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Study the Strength of Concrete Made Using Glass Powder as Partial Replacement of Cement

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Abstract – **Climate change or global warming is caused by emission of green house gases such as carbon dioxide, methane, ozone, water vapor to the atmosphere among them carbon dioxide play important role to enhance the global warning about 65% .The world wide cement industry contributes about 7% of green house gas emission to environment. Keeping in mind to address ecological impacts related with cement manufacturing there is a need to create alternative binding material for concrete therefore broad research is on going in to the utilization of cement replacement utilizing many waste materials. Efforts have been made in concrete to utilize waste glass as partial replacement of coarse, fine aggregate and cement. In present study glass powder is used as a partial replacement of cement in concrete and compared with conventional concrete. To accomplish cement is replaced by glass powder from 0 to 30% at an interval of 10 and tested for its compressive strength. Results show the compressive strength increases at 10% replacement of cement with glass powder.**

Keywords: **Compressive strength, fine aggregate, coarse aggregate, glass powder replacement, concrete.**

I. INTRODUCTION

The construction community interested in using waste or recycled materials in concrete because of the emphasis placed on sustainable construction, it may be of various type like stone dust, fly ash, silica flume, rice husk, glass powder, marble powder, etc. The wastes toughen glass from in and around the small shops are packed as a waste and disposed as landfill. Glass is an inert material which could be recycled and used many times without changing its chemical property(Aimin Xu and Ahmad shayam,2004) Glass is unformed material with high silica content, thus making it potentially pozzolanic when particle size is less than 75µm. Studies have shown that finely ground glass does not contribute to alkali – silica reaction. In the recent, various efforts and research have been made to use ground glass as a replacement in conventional constituents in concrete production as a part of green house management.

II. MATERIALS AND METHODS

1 Cement: Birla Gold brand name Portland Pozzolana Cement (fly ash based) confirming to IS 1489 (Part 1) – 1991 single batched used in this investigation. The properties are shown in table 1.

Table 1: Properties of Cement

Standard Consistency	31%
Initial Setting Time	240 minutes
Final Setting Time	315 minutes
7 days Compressive Strength	33 N/mm^2
28 days Compressive Strength	44 N/mm^2
Specific Gravity	2.72

2. Fine Aggregate: River sand available in Allahabad confirming to IS 383-1997, zone II used in this study. Fineness modulus and specific gravity of this material was 2.76 and 2.3 respectively.

3. Coarse Aggregate: Locally available coarse aggregate having two fraction 20mm and 10mm sizes individually sieved was used in the study. One fraction was passed through 20 mm sieve and another through 10 mm sieve. The specific gravity of coarse aggregate was 2.66 for both fractions. Fineness modulus was 6.9 for 10 mm aggregate and 7.7 for 20 mm aggregate. For concrete mix a proportion of 40:60 of coarse aggregate was used where 40% 10 mm aggregate and 60% 20 mm aggregate.

4. Glass powder: Locally available waste glass in Allahabad is been collected and made into glass powder. Before adding glass powder in the concrete it has to be powdered in desired size. In this studies glass powder ground in ball/pulverizer for a period of 30 to 50 minutes resulted in particle sizes less than 150 µm and sieved in 75 µm. The specific gravity is 2.65 and fineness passing through 150 µm is 99.8 percent.

5. Super plasticizer: KEM SUPLAST 101 S super plasticizer manufactured by Chembond Chemicals was to be used in the study. It was synthetic super plasticizer based on sulphonated naphthalene and instantly dispersible in water having specific gravity 1.2.

M25 grade of concrete is used as bench mark which was designed as per IS 10262 – 2009 guidelines. The proportion of materials was 1:1.54:3 with water cement ratio 0.42 and dose of super plasticizer was 0.6% by weight of cement. The coarse aggregate used in a combination of 40:60 individually sieved with IS sieve size 10 mm and 20 mm respectively. Total 42 specimen of size 150 X 150 X 150 mm were casted for this investigation. Initially 18 cubes of size 150 mm were

casted for mix design calculation contained 380 kg cement per cubic meter of concrete with varying water cement ratios. Then 24 specimen of same size casted for replacement of glass power with cement at different percentage. For a percentage replacement 6 cubes were casted, 3 for 7 days and 3 for 28 days strength calculation. The cube was filled in two parts with manually mix mixture and vibrated on a table vibrator. Workability of fresh concrete was measured by slump cone. Uniformity and accuracy was maintained during mix preparation and test. After 24 hours of casting specimens were demoulded and put in water bath for curing. The compressive strength of concrete for 7th days and 28th days were tested on analogue compression testing machine confirm to IS 14858 – 2000 of capacity 2000kN. The compression testing machine with a tested specimen shown in figure.1.

Fig. 1: Compression Testing Machine.

III. RESULT AND DISCUSSION

The average compressive strength of concrete for 7th days and 28th days were tested as per IS 516 – 2004 guidelines and results are tabulated in table 2 and its graphical representation on figure 2. It was observed that the compressive strength of specimen at all replacement level of glass powder with cement was more than designed value. The 7 days strength variations within 17.3 percent throughout the replacement level and maximum strength attains at 10 percent replacement of glass powder with cement. The 28 days strength initially increased from 0 to 10 percent and then gradually decreases. The increment of strength at 10 percent replacement is 8 percent which is slightly more than referral value. The variation in compressive strength may be due to different dose of super plasticizer, different angularity of particles, pozzolanic behavior of glass powder etc. Finally it can be stated that the glass powder is to be used in concrete with partially replacement of cement.

Table 2: Compressive Strength of Concrete

Concrete Cube Group Designation	% of Glass powder in Concrete	Compressive Strength (N/mm^2)	
		7 days	28 days
B0	0	27.12	38.58
B1	10	31.8	41.5
B2	20	27.2	39
B3	30	27.56	38.68

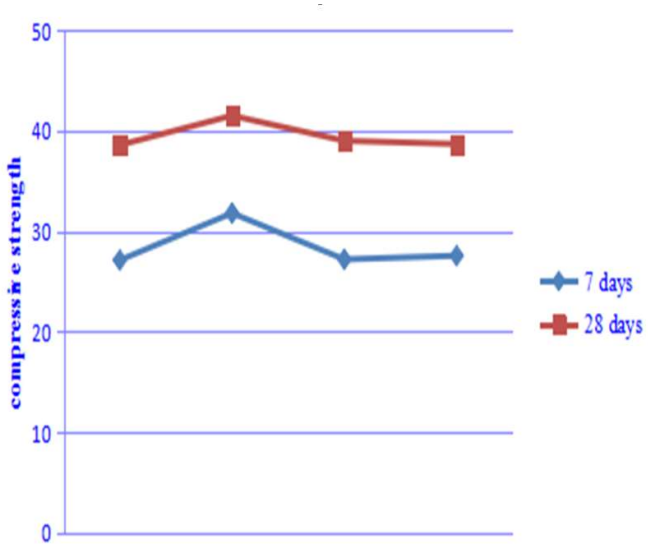

Figure 2: Compressive Strength of Concrete.

IV. CONCLUSION

On the basis of the study it can be concluded that –

- Glass powder is to be used in place of cement as partially in concrete.
- The use of glass powder in concrete is beneficial in environmental aspects.
- The maximum compressive strength of concrete with glass powder as cement replacement attains at 10 percent replacement level.

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