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# INFLUENCE OF WASTE GLASS ON PROPERTIES OF CONCRETE

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**Abstract**
concern concerning environmental problems and a modification over from the mass-waste, mass consumption, mass-production society of the past to a zero-emanation society is currently viewed as important. Glass is an amorphous solid that may well be recycled and used again and again while not dynamical its property. Many attempts have been made by various researchers to utilize waste glass as coarse aggregates, fine aggregates or as a partial replacement of cement with variation in particle size having different proportions and in various types of concretes.
Normally glass does not harm the environment in any way because it does not give off pollutants, but it can harm humans as well as animals, if does not dealt carefully and it is less friendly to environment because it is non-biodegradable. Thus, the development of new technologies has been required. Many efforts have been made to use waste glass in concrete industry as a replacement of coarse aggregate, fine aggregate and cement. Incorporating waste materials in concrete has been demonstrated to be an effective way to increase the sustainability of structures and infrastructures. This work examines the possibility of using Glass powder as a partial replacement of cement for new concrete.
**Keywords:** Glass power, cement, compressive strength.

## 1. Introduction

Numerous waste materials are generated from manufacturing processes, service industries and municipal solid wastes. The increasing awareness about the environment has tremendously contributed to the concerns related with disposal of the generated wastes. Solid waste management is one of the major environmental concerns in the world. With the scarcity of space for land filling and due to its ever increasing cost, waste utilization has become an attractive alternative to disposal. Research is being carried out on the utilization of waste products in concrete as a replacement of natural sand. Such waste products include discarded tires, plastic, glass, burnt foundry sand, and coal combustion by-products (CCBs). Each of these waste products has provided a specific effect on the properties of fresh and hardened concrete. The use of waste products in concrete not only makes it economical, but also helps in reducing disposal problems. Reuse of bulky wastes is considered the best environmental alternative for solving the problem of disposal.

The interest of construction community in using waste or recycled materials in

concrete is increasing because of the emphasis placed on sustainable construction. Presently the waste glass in and around the small shops is packed as a waste and disposed as landfill.

Glass is amorphous 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 attempts and research have been made to use ground glass as a replacement in conventional ingredients in concrete production as a part of greenhouse management [1].

A major concern regarding the use of glass in concrete is the chemical reaction that take space between the silica – rich glass particle and the alkali in pore solution of concrete, which is called Alkali – Silicate reaction can be very detrimental to the stability of concrete, unless appropriate precautions are taken to minimize its effects. ASR can be prevented or reduced by adding mineral admixtures in the concrete mixture, common mineral admixtures used to minimize ASR are pulverized fuel ash (PFA), silica fume(SF) and met kaolin (MK) [2] [4]

**Objective and scope of work:**

Experiments were conducted on concrete prepared by partial replacement of cement by waste glass powder of particle size 600 micron and downwards. The main objective of this work was to evaluate the effect of waste glass powder on the compressive strength and the other properties of concrete and to evaluate the possibility of using glass powder in concrete without sacrificing the strength.

The ultimate aim of this work was to ascertain the performance of concretes containing glass powder and compare it with the performance of conventional concretes.

- To investigate the structural behaviour of such replaced concrete components
- To determine the percentage of glass powder which gives maximum strength when compared to control concrete.
- To study the compressive strength of concrete using waste glass powder as partial replacement for cement.
- To study the workability of concrete using waste glass powder as partial replacement for cement.

## 2. Methodology

### 2.1 Properties of glass:

Basically waste glass powders are made from the waste glass material that cannot be reused due to the high cost of manufacturing. Therefore the manufacture will disposed it in the waste landfill. Due to environmental problem, researcher tries to use the waste glass in to concrete, to create a new material to use in construction field. Earlier studies found that, the main material composition of glass is silica that also contain in cement production and other compound that also similarly contain in cement production.

## 3. Result and Discussion

### 3.1 Properties of cement

The cement used for experimental purpose

is ordinary Portland cement (OPC). The OPC of 43 grade (Ultratech OPC) confirming to IS: 8112 - 1989 is used. The cement is in dry powdery form with the good quality chemical compositions and physical characteristics. Many test were conducted on cement, some of them are specific gravity, compressive strength.

Table 1: Physical Properties Of Cement (Source: IS: 10262-2000)

| S.NO | PROPERTY | VALUES |
|---|---|---|
| 1. | Specific gravity | 3.13 |
| 2. | Fineness | 4% |
| 3. | Standard Consistency | 31% |
| 4. | Initial setting Time | 55 minutes |
| 5. | Final setting Time | 260 minutes |
| 6. | Compressive Strength | 54 MPa |

Table 2 : Chemical Properties Of Cement And Glass Powder {Source : IS:10262-2000)

| COMPOSITION(% BY MASS) | CEMENT | GLASS POWDER |
|---|---|---|
| Silica | 17-25% | 50-80% |
| Alumina | 3-8% | 1-10% |
| Iron oxide | 0.5-6% | <1% |
| Calcium oxide | 60-67% | 5-15% |
| Magnesiun oxide | 0.1-4% | <1.5% |
| Sodium oxide | 0.5-1.3% | 1-15% |
| Potassium oxide | 1-3% | <1% |

### 3.2 Mix design

A reference concrete mix was selected with water-to-cement ratio of 0.458. Glass powder was used as cement substitute at replacement level of 5%, 10%, 15% and 20%, respectively. The Indian Code IS10262 [3] recommended a mix design procedure for concrete without chemical and mineral admixtures however no mix proportioning procedure is available for the glass powder concrete for the typical Indian concrete making materials and ix proportioning of glass powder concrete is generally carried out by trial and error . Extensive research has been carried out to arrive at a proper method of proportioning the glass powder concrete mixes and to study the effect of glass powder addition on the properties of concrete [6].

According to IS: 10262-2000 the water cement ratio of glass powder ratio for concrete was calculated. This factor depends on the curing period, strength of mix.

### 3.3 Compression test on specimen

All the cast specimens were de-moulded after 24 hours and were placed in curing tank for a period of 7 to 28 days. The specimens were tested in the compression testing machine of 200 tonne capacity. Three numbers of specimens in each were tested and the average value was calculated. The results were compared with that of control mix. The compressive strength of concrete is given in terms of the characteristic compressive strength of 150 mm size cubes tested at 28 days (fck) - as per Indian Standards (ACI standards use cylinder of diameter 150 mm and height 300 mm). The characteristic strength is defined as the strength of the concrete below which not more than 5%

of the test results are expected to fall.

Characteristic strength of concrete is the strength of concrete specimens casted and tested as per given code of practice and cured for a period of 28 days; 95% of tested cubes should not have a value less than this value.

Table 3: Details of mix proportion

| Glass powder | Cement ($kg/m^3$) | Fine aggregate ($kg/m^3$) | Coarse aggregate ($kg/m^3$) | Water content ($kg/m^3$) |
|---|---|---|---|---|
| 0 | 350.00 | 740.74 | 1234.56 | 188.00 |
| 5 | 332.49 | 680.49 | 1159.01 | 188.00 |
| 10 | 314.96 | 669.13 | 1139.25 | 188.00 |
| 15 | 297.48 | 655.30 | 1116.04 | 188.00 |
| 20 | 280.00 | 641.97 | 1093.33 | 188.00 |
| 25 | 265.56 | 637.24 | 1086.78 | 188.00 |

From the experimental investigations it was found that the partial replacement of fine aggregate with waste glass powder yields more compressive strength, when compared to the partial replacement of Coarse aggregate, because the glass powder has more tendency to fill the voids in concrete more effectively, where as in the case of coarse aggregate it doesn't happened. The maximum compressive strength of our concrete cubes was found at 20% of waste glass powder. Hence it is evident that we obtain more compressive stress at 20% replacement. So, incorporating 20% of waste glass powder to partially replace the fine aggregate in concrete yields ideal results.

### 3.4 Compressive strength after 7 days

It is found from above result that addition of GLP increase the 7th day strength of all samples. It is seen from above result that GLP is taking small part in early strength gain in concrete. Also it is observed that mixture containing cement replacement by 25% GLP get higher strength to that of 15% & 20% replacement.

Table 4: Compressive strength after 7 days

| Sample | Average compressive Strength at 7 days |
|---|---|
| Control sample | 19 |
| 0% w/w waste glass powder | 19 |
| 5% w/w waste glass powder | 20 |
| 0% w/w waste glass powder | 20 |

### 3.5 Compressive strength after 14 days

It is found that above result represents normal concrete of M25 grade. Table shows the 14 days compressive strength. For this three samples cube were taken and the average compressive strength is found to be 21.93 N/mm2.

Table 5. compressive strength after 14 days

| Sample | Average compressive Strength at 14 days |
|---|---|
| Control sample | 26 |
| 0% w/w waste glass powder | 22 |
| 5% w/w waste glass powder | 23 |
| 0% w/w waste glass powder | 29 |

### 3.6 Compressive strength after 28 days

It is found that above result represents normal concrete of M25 grade. Table shows the strength on 28thday. The average compressive strength is found to be 42.82 N/mm2.

Table 6. compressive strength after 28 days

| Sample | Average compressive Strength at 28 days |
|---|---|
| Control sample | 33 |
| /w waste glass powder | 25 |
| /w waste glass powder | 29 |
| /w waste glass powder | 32 |

## 4. Conclusion

Concrete with using waste glass powder has a very high workability from control sample. The result achieved from the slump test that the use of waste glass powder would increase the workability of concrete. In term of strength, concrete with using waste glass powder averagely have higher strength at 14 days but once the concrete reached at 28 days the control mix give more higher value compare to mix that contained waste glass powder but still give high value of the grade 30. Using waste glass powder is giving positive value even though the value compare to standard mix and it was just less about $1N/mm^2$ [5]. Concrete become lighter when mix with waste glass powder. The average cube density of concrete with using more percentages of waste glass powder averagely gives lowest value compared to control sample. Therefore, concrete mix that using glass powder is giving lightweight concrete .We have chosen this topic because of most developing country facing shortage of post consumer's disposal waste site and it's become very serious problems. For this reason, regenerating and using waste product as resources and prevent environmental pollutions.

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