ANALYSIS OF COMPRESSIVE STRENGTH OF CONCRETE PREPARED BY PARTIAL REPLACEMENT FINE AGGREGATE WITH WASTE GLASS

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Abstract – *The problem of the waste being produced which is not disposable in any way leaving behind the option of dumping is not the real solution of the problem. In the today scenario, the world is carrying out the research over the properties of the waste produced from industries with an aim of utilizing the valuable component of the waste which is produced so that its utilization could be done partially or fully used as secondary raw material in other industrial branches. With such aims and such utilization in the construction waste like steel or iron, cement, binder etc.*

We have been continuously facing problem with the broken glass from the window or other broken glass as the production of such item is far away from the area and disposing of them is difficult. Recycle option is also not suitable as due to cuts during the process of handling. The use of them in the development of the concrete could be an appropriate solution rather than dumping as a lot of stress is being put on the natural resources such as aggregates, binder.

Over the period of time concrete has being become essential part of the development of the country. We have been looking for the alternative products for the replacements of the ingredient with the industrial waste in such a way the optimum mix could be created.

Keywords*: concrete mix, waste glass, compressive strength, split tensile strength.*

1. INTRODUCTION

Sand is required to make glass. The formation of the glass is as it is made up of the mixture of silica sand which is also known as white sand and quartz sand in physical world, lime stone and soda ash in a definite proportion. These minerals are blended together and heated to molten at the temperature of between 1400-1600 °C. The resultant obtained is then cut and shaped by using different processes. The problem of waste glass is increasing day by day to counter it they have been used in developing concrete. The stress over natural resources is more as we have been a developing country and infrastructure development is the necessity of the modern world.

In the present time, we have been looking for the alternative to our natural resources and stressing on the utilization of the waste specially that which has dumping problem and whose property can be used as the replacement of one of the ingredient required for the manufacturing of the concrete. With this aim utilization of waste glass which is produced in the locally glass house, it is than powdered and replaced by the fine aggregate partial in the development of the concrete.

2. MATERIAL

The materials used for the preparation of the concrete can be broadly classified as base material, filler material, binders and admixtures with definite proportion taken by weight. The combination of the inert and reactive materials is used for this study. The individual materials used in this work are discussed with their properties and their result is discussed below:

2.1 Cement: Ordinary portland cement of 43 grade was used in this study which was provided by Ultratech Cements Ltd.

2.2 Aggregates: There are two types of aggregate being used for the experiment: Fine aggregate and course aggregate. The Fine aggregates used in this research are taken from nearby river tributary of Beas having max size of 4.75mm. Coarse aggregates used are of crushed stone from the nearby crusher such that the stone passing through 20mm IS sieve and retained on 4.75mm IS sieve.

2.3 Waste Glass Powder: Discarded material from the glass manufacturing process or from used consumer products made of glass were obtained from nearby glass manufacturing house were collected and brought to the lab. The waste obtained was then crushed in Los Angeles abrasion apparatus till we get powdered glass and ultimately sieved through 1.18mm IS sieve for further use. The x-rd of the sample was done and chemical composition of the powder is:

Sr no.	Oxide compounds	Marble Dust (Mass %)
1	SiO2	70.4
2	Al2O3	1.9
3	Fe203	1.2
4	MgO	10.3
5	Na_2O	14.0
6	K2O	0.4

Table 1: Chemical Properties of waste glass

2. Methodology

For the experiment a nominal mix of grade M20 is prepared with the appropriate proportion of the ingredient such as aggregate, cement, water, admixture, waste glass powder etc as per the norms. After that, partial replacement of the fine aggregate is done with the waste glass powder having varying percentage of 0, 5, 15, 25, 35 of weight of fine aggregate and mix is prepared. The compressive strength and split tensile strength of the sample is checked by performing various test in lab related to them. Cubes of size 150mmX150mmX150mm and cylinder of size 300 mm X 150 mm are casted to check the compressive strength and split tensile strength with normal curing.

In this experiment, the testing of concrete for workability, compressive strength and split tensile strength prepared by using partial replacement of the fine aggregate in the varying percentage of 0, 5, 15, 25, 35 % of the weight. The conclusion is discussed.

3. TESTING AND RESULTS

The nominal concrete mix was designed for M20 grade and the mix design was done. Mix design for concrete was done by taking the ingredient in a definite proportion by weight. Different concrete mixes with varying percentage of waste glass powder which was prepared in lab, replacing 0, 5, 15, 25, 35 % fine aggregate in terms of weight. Cubic specimens of 150 mm and cylinder size 300 mm X 150 mm were casted for compressive strength test as well as split tensile strength and tamping was done as per Indian standard. The cubes and cylinder were casted in stainless steel moulds and wet cured at standard temperature until the time of test. The cubes and cylinder were cured for 3 days, 7 days and 28 days.

3.1 VARIATION IN STRENGTH AT DIFFERENT REPLACEMENT LEVEL OF WASTE GLASS POWDER

Different concrete mixes with varying waste powder glass content percentage were produced, replacing 0, 5, 15, 25, 35 % fine aggregate in terms of weight. Cubic AND CYLINDER specimens of 150mm, 300X150mm size were casted for compressive strength test, split tensile strength and tamping was done as per Indian standard.

3.1.1 WORKABILITY

Slump test was carried out such that firstly without the replacement i.e. 0% or control mix was prepared. Secondly with the replacement of fine aggregates by waste glass powder with varying percentage as 5, 15, 25, 35 % whose result has been discussed below in the table

WASTE GLASS %	SLUMP VALUE
0	24
5	28
15	33
25	38
35	45

Table 2: Slump Value by replacing Fine Aggregates with Waste Glass Powder.

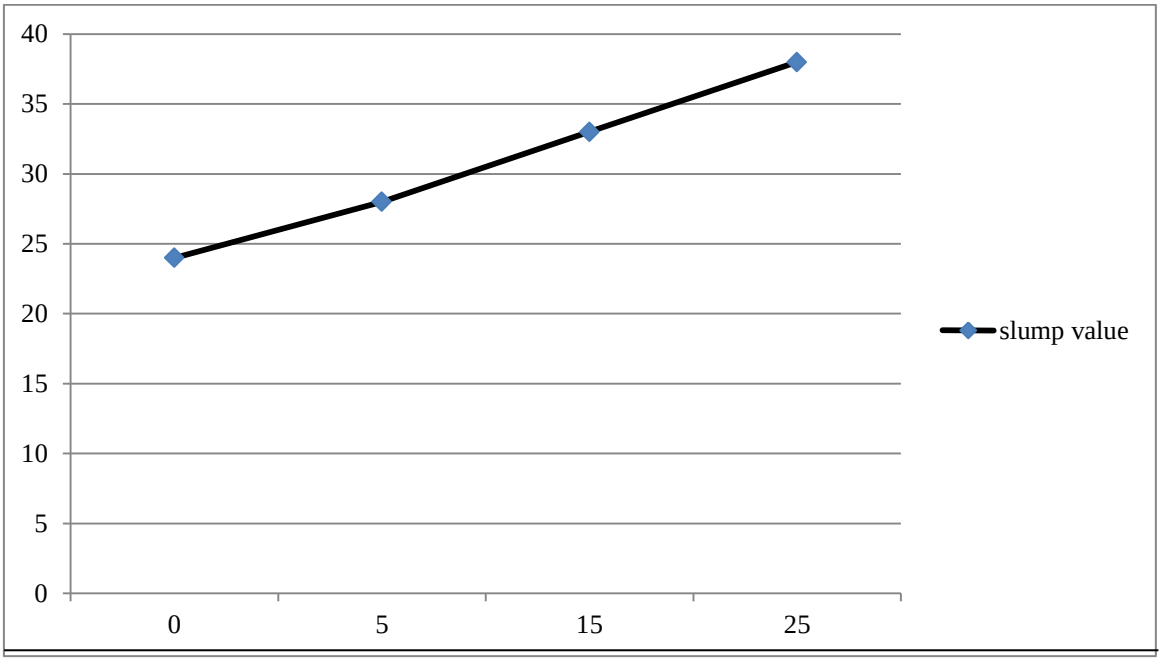

Fig 1: Variation of Slump value

3.1.2 COMPRESSIVE STRENGTH

Test specimens of size 150 *150* 150 mm were prepared for testing the compressive strength concrete. The concrete mixes with varying percentages (0%, 5%, 15%, 25%, and 35%) of Waste glass as partial replacement of aggregate were cast into cubes. The results are as follow:

Mix(%)	Compressive strength(N/mm²)		
	Average compressive strength after 7 days	Average compressive strength after 14 days	Average compressive strength after 28 days
0	21.04	25.31	27.11
5	23.62	28.17	30.76
15	24.37	30.52	32.63
25	26.01	31.34	34.01
35	22.11	27.27	29.14

Table 3: Compressive strength of cube

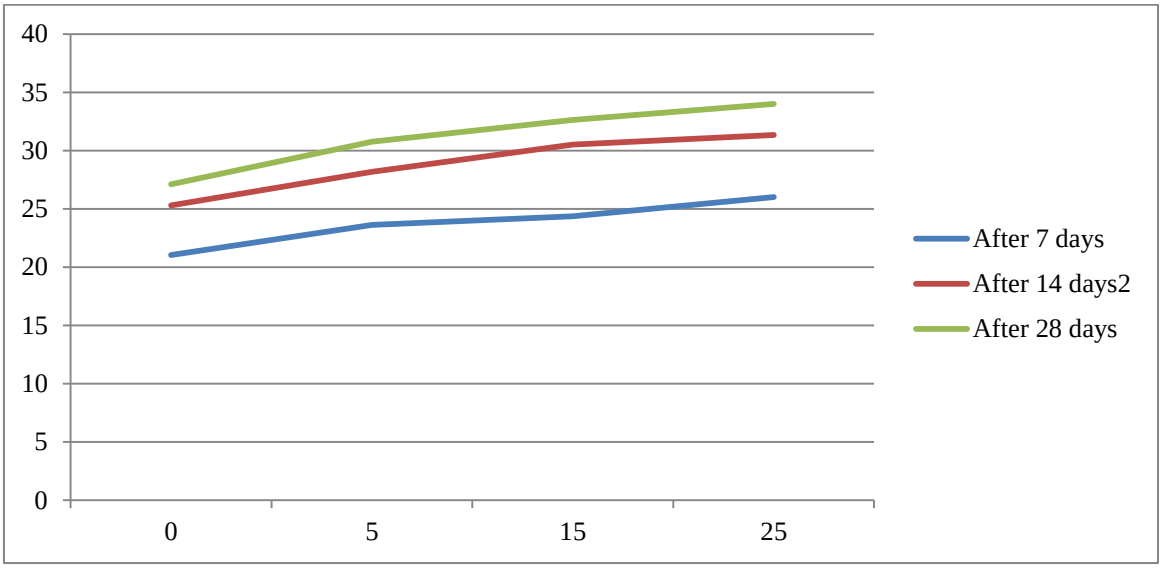

Fig 2: Variation of strength of cube according to days

3.1.3 SPLIT TESNILE STRENGTH

Test specimens of size 300 *150 mm were prepared for testing split tensile strength concrete. The concrete mixes with varying percentages (0%, 5%, 15%, 25%, and 35%) of Waste glass as partial replacement of aggregate were cast into cylinder. The average results obtained after 7, 14 and 28 days of curing whose results are shown in fig.

Mix (%)	Split tensile strength strength(N/mm²)		
	Average Split tensile strength after 7 days	Average Split tensile strength after 14 days	Average Split tensile strength after 28 days
0	2.09	2.29	2.59
5	2.06	2.25	2.56
15	2.04	2.17	2.40
25	1.94	2.03	2.27
35	1.77	1.84	2.03

Table 4: Split tensile strength strength (N/mm²)

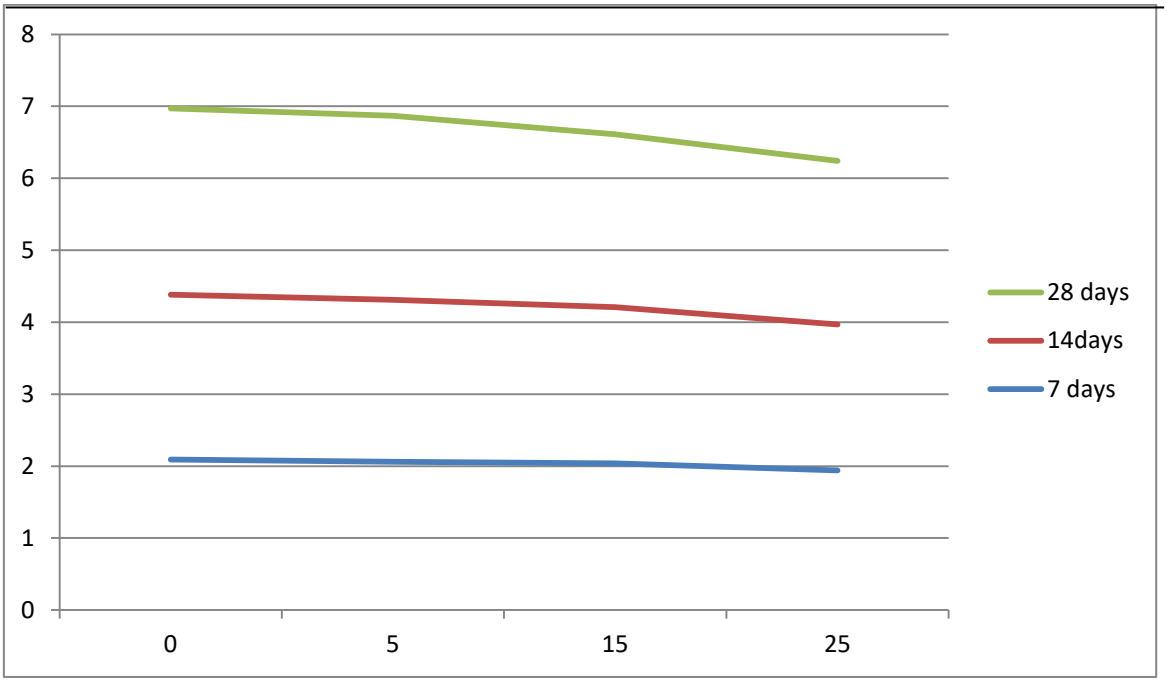

Fig 3: Comparison of of cylinder according to days

4. CONCLUSION

The strength and durability characteristics of concrete mixtures have been computed in the present work by replacing 0%, 5%, 15%, 25% and 35% waste glass with the fine aggregate. On the basis of present study, following conclusions are drawn

4.1 COMPRESSIVE STRENGTH

- There is 20% increase in compressive strength by replacing 25% of Fine Aggregates with Waste Glass Powder after 7, 14 and 28 days.
- Workability increases with increase in Waste Glass Powder due to less absorption of water by Glass.

4.2 SPLIT TENSILE STRENGTH

- 10% increase in Split Tensile Strength after 7 and 14 days and 5% increase in split tensile strength after 28 days.
- The optimum strength of cylinder is gain at 10% replacement for all 14 and 28 days respectively.
- Use of waste glass in appropriate percentage in concrete results in improvement in strength of concrete.

4.3 SCOPE FOR FUTHER WORK

- In the present study only up to 35 per cent replacement of cement by Waste glass has been considered.
- The other percentages i.e. 50, 75 and 100 per cent need investigation.
- In the present study only 0.55w/c ratio has been considered. The other ratios i.e. 0.45 and 0.50 need investigation

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