Evaluation Studies on The Capability of Crushed Oyster Shell Powder As Partial Replacement of Cement On Sisal Fibre Reinforced Concrete

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Abstract- *In this day and age we are in front of most complex safety problems connected to environment. Many things which are made-up for our comfortable life are accountable for polluting environment due to offensive waste management technique. The usage of cement is increasing day by day for satisfying the need of development of infrastructure facilities. Production of cement depletes significant amount of natural resources and releases large volume of carbon dioxide add to the pollution of environment. In order to reduce the usage of ordinary Portland cement, there is a need to find the alternate material to the cement. Oyster shell powder (OSP) is an aqua cultural by-product derived from the processing of Oyster shell. It is primarily composed of calcium carbonate, a rich source of calcium that can be used as a partial replacement for traditional construction materials and can help improve the strength in the concrete and also helps improve resistance against heat and chemicals. Concrete is the ones with compression strongness and weakness in tension. So concrete needs reinforcement to increase the tensile strength. Natural fibers are less chemically compatible with the cement matrix. As a result, it is essential to modify the surface of natural fibers to achieve good fiber-matrix interfacial bonds. In the current study, sisal fibers intended for use as reinforcement in concrete matrices. The present project involves a laboratory experimentation study for the application of new waste materials in the preparation of concrete. The main objective of investigation is to study the strength behaviour i.e. compressive strength, Split tensile strength and flexural strength of concrete with different percentages replacement of cement with Oyster shell powder and to study the tensile behaviour on adding with sisal fibres.*

Keywords- Oyster powder, Sisal fibre, Compressive strength, split tensile strength test, flexural strength test.

I. INTRODUCTION

Concrete is composite material which consists of portland cement, coarse aggregate, fine aggregate ad water in required proportions. Concrete is is one of the most popular building materials in the world which used for the purpose of construction in now days. Due to its composite nature concrete is weak in tension but strong in compression. Basic Principle involved in the increase in strength of concrete is heat of Hydration. The desired physical characteristics of the finished material can be achieved by including additives and reinforcement portland cements in the mixture. Rapid industrial expansion produces severe difficulties all around the world, including as the depletion of natural resources and the creation of vast amounts of waste materials throughout the manufacturing, construction, and demolition stages; one option to mitigate this problem is to utilize wastes. The fresh concrete must be composed to achieve the desired hardening and hardening state performance. The use of palm oil fuel ash waste as a partial replacement for cement in concrete has been found to improve microstructure features, potentially improving strength, durability, and surface quality.

In the last decades, environmental sustainability has become one of the most important issues. Because of global growth and non-renewable resource scarcity resulting in severe environmental Issues Not only the reduction of Greenhouse Gas (GHG) emissions and of fossil energy utilization, but Also the efficient use of materials is the most important aspects that need to be taken into account in production chain analysis. Recently, the most material-consuming industries are considered by researchers, policy makers and environmental agencies in order to redesign production chains aiming to reduce their environmental impact. Clinker, cement, and concrete production represent a set of processes characterized by high CO2 emissions, huge energy consumption, and intensive utilization of natural resources.

To reduce mainly the natural resource consumptions different production chains whose byproducts can substitute natural materials mixed with cement and/or concrete are investigated and, then, modeled. Hence, concrete and by-products production chains are jointly modeled to evaluate comprehensive and environmental benefits, the effective

design of linked production chains, and to compare different economical and technical solutions. For instance, materials resulting from building demolition are proved to be effective also in terms of reduction of landfill space consumption. Portland cement, already being a very expensive material constitutes a substantial part of the total construction cost of any project and the situation has further been aggravated by the energy crisis, which has further increased the cost of production of Portland cement. Therefore, it is of current importance for the country to explore and develop cementing materials cheaper than Portland cement.

The main objective of the present study is to know the influence of oyster powder and sisal fibreon properties of concrete and detecting workability, compressive strength, flexural and tensile strength on comparison with conventional concrete M30 grade concrete.

II. REVIEW OF LITERATURE

This part of the study deals with the review of several research papers related to compressive strength and workability of concrete poised by employing various source materials such as oyster powder, Sisal fiber etc. But considering availability of material and cost considerations many researchers studied various properties of concrete are given below.

Experimental study on partial replacement of coarse aggregate by Oyster shell & partial replacement of cement by fly ash Yamuna Bharathi in 2016. This research helps to access the behavior of concrete mixed with Oyster shell and determination of optimum percentage of combined mixture which can be recommended as suitable alternative construction material in low cost housing delivery especially in coastal areas and near fresh water where they are found as waste. Oyster shell is mainly composed of calcium and the rough texture makes it suitable to be used as partial coarse aggregate replacement which provides an economic alternative to the conventional materials such as gravel. The mechanical properties of concrete such as compressive strength is taken. Mechanical properties of Oyster shell concrete

MonitaOliviaa and LitaDarmayantia 2015, in this research, the ground cockle Oyster shell was used as a partial cement replacement. The ground Oyster shells were prepared by burning, crushing, grinding and filtering the cockle using no #200 sieve. The mechanical properties studied were compressive strength, splitting tensile strength, flexural strength and modulus of elasticity of Oyster shell concrete. These properties were compared with those of a control Ordinary Portland Cement (OPC) concrete. Based on the trial mixes using the ground Oyster shell with proportion of 2, 4, 6 and 8% by weight of cement, the optimum compressive strength was achieved for the mix that replaced cement by 4%. The Oyster shell concrete yielded less compressive strength and modulus elasticity compared to the OPC concrete. It is noted that the tensile strength and flexural strength were higher than those of the OPC concrete, which is advantageous to increase concrete tension properties. In this study, the effect of replacing cement by ground Oyster shell on the mechanistic properties of concrete was examined. Replacement of the cement with the ground Oyster shell led to a decrease of compressive strength of Oyster shell concrete compared with the control OPC concrete. The tensile and flexural strength of the Oyster shell concrete were higher than the control concrete. The Young's Modulus of Elasticity of Oyster shell concrete increased with the age of concrete. It can be concluded that the concrete containing ground Oyster shell yielded relatively better tension properties, but lower compressive strength and modulus of elasticity than the control concrete.

Review on Oyster shells ash as partial cement replacement Wan Ahmad and Bin Wan Mohammad 2017 This review paper emphasis on various sea shells ash such as cockle, clam, oyster, mollusk, periwinkle, snail, and green mussel shell ash as partial cement replacement and its objective is to create sustainable environment and reduce problems of global warming. This study includes previous investigation done on the properties of chemical and mechanical such as specific gravity, chemical composition, compressive strength, tensile strength and flexural strength of concrete produced using partial replacement of cement by Oyster shells ash. Results show that the optimum percentage of Oyster shells as cement replacement is between 4 – 5%.From this review, we can say that the development of sea shell ash as partial cement replacement could be produce as a cement-like material where the particle size will be the same or finer than cement. Concrete with Oyster shells as cement replacement will produce better concrete in term of chemical composition, specific gravity, compressive strength, flexural strength and tensile strength. It could be investigated by using difference types of sea shells to reduce environmental issues. Implicitly, this effort will create better benefit in future economic value to the local community and industries and also, provide better solution in concrete technology. Good values on developing the future of concrete industry should be expend through quality research among industry players and higher learning institutions to involve all parties into sustainable situation.

Properties of concrete with Oyster shell powder as cement replacement by AmarnathYerramala et al.,(2014) In this paper the research describes the use of poultry waste in concrete through the development of concrete incorporating Oyster shell powder (SSP). Different SSP concretes were developed by replacing 5-15% of SSP for cement. The results indicated that SSP can successfully be used as partial replacement of cement in concrete production. The data presented cover strength development and transport properties. With rSSPect to the results, at 5% SSP replacement the strengths were higher than control concrete and indicate that 5% SSP is an optimum content for maximum strength replacement in terms of transport properties with control concrete.

III. MATERIALS AND METHODS

The experimental investigation work is started with various tests on the constituent materials. The constituent materials are given below.

1. Cement
2. Coarse aggregate
3. Water
4. Oyster powder
5. Sisal fiber.
6. Super plasticizer

I. Cement

Ordinary Portland Cement (OPC) was used in the experimental work which is conforming to I.S 4031-1988.The O.P.C is classified into three grades, those are 33grade, 43grade and 53 grade, depending upon the strength of the cement in this experiment 43grade cement is used.

II. Fine Aggregate

Fractions from 4.75 mm to 150 microns are termed as fine aggregate. Locally available river sand passed through 4.75mm IS sieve is applied as fine aggregate conforming to the requirements of IS 383:1970.

III. Coarse Aggregate

The crushed aggregates used were of 20mm nominal maximum size.Aggregate most of which is retained on 4.75-mmIS Sieve and containing only so much finer material as is permitted for the various types described in this standard.

IV. OysterPowder

The Oyster shell powder (OSP) is an aqua cultural by-product derived from the processing of Oyster shell. It is primarily composed of calcium carbonate, a rich source of calcium that can be used as a partial replacement for traditional construction materials and can help improve the strength in the concrete and also helps improve resistance against heat and chemicals.

Table 3.1 Shows the Physical properties of oyster shell powder

S.No	Description	Properties
1	Specific gravity	0.81
2	Moisture content	1.20
3	Bulk density (g/m^3)	0.79
4	Particle density (g/m^3)	1.215
5	Porosity (%)	23.4

Table shows the chemical properties of oyster shell powder

S.No	Contents	Percentage
1	SiO_2	1.60
2	Al_2O_3	0.92
3	CaO	51.56
4	MgO	1.43
5	Na_2O	0.08
6	K_2O	0.06
7	H_2O	0.31
8	LOI	41.84

V. Sisal fibre

The Sisal is a hard fibre derived from the leaves of the sisal plant . Sisal is a completely biodegradable and highly renewable energy resource. The material is chosen to enhance the various strength properties of the structure in order to achieve durability and a higher quality structure. There are three types of sisal fibres, arch fibres, conductive fibres and structural fibres. The structural fibres are often taken out of because of their toughness as they do not break during the extraction process. The structural fibres are often taken out of because of their toughness as they do not break during the extraction process. Such fibres are of good tensile strength. Such fibres are of strong tensile strength or tensile strength. They are very resistant against heat. Across developing countries, sisal fibres are used as reinforcement in houses.

The sisal fibre properties are shown below:

- Density (g/cm3) – 1.46
- Moisture content (%) – 11.4
- Tensile strength (M Pa) - 297
- Elongation at Break (%) - 2.5

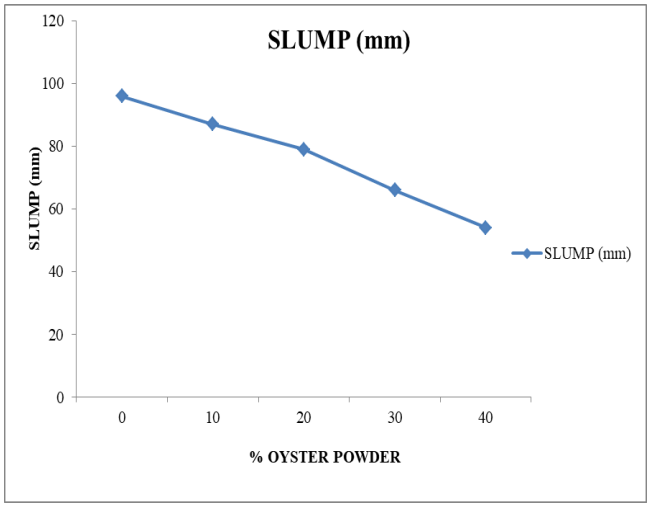
• Young's modulus (M Pa) – 10.64

IV. TESTS ON FRESH CONCRETE

4.1 WORKABILITY OF CONCRETE

It is the important property of fresh concrete which gives the behavior of concrete from mixing to compaction. The workability of concrete is the most complex property, which is difficult to define and measure. A concrete which has high consistency and which has high consistency and which is more workable, need not be of right workability for a particular job. Every job requires a particular workability.

The vertical settlement of unsupported fresh concrete, flowing to the sides and sinking in height is known as slump. Slump is a measure indicating the consistency or workability of cement concrete.

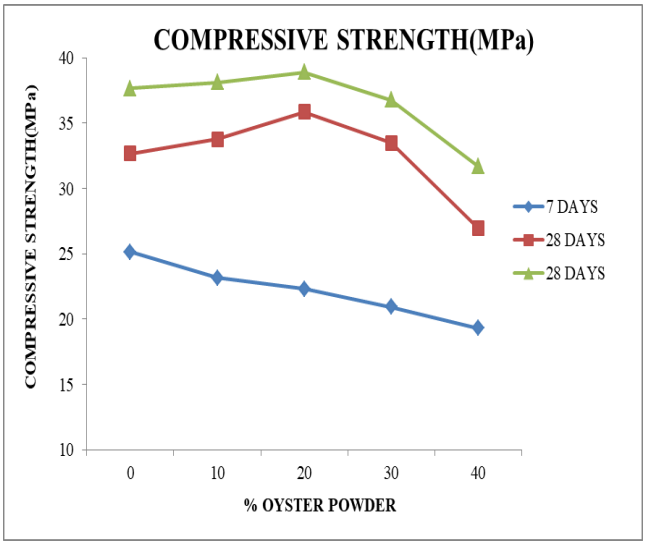


Plot shows the Variation of Slump Values for % Oyster powder

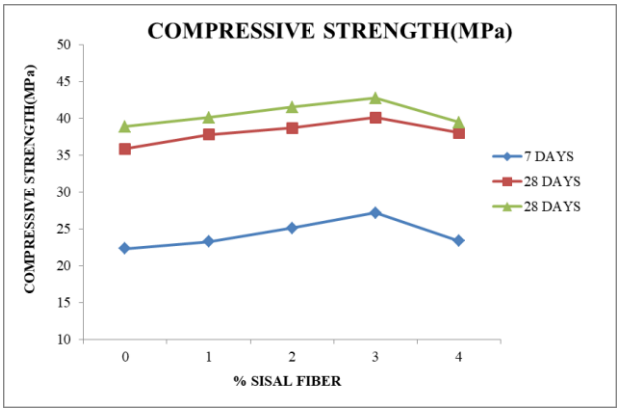
V. TESTS ON HARDENED CONCRETE

5.1 VARIATION OF COMPRESSIVE STRENGTH FOR DIFFERENT MIXES

Compressive strength of concrete replaced with palm oil fuel ash for curing period of 7-days, and 28-days respectively and figure shows the summarized Compressive strength Results for different curing periods– M30 grade.



Plot shows the Variation in Compressive Strength for % Oyster powder



Variation in Compressive Strength for % Sisal Fibers to optimum percentage of Oyster powder

5.2 VARIATION OF SPLIT TENSILESTRENGTH FOR DIFFERENT MIXES

The cylinder specimen is of the size 150 mm diameters and 300mm height was cast to determine the split tensile strength of concrete. The test is carried out by placing a cylindrical specimen horizontally between the loading surfaces of compression testing machine and the load is applied until failure of cylinder, along its longitudinal direction. The cylinder specimens are tested at 7 days and 28 days. The average of three specimens was reported as the split tensile strength provided the individual variation is not more than 15% of average value.

Split tensile strength $=2P/\pi DL$

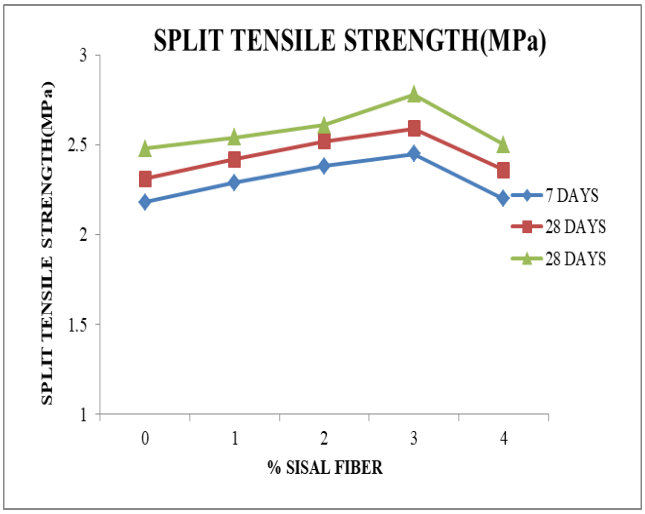
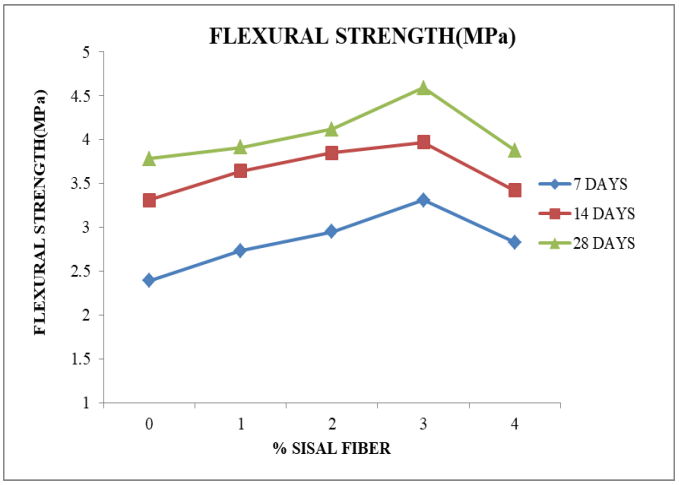


Fig 6.6: Plot shows the Variation in Split Tensile strength for different percentages of Sisal fibers



Plot shows the Variation in Flexural strength for different percentages of Sisal fibres

5.3 VARIATION OF FLEXURAL STRENGTH FOR DIFFERENT MIXES

Tensile stress is developed in concrete due to drying shrinkage, rusting of steel reinforcement, temperature gradient and many other reasons. Therefore, the knowledge of tensile strength of concrete is important. We measure the tensile strength of concrete in indirect method like flexural test. In flexural test we find the modulus of rupture (extreme fibre stress in bending), this value depends up on the dimension of beam manner of loading. In the flexural test two types of loading conditions, there are central point loading, third point loading. In our experimentation use third point loading with a size of beam is 70 x 15 x 15 cm. this test performed as per IS: 516 code.

Flexural strength of concrete with different percentages of oyster powder for curing period of 7-days, 14-days, 28-days respectively and Table shows the summarized results for flexural strength of concrete for different percentages of oyster powder at different curing periods.

From the results it is evident that with the increase of fibre content the tensile nature of the concrete also increases results in higher values compared to that of Plain concrete.

The figure shows that the test results of splitting tensile strength and flexural strength of specimens after water curing, it is concluded that the percentage increase in strength increases with the increase in percentage of fiber content. Also, from the results it is evident that compressive and flexural strength also increases with the increase of fiber content.

VI. CONCLUSIONS

This study has been carried out to investigate the combined influence of Oyster powder and Sisal Fibers replacing cement on fresh and hardened properties of Concrete. Accordingly, experimental program is carried out with M30 grade concrete and tested the specimens. Following conclusions are inferred from the test results.

- It has been observed that workability decreases linearly at rate of 10 % for every 10% Oyster powder addition. It has been observed that by the incorporation of Compressive strength of concrete increases linearly with increase of % Oyster powder up to 20 % and decreases thenceforth. Hence 20 % is the optimum Oyster powder limit for M30 concrete.
- Only for 20% Oyster powder and 3% Sisal fibres reinforced concrete, Compressive strength is meeting more than the target mean strength. This may be due to the fact that the C-S-H gel formed at this percentage is of good quality and have better composition.

- The compressive strengths of M30 concrete for optimum values of Oyster powder (20%) and Sisal fibre (3%) are 27.17 MPa for 7 days and 42.72 MPa for 28 days. It is evident from the present investigation that the addition of Sisal fibers to concrete improve compressive strength, split tensile strength, flexural strength of the mix.
- It is evident from the present investigation that the addition of Sisal fibers to concrete improve compressive strength, split tensile strength, flexural strength etc. of the mix.
- There was a 17.7% increase in the compressive strength and 10% increase in the tensile strength and 21.42% increase in the flexural strength because of the high elastic modulus of Sisal fiber. Due to the high stiffness of Sisal fibres, resulted in a significant enhancement in split tensile strength and flexural strength.
- The use of Oyster powder and Sisal fibre combined is economic when compared to cement in concrete. Likewise saves a great deal of waste disposal problems and reduces the cement price rise and intensities of CO_2 release by the cement production. Also these materials make the concrete more sustainable, light weight and low energy emitting which is noble.

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