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# EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF COARSE AGGREGATE USING CARBON BUSTER

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**Abstract -** *Recent decades have shown upsurge in industrial and economic growth, contributing to an improved quality of life and well-being for citizens. Carbon buster is a material made from recyclable wastes which has a capability of absorbing Carbon-Di-Oxide and it is made from 50% recyclable materials. The mix design is $M_{20}$ grade with a mix proportion of 1:1.5:3 and water content of 0.42. The carbon buster is replaced partially with a percentage of 25, 50, 75 and 100%. Primarily, the coarse aggregate is replaced with 25% of carbon buster and concrete is made. Then the coarse aggregate is replaced with 50%, 75% of carbon buster and the concrete is made. At last, the coarse aggregate is fully replaced with carbon buster i.e., 100% and concrete is made. The properties of Conventional concrete differs from Carbon Buster concrete. The comparison of Conventional Concrete with that of concrete having various percentages of carbon buster results gradually decrease in Compressive Strength, Split Tensile Strength and Flexural Strength.*

***Key Words***: **Glass, Oyster Shell, Charcoal Replacement, Compressive Strength, Split Tensile Strength, Flexural Strength.**

## 1. INTRODUCTION

The world is developing with advanced technologies in construction field now a day, but at the same time some major problems are arising simultaneously due to these advanced technologies. In our sector one of the major problem is air pollution, a survey says that out of 100 percentage of air pollution, construction sector contributes 6 percentage. So, this is a major defect in environmental aspect. Also the intensive use of aggregates in construction is a very important environmental concern. All over the world, the availability of aggregate becomes a serious problem. In order to minimize the consumption of natural aggregates the use of recycled aggregates in concrete is essential. The Indian market is extremely receptive to Clean Development Mechanism (CDM), with a fair amount of appreciation both by the government and the industry. Developed countries like US account for 30 % of global emissions, while India contributes about 3 % of the global Green House Gases (GHS) against the global average of 5.2 %.

**CARBON BUSTER** is made up of more than 50% recycled materials which includes the carbon pellets which are produced by combining $CO_2$, sand, water and cement, the result is a unique aggregate. It can be produced from various wastes such as byproduct from bio-mass power plant. The specialty of this carbon buster is that it can absorb Carbon-Di-oxide in certain range.

It is an eco-friendly product because, one tonne of carbon buster absorbs 14 kg of carbon-Di-oxide.

## 2. MATERIALS USED

### 2.1 Cement

The Ordinary Portland Cement is used for this experiment of grade 53 as per IS12269-1987.

### 2.2 Sand

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. Sand is used as fine aggregate in the preparation of Concrete and Cement mortar. Sand is one of the main constituents of Concrete making about 35% of volume of Concrete used in Construction industry. The fine aggregate is used conforming to IS 383:1970.

### 2.3 Coarse Aggregate

Coarse aggregates are particles greater than 4.75mm, but generally range between 9.5mm to 37.5mm in diameter. Gravel is used in concrete which is responsible for the strength of the concrete. Coarse aggregate constitute the majority of volume in concrete.

### 2.4 Water

Water used for concrete mixing and curing conforming to IS 3025. The Water used should be free from any salt and impurities is generally considered.

### 2.5 Oyster Shell

Oyster Shell is the dead remain of the living beings in sea. It found naturally as a tetritus deposited along the coast by tides and waves. These shells are of family Mollusca and

Lamella branch. The shell used is washed to remove the chlorine ion which gets stick to it due to the constant contact of sea water

### 2.6 Charcoal

Charcoal is collected from nearby area. Charcoal is a good absorbing material, it plays an main role in carbon-Di-oxide. The charcoal is crushed and sieved in 20mm IS-sieve.

### 2.7 Glass

Glass is a hard, brittle, amorphous substance that is composed of silicon oxides mixed with various metal oxides. Amorphous solids have their atoms arranged randomly, unlike crystals. The mechanical properties of Glass such as strength, a normal glass have an theoretical strength of 17 Gpa. The practical strength is much less it depends upon flaws, usually on surface scratches, bubbles, in homogeneities, inclusion, any mechanically distinguishable phase. Manufactured Glass has nominal strength of 70MPa.

The fracture behavior of Glass possess, low energy impact, distinct point of origin, low to moderate radial cracking, few fragments. The methods of strengthening of glass are quench-hardening, ion exchange, surface crystallization, etching, fire polishing etc.., fire polishing improves the strength the most. Quench-hardening is the most commercially used method.

## 3. PROPERTIES OF MATERIALS

**Table-1: Properties of Cement**

| S.no | Property | Result |
|---|---|---|
| 1. | Specific Gravity | 3.15 |
| 2. | Normal Consistency | 28% |
| 3. | Initial setting time (min | 35 |
| 4. | Final setting time (min | 300 min |

**Table-2: Properties of Fine Aggregate**

| S.no | Property | Result |
|---|---|---|
| 1. | Specific Gravity | 2.65 |
| 2. | Particle Size | 2.75 |
| 3. | Fineness Modulus | 3.7 |

**Table-3: Properties of Coarse Aggregate**

| S.no | Property | Result |
|---|---|---|
| 1. | Specific Gravity | 2.75 |
| 2. | Particle Size | 15 |
| 3. | Fineness Modulus | 7.10 |

**Table-4: Properties of Glass**

| S.no | Property | Result |
|---|---|---|
| 1. | Impact Value | 19.1 |
| 2. | Specific Gravity | 2.70 |
| 3. | Crushing Value | 24.05 |
| 4. | Abrasion Value | 32.8 |

## 4. RESULTS AND DISCUSSION

### 4.1 Compressive Strength of Concrete Cubes

The cube specimens were tested on Compression Testing Machine of capacity 1000KN. The bearing surface of machine was wiped off clean and sand or other material removed from the surface of the specimen. The load applied to the specimen is increased continuously at a constant rate until the resistance of the specimen to the increasing load breaks down. The maximum load applied on specimen was recorded.

The specimens are tested for Compressive Strength on Compression Testing Machine provided with two steel bearing plates with hardened faces. These specimens are tested by compression testing machine after 7 days, 14 days and 28 days curing.

The Compressive Strength of Conventional Concrete is 2.6%, 6.98%, 27.78% and 50.81% times higher than of the Concrete having 25%, 50%, 75% and 100% replacement of Carbon Buster for 28 days curing

**Table -5: Compressive Strength of Concrete**

| Addition of Carbon Buster percentage | Compressive strength (fck ) $N/mm^2$ | | |
|---|---|---|---|
| | 7 Days | 14 Days | 28 Days |
| 0% | 13.4 | 21.3 | 27.6 |
| 25% | 12.1 | 21.4 | 26.9 |
| 50% | 11.3 | 20.7 | 25.8 |
| 75% | 9.8 | 16.8 | 21.6 |
| 100% | 8.2 | 12.9 | 18.3 |

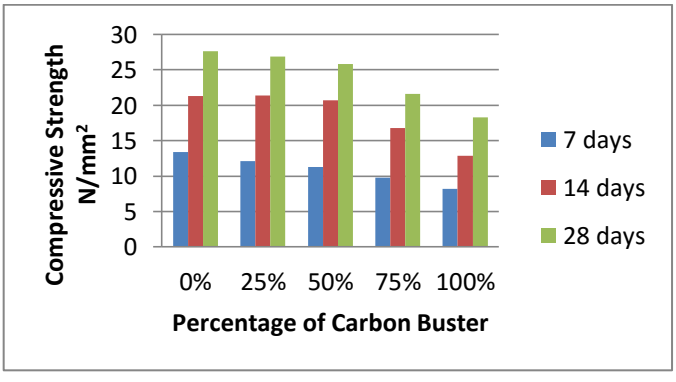


**Chart -1: Compressive Strength of Concrete**

### 4.2 Split Tensile Strength of Cylinder

The Split Tensile Strength test on Concrete cylinder is a method to determine the tensile strength of Concrete. The cylinder specimens were tested on Compression Testing Machine of capacity 1000KN.

The bearing surface of machine was wiped off clean and loses other sand or other material removed from the surface of the specimen. The load applied to the specimen is increased continuously at a constant rate until the resistance of the specimen to the increasing load breaks down. The maximum load applied on specimen was recorded.

**Table -6: Split Tensile Strength of Concrete**

| Addition of Carbon Buster percentage | Split tensile strength (fck ) N/mm$^2$ | | |
|---|---|---|---|
| | 7 Days | 14 Days | 28 Days |
| 0% | 1.78 | 2.31 | 2.84 |
| 25% | 1.95 | 2.44 | 3.09 |
| 50% | 1.63 | 2.15 | 2.54 |
| 75% | 1.24 | 1.59 | 2.16 |
| 100% | 0.89 | 1.09 | 1.83 |

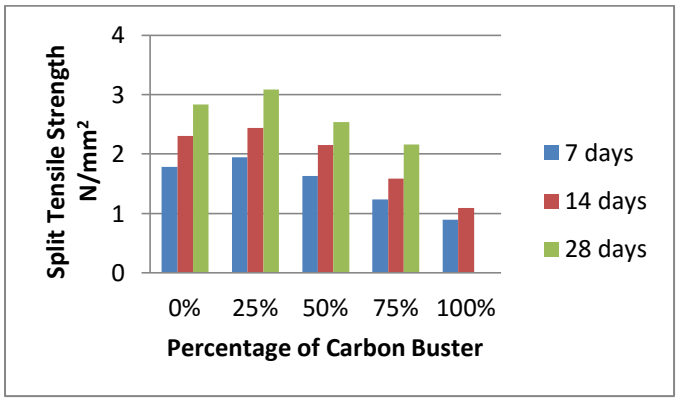


**Chart -2 Split Tensile Strength of Concrete**

In Tensile Strength test, the value increases with 25% replacement of Carbon Buster. It is 8.8% higher than the Conventional Concrete**.** But, 50%, 75% and 100% replacement of Carbon Buster shows 11.8%, 31.48% and 55.19% lesser Tensile Strength for a period of 28 days curing

### 4.3 Flexural Strength of Beam

Flexural test evaluates the Tensile Strength of Concrete. The beam specimen of size 100 mmX100 mmX500 mm were casted to determine the Flexural Strength of Concrete with various percentages of Glass, Oyster Shell and Charcoal. The specimen were cured for a curing period of 28 days. The beam is dried in oven and subjected to Flexural Strength Test.

**Table -7: Flexural Strength of Concrete**

| Addition of Carbon Buster percentage | Flexural strength of Concrete N/mm$^2$ | | |
|---|---|---|---|
| | 7 days | 14 days | 28 days |
| 0% | 2.8 | 4.3 | 5.6 |
| 25% | 2.8 | 4.2 | 5.5 |
| 50% | 2.3 | 3.7 | 5.0 |
| 75% | 1.9 | 2.8 | 4.7 |
| 100% | 1.7 | 2.4 | 4.3 |

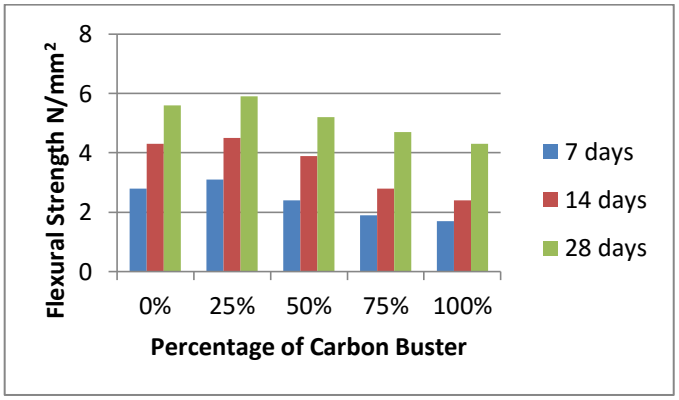


**Chart -3 Flexural Strength of Cylinder**

### 5. CONCLUSIONS

- Carbon Buster behaves well in Tension than under Compression. The Tensile Strength of Concrete having 25% Carbon Buster is 3.09 N/mm$^2$ higher than that of the Conventional Concrete value.
- There is decrease in the compressive strength of the Concrete replaced by Carbon Buster when compared to that of the Conventional Concrete.
- The Compressive Strength of Conventional Concrete is 2.6%, 6.98%, 27.78% and 50.81% times higher than of the Concrete having 25%, 50%, 75% and 100% replacement of Carbon Buster for 28 days curing.
- In Tensile Strength test, the value increases with 25% replacement of Carbon Buster. It is 8.8% higher than the Conventional Concrete.
- But, 50%, 75% and 100% replacement of Carbon Buster shows 11.8%, 31.48% and 55.19% lesser Tensile Strength for a period of 28 days curing.
- On addition of Carbon Buster in Concrete, highest value of Flexural Strength 5.9N/mm$^2$ was observed on 25% addition which is 5.36% higher than the ordinary Conventional Concrete for 28 days curing. The values of Flexural Strength of

50%, 75% and 100% replacement of Carbon Buster are 7.14%, 16.07% and 23.21% lower than that of the Conventional Concrete for 28 days curing.

- Though there is decrease in trend of Compressive Strength and Tensile Strength of the concrete replaced with Carbon Buster, effective utilization of waste materials is beneficiary

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