

RESEARCH ARTICLE



ISSN: 2321-7758

## USING GLASS WASTE AS A PARTIAL REPLACEMENT FOR FINE AGGREGATE ON THE STRENGTH OF THE CONCRETE

Dr A.LEEMA ROSE<sup>1</sup>, MEGHA.S.SAJI\*<sup>2</sup>

<sup>1</sup>Associate Professor, Department Of Civil Engineering, Adhiparasakthi Engineering Collage, Melmaruvathur, India

<sup>2</sup>ME Student, Department Of Civil Engineering, Adhiparasakthi Engineering Collage, Melmaruvathur , India

Article Received: 19/01/2015

Article Revised on: 29/01/2015

Article Accepted on:02/02/2015



### ABSTRACT

During the past few decades Common River sand has become expensive due to excessive cost of transport from natural sources. Large scale depletion of these impacts an alternative has to be found in order to replace sand. Glass powder is obtained as a waste material after the extraction and processing of glass to form fine particles less than 4.75mm. Glass powder has been used in large scale in highways as a surface finishing material and also used in the manufacture of hollow blocks and light weight concrete prefabricated elements. Fine aggregate were replaced as waste glass powder as 10 %, 20%, 30% and 40% by weight for M-30 mix. The concrete specimens as to be tested compressive strength, splitting tensile strength, and durability at 7days,28 days and 60 days of age. The main focus of this research is to found out the strength and durability of partially replaced of fine aggregate by using glass waste.

**Keywords:** waste glass powder, Compressive Strength, Tensile strength, Durability, Fine aggregate, course aggregate

©KY Publications

### INTRODUCTION

Concrete is a widely used material in the world. Based on global usage it is placed at second position after water. River sand is one of the consistencies used in the production of convention concrete has become highly expensive and also scare. Glass is one of the oldest manmade materials. It is produced in many forms, including packaging or container glass, all of which have limited life in the forms in which they are produced and need to reused or recycled in order to avoid environmental problems that would to create if they were to be stockpiled or send to landfill. The using of waste glass as fine aggregate in

concrete creates a problem due to alkali silica reaction. The reaction between alkalis in Portland cement and silica in aggregate forms silica gel. This gel is prone to swelling. It absorbs water and the volume of the gel increases. Under generates hydrostatic pressure. If the reaction continues and the internal pressure exceeds the tensile strength of the matrix, cracks will form around the reactive aggregate particles. Ground waste glass was used as fine aggregate in concrete and no reaction was detected with fine particle size, thus indicating the feasibility of the waste glass reuse as fine aggregate in concrete. In addition, waste glass seemed to

positively contribute to the mortar micro-structural properties resulting in an evident improvement of its mechanical performance. Larger the particle size of waste glass more is the chance of Alkali Silica Reaction occurrence. The size of the waste glass used was in the range 0-1.18mm. In this research, fine aggregate were partially replaced by waste glass as 10%, 20%, 30% and 40% by weight. Concrete specimens were tested for compressive strength, splitting tensile strength, and durability for different waste glass percentages.

#### MATERIALS AND METHODS

##### Materials

The following are the details of the materials used for the concrete cubes.

**Cement:** In this experiment Ordinary Portland Cement (OPC)-53 grades. The cement used is fresh and without lumps. The testing of cement is done as per IS: 12269-1987 was used.

Table 1. Physical Properties of Cement

| Property           | Value |
|--------------------|-------|
| Specific gravity   | 3.16  |
| Fineness of cement | 4%    |

As per IS 269:2013, the results are within the maximum limits.

**Water:** The water was potable, fresh, colourless, odourless and tasteless water that is free from organic matter of any type.

**Sand:** The fine aggregate were used for the experiment in with maximum size 4.75mm diameter.

Table 2. Physical Properties Of Fine Aggregate

| S.No | Name of test     | Observed Value |
|------|------------------|----------------|
| 1.   | Fineness modulus | 2.668          |
| 2.   | Specific gravity | 2.316          |
| 3.   | Water absorption | 0.905%         |

As per IS 383:1970, the result are within the maximum limits.

**Coarse Aggregate:** Coarse aggregate are used for making concrete. A maximum size of 10mm is usually selected as coarse aggregate up to 20mm.

Table 3. Properties Of Course Aggregate

| S.No | Name of test     | Observed value |
|------|------------------|----------------|
| 1.   | Fineness modulus | 2.29           |
| 2.   | Specific gravity | 2.54           |
| 3.   | Water absorption | 0.60%          |

As per IS 383:1970, the results are within the maximum limits.

**Glass Waste:** Wasteglass locally available and it has been collected and glass to be crushed. The size of the waste glass is 150mm range.

Table 4. Physical Properties of Glass Waste

| S.No | Property         | Value |
|------|------------------|-------|
| 1.   | Fineness modulus | 2.114 |
| 2.   | Specific gravity | 2.50  |
| 3.   | Water absorption | 0.55% |

#### DESIGN MIX FOR M30 GRADE CONCRETE

Grade of concrete : M30

Cement : OPC 53 grade

Target Strength :  $f_{ck} + 1.65(s) = 38.25 \text{ N/mm}^2$

Cement content :  $430 \text{ kg/m}^3$

Water cement ratio : 0.4

Table 5. Mix Design Proportions

| Cement | Fine Aggregate | Course Aggregate | Water |
|--------|----------------|------------------|-------|
| 493    | 594.3          | 1153.6           | 197   |
| 1      | 1.4            | 2.5              | 0.40  |

**Compressive Strength Test:** The steel mould of size 150x150x150 mm is well tightened and oiled thoroughly. The fresh mixed concrete is placed and well compacted thoroughly mechanical vibrators and after 24 hours they were allowed for curing in a period of 7, 28, 60 days and they were tested.

#### RESULT AND DISCUSSIONS

Table 6. Result for Compression test at 7<sup>th</sup> day

| Sample                        | Compressive Strength (N/mm <sup>2</sup> ) @7 days |
|-------------------------------|---|
| Control Concrete              | 22.18   |
| Concrete with 10% glass waste | 25.40   |
| Concrete with 20% glass waste | 28.50   |
| Concrete with 30% glass waste | 29.29   |
| Concrete with 40% glass waste | 25.50   |

Table 7. Result for Compression test at 28 days

| Sample                        | Compressive Strength (N/mm <sup>2</sup> )@ 28 days |
|-------------------------------|--|
| Control Concrete              | 33.71  |
| Concrete with 10% glass waste | 36.30  |
| Concrete with 20% glass waste | 42.68  |
| Concrete with 30% glass waste | 46.42  |
| Concrete with 40% glass waste | 43.62  |

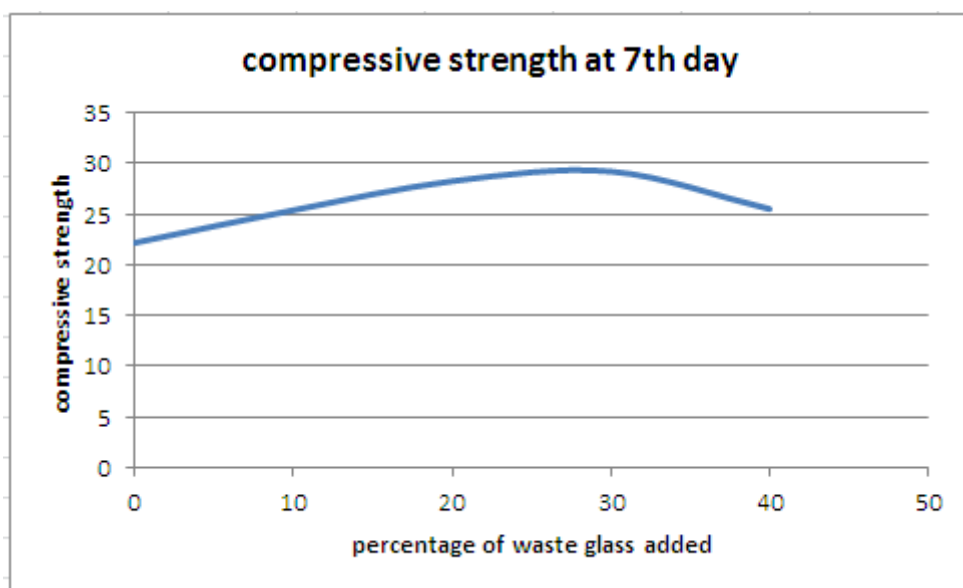


Figure 2. Compressive strength of concrete at 7<sup>th</sup> day

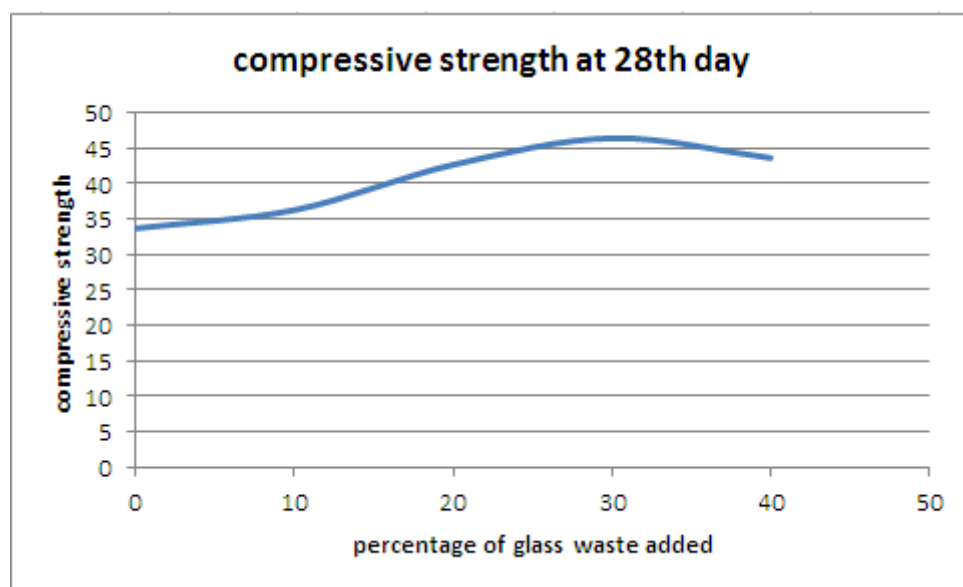


Figure2. Compressive strength of concrete at 28<sup>th</sup> day

**CONCLUSION**

- Crushed glass is suitable material for use of replacement of fine aggregate.
- The workability of concrete mix is increase with increase in waste glass content.

- Up to 30% the compressive strength increased.

#### ACKNOWLEDGEMENT

The authors would like to express their thanks to the Principal and Department of Civil Engineering, Adhiparasakthi Engineering College, Melmaruvathur, Tamilnadu for the project approval and support.

#### REFERENCE

- [1]. Iqbal Malik, Muzfar Bashir "Study of concrete involving use of waste glass as partial replacement of fine aggregate."IOSR Journal of Engineering (IOSRJEN)2013.
- [2]. Jostin.P.Jose,S.Suganya,Banu Priya "Use of glass powder as fine aggregate in High Strength Concrete. "International Journal of science and Engineering Research(IJOSER)2014.
- [3]. Mrs. Bhandari PS,Mr Dhale "Influence of fine glass aggregate on cement mortar "International engineering and computer science|ISSN2319-72422014.
- [4]. Pricilla .M, AssProf Pushparaj "Strength and durability study on recycled aggregate concrete using glass powder.
- [5]. T.Phani Mdhav and P.Gunasekaran (2013) " The use of fly ash as cement replacement material and glass aggregate as fine aggregate material partially in concrete..
- [6]. G.D. Perkins(2007) The glass powder is being used for partial binder replacement in proportions of 10%, 20% and 30%
- [7]. Sunny O. Nwaubani (2013) The feasibility of waste glass inclusion as partial cement replacement in cementations systems.
- [8]. Mohammad Abdhur Reshid and Mohammad Abdul Mansur (2011)The requirements of ingredient-materials for producing normal strength concrete.
- [9]. Dr. Haider K. Ammash and Muhammed S. Muhammed (2009) the possibility of using waste glass of size up to5mm as a fine aggregate in concrete and mortar.
- [10]. Aimin Xu and Ahmad shayam, "Value – added utilization of waste glass in concrete", Cement and concrete research, vol.34,81-89,2004.
- [11]. Pereira de Oliveira. L.A, J.P. Castro – Gomes, P. Santos, "Mechanical and Durability Properties of concrete with Ground waste Glass Sand", International conference on durability of Building Materials and components, Turkey, 2008
- [12]. Meyer, C. and Baxter, S., Use of Recycled Glass for Concrete Masonry Blocks, Final Report 97-15, New York State Energy Research and Development Authority, Albany, NY, November 1997.
- [13]. Meyer, C. and Bextex, S., Use of Recycled Glass and Fly Ash for Precast Concrete, Final Report 98-18, New York State Energy Research and Development Authority, Albany, NY, October 1998.