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"Study of Replacement of Cement and Aggregate by Glass Powder and Recycled Aggregate in Concrete

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Abstract - *It has been estimated that several million tons of waste glasses are generated annually worldwide. The key sources of waste glasses are waste containers, window glasses, window screen, medicinal bottles, liquor bottles, tube lights, bulbs, electronic equipments etc. Only a part of this waste glass can be used in recycling. The remaining waste glass cannot be used for any purposes. But recently the research has shown that the waste glass can be effectively used in concrete either as glass aggregate (as fine aggregate or as coarse aggregate) or as a glass pozzolana. The waste glass when grounded to a very fine powder shows some pozzolanic properties. Therefore the glass powder to some extent can replace the cement and contribute to the strength development.*

The project explores a theme on the need for recycled aggregates and glass powder and highlights its potential use as aggregate and cement in new concrete construction. Research comprises of studies on offer of replacement of cement & aggregate by glass powder and recycled aggregate in concrete by some percentage for 28 days flexural strength of concrete. A result show that the flexural strength of recycled concrete gives higher results with(5% glass powder and 20% recycled aggregate)& slightly lower result with (10% glass powder and 20%recycled aggregate) & (20% glass powder and 10 % recycled aggregate).

Key Words: R.A. (Recycled Aggregate), G (Glass Powder), CONT.C. (Controlled concrete), Modified Concrete in which glass powder and recycled aggregate are mix.

1. INTRODUCTION

Concrete is a most widely used construction material today. Flexibility, molding ability of concrete material, its high compressive strength and the steel reinforcing and pre-stressing technique in concrete facilitates to improve its strength as against its low tensile strength property and contributed largely to its widespread use.

The concrete is the most important construction material which is manufactured at the site, it is a composite product obtained by mixing cement, water and an inert matrix of sand and gravel or crushed stone, it undergoes a number of operations such as transportation, placing, compacting and curing. The distinguishing property of the concrete is its ability to harden under water. The ingredients of the concrete can be classified into two groups, namely active and inactive. The active group consists of cement and water, whereas inactive group comprises of fine and coarse aggregates, the inactive group is sometimes called as inert matrix. Good concrete, whether plain, reinforced or pre-stressed, should be strong enough to carry superimposed loads during its anticipated life and should have all other essential properties include durability, impermeability, minimum amount of shrinkage and cracking.

The following factors contribute to the production of good quality of concrete.

Type and quality of its component materials Based on exposure of concrete to atmosphere, temperature, rain, sea water selects w/c ratio Water content in the mix. Curing time and placing time of concrete Method of compaction of concrete Ratio of cement: sand: coarse aggregate: water as per design of the mix Temperature maintained during pouring and compaction competent direction and supervision.

Use of Industrial Waste and by-products in concrete will lead to green environment and such concrete can be called as "Green Concrete". The most commonly used Industrial waste materials to replace sand and cement in concrete are Fly Ash, Rice Husk Ash, Sugar Cane Bassage Ash, Foundry Sand, Blast Furnace Slag, Hypo Sludge, Red Mud and Phosphor, Gypsum, Silica Fume, Crushed glass and Pond Ash.

Use of recycled waste glass in Portland cement and concrete has attracted a lot of interest worldwide due the increased disposal costs and environmental concerns. The glass used for containers, jars and bottles are soda lime silica counts for 80% of the recycled glass The glass being mainly a silica-based material in amorphous form can be used in cement-based applications. Due to its silica content, ground glass is considered a pozzolanic material and as such an exhibit properties similar to other pozzolanic materials such as fly ash, metakaolin, slag and wheat husk ash.

METHODOLOGY

It's the foremost preliminary step for proceeding with any research work writing. While doing this go through a complete thought process of your Journal subject and research for it's viability by following means:

Table -1: Mix design value: -

Cement	450kg /m3
Water	186 kg /m3
Fine agg.	598.105kg /m3
Coarse agg.	1114.47 kg /m3
Admixture	9 kg /m3
W/ C ratio	0.35
Then M40 grade ratio = **1: 1.329 :2.47**	

1. TESTING OF FRESH CONCRETE

1.1 Workability test

Workability is the property of freshly mixed concrete that determines the ease with which it can be properly mixed, placed, consolidated and finished without segregation. The workability of fresh concrete was measured by means of the conventional slump test as per IS; 1199 (1989). Before the fresh concrete was cast into molds, the slump value of the fresh concrete was measured using the slump cone. In this project work, the slump value of fresh concrete was maintained in the range of 25mm to 50mm.

2. TESTING OF HARDENED CONCRETE

2.1 Flexural strength of concrete

Flexural strength is one measure of the tensile strength of concrete. It is a measure of a concrete beam or slab to resist failure in bending. The flexural strength is expressed as Modulus of Rupture (MR) in measured psi (MPa).

Flexural strength is checked after 7 and 28 days curing. Beams of size 700 x 150 X 150 mm are cast for both controlled concrete as well as for modified concrete from reference mixes. The specimens are tested in a universal testing machine with 2 ton load capacity cell as per IS: 516-1959 (2004).

$$\sigma = \frac{3\ x\ W\ x\ L}{2\ x\ b\ x\ d2}$$

Where,

W= load, l= length of beam
b= breath of beam, d= depth of beam

Experimental Setup and Observations

Table 2- Workability of various concrete mixes

Types of Mix	% addition of admixture (by weight of Cement)	Slump value (mm)
CONT.C.	0%	23 mm
	0.7%	33mm
G05RA05	0.7%	29mm
G05RA10	0.7%	27mm
G05RA15	0.7%	24mm
	0.8%	40mm
G05RA20	0.8%	38mm
G05RA25	0.8%	36mm
G10RA05	0.8%	39mm
G10RA10	0.8%	37mm
G10RA15	0.8%	32mm
G10RA20	0.8%	35mm
G10RA25	0.8%	34mm
G15RA05	0.8%	38mm
G15RA10	0.8%	35mm
G15RA20	0.8%	32mm
G15RA20	0.8%	32mm
G20RA05	0.8%	37mm
G20RA10	0.8%	35mm
G20RA15	0.8%	32mm
G20RA20	0.80%	30mm
G20RA25	0.80%	28mm
G25RA05	0.80%	32mm
G25RA10	0.80%	30mm
G25RA10	0.80%	30mm
G25RA20	0.80%	28mm
G25RA25	0.80%	26mm

Figure No.1: - MIXING OF MATERIAL M-40

FLEXURAL STRENGTH OF CONCRETE

The Flexural strength of beams are shown in below table.

Table 3 Flexural Strength of Concrete Mixes

Types of Mix	Flexural strength(N/mm²)	
	7 days	28 days
CONT.C.	4.89	6.67
G05RA05	3.82	5.06
G05RA10	4.53	5.15
G05RA15	4.84	6.67
G05RA20	4.84	6.67
G05RA25	4.84	6.67
G10RA05	4.84	6.67
G10RA10	4.84	6.67
G10RA15	4.84	6.67
G10RA20	4.84	6.67
G10RA25	4.84	6.67
G15RA05	4.84	6.67
G15RA10	4.84	6.67
G15RA20	4.84	6.67
G15RA20	4.84	6.67
G20RA05	4.84	6.67
G20RA10	4.84	6.67
G20RA15	4.84	6.67
G20RA20	4.84	6.67
G20RA25	4.84	6.67
G25RA05	4.84	6.67
G25RA10	4.84	6.67
G25RA10	4.84	6.67
G25RA20	4.84	6.67
G25RA25	4.84	6.67

Figure No. 2:- FLEXURAL STRENGTH TEST

CONCLUSIONS

Glass Powder & Recycled Aggregate withstand under any aggressive environment and climatic conditions because of balanced combined physical and chemical properties. In this project flexural strength & cost of modified concrete and controlled concrete is compared. From the observations of test results following conclusions are drawn.

1) When we increase glass powder and recycled aggregate in a range of 5-10%, there is no appreciable increase in the flexural strength in beam specimen, but when the range is 10-15%, there is an appreciable change at a very high rate in flexural strength.

   Then as we increase the percentage of glass powder and recycled aggregate from 15-20%, then initially flexural strength start from higher level and increase as further 5% variation.

   Further Increase in glass powder and recycled aggregate percentage, lowers down the flexural strength very considerably and it ends at the flexural strength level, which was arrived at 5% replacement of glass powder and recycled aggregate.

2) Precisely on our experimental study basis 5% glass powder with 20% recycled aggregate, 10% glass powder& 20% recycled aggregate and 20% glass powder with 10% recycled aggregate) provides higher flexural strength hence these combinations of glass powder and recycled aggregates can be considered.

3) Cost per cubic meter of modified concrete is reduced by 4.98% with (5% glass powder &20% recycled aggregate) &6.69% with (10% glass powder& 20% recycled aggregate)& 8.29% with (20% glass powder and 10% recycled aggregate) of controlled concrete.

4) Workability of concrete slightly decreased with increase in percentage of recycled aggregate because recycled aggregate initially absorbs more quantity of water.

5) Water cement ratio is not getting affected as recycled aggregate is fixed at 20% and the ultimate effect of glass powder & recycled aggregate is constant (from the water cement ratio point of view).

6) Initial rate of gain of strength of concrete is low, but at 28-days it meets with the required strength in addition of glass powder and recycled aggregate.

7) Use of glass powder helps in reduceing the use of cement in concrete and leading for reduction in pollution.

8) Use of recycled aggregate in concrete can save the natural source of stone and also produces a greener concrete for construction.

9) Environmental effects of waste and residual amount of cement manufacturing can be reduced.

FUTURE SCOPE

It is recommended for future studies that the research on the use of glass powder is required to extend to a wider perspective in order to know the actual behavior and effective utilization of glass powder which gives an idea to study more parameters and different governing effect of glass powder on engineering properties of fresh and hardened concrete. Hence, future work can be extended as follows

- This project can be extended to find out the modulus of elasticity of modified concrete.
- To know the effect of different type of glass powder on concrete strength.
- Effect of glass powder on high strength concrete.
- Effect of glass powder on strength of concrete with various w/c ratios.
- Effect of glass powder on strength of concrete with combination of glass powder with different strengthening agent.
- To know the exact reason behind the increment in strength of concrete.
- To know the effect of glass powder on the bond strength between inter-materials and between materials and steel.
- To determine the Durability of concrete.

REFERENCES

1) **Dr.G.Vijayakumar, Ms H. Vishaliny, Dr. D. Govindarajulu**, "Studies on Glass Powder as Partial Replacement of Cement in Concrete Production", International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 2, February 2018.

2) **Sunny O. Nwaubani and Konstantinos** I. Photos, The Influence of Waste Glass Powder Fineness on the Properties of Cement Mortars" International Journal of Applied or Innovation in Engineering & Management (IJAIEM), Volume 2, Issue 2, February 2017.

3) **Dr.G.Vijayakumar, Ms H. Vishaliny, Dr. D. Govindarajulu,** "Studies on Glass Powder as Partial Replacement of Cement in Concrete Production", International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 2, February 2017.

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