 10%, 12%, 13%) to weight of cement in concrete. Compressive strength is evaluated after 7, 28 days of curing.CSA and ESP are founded as of useful binding materials. Properties of both the materials are very similar to cement, which we are using in concrete. ESP and CSA of 10% replacement give the maximum compressive strength

- **Divya, B, Vasanthavalli K, Ambalavanan, R (2017)** conducted a "Investigation on cement concrete at mixed with egg shell powder". They studied that the eggshell usually which are disposed, is used as an alternate for the cement since the shell is made up of calcium. When the calcium carbonate is heated a binding material calcium oxide (lime) is obtained. The chemical parameters and compressive strength of concrete cubes was determined. The concrete mix proportion is 1:1.5:3 in which cement is partially replaced with eggshell powder as 5%, 10%,

15%, and 20% by weight of cement. The compressive strength was determined at curing of 7 and 28 days. The conclusion of the study were as Replacement of 5% and 10% of ESP results in increase of about 4% in 28 –day compressive strength. Replacement of 15% of ESP results in increase of about 8% in 28-day compressive strength. Further increases in replacement (20%) results in decrease of compressive strength by about 4%, and a recommended replacement was15%.

- **Mohamed Ansari M., et al. (2016)** studied on "Replacement of cement using egg shell powder". The paper describes the effect and experimental result of replacement of eggshell powder in cement. The compressive test was carried out for concrete replaced with 10%, 15% and 20% of eggshell powder in Portland pozzolona cement. The results came indicates the eggshell powder can be used in replacement for cement. The result of the study indicates that eggshell powder can be used as an replacement material for cement. From the results it is proved that replacement of eggshell powder if about 10 % to 15 % is effective and when we increasing further the percentage of eggshell powder decrease the compressive strength.

- **Raji, S.A. and Samual, A.T. (2015)** investigated on "Egg shell as a fine aggregate in concrete for sustainable construction". This work has investigated the potential use of used egg shell as a concrete material. The used egg shells were used as fine concrete aggregate. In the laboratory test, conventional fine aggregate was replaced at 100% replacement level. A total of 18 cubes were cast, cured and tested. The strength development of the concrete mixes containing egg shell aggregates was compared to that of conventional concrete with sand as fine aggregate. The result showed a reduction in compressive strength of the concrete but still falls within limits of lightweight concrete. This paper recommends that egg shell can be used for producing concrete where a lighter weight concrete is required and a reduction of dead load of structure is desired.

IV. RESULTS AND DISCUSSIONS

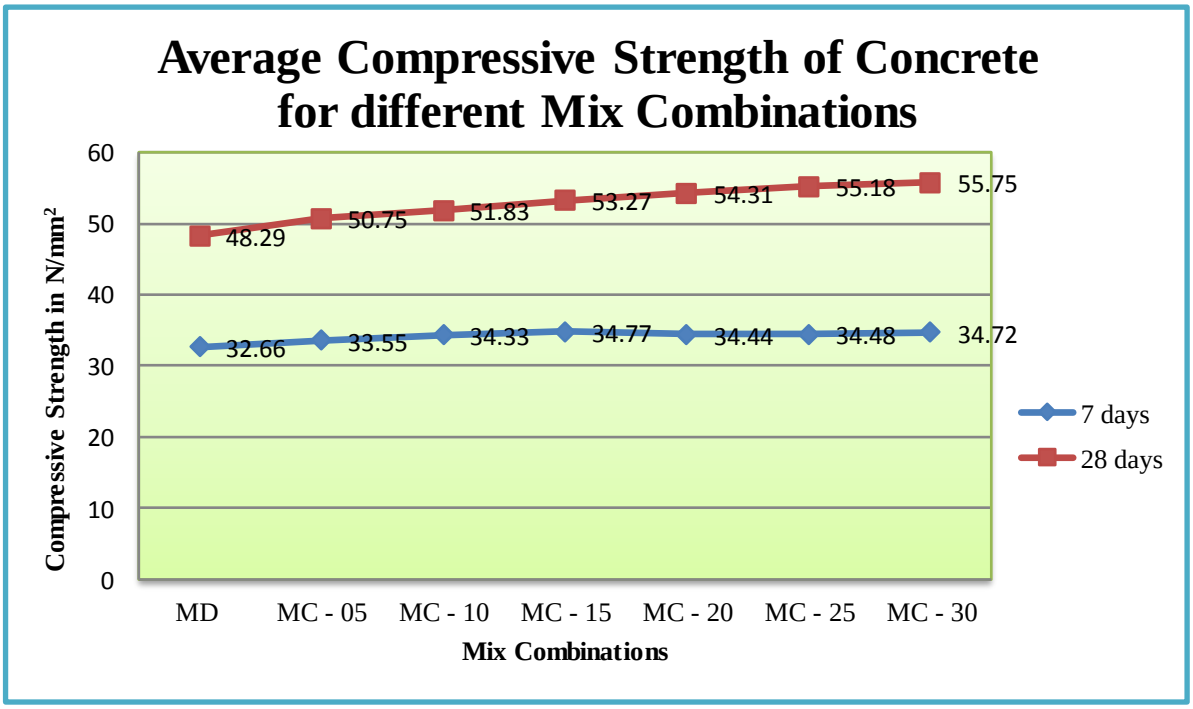

Fig. 1 Average Compressive strength of concrete for different mix combinations at 7 days and 28 days

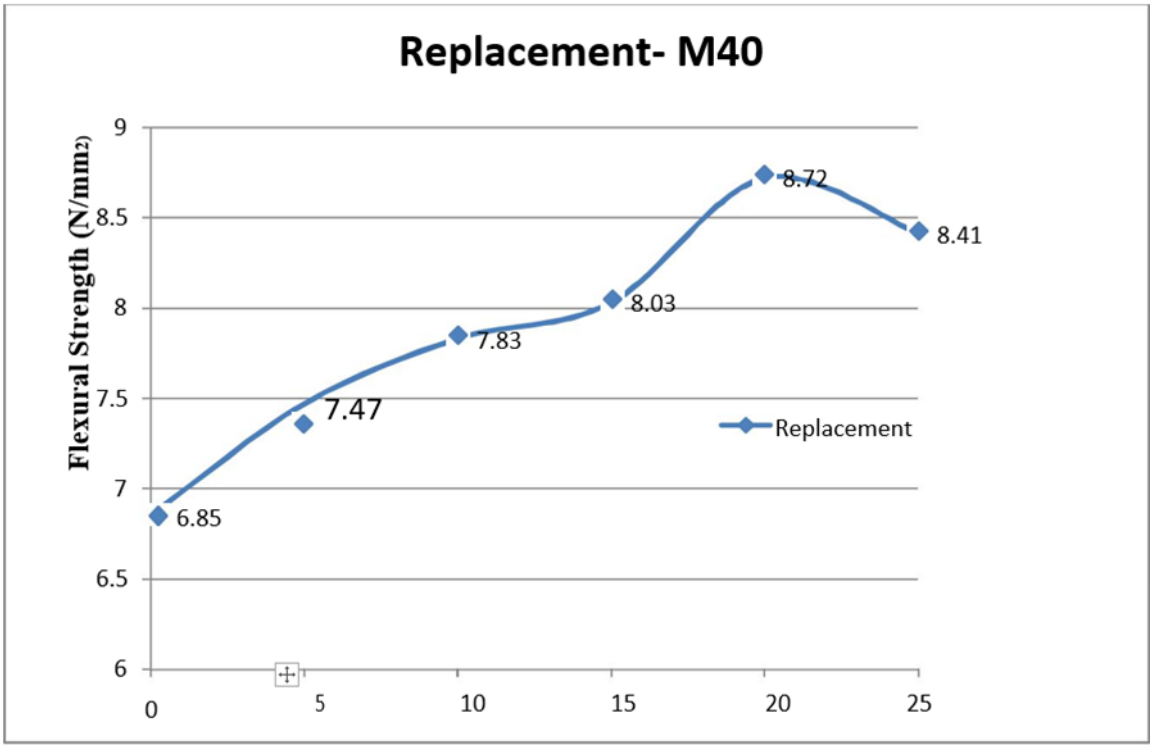

Fig. 2 Influence of ESP + CSA on Concrete of M40 Grade on Replacement for 28 Days Flexural Strength of Beam

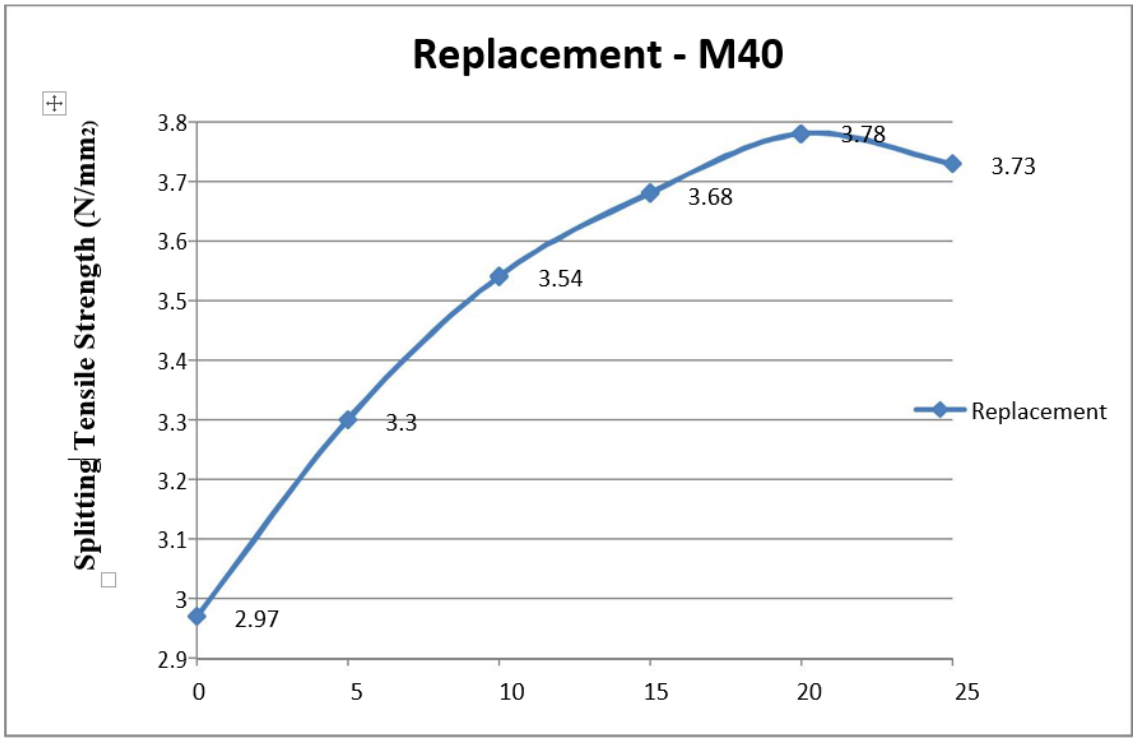

Fig. 3 Influence of ESP+CSA on Concrete of M40 Grade on Replacement for 28 Days Splitting Tensile Strength of Cylinder

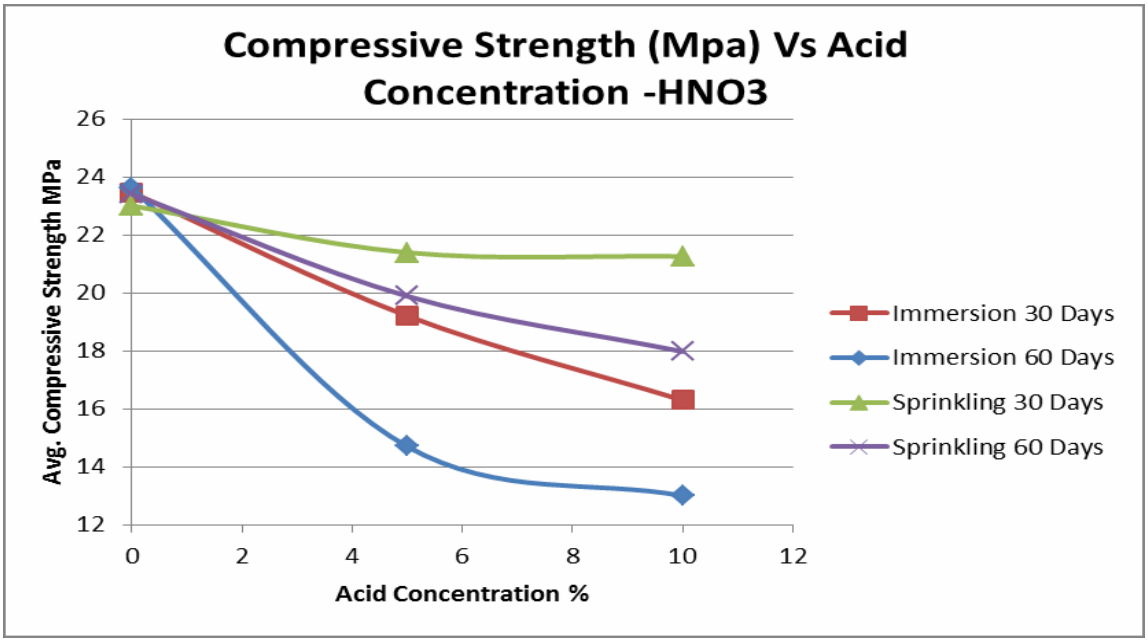

Fig 4: Compressive Strength Vs Acid Concentration for H2SO4 Acid

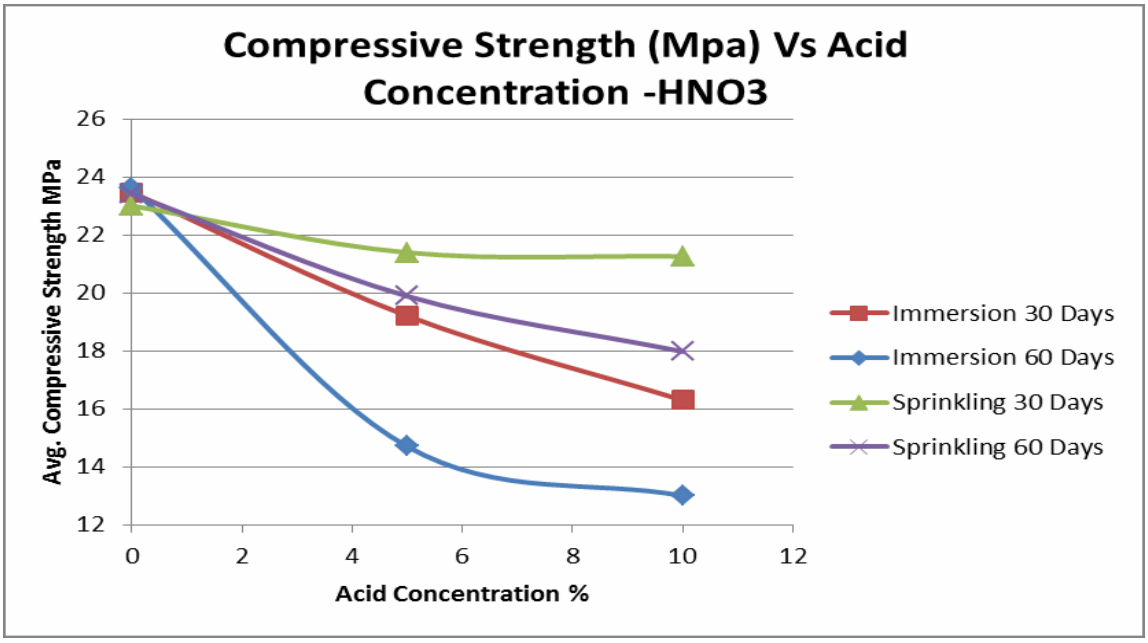

Fig 5**:** Compressive Strength Vs Acid Concentration for HNO3 Acid

V. CONCLUSION

The study of strength and durability of concrete made with using alternate material such as Egg Shell Powder and Earthenware Aggregate in different percentages as part replacement of cement and fine aggregate (sand) is concluded that up to 20 % of these material quantity either single or both can be used in concrete formation to achieve designed characteristic compressive strength in 28 days. The use of alternate materials (ESP and CSA), exceeds beyond 20 % results in gaining strength below the specified designed strength.

Immersion of cubes leads to drastic reduction in compressive strength as compared to sprinkling for any type of acid. The reduction in compressive strength due to complete immersion is almost double than that for sprinkling of any particular acid (Hydrochloric or Sulphuric or Nitric acid) for particular exposure period (30 days or 60 days).

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