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# Exploration of Mechanical Properties of Concrete by Inequitable Surrogate for Fine Aggregate

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**Abstract:**
This study investigates the strength properties of hardened concrete with biased replacement of Burnt Glass Sand instead of Conventional Materials.Burnt Glass Sand(BGS) is used in concrete as fine aggregate by replacing M-Sand at different percentages (10%, 20%, 30%, 40%, and 50%).M25 grade concreteandOrdinary Portland Cement 53 Grade is used. The hardened concrete cubes, cylinder, and prism are tested for compressive, split tensile and flexural strength and these tests are performed after 7 days and 28 days curing.The results obtained from the different percentages of replacement are compared.
***Keywords:*** *Burnt Glass Sand, Concrete, M-Sand, Ordinary Portland Cement*

## I.Introduction

Concrete is extensivelyused in the construction industryfor various civil engineering structures. The strength of the concrete mainly depends on the strength of the materials such as cement, aggregates and their properties. Concrete is the vitalkey material in engineering and the addition of some other materials in concrete may change the concrete properties. The various studies are being carried out in investigating the possibility of utilizing the various materials as partial replacement of cement, fine and coarse aggregate. The various types of materials used in concrete are replaced by waste materials to reduce the usage of conventional materials. The wastes generated from the industries are substantially increasing and it becomes difficult to dispose of these wastes. These left-over materials can be used as ansubstitute material in the concrete. This study deals with the replacement of fine aggregate by burnt glass sand. The burnt glass sand is the waste material collected from the industry. This waste is taken from the industry and its properties are analyzed. And this waste glass sand is introduced in concrete as ainequitablesubstitute for M-Sand.

## II.Materials

The conventional materials are utilized in the concrete.Thepotency of the concrete relies upon these various materials.Properties of conventional materials are discussed.

### A. Cement

Cement is the extensively used cementitious ingredient in concrete. The Ordinary Portland Cement 53 Grade cement is used in the concrete.Thephysical properties of the cement are given in Table I.

**Table I: Physical properties of Ordinary Portland Cement 53 Grade**

| S.No | Property | Results |
|---|---|---|
| 1. | Specific gravity OPC | 3.18 |
| 2. | Fineness of cement | 6 |
| 3. | Benchmark consistency | 32 |
| 4. | Primary setting time | 31 |
| 5. | Ultimate setting time | 266 |

### B. M-Sand

In current scenario M-Sand is used as the auxiliarymaterial instead of fine aggregate in concrete. The demand for M-Sand in the construction field has been increased. The various workable properties of the M-Sand are listed in Table II.

**Table II: Workable properties of M-Sand**

| S.No | Property | Unit | ObtainedResults |
|---|---|---|---|
| 1. | Specificgravity | Nil | 2.55 |
| 2. | Fineness modulus | Nil | 2.59 |
| 3. | Water absorption | % | 1.3 |

### C. BurntGlassSand

The burnt glass sand is that the waste material collected from the industry.Fiine aggregate is replaced by M-Sand in concrete as an alternative.The variousworkable properties of BGS are listed in Table III.

**Table III:Workable properties of BGS**

| S.No | Workable Property | Unit | ObtainedResults |
|---|---|---|---|
| 1. | Specificgravity | Nil | 2.53 |
| 2. | Fineness modulus | Nil | 2.51 |
| 3. | Water absorption | % | 1.6 |

### D. Coarseaggregate

The standardizedstone aggregate size in the concrete mix is 20 mm. The variousworkable properties of the coarse aggregate are given in Table IV.

**Table IV: Workable properties of Coarse Aggregate**

| S.No | Workable Property | Unit | Value obtained |
|---|---|---|---|
| 1. | Specificgravity | Nil | 2.66 |
| 2. | Fineness modulus | Nil | 7.2 |
| 3. | Water absorption | % | 1.1 |

## I. TESTS PERFORMED ON HARDENED CONCRETE

### A. COMPRESSIVE STRENGTH TEST

The concrete is strong in compression; hence it becomes necessary to find the compressive strength of the various concrete mixes. The compression test is carried out on the hardened concrete cubes.Thecasted concrete cubes are tested for compressive strength. The cube size is 15cm x15cm x15 cm. The casted cubes are subjected to compression and the respective strength obtained at the age of seven days and twenty eight days is listed in table V

**Image:1**

### B. FRAGMENTEDMALLEABLE STRENGTH TEST

Concrete is weak in tension however the reinforced structures likely depend on the malleable strength of concrete. The fragmentedmalleable strength is conducted on a tube-shaped specimen. The size of the tube-shapedspecimen used for this test is 15 cm diameter and the heightis 30 cm. The testing of the cylinder at the age of 7 and 28 days after curing.

**Image:2**

### C. FLEXURAL STRENGTH TEST

The prism is cast and tested for flexural strength. The size of the specimen used is 10cm x10cm x50 cm. Unlike crushing failure,the flexural failure will be sudden and abrupt and failure load is recorded accurately. The prism is tested for flexural strength at the age of seven days and twenty eightdays after curing. The flexural strength can be calculated by the formula,

Image:3

## II. RESULTS

### A. CONFINING STRENGTH

The results of compression test for diverse percentage replacement of burnt glass sand at the age of seven days and twenty eight days aftercurative processis listed below in Table V and the comparison of strength is shown in figure 4.

**Table V: Results of Compressive strength test**

| REPLACEMENT ( %) | 7th DAY RESULT(MPa) | 28th DAY RESULT(MPa) |
|---|---|---|
| 0 | 17.35 | 26.23 |
| 10 | 18.44 | 27.95 |
| 20 | 20.23 | 28.53 |
| 30 | 21.54 | 29.92 |
| 40 | 18.97 | 28.17 |
| 50 | 16.89 | 25.54 |

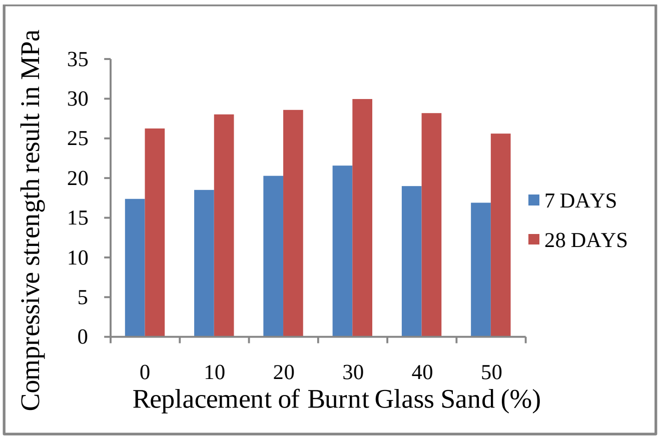


**Image 4: Confining strength result of concrete for differentpercentage replacement of burnt glass sand**

### B. FRAGMENTEDMALLEABLE STRENGTH

Thefragmentedmalleable strength test results for different percentage replacement of burnt glass sandat the age of seven days and twenty eightafter curing is listed below in Table VI and the comparison of strength is shown in figure 5.

**Table VI:Fragmentedmalleable strength test for varying % replacementof burnt glass sand**

| REPLACEMENT (%) | 7th DAY RESULT (MPa) | 28th DAY RESULT (MPa) |
|---|---|---|
| 0 | 2.09 | 2.54 |
| 10 | 2.27 | 2.96 |
| 20 | 2.56 | 3.19 |
| 30 | 2.87 | 3.48 |
| 40 | 2.45 | 3.07 |
| 50 | 2.04 | 2.48 |

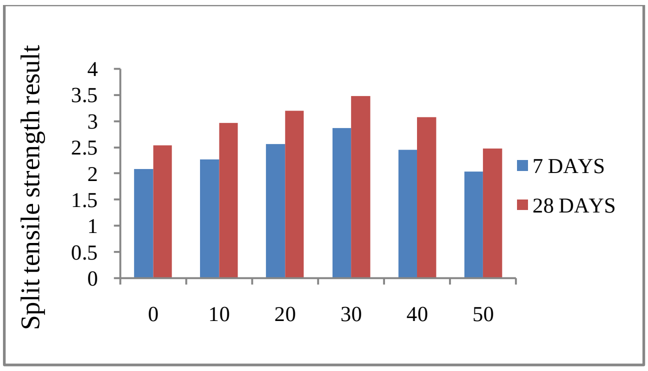


**Image 5: Fragmentedmalleable strength result of concrete for varying % replacement of burnt glass sand**

### C. BENDING STRENGTH

The bending strength test results for varying percentage replacement of burnt glass sandat the age of seven days and twenty eight days after curing is listed in Table VII and the comparison of strength is shown in figure 6.

**Table VII:Results ofBending strength test**

| REPLACEMENT ( %) | 7thDAY RESULT(MPa) | 28th DAY RESULT(MPa) |
|---|---|---|
| 0 | 2.95 | 3.75 |
| 10 | 3.15 | 3.91 |
| 20 | 3.50 | 4.26 |
| 30 | 3.74 | 4.53 |
| 40 | 3.46 | 4.12 |
| 50 | 2.67 | 3.25 |

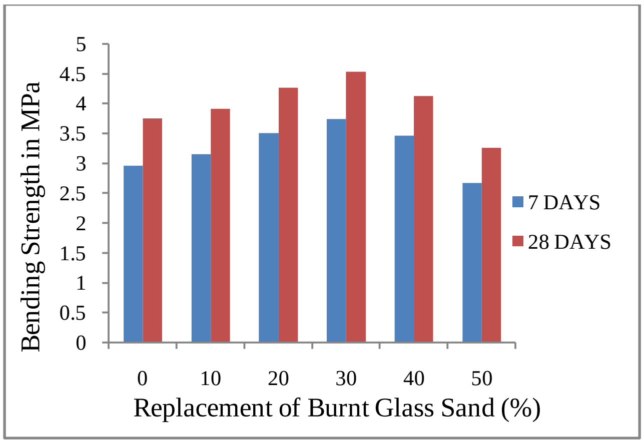


**Figure 6: Flexural strength result of concrete fordifferentpercentage replacement of burnt glass sand**

## III. CONCLUSION

The Burnt Glass Sand gives the desirable strength to the concrete when it replaces the M-Sand in the concrete. Theconfining strength increases up to 30% by substituting burnt glass sand beyond which the value tends to decrease. The split tensile and flexural strength results goincreasing up to 30% replacement of burnt glass sand. So, the recommended percentage of replacement is 30%. By using this waste burnt glass sand from the industry as analternative to fine aggregate, the depletion of natural resources can be controlled.

## REFERENCES

[1] Aratchelvan A, “A STUDY ON STRENGTH CHARACTERISTICS OF MORTAR AND CONCRETE USING SILICA SAND AS FINE AGGREGATE”, International Journal of Recent Scientific Research, Vol.9, issue 6, 2018

[2] B. Durga et al., “Experimental Study on Various Effects of Partial Replacement of Fine Aggregate with Silica Sand in Cement Concrete and Cement Mortar”, IJETT Vol.33, March 2016

[3]HanifiBinici et al., “Durability of concrete made with natural granular granite, silica sand and powders of waste marble and basalt as fine aggregate”, Journal of Building Engineering 19(2018) 109-121

[4]A Jayaraman et al., "Effect of Using Different Types of Sand on Workability, Mechanical and Durability Performance of High Strength Concrete", International Journal of ChemTech Research, Volume 12, No.02, 2019

[5] Kerai Jignesh et al., “Effect of use of Silica Sand as Fine Material in Concrete”, IJIRST, Vol.2, issue 1, 2015

[6] Mukesh C. Limbachiya, “Bulk engineering and durability properties of washed glass sand aggregate”, Construction and Building Materials 23 (2009) 1078-1083

[7] Nafisa Tamanna et al., “Performance of recycled waste glass sand as partial replacement of sand in concrete”, Construction and Building Materials 289 (2020) 117804

[8] Nancy A. Soliman et al., “Using glass sand as an alternative for quartz sand in UHPC”, Construction and Building Materials 145 (2017) 243-252

[9] SamihaRamdani et al., "Physical and mechanical performance of concrete made with waste rubber aggregate, glass powder, and silica sand powder", Journal of Building Engineering 21(2019) 302-311

[10] L. Senthil Nathan, “Partially Replacement of Silica Sand with Excellent Aggregate by Increasing Stability and Lack of Natural Aggregates”, Journal of Engineering and Applied Sciences, 13(4):852-853, 2018

[11] Mukesh P, Balamurugan P 2020, Experimental investigation of buckling characteristics of FRP hollow circular section, Adalya Journal, 9(1), 398-402.

[12] R.Vetturayasudarsanan, P.Balamurugan 2020, Utilization of magnesite soil in manufacturing of bricks, Adalya Journal, 9(1), 310-315.

[13] M.Renumathi, P.Mukesh& P.Balamurugan 2020, A State of art on geopolymer concrete, Adalya Journal, 9(1), 372- 378.