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Partial Replacement Of Fine Aggregate By Using Glass Powder

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Abstract:

Glass waste creates chronic environmental problems, mainly due to the inconsistency of waste glass streams. Glass is widely used in our lives through manufactured products such as sheet glass, bottles, glassware, and vacuum tubing. Glass is an ideal material for recycling. The use of recycled glass helps in energy saving. The increasing awareness of glass recycling speeds up inspections on the use of waste glasswith different forms in various fields. One of its significant contributions is to the construction field where the waste glass was reused for concrete production. The properties of concretes glass dust waste as fine aggregate were investigated in this study. Glass dust waste was used as a partial replacement for sand at 10%, 20% and 30% of concrete mixes. Compression strength for 7, 14 and 28 days concrete of age were compared with those of concrete made with natural fine aggregates. The results proved that highest strength activity given by glass dust waste after 28 days.

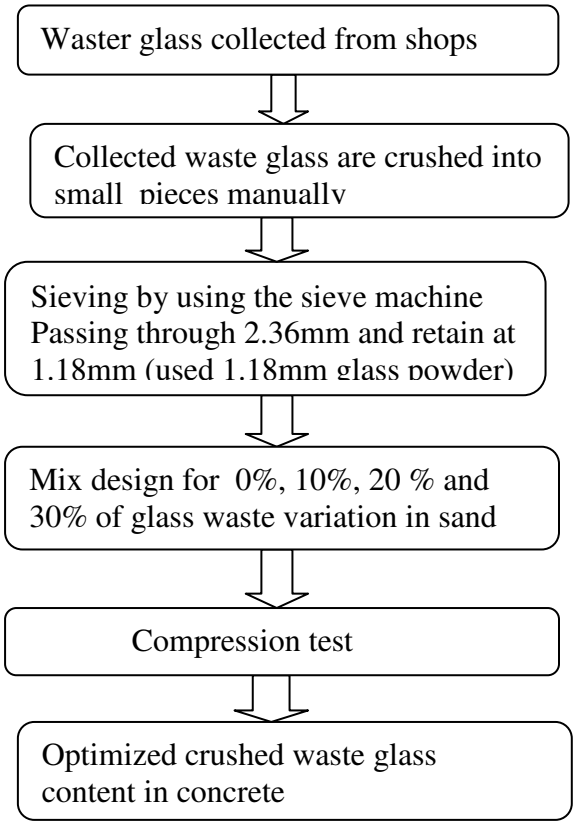
Keywords- **Glasscrete, cube casting , compressive strength testing.**

INTRODUCTION

Nowadays, many recycling company realize that they gain little or even have a loss of income by processing glass. The general process recycling included of collecting, sorting, transporting,beneficiating, and manufacturing glass back into bottles, is the most common form of glass recycling and has costs embedded in each step of the process . Glass is produced in many forms,including packaging or container glass, flat glass, bulb glass, and cathode ray tube glass. All of each type of glass have a limited life in the form in which they are produced and need to be reused in order to avoid environmental problems .The plain glass dust waste can be recycled, but it is costly to remove the colour of coloured glasses and recycle again . The glass waste was collected from shops with type bottles. Cathode ray tube glass (TV screens, monitors, etc.) was not used in this study due to concern about hazardous metals content. Glass containers compositions from abundant raw materials are sand, soda ash, limestone and cullet. The proportion of raw materials is based on availability, chemical and physical consistency, sizing, purity and cost. The goal is to use the most economical and high quality raw materials available. Glass containers are commonly made with a combination of various oxides or oxygenbased compounds and are commonly referred to as “Soda-Lime” glass. The combining of raw materials creates glass containers that are durable, strong, impermeable, easily shaped, and inexpensive.

Some oxides will form glass without adding any other elements and are known as network formers. The most common of these is silica (SiO^2). The land filling of waste glasses is undesirable because they are not biodegradable, which makes them environmentally less friendly. There is huge potential for using waste glass in the concrete construction sector. When waste glasses are reused in making concrete products, the production cost of concrete will go down .Glass concrete products can be categorized as commodity products and value-added products. For simple commodity products, the primary objective is to utilize as much waste glass as possible. This research has been conducted to identify the suitable composition of glass dust waste as fine aggregate replacement material in concrete and also to study the compressive strength of concrete.

1. **METHODOLOGY**



2. MATERIALS:-

CEMENT: A cement is a binder, a substance used for construction that sets, hardens and adheres to other materials, binding them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement is used with fine aggregate to produce mortar for masonry, or with sand and gravel aggregates to produce concrete. Cements used in construction are usually inorganic, often lime or calcium silicate based, and can be characterized as being either hydraulic or non-hydraulic, depending upon the ability of the cement to set in the presence of water (see hydraulic and non-hydraulic lime plaster).

Non-hydraulic cement will not set in wet conditions or underwater; rather, it sets as it dries and reacts with carbon dioxide in the air. It is resistant to attack by chemicals after setting.

Hydraulic cements (e.g., Portland cement) set and become adhesive due to a chemical reaction between the dry ingredients and water. The chemical reaction results in mineral hydrates that are not very water-soluble and so are quite durable in water and safe from chemical attack. This allows setting in wet condition or underwater and further protects the hardened material from chemical attack. The chemical process for hydraulic cement found by ancient Romans used volcanic ash (pozzolana) with added lime (calcium oxide).

The word "cement" can be traced back to the Roman term opus caementicium, used to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder. The volcanic ash and pulverized brick supplements that were added to the burnt lime, to obtain a hydraulic binder, were later referred to as cementum, cimentum, cäment, and cement. In modern times, organic polymers are sometimes used as cements in concrete.

Coarse Aggregate: Those particles that are predominantly retained on the 4.75 mm (No. 4) sieve and will pass through 3-inch screen, are called coarse aggregate. The coarser the aggregate, the more economical the mix. Larger pieces offer less surface area of the particles than an equivalent volume of small pieces. Use of the largest permissible maximum size of coarse aggregate permits a reduction in cement and water requirements. Using aggregates larger than the maximum size of coarse aggregates permitted can result in interlock and form arches or obstructions within a concrete form. That allows the area below to become a void, or at best, to become filled with finer particles of sand and cement only and results in a weakened area.. Construction aggregate, or simply "aggregate", is a broad category of coarse to medium grained particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. Aggregates are the most mined materials in the world. Aggregates are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material.

Sieve analysis of 20 mm coarse aggregates

Sieve size (mm)	% Passing by Weight	Indian Standard Specifications
19.5 mm	100	100
12.5mm	93.4	90-100
9.5 mm	67.1	40-70
4.75mm	9.38	0-15
2.36 mm	0.62	0-5

Fig.2 Coarse aggregates

Fine Aggregate: Those particles passing the 9.5 mm (3/8 in.) sieve, almost entirely passing the 4.75 mm (No. 4) sieve, and predominantly retained on the 75 µm (No. 200) sieve are called fine aggregate. For increased workability and for economy as reflected byuse of less cement, the fine aggregate should have a rounded shape. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.

Sieve analysis of fine aggregate:

.Sieve size (mm)	% Passing by Weight	Indian Standard Specifications
4.75	98.56	95-100
2.36	91.31	80-100
1.18	62.15	50-85
0.60	33.12	25-60
0.30	8.6	5-30
0.15	0.85	0-10
Fineness modulus =3.05		

Glass aggregates : Glass is an amorphous (non-crystalline) that inessence, a super cooled liquid and not a solid.Glass can be made with excellent homogeneity in a variety of forms and sizes from small fibersto meter-sizes pieces.Primarily glass is made up of sand, soda ash, limestone and other additives (Iron, Chromium,Alumina, Lead and Cobalt).Glass has been used asaggregates in construction of road, building and masonry materials.

Source of Glass

- Sand is filtered through three different size screens having three different sizes.
- The finest sand makes the finest glass the largest sand makes the strongest glass.
- Sand is melted in crucible to make glass.

Source of Waste Glass:

- Glass food and beverages container.
- Window repair shops
- Glass decorative items
- Old tube lights, electric bulbs
- Glass polishing and glass window and door manufacturing shop.

Sieve size (mm)	Mass Retained (gms)	% Retained	% Passing	Cumulative %age Retained	Indian Standard Specifications
4.75	0	0	100	0	95-100
2.36	1.7	0.17	99.83	0.17	80-100
1.18	357.7	35.77	64.04	35.94	50-85
0.60	230.9	23.09	40.97	59.03	25-60
0.30	200.2	20.02	20.95	79.05	5-30
0.15	113.2	11.32	9.63	90.37	0-10
Pan	96.3	9.63	0	0	0
Fineness Modulus of glass aggregate = ΣF/100 = 264.56/100 = 2.64			264.56		

Grading of waste glass:

Fig:5 . Glass (1.18mm)

Water: The Water used for concrete mix for this experiment was taken from pipe in the laboratory of concrete technology in NAGPUR INSTITUTE OF TECHNOLOGY ,NAGPUR. The water was ensured to be clean and free from impurities or reactive agent .

3. Experimental investigations Mix design

Mix proportioning for a concrete of M25 is as follows:

1. Stipulation for proportion

a. Grade designation : M 25
b. Type of cement : OPC 43 grade conforming to IS 8112
c. Maximum nominal size of aggregate : 20 mm
d. Minimum cement content : 320 kg/m³
e. Maximum water-cement ratio : 0.55
f. Workability (slump) : 100 mm
g. Exposure condition : Severe (for reinforced concrete)
h. Method of concrete placing : Pumping
i. Degree of supervision : Good
j. Type of aggregate : Crushed angular aggregate
k. Maximum cement content : 450 kg/m³
l. Chemical admixture : Super plasticizer

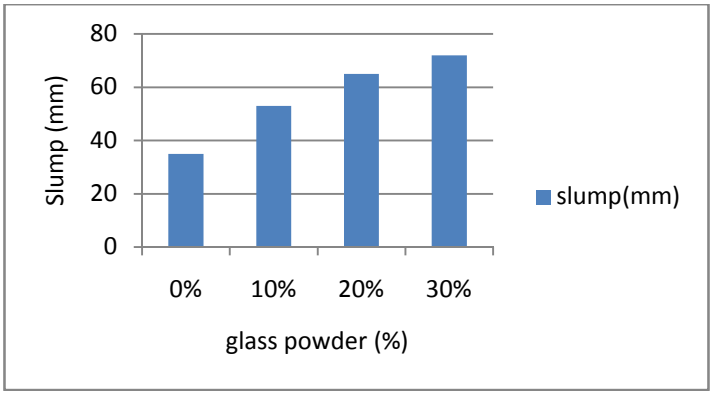
4.. Experimental procedure:

Glass dust waste was used in mixture proportioning of the raw materials in concrete. Collected wastes glass are crushed into small pieces manually, then the sieve machine was used to make the graded below 2.36 mm. The procedure of making glass dust waste concrete. Ordinary Portland cement (OPC) was used in this project. available river sand. The coarse aggregate is a normal weight aggregate with a maximum size of 12.5 mm. Concrete grade 25 was selected with proportion mix cement: sand: coarse 1:2:4 by volume. The sand was replaced with 10%, 20% and 30% glass dust waste. Concrete mixes were cured for 7 days, 14 days and 28 days. This project start with 36 cubes concrete with size 150 mm x 150 mm x 150 mm and each were cast in accordance to relevant standard. The maximum free water cement ratio use is 0.55-0.6.

5.Results And Discussion:

I. Slump cone test:

SR NO.	% replacement of glass powder(%)	Slump for M25 grade concrete(mm)
1.	0%	35
2.	10%	53
3.	20%	65
4.	30%	72



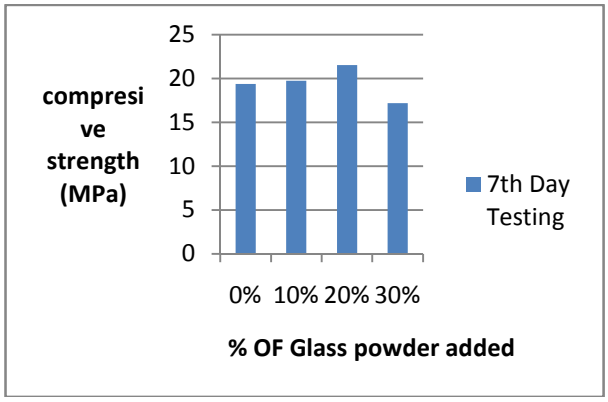
2 COMPRESSIVE STRENGTH OF CONCRETE:

1. 7th Day COMPRESSIVE STRENGTH OF CONCRETE.

Compresive strength of concrete for M25 grade of

Sr no.	%replacement	Specimen 1	Specimen 2	Specimen 3	Average compressive strength(MPa)
1.	0%	19.20	19.50	19.45	19.38
2.	10%	19.65	19.80	19.75	19.73
3.	20%	21.30	21.63	21.55	21.49
4.	30%	17.08	17.18	17.20	17.15

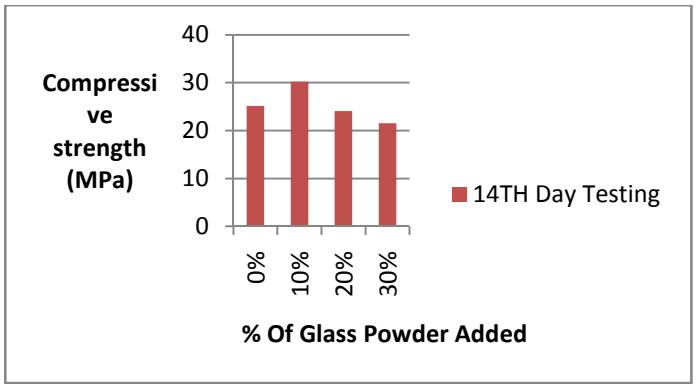
7th Day COMPRESSIVE STRENGTH OF CONCRETE
(Graphically represented)



2. 14th Day COMPRESSIVE STRENGTH OF CONCRETE.

Compresive strength of concrete for M25 grade

Sr no.	%replacement	Specimen 1	Specimen 2	Specimen 3	Average compressive strength(MPa)
1.	0%	25.15	25.12	25.14	25.13
2.	10%	30.10	30.05	30.23	30.12
3.	20%	24.15	24.00	24.05	24.06
4.	30%	21.20	21.35	21.55	21.36

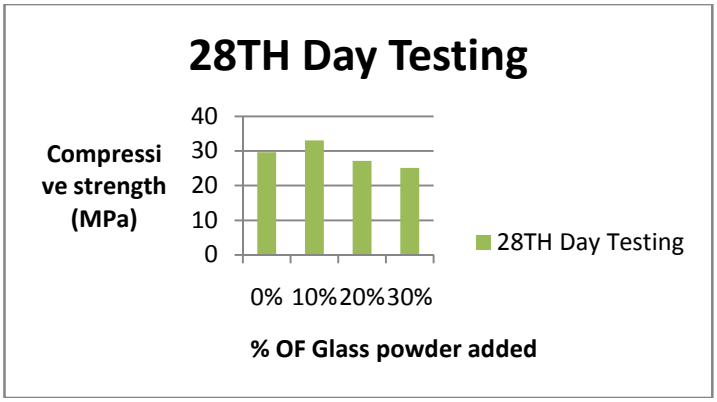


14th Day COMPRESSIVE STRENGTH OF CONCRETE
(Graphically represented)

28th Day COMPRESSIVE STRENGTH O CONCRETE.

Compresive strength of concrete for M25 grade

Sr no.	%replacement	Specimen 1	Specimen 2	Specimen 3	Average compressive strength(MPa)
1.	0%	30.00	29.50	29.56	29.68
2.	10%	32.90	33.05	33.15	33.03
3.	20%	27.02	27.12	27.30	27.14
4.	30%	25.05	25.1	25.18	25.11



28th Day COMPRESSIVE STRENGTH OFCONCRETE.
(Graphically represented)

7.CONCLUSION:

Results from this research confirm that the usage of glass waste as fine aggregate replacement material in concrete is effective and can use in the future. The effect of glass waste in concrete is more obvious at the later age of 28 days. The optimum percentage of glass waste that gives the maximum values of compressive strengths is 10%. This study intended to find effective ways to reuse waste glass as fine aggregate in concrete. The data presented in this paper show that there is a promising potential for the use of waste glass in concrete; further investigations may be considered regarding its long-term effect on concrete properties.

8.REFERENCE:

1. Modhera.C.D, M.N. Bajad, A.K. Desai " A State of Art Report on Benefits of Using Glass Powder as a Partial Replacement in Concrete", International Journal of Engineering studies, Vol 4, Issue 1, Pages: (41-54), (2012).

2. Nithin.V, Mr. M.U.Kiran "Experimental Investigation on Strength Parameters for Composite Concrete by Using Waste Glass Powder, Flyash Aggregate and M-Sand", International Journal of Civil and Structural Engineering Research, Vol. 3, Issue 1, pp: (407-412), Month: April 2015 - September 2015.

3. Priscilla.M, Mr.Pushparaj A Naik "Strength and Durability Study on Recycled Aggregate Concrete Using Glass Powder" , International Journal of Engineering Trends and Technology (IJETT) – Volume 11, Issue 5, pp:(259-264), May 2014.

4. Shruthi.S, S.Chandrakala, G.Narayana "Partial Replacement Of Cement In Concrete Using Waste Glass Powder And M-Sand As Fine Aggregate", International Journal of Research in Engineering and Technology, Volume 4, Issue 8, pp:(133-138), August-2015.

5. IS 516-1959, Method of Tests for Strength of Concrete, Bureau of Indian Standards, New Delhi.

6. IS 383-1970, Specifications for Coarse and Fine Aggregate from Natural Source of concrete", Bureau of Indian Standards New Delhi.

7. IS 12269-1987, Specifications for 53 Grade Ordinary Portland Cement", Bureau of Indian Standards, New Delhi.

8. IS 10262-2009, Recommended Guidelines for Concrete Mix Design", Bureau of Indian Standards, New Delhi.

9. IS 456-2000, Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards New Delhi.

10. AsokaAsokaPappu, MohiniSaxena, and Shyan R. Asolekar, "Solid Waste Generation In India And Their Recycling Potential In Building Materials", Regional Research Institute (CSIR) and IIT Bombay, India.

11. Carpenter, A. J. and Cramer, C.M, Transportation Research Record 1668, Paper No. 99-1087,pp. 60-67,1999 "Mitigation of ASR in pavement patch concrete that incorporates highly reactive fine aggregate"

12. Corinaldesi. V, Gnappi.G, Moriconi.G, andMontenero.A, vol.2, pp.197-201, Jan.2005 "Reuse of ground waste glass as aggregate for mortars", Waste Management.

13. Ismail.Z, and Al-Hashmi.E., Vol. 29, pp. 655-659, 2009 "Recycling of waste glass as a partial replacement for fine aggregate in concrete", Journal of Waste Management.