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Experimental Analysis on Partial Replacement of Cement by Oyster Shell in Plain Concrete

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ABSTRACT : In this day and age we are in front of most complex safety problems connected to environment are made-up for our comfortable life are accountable for polluting environment due to offensive waste management technique. The present exploration assesses the merging of oyster shell in concrete. The consequence of oyster shell as fractional replacement of cement on the compressive strength (primary) of concrete has been investigated. Globally, over 150 countries produce cement and/or clinker, the primary input to cement. In 2001, the United States was the world's third largest producer of cement (90 million metric tons (MMT)), behind China (661 MMT) and India (100 MMT). This work reports an experimental procedure to investigate the effect of using oyster shell powder as partial replacement of cement. Tabby is a type of concrete made by burning oyster shells to create lime, then mixing it with water, sand, ash and broken oyster shells. Tabby was used by early Spanish settlers in present-day North Carolina and Florida, then by English colonists primarily in coastal South Carolina and Georgia. Oyster shell as a alternate for straight cement with partial replacement using M25 grade concrete The main objective is to support the use of these outwardly waste products as a construction material.

KEYWORDS: oyster shell, compressive strength, OSP (Oyster Seashell Powder)

I. INTRODUCTION

Concrete is one of the two most used structure materials in construction. In order to reduce reliance of raw material in concrete producing, the green concrete had been promoted. Green concrete is the concrete that had been produced using recycle or wasted natural materials. One of the ways to produce green concrete is by using modified cement. Cement is the second largest volume materials used by human being after water. Cement plays the role of a binder, a substance that sets and hardens and might bind alternative materials along. During production of cement and hydration process of cement, the amount of CO₂ emitted by the industry is nearly 900 kg of CO₂ for every 1000 kg of cement produced. This CO₂ production causes serious environmental damages. The sea shells are high potential materials to become partial cement replacement and filler in concrete. The calcium carbonate (CaCO₃) in the sea shells is more than 90% and is similar to contain of calcium carbonate in the limestone dust that been used in the Portland cement production. Impressively, the crystal structures of seashells are largely composed of calcite and aragonite, which have higher strengths and density than limestone powder. Also, the particle sizes of seashells are between 36µm to 75µm and are similar to the particle size of Portland cement. Due to the physical and chemical properties of conch and oyster shells, they may be a suitable substitute for cement and aggregates. The crushed shells would be beneficial to the waste industry along with the construction industry. When the shells get crushed they can be substituted for all different types of concrete constituent depending on the size of the specimen. Oyster shells are a viable option because they contain a large amount of calcium carbonate. This can help improve the strength in the concrete. Also the calcium carbonate can help improve resistance against heat and chemicals. The shells may increase strength in the concrete due to the uniquely weaved pattern they Shellfish shells have gained interest in studies revolving around recycled concrete aggregate. The reason why shellfish shells and other seashells are part of this study is because they are easily obtainable from the seafood industry and they have mechanical and chemical properties that make them attractive to the construction industry. After preliminary research, the shells that were chosen are oyster and conch shells. Other shells that could have been used were various types of mussel shells or clam shells. These were selected off of their physical properties as well as their availability. Oysters have high calcium carbonate content and also contain rare impurities that improve strength as well. Oyster shells have been used throughout history to help aid in construction. Quicklime is obtained from oyster shells when the CaCO₃ in the shell is heated at an excess of 2000°F or about 1100°C and converted to calcium oxide (CaO), otherwise known as lime. This lime is then used in mortar mixtures and is called

tabby. Tabby used in construction has been found commonly in Muslim territories such as Cordoba and Seville in the 15th century for military structures. Perhaps the most common tabby constructed buildings are 11th century British Castles. For example the Wareham Castle, in Dorset, England was found in ruins, but was excavated in the 1950s, revealing that tabby was used for much of the mortaring.

L OBJECTIVES

L Objectives for the project work are as follows:

1. Investigation on the concrete mixes containing 5%, 10% and 15% of shell as partial replacement of cement to evaluate the mechanical properties of concrete such as compressive strength characteristics.
2. Evaluating and studying the effect of varying percentages of shell and comparing the results with normal concrete without any replacements.
3. To develop a possible use of seashells suitable for sustainable construction materials.
4. To conduct compressive strength test.

II. LITERATURE REVIEW

Experimental study on partial replacement of coarse aggregate by seashell & partial replacement of cement by fly ash Yamuna Bharathi in 2016. This research helps to access the behavior of concrete mixed with seashell 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. Seashell 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 seashell concrete Monita Oliviaa and Lita Darmayantia **2015**, in this research, the ground cockle seashell was used as a partial cement replacement. The ground seashells 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 seashell concrete. These properties were compared with those of a control Ordinary Portland Cement (OPC) concrete. Based on the trial mixes using the ground seashell 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 seashell 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 seashell on the mechanistic properties of concrete was examined. Replacement of the cement with the ground seashell led to a decrease of compressive strength of seashell concrete compared with the control OPC concrete. The tensile and flexural strength of the seashell concrete were higher than the control concrete. The Young's Modulus of Elasticity of seashell concrete increased with the age of concrete. It can be concluded that the concrete containing ground seashell yielded relatively better tension properties, but lower compressive strength and modulus of elasticity than the control concrete.

Review on seashells 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 seashells ash. Results show that the optimum percentage of seashells 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 seashells 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. Besides that, collaboration with local

authorities through regulations and laws will create better opportunity to stake holders to come up with programs on waste minimization and utilization.

└ METHODOLOGY

It is the method followed to perform the experiment. In this section we have made step wise procedure to perform experiment which is briefly described as follows:

- A. Collection of material
- B. Testing of material (Physical and Chemical)
- C. Mix design
- D. Batching of material (volume batching / weight batching)
- E. Mixing
- F. Casting of concrete cube,cylinder,beam
- G. Testing
- H. Compilation Of Result Of Testing
- I. Conclusion

3.1 CHARACTERISTIC STRENGTH

The compressive strength of concrete is given in terms of the characteristic compressive strength of 150 mm size cubes tested at 28 days (fck). The characteristic strength is defined as the strength of the concrete below which not more than 5% of the test results are expected to fall. This concept assumes a normal distribution of the strengths of the samples of concrete.

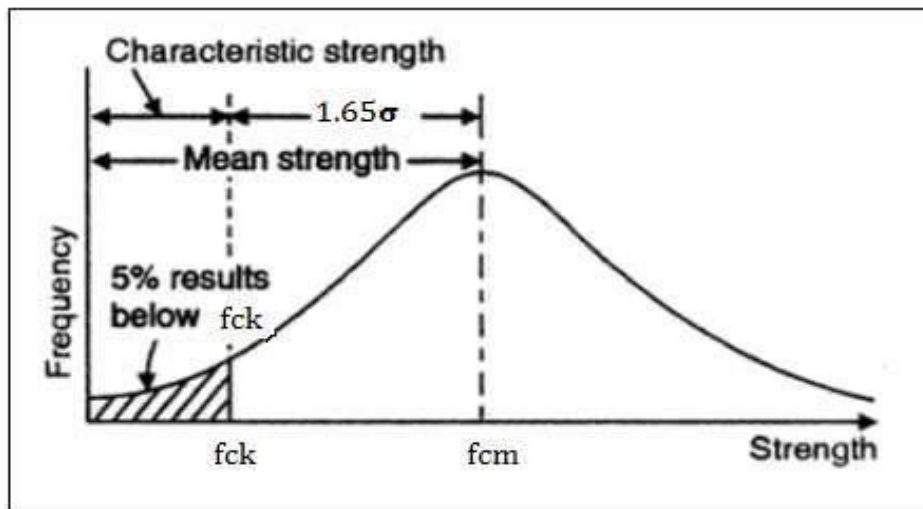


Fig 3.1: Normal Distribution curve on test specimens for determining compressive strength

Target strength for mix proportioning

$$f'_{ck} = f_{ck} + 1.65 s$$

Where, f'_{ck} = Target Average compressive strength of 28 Days, f_{ck} = compressive strength of 28 Days, Tolerance factor = 1.65

S = Standard deviation, $S = 4 \text{ N/mm}^2$, from IS 456; 2013, table no 8

Standard deviation can increase by +1 if your site management is not good.

Therefore, target strength = $25 + 1.65 \times 4 = 31.6 \text{ N/mm}^2$.

So, tested concrete cube compressive strength must be 90% of $33.25 \text{ N/mm}^2 = 29.93 \text{ N/mm}^2$.

Concrete mix ratio: 1 : 1.46 : 2.69



SR NO.	Materials	Quantity (Kg/m3)	Proportion
1	Cement	437.78	1
2	Natural Sand	641.22	1.46
4	Coarse aggregate	1178.66	2.69
5	Water	197	0.45

Table No 3.2 Final Mix Proportion in Laboratory

IV. RESULTS

Compressive Strength Result:

The compressive strength measurement of the concrete samples was done as per IS 516: (1959) standard practiced. The test was conducted on the three samples of each composition and the average value of all is evaluated by a sample of each composition as the result compressive strength. The compressive strength values of different compositions of Dolomite powder and Cement.

$$\text{Compressive strength} = \frac{\text{Load}}{\text{Area}}$$

Table No. 4.1.1 Observation of Compressive Strength:

Days	Average Compressive strength		
	Days (N/mm ²)	Days(N/mm ²)	Days(N/mm ²)
OSP-0-100C	21.86	29.30	32.83
OSP-5-95C	23.05	31.30	33.10
OSP-10-90C	24.50	32.90	34.90
OSP-15-85C	24.90	33	34.20

From the experimental results it is clear that Compressive strength of the M25 Concrete mix when cement is substituted with Oyster shell powder 5 to 10%, then the strength is increased compared with conventional concrete. But in case of 15% the compressive strength is found to not increasing too much up to 7 day and 14 day but its start reducing after 28 day slightly

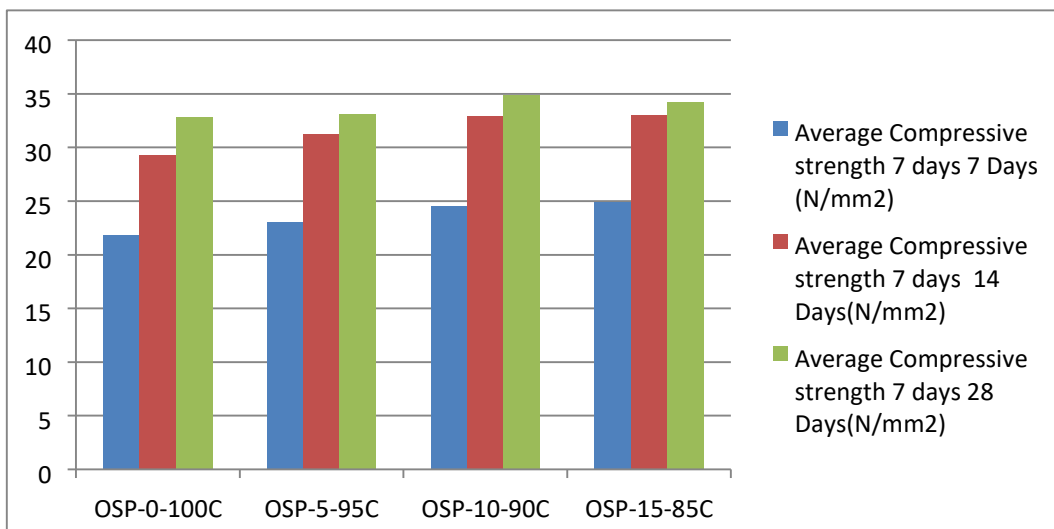


Fig. 4.1.2 Comparison of Average Compressive strength

V. CONCLUSION

1. The replacement of oyster shell powder with cement found to be increase in strength with 5% and 10% replacement than conventional concrete.
2. The 10 % replacement of oyster shell powder with cement not increase the strength much more
3. It is observed that the strength of concrete with 15% replacement is starting to reduce after 28 days.

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