

# A survey on experimental studies on oyster shell concrete

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## ABSTRACT

Concrete is the most used material in the construction industry due to its unique properties like compressive strength, durability, fire resistance, thermal resistance and impact resistance. With the population increase and migration of people to the urban cities the demand of cement, sand, aggregate is rapidly increasing. Now in the era of scientific experiments there is many research going on using the environmental wastes as the replacement of the materials in concrete. Oyster shell can be used as an

## I. INTRODUCTION

Today concrete is the world most used material in the construction industry due to this the global Co<sup>2</sup> emission are increasing daily. The main component of concrete is cement which contributes to 8% of the total global Co<sup>2</sup> emission. The main components of concrete are cement, water, sand, aggregate and air. When we mix cement, water and air it is called paste, but when the aggregate is added in paste it is known as mortar.

Sometimes artificial stones such as crushed glass bottles and parts of crushed marbles are also added to the concrete surfaces to give a good aesthetic appearance. Concrete is used in construction of almost all the structures like bridges, dams, roads, sidewalks, high rises, houses. Concrete has problems which are generally caused by improper construction methods and supervision. Problems like segregation, honeycombing, cracks, spalling. Some defects like efflorescence is caused due to excess amount of alumina.

So admixtures are added to concrete to improve the properties of fresh and hardened concrete. They are also used to make the reaction time of concrete fast, slow and to accelerate the rate of strength development of concrete, superplasticizers are also known as water reducers, by adding it the concrete can produced with 15 % less water content.

alternate material used for increasing the strength of concrete. The requirement of today construction is to make better quality of concrete with less cost and higher strength than the normal concrete. The main aim of this research is to find the compressive strength, tensile strength of oyster shell concrete. Concrete mixes of M30 grades are prepared with substitution of 5% to 25 % of oyster shell by the volume of cement in the mixer.

## History of concrete

The predecessor of concrete was found in 1300 BC. It was accidentally found when the middle eastern builders found that when the surfaced the outer wall of fortress and home walls with a thin, moist coating of burned limestone it chemically reacted with the gasses in air and a hard layer was formed. This was the first use of cement.

The concrete was first used by Romans between 300 BC to 476 AD. The romans knew that concrete was a revolutionary material so the perform experiments by placing it inside the moulds of arches and domes and it quickly hardened reducing the troubles of builders, but as the roman empire collapsed the use of concrete became rare ,than in the 18<sup>th</sup> century it was redeveloped. Today the usage of concrete is more than steel worldwide.

## History of oyster shell(OS)

Oyster shells are created when the oyster secretes the proteins and minerals from mantle extracellularly, they don't shed their shell they enlarge as they grow.

Oyster shell are commonly used in the roman archaeological sites like villas ,towns and forts they are also used in south of England and in north till the harian's wall.

Tabby is a type of concrete use in coastal areas as the availability of oyster shell are in ample amount ,they are burnt and mixed with water , sand , ash and broken oyster shell . Early Spanish settlers in

northern Carolina and Florida are using this substance for building purposes till now.

## II. LITERATURE REVIEW

Kheikye Aye et. al. (2019) [1]

With the replacement of fine aggregate as oyster shell, the compressive strength is increased as the replacement is done till 30%, above that the compressive strength decreases gradually. Now in the case of split tensile test the strength increase till 20% replacement and after that the strength gradually decreases.

Eun IK yang et. al. (2005) [2]:

When crushed oyster shell is added to concrete, workability and fineness modulus decreases, while substitution rate increases, setting time is not affected when you add oyster shell till 20 % of fine weight. The compressive strength of the oyster shell concrete at 28 days are more than the normal concrete, elastic modulus reduce by 10 % when you substitute oyster shell 20%.

Xinglu Cai et. al. (2021) [3]:

At water content of 0.94 cubes of 150x150x150 and 100x100x100 were cast and experiments are performed. Results show that the compressive strength and sustainability of concrete is better than normal concrete.

O. A. Ubachukwu et. al. (2020) [4]:

As the percentage replacement of aggregate increases the workability initial and final setting time increases, but in split tensile test the values decrease at 7, 14, 28 days.

Hai-Yan Chen (2019) [5]:

The crushed oyster shell in concrete show good results till 20% replacement for cube strength, water penetration, and cyclic wetting test, after 20% the test show negative results. 8% to 12 % show the best result cube strength and sea water resistance and have no adverse effects.

From the above literature the comparative analysis of effect of Oyster Shell Concrete is presented in Table - 1.

**Table 1: Comparative analysis of effect of Oyster Shell Concrete**

Paper Id	Problem Statement	Objective	Approach used	Strength
1	Excessive excavation of river bed for natural sand	Replacement of sand with oyster shell or oyster shell powder	Nominal mixing of concrete with metakolin used as a admixture	<ul style="list-style-type: none"> <li>To reduce cost, emission of carbon dioxide in environment</li> </ul>
2	Excessive accumulation of Oyster shell leads to foul smell and effect on health	It is done to find fineness modulus and Effect of substitution rate of oyster shell on fresh and hardened concrete	<p>To compare rheological characteristics of fresh concrete with SR of concrete</p> <p>To find mechanical Characteristics of hardened concrete with SR</p>	<ul style="list-style-type: none"> <li>Fineness modulus and workability decreases as the substitution rate increases</li> <li>Setting is not affected by substitution of OS up to 20% of fine aggregate weight</li> <li>Elastic modulus decreases by 10% when fine aggregate is substituted with 20% OS</li> <li>Government decided to use it as replacement of fine aggregate</li> </ul>
3	Excessive excavation of river bed leads to increase in depth of riverbed, water table and salt contents of river	To check the sustainability of crushed oyster shell concrete, slump properties and workability.	In all mixes the amount of admixtures gravel and cement were kept constant	<ul style="list-style-type: none"> <li>Reduced cost efficiency and improved eco-efficiency compare to normal concrete.</li> </ul>

4	The construction industry contributes to 5% of the global emission of carbon dioxide	To check the split tensile strength of oyster shell concrete.	Dry mix method was used for concrete constituent before the addition of water	<ul style="list-style-type: none"> <li>• Increased initial setting time and final setting time</li> <li>• Decreases split tensile strength at 3,7,14,28 days</li> <li>• OS contains CaCO<sub>3</sub> in trace amount which is similar to ordinary Portland cement so it has the ability to replace it.</li> </ul>
5	To recycle the waste, reduce cement and aggregate consumptions and improve concrete performance	To find cube strengths, water penetration resistance, cyclic wetting and drying chloride resistance and long-term seawater attack resistance	Nominal mixing of M40 grade oyster shell concrete with fly ash as additive	<ul style="list-style-type: none"> <li>• To find density and corrosion of bars of oyster shell concrete in marine environment.</li> </ul>

**Description of material testing:**

The different materials used are concrete, sand, coarse aggregate and oyster shell, the motive of material testing is to find the best material from the all classes of material. The aim is to get maximum strength and durability in construction.

**Cement**

Cement is a made up of calcium silicate sand aluminate sand alumina ferrite. It is obtained by combining fixed proportions limestone, clay and other minerals in, which is mixed and heated at temperature range of 1500°C. This process gives out clinker where a small amount of gypsum is added and a fine powder is produced called ordinary Portland cement. The cement when mixed with sand and water forms a paste and slowly sets to form a concrete mass. 43 Grade cement was used for this experiment. The specific gravity, initial setting time and fineness were determined by carrying out the test in the lab. Specific gravity was 3.25.

**Fine aggregate**

If the aggregate passes through IS Sieve 4.75 than it is classified as fine aggregate. These are added to concrete to increase workability and to give a homogenous mix. Normally the sand obtained naturally from river is preferred and used as fine aggregate. For the study, locally available river sand was used. Various physical properties were determined by conducting a test as per IS 383(part-III) - 1970. Specific gravity 3.2

**Coarse aggregate**

The aggregate of size between 20mm to 4.75mm is considered as coarse aggregate. For the study the test was carried out on 20mm size aggregate. Specific gravity 2.68.

**Oyster shell**

Because of its physical and chemical properties, oyster shells are considered as suitable replacement of aggregates. The crushed oyster shell are found to be beneficial to the waste industry and construction industry. Depending upon the size of specimen the crushed shell can be substituted for different size of aggregate. High amount of calcium carbonate on shell makes it suitable. This helps in improving the strength of the concrete and calcium carbonate content contributes to the resistance of heat and chemicals. Specific gravity 2.62.

**Marble powder**

Re-using the wastes from industries has environmental, economic and technical advantage. These benefits can be seen from two different perspectives, one from the point of waste producer and the other from the user part. Marble powder being one of the basic pollutants, reusing these waste in some parts as replacement with cement, contributes in lowering the pollution risk.

**Metakoalin**

Metakoalin is a valuable admixture for concrete is a pozzolanic product which has many specific features. They are available in many different varieties. Metakoalin also provides special reactivity. Partial replacement of 8-20% (by weight) of ordinary Portland cement by metakoalin gives favourable engineering properties.

#### Water

The most essential ingredients of concrete mix is water as it actively hydrates in reaction with cement. It contributes to the strength such that giving cement a paste. The amount and type of water requires proper care. Water used should be free from impurities. Sea water shall not be used. Ordinary portable water available in university campus was used.

### III. CONCLUSION

The study is done to find the replacement of fine aggregate as oyster shell in concrete. In this the marble powder and metakoalin is added as small part as 10% cement replacement .The water/cement ratio is 0.45. The concrete with 20 % oyster shell show better result than normal cement concrete. The compressive strength was 4-19% higher than the normal cement concrete, and the split tensile strength 2-11% higher than the normal cement concrete. The flexural strength is also higher

than normal cement concrete. Thus it is found that the oyster shell along with metakoalin and marble powder behaves same as normal concrete made with normal river sand.

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