

WASTE GLASS POWDER AS A PARTIAL REPLACEMENT OF CEMENT FOR SUSTAINABLE CONCRETE PRACTICE

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Abstract – In industry, as well as in cities, a large amount of solid waste is produced, some of which is partially recycled or is disposed of in its entirety in landfills, thereby generating negative environmental effects. Of this waste industrial waste glass from numerous application sources is a major source of pollution because only an estimated 30% is reused globally. In the search for an alternative outcome for waste, various applications have arisen, some of which are related to the construction sector. This research study concerns the use of waste from glass bottles, fluorescent lamps and soda lime window glass, used in its entirety as a raw material in the manufacture of tiles by applying the technique of alkaline activation to generate an alkaline cementitious material is enabled by the high content of silica in the glassy state.

Key Words: waste glass powder, waste flat window, waste lamp glass.

1. INTRODUCTION

Concrete is a very popular material, but new tendencies are heading toward nature and environmental friendly material. That is why it is the appropriate time to think about improving concrete in an ecological way.

Glass is a material that is used in many applications, including in the construction industry. A huge amount of waste glass is produced all over the world. It is necessary to store the waste glass somewhere, but waste glass already consumes a large part of our land.

1.1 Material Required

1. Cement : The cement used for this experiment Ordinary Portland Cement of Grade 43. It has conformed to the requirements of Indian standard specification.

2. Coarse aggregate : Crushed stone of maximum size 20 mm was used as coarse aggregate.

3. Fine aggregate : Natural river sand of maximum size 4.75 mm was used as fine aggregate.

4. Waste glass powder : Glass is a non-crystalline material that in a super cooled liquid and not a solid. Glass is made by the melting together of several minerals at very high temperature. Primarily glass is made up of several elements such as sodium oxide, calcium oxide, potassium oxide. Glass can also be used as aggregate in construction of road and building.

5. Source of Waste Glass: Glass packaging of food and beverages containers. Window shops. Glass decorative items. Waste tube lights, electric bulbs. Glass polishing and glass window and door manufacturing shop

1.2 Methodology

1 Preparation of Glass Powder : The entire glass sample collected is broken into pieces and then it is crushed so that it can be fine and then fine glass powder is passed through the 90 micron sieve.

2 Casting of Specimen: There were six types of mix considered; of which one control mixture (without glass powder) was designed according to Indian Standard Specification to achieve 7 days strength 16.67 MPa and for 28 days strength 25 MPa. The other five concrete mixes were made by replacing the cement with 5%, 10%, 15%, 20% and 25% of glass powder by weight.

3 Procedure: The control mix was M25 designed according to the design mix in the IS: 10262(1982). For all other mixes the proportions of sand, water and aggregates remained constant and various proportions of cement were replaced by glass powder. All replacement was carried out by weight. Normal tap water was used for casting and curing. The test specimen was cast in steel moulds of standard dimensions i.e. 150X150X150 mm and is vibrated. All specimens were removed from moulds after 24 hours. Tests were carried out for compressive strength.

4 Experimental Setup: The waste glass is collected from various places such as construction sites, industries, then it

is crushed to a size fine enough to achieve its pozzolanic behaviour. Cement is now partially replaced by its weight by glass powder at varying amount such as 5%, 10% ,15%, 20% and 25%. Now 3 cubes such as two specimens for each combination – is to be casted for the whole and cured at room temperature. At the end of curing period, each specimen is tested for compressive strength and the average is recorded

2. RESULT

The compressive strength test results for the M25 grade concrete is given below-:

Table 1: compressive strength at 7 days

SR. NO.	Percentage of glass as a partial replacement of cement	Age of cube (days)	Load (KN)	Compressive strength (N/mm.sq.)
1	5%	7	400	17.77
2	10%	7	390	17.33
3	15%	7	320	14.22
4	20%	7	330	14.66
5	25%	7	270	12

Table 2 : compressive strength at 28 days

SR. NO.	Percentage of glass as a partial replacement of cement	Age of cube (days)	Load (KN)	Compressive strength (N/mm.sq.)
1	5%	28	600	26.66
2	10%	28	570	25.33
3	15%	28	520	23.11
4	20%	28	640	28.44
5	25%	28	530	23.55

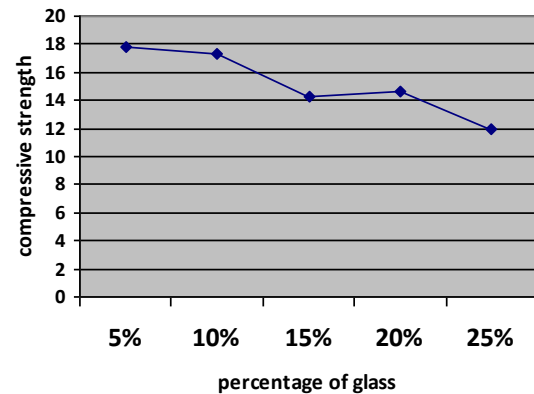


Chart -1: compressive strength graph for 7 days

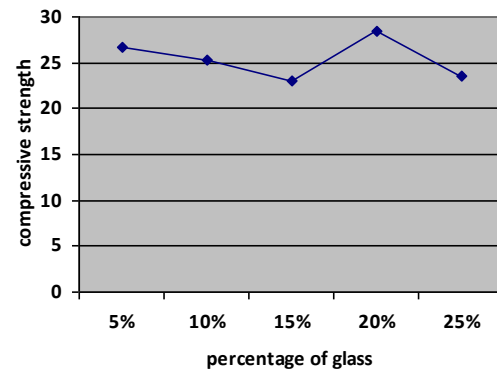


Chart -2: compressive strength graph of 28 days

3. CONCLUSIONS

- Compressive strength increases with increase in percentage of glass powder upto 10% replacement and beyond 10% strength decreases in 7 days .
- Compressive strength increases with increase in percentage of glass powder at 20% replacement and beyond 20% strength decreases in 28 days .
- Considering the strength criteria, the replacement of cement by glass powder is feasible. Therefore we can conclude that the utilization of waste glass powder in concrete as cement replacement is possible.
- Very finely glass powder has been shown to be excellent filler and may have sufficient pozzolonic properties to serve as partial cement replacement.

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