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# EXPERIMENTAL INVESTIGATION OF FORMULATION AND CHARACTERIZATION OF BIOCRETES

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**ABSTRACT-***The development of construction industries provides more benefits to the society and the people. This study is used to improve the engineering properties of cement concrete with the help of oyster shell. The properties of freshly made materials are tested at a fixed water-cement ratio (0.45) and at five different weight ratios with partial replacement of course aggregate. The hardened properties and the durability are tested and various engineering properties are investigated. Present scenario in construction field, all around the world is facing a serious problem with price hike of raw materials. So, they are much concerned to reduce the consumption of readily available raw materials. Usage of biocrete is an innovative idea to achieve this requirement. Because of its strength and weight, the speed of construction is quick and the installation becomes easy. The benefits of biocrete is endless, which are good in strength and reduction in weight is noticed which in turn saves cost, high load bearing strength and high durability. In this project, the bio-concretes are formulated using bio waste materials such as oyster shell in various percentages mixed with concrete. The design mix proportion used is 1:0.75:1.5 at which 5%, 10%, 20% of biocrete waste is partially replaced with coarse aggregate in concrete. Compressive strength test, split tensile test and flexural strength tests are conducted and partially replaced specimens are compared with the control concrete to explore the potential use of these materials in the field.*

## 1. INTRODUCTION

The disposal of solid wastes is major problem around the world. Recycling and use of these waste materials is increasing worldwide, especially in construction fields. In construction industries use of recycled materials and waste is becoming more popular due to shortage of natural mineral resources and increasing waste disposal cost. However, with the use of waste in engineering applications, a need for further understanding of their engineering behavior is required. The coastal wastes from coastal area are usually disposed as waste product which becomes an environmental hazard. Light weight aggregates have wide application in various field in civil engineering. In environmental engineering bacteria, in waste water treatment facilities can be grown and fixed on their surface in a dispersive manner in soil engineering and horticulture due to richness in pores they can be used for holding water. Light weight aggregates with low density and water absorption rate, respectively are desired to reduce construction objects deadweight and to promote the workability of light weight aggregate mortar.

In Taiwan oyster shell are the byproduct of shelled oyster consumption, and the yield in 2009 was approximately 34,000MT. The total quantity of "waste oyster shell" produced globally after shelling is approximately 200,000MT per year: however only a very small portion of this enormous fishery waste is recovered and reused (e.g., fertilizer for soil crops or handicrafts). Instead, most of the waste oyster shell is discarded or buried, which can result in sewage, offensive odors, or the breeding of mosquitos and flies. These problems influence the quality of the local living environment and cause environment sanitation, pollution and production problems.

Therefore, this research work is tailored towards the possibility of using oyster shell as replacement for coarse aggregate at different level in production of high strength concrete.

## 2. MATERIALS

### 2.1 Cement

Ordinary Portland Cement of 53 grade confining to IS 8112 was used throughout the work. The Fine aggregates sued throughout out the work comprised of river sand with maximum size of 4.75mm conforming to zone II as per IS 383-1970 with specific gravity of 2.6. Then Coarse aggregates used consisted of machine crushed stone angular in shape and passing through 20mm IS sieve and retained on 4.75mm IS sieve with specific gravity of 2.66.

**Table-1** Properties of Cement

| S.No | property | Cement |
|---|---|---|
| 1 | Initial Setting time | 30 minutes |
| 2 | Final Setting time | 447 minutes |
| 3 | Consistency | 30% |
| 4 | Specific Gravity | 3.13 |

### 2.2 Water

A tap water available in the concrete laboratory was used in preparation of concrete. The qualities of water samples are uniform and potable. PH value lies between 6 to 8 and the water us free from organic matter and the

solid content should be within the permissible limit as per IS 456 2000 and conforming to IS 3025-1964.

### 2.3 Physical Properties of Sand, Oyster shells and Coarse aggregate

#### 2.3.1 Sand

Sand is used as fine aggregates in mortars and concrete. Natural river sand is the most preferred choice as a fine aggregate material. River sand is the natural weathering of rocks and over a period of million years. It is obtained from the river beds. River sand is becoming a scarce commodity now.

#### 2.3.2 Oyster Shell

Oyster shell farming in the sea. Large quantity of Oyster shell is waste result in the vicinity of an oyster container freight station because the shells are discarded during processing

**Fig.1 Oyster shell**

**Table-2** Properties of Sand & Oyster shell

| Properties of aggregates | Sand | Oyster Shells |
|---|---|---|
| Specific gravity | 2.64 | 2.1 |
| Absorption rate (%) | 2.38 | 7.66 |
| Finenessmodulus (FM) | 2.84 | 2.75 |
| Dryness-rodded unit weight(kg/m$^3$) | 1750 | 1051 |

#### 2.3.3 Coarse Aggregate

Aggregates are inert granular materials such as sand, gravel, or crushed stone that along with water and Portland cement, are an essential ingredient in concrete. Aggregates, which account for 60 to 75 percent of the total volume of concrete are divided into two distinct categories-fine and coarse aggregates.

**Table-3** Properties of Coarse aggregate

| | |
|---|---|
| Specific gravity | 2.74 |
| Fineness modulus | 6.9 |
| Absorption rate (%) | 1.52 |
| Drynessrodded unit weight(kg/m$^3$) | 1744 |


**Fig.2 Fine and Coarse aggregates**

### 2.4 Batching and Mixing of Materials

Batching of materials was done by weight. The percentage addition of Ordinary Portland Cement (OPC) by biocretes were 0%, 5%, 10% and 20%. The 0% addition was to serve as control concrete for other samples.

### 2.5 Concrete Mix Design

The Indian standard suggested a technique of concrete mix design. This mix design process is enclosed in IS 10262-82. The concrete is used in this research work was made using Binder, Sand and Gravel. The concrete mix proportion was 1:0.75:1.5 by weight.

### 2.6 Casting Sample

Concrete Cubic specimens' size 150mm X 150mm X 150mm and cylinder specimens' size 150mm X 300mm were casted for determine all strength. The concrete was mixed, placed and compacted in three layers. This samples were de-moulded after 24 hours and kept in curing tank for 28 days as required.

## 3. RESULT AND DISCUSSION

### 3.1 Testing of Compressive Strength

**Table-4** Compressive Strength Result

| Addition of oyster shell | Compressive Strength ($f_{ck}$) N/mm$^2$ | | |
|---|---|---|---|
| | 7$^{th}$ day | 14$^{th}$ day | 28$^{th}$ day |
| 0% | 16.48 | 21.30 | 28.02 |
| 5% | 16.69 | 23.20 | 29.30 |
| 10% | 19.20 | 25.50 | 30.42 |
| 20% | 15.10 | 23.16 | 27.38 |

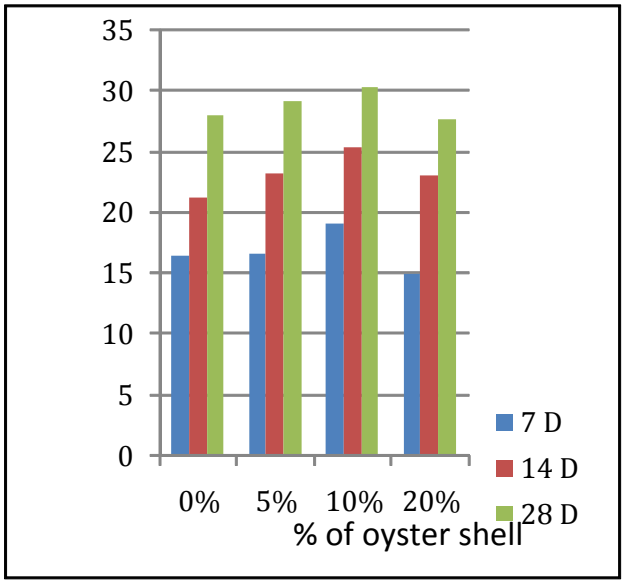


**Chart-1:** Compressive strength for various mix proportions of biocretes at 7th, 14th and 28th day test

### 3.2 Testing of Split Tensile Strength

**Table-5** Tensile Strength Result

| Addition of oyster shell | Tensile Strength ($f_{ck}$) N/mm² | | |
|---|---|---|---|
| | 7th day | 14th day | 28th day |
| 0% | 1.1 | 1.3 | 1.85 |
| 5% | 1.23 | 1.51 | 1.73 |
| 10% | 1.3 | 1.62 | 1.61 |
| 20% | 1.2 | 1.3 | 1.52 |

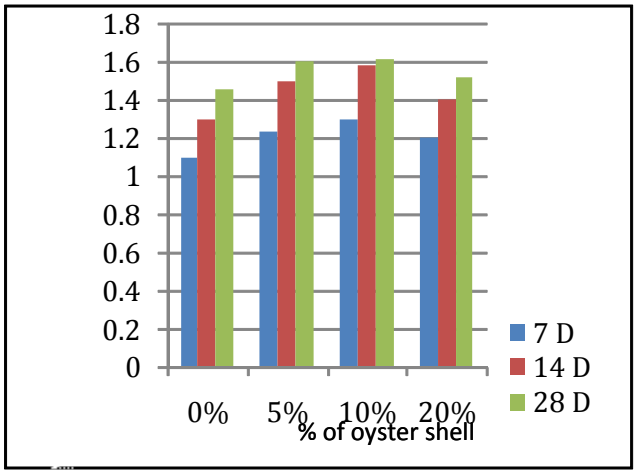


**Chart-2:** Split Tensile strength for various mix proportions of biocretes at 7th, 14th and 28th day test

### 3.3 Testing of Flexural Strength

**Table-6** Flexural Strength Result

| Addition of oyster shell | Compressive Strength ($f_{ck}$) N/mm² | |
|---|---|---|
| | 14th day | 28th day |
| 0% | 3.6 | 4.96 |
| 5% | 4.1 | 5.6 |
| 10% | 4.6 | 6.1 |
| 20% | 4.2 | 5.4 |

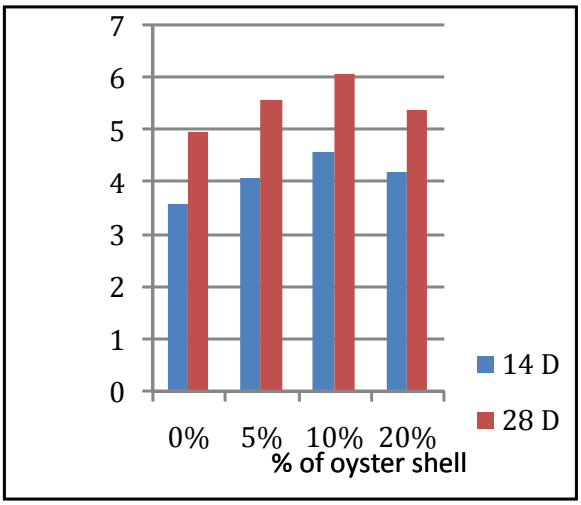


**Chart-3:** Flexural strength for various mix proportions of biocretesat 14th and 28th day test

## 4. CONCLUSIONS

1. The Compressive strength, Tensile strength and Flexural strength of concrete achieved good strength up to 10% addition of oyster shell. Further addition of oyster shell is decrease in the compressive tensile and flexural strength is noted.

2. Based on this experiment it is concluded that the mix can be made by replacing oyster shell for coarse aggregate without decreasing strength. 10%of replacement of oyster shell for coarse aggregate has produced maximum compressive strength.

3. The comparison with ordinary concrete with oyster shell replaced concrete gave better performance in strength. Thus, results in increasing the strength of the concrete by replacing the oyster shell for coarse aggregate.

4. Hence, the demand for coarse aggregate can be reduced.

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