Experimental Study on Reuse of Bottle Glass Waste and Tiles Waste As A Partial Replacement To Fine Aggregate in Concrete

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***Abstract*—concrete is a mix it consumes large amount of cement, sand and aggregate, which causes depletion of natural resources. At the same time human societies grow, the problem of waste management because one of the pressing issues that need to be addressed. Recycling and reuse of waste are effective waste management measures that prevent pollution and conserve natural resources. Construction industry is in search of cleaner and greener alternatives for material in concrete. The main objective of this study was possibility of using glass waste and tiles waste as an alternative was used as a partial weight substitute for fine aggregates with replacement. Take the glass waste as constant and adding tiles waste with replacement ratios of 5,10,15 and 20 percentage by the weight and formed into test models (15cm*15cm) cubes and (15cm* 30cm) cylinder, then matured tested their strength compression and tensile strength at the age of 7 and 28 days. The result showed the possibility of using crushed glass and tiles waste in concrete as a good alternative to fine aggregate.**

Keywords—sustainable concrete, compressive strength, tensile strength,tiles waste

I. Introduction

Concrete is regarded as the most widely used man made material in the world. Comparatively economical, easy to make and fast to bind with other materials. Concrete is one of the key construction materials worldwide. Large amount of concrete is being used in construction industry. Use of concrete implies use of cement, fines and coarse aggregate as well. Aggregate is key ingredient in terms of strength and volume in concrete. Aggregate is non-renewable natural resource. The resources in our country are being overexploited and the natural stock is decreasing at an alarming rate. Growing urbanization, population growth, and increasing living standards have helped increase the quantity of a variety of solid waste produced by manufacturing, farming, mining, and domestic activities due to technological innovations. The construction industry is in search of cleaner and greener alternatives for materials used in concrete to provide a sustainable environment in materials construction. Reduction of natural resources and the high cost of construction materials lead to finding another source of waste material in the production of concrete. The main goal is to reuse of recycle the waste material by using an aggregate in concrete. Use of bottle glass waste and tiles waste as

aggregate replacement in concrete production. By using the replacement materials offers cost reduction, energy savings and few hazards in the environment.
Use of waste tile aggregate as replacement for coarse aggregate helps to reduce overexploitation as well as manage the waste. The amount of tile waste on earth is enough for use as an aggregate in concrete. Tile is produced from natural materials sintered at high temperatures. Waste tiles cause only the apparition of pollution. Bottle glass is also a waste increasing timely. The source of bottle is mainly from liquor bottles and glass bottle items. Glass is very hard, durable and if finely ground, it can serve as a pozzolanic material thus making it suitable for use as partial replacement of cement and fine aggregate.

II. Objectives of work

- To find the strength of concrete by partial replacement of fine aggregate
- To determine the workability of concrete by adding different proportions of tile wastes
- To determine compressive strength of concrete specimen
- To determine tensile strength of concrete by split tensile test

III. Methodology

The test is carried out to find the strength of the specimen by adding bottle glass and tile waste as a partial replacement of fine aggregates. In this experiment we take M25 mix with mixing ratio 1:1:2. Firstly we collected the samples to be mixed in the concrete. The samples are glass bottles and tile waste. After that we crushed bottle glass and tile waste it in the form to get mixed in the concrete. After crushing is done we sieve the crushed samples and now the sieved sample is passed to do the material testing. When material testing is done. We start preparations and procedures to do the casting. 10% of glass waste is made constant and tile waste is added in different proportions to the concrete mixture as partial replacement of fine aggregates. Slump test is carried out when mixing of concrete is done. To determine the compression strength we cast the cubes and do the compression test .similarly to determine the tensile strength we cast cylinders and do the split tensile strength. After analyzing through the test results we are providing suitable proportions of bottle glass and tile waste to use as the partial replacement of fine aggregate.

IV. MATERIALS AND METHODS

The materials used in this study are cement, fine aggregate, coarse aggregate, water, grinded glass waste and tile waste as fine partial aggregate replacement.

a) Cement

Cement is an essential component of the concrete industry as it is responsible for bonding concrete components. Ordinary Portland cement (Type 1), conforming to IQS Standard No. 5 / 1984, has been used in concrete mixtures.

b) Fine aggregate

The fine aggregate used was M sands of the clean quarries. The maximum size was 4.75 mm. Impurities were removed and conform to IOS45:1980.

c) Coarse Aggregate

Coarse aggregates used were from quarries. The maximum size of coarse aggregate was 20 mm.

d) Mixing waste

Tap water has been used in this study for concrete mixture.

e) Glass waste

Origin of glass aggregate is from bottle glass from locally collected. . After being collected, the workgroup was cleaned. The next step in preparing the aggregate glass was the cracking process, which was performed manually with the hand hammer and sifted to obtain grades similar to those in natural sand. The maximum diameter of nominal particle size was 4.75 mm.

f) Tiles waste

Tiles were obtained from building construction sites. For this Experiment waste tiles was used. Its bulk density and water absorption were 2.35 gm/cc and 0.08% respectively.

V. TESTING TECHNIQUE

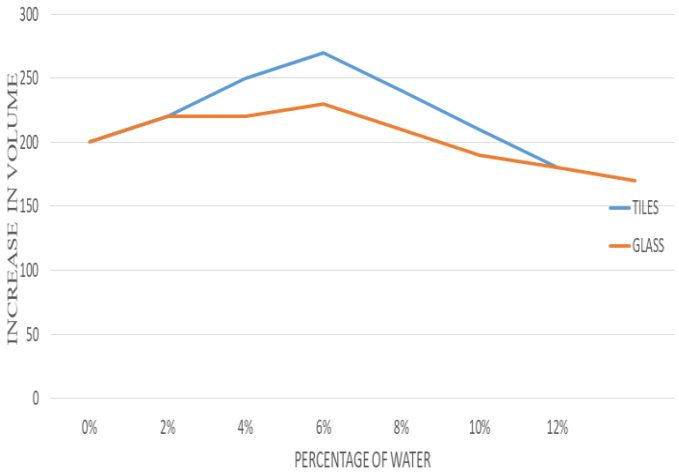
1. MATERIAL TESTING

A. BULKING OF FINE AGGREGATE.

Bulking of fine aggregate or sand is the phenomenon of increase in sand volume due to the increase of moisture content. Bulking test on fine aggregates has to be performed before using it in construction.

Percentage	Increase in volume (ml)

of water	Tiles	Glass
0%	200	200
2%	220	220
4%	250	230
6%	270	210
8%	240	190
10%	210	180
12%	180	170



B. SPECIFIC GRAVITY

It is defined as the ratio of the weight of a given volume of aggregates to the weight of equal volume of water. Pycnometer test is used to find out the specific gravity of fine aggregates. The specific gravity of fine aggregate is considered to be around 2.65 to 2.67.

Specific gravity of glass waste = 2.64
Specific gravity of tiles waste = 2.58

2. WORKABILITY

Workability is a characteristic of fresh concrete that shows how easy it is to pour and handle concrete. It is a characteristic that expresses the degree of homogeneity of the concrete mixture and its resistance to granular separation.
The mold was mounted on a flat, horizontal board and solid metal plate, and the mold was held firmly in place while filling in three layers. Each layer the third height of the template. A round end compacting rod was used to staple each layer by 25 strokes, and after the final layer was completed, the concrete was separated from the level with a trowel so that the mold was completely filled. The mold in the vertical direction was removed slowly and carefully. The concrete was allowed to fall, and then the slumps were calculated by determining the distance between the level of the mold and the highest point in the form after the mold was removed.

3. COMPRESSIVE STRENGTH

Compressive strength is the capacity to resists or withstands pressure on a substance or structure. The compressive strength of a material is defined by the capacity of the material to resist defects in the form of fractures. Compressive strength as a function of the concrete relies on many factors linked to consistency, mixing nature, and quality management of the products used in concrete construction.
The compressive strength is tested as follows:

1. The concrete was poured into the mold on three layers, compact each layer 25 times to compact it properly to reduce the amount of voids.

2. After 24 hours, molds are removed, and test samples are placed in water for processing.

3. After the specified curing period 7 and 28 days, samples are tested using the pressure testing machine.

4. The load is applied gradually until the sample fails.

5. Divide the failure load by the cross-sectional area of the sample to obtain the compressive strength of the concrete

4. SPLITTING AND TENSILE STRENGTH

The tensile strength of the concrete tests the tension of the structure as it hit its rupture point at which it shatters or losses its stability, which ensures that the structure can endure the highest stress without failure. The tensile strength is a non-quantitative property, meaning the quantity of tested material does not change.

VI. RESULTS

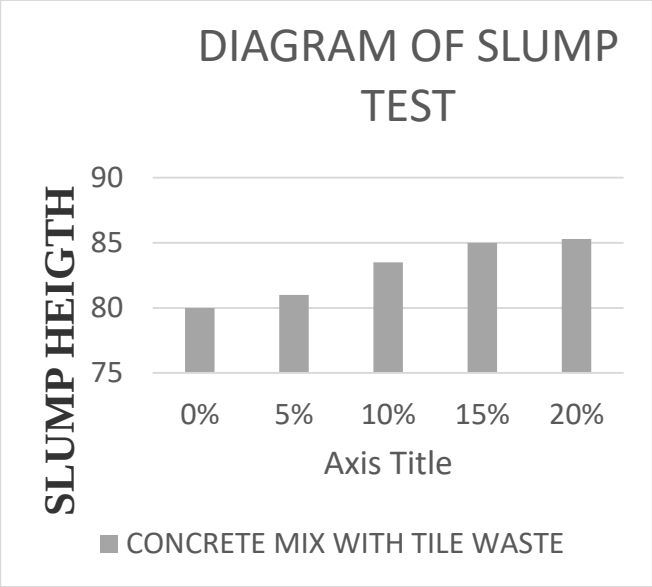
1. Workability

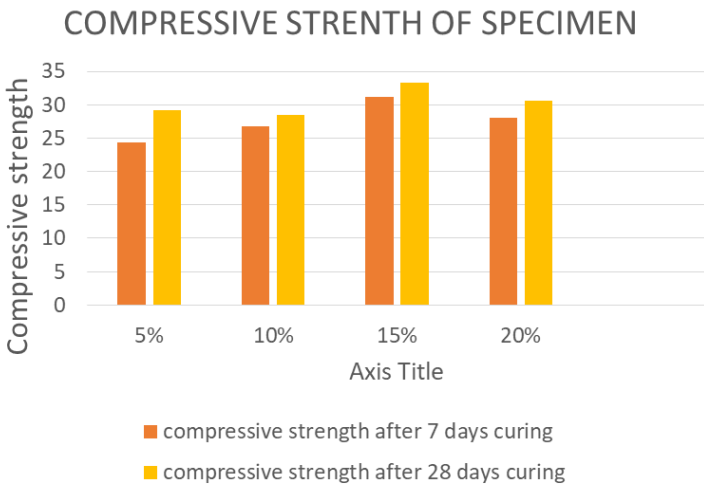
An increase in the workability of concrete made using glass waste constant as 10% and tiles waste added to different proportions as alternative to fine aggregates.

Percentage of tiles waste added	Slump (mm)
0%	80

5%	81
10%	83.5
15%	85
20%	85.3

	30		32.5	
20%	28	28.16	30.5	30.16
	29		31	
	27.5		29	





2. Compressive Strength

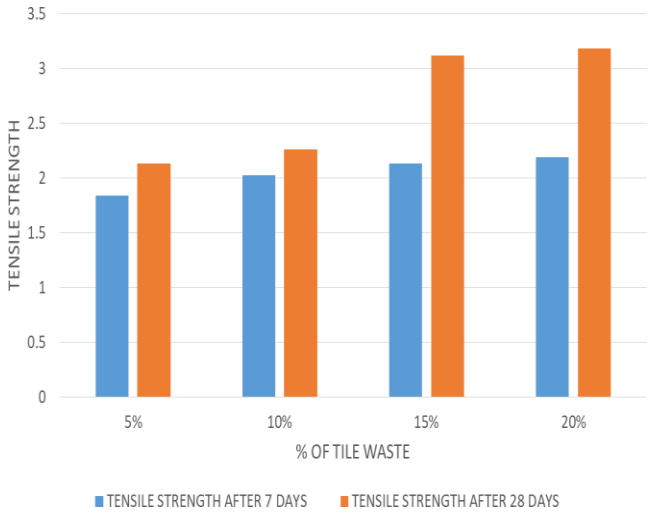
As previously mentioned, glass and tiles residues were initially crushed by hand and then sieved to a maximum size of 4.75 mm. The use of glass waste and tiles wastes in concrete increased the compressive strength of the concrete at both ages (7 and 28 days).

3. Tensile strength

Split tensile strength results for samples with the addition constant glass waste and tiles with 5%, 10%, 15% and 20% weight.

Percentage of tile waste	Compressive strength after 7 days curing (N/mm2)		Compressive strength after 28 days curing (N/mm2)	
5%	23.5	23.1	29.	29
	22		28	
	24		30	
10%	27	26.16	27.8	28.26
	25.5		28	
	26		29	
15%	31.3	30.1	33	33.16
	29		34	

Percentage of tile waste	Tensile strength after 7 days curing (N/mm2)	Tensile strength after 28 days curing (N/mm2)
5%	1.839	2.13
10%	2.05	2.26
15%	2.13	3.12
20%	2.19	3.18



VII. CONCLUSION

From the results of this research, the following conclusions can be highlighted and summarized as follows:

- Recycled glass waste and tiles waste used in concrete made a sustainable product and reducing the depletion of normal resources.
- The result showed that the use tiles and glass waste as partial replacement of fine aggregate is a successful project.
- 15% of tiles waste mix shows the most compressive strength in 7 and 28 days.
- In tensile strength a slight difference in the strength of 15% and 20% mixes.

VIII. REFERENCE

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