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UNDERSTANDING THE STRENGTH OF CONCRETE BY REPLACING GLASS POWDER AGAINST SULPHATE ATTACK

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ABSTRACT

To Study the resistance of concrete containing glass powder against sulphate attack In order to reduce waste age ofdamaged glass sheets and sheet glass cuttings are using in concrete is an interesting possibility for economy on waste disposal sites and conservation of environmental. Today many researchers are ongoing into the use of ordinary Portland cement replacements, using many waste materials like flyash,silica fume, waste glass powder are also used as a binder with partial replacement of cement while take sum part of reaction at the time of hydration, also it is act as a filler material. Concrete produced by replacing ordinary Portland Cement (OPC) 53 grade cement with waste glass powder (GP) in different proportions has been studied.OPC 53 grade Cement replacement by glass powder in the range 5% to 25% in increments of 5 percentages has been studied and conducted compressive strength (cube) for 7 days and 28 days. It is concluded that without sulphate and with sulphate are having higher strength and maximum resistance was obtained when 20% cement was replaced by waste glass.

Keywords: waste glass powder, ordinary Portland cement, MgSo4 salt.

I. INTRODUCTION

Glass is one of the most versatile substances on earth used in many applications and in a wide variety of forms. Volcanic glass is a well-known example of naturally occurring glass. The Glass is manufactured by human's the glass is a mixture of silica, sand, lime and other materials. The elements of glass are heated to 9820 Celsius. Heat can return the glass to a liquid and workable form, making it easy to reuse and recycle.

The term glass comprises several chemical varieties including binary alkali-silicate glass, borosilicate glass, and ternary soda-lime silicate glass. Most of the packaging glass which is the subject of this paper is of the soda-lime silicate variety. It is manufactured in various colors, mostly green, amber and clear, but waste glass after being collected from the domestic waste stream is of a mixed color.

Utilization of waste glass is very important for human development because huge amount of glass waste produce by human increases the need of land to get rid Use up precious landfill space, decreasing possible area that can be used for landfills of other waste increasing the need to establish new expansive landfills ,lactates and gas releases from the landfill site degrade communities living condition and harmful to human health,location of most recycling plants are built within low income neighborhoods because of cheap labor and strict regulation may affect respiratory system if breath in pollutants.

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II. SULPHATE ATTACK

Sulfate attack is a chemical breakdown mechanism where sulfate ions attack components of the cement paste. The compounds responsible for sulfate attack are water-soluble sulfate containing salts, such as alkali-earth (calcium, magnesium) and alkali (sodium, potassium) sulfates that are capable of chemically reacting with components of concrete.

Sulphates reacts chemically with the product of hydration (hydrated lime and hydrated calcium aluminates in the cement paste to form calcium sulphate and calcium sulfa aluminates) are called ettringite. These new crystals occupy empty space (Figure 4) and as they continue to form, they cause expansion, disruption, loss of bond between the cement paste and aggregate because paste expansion produces a small gap around small aggregate particles and a bigger gap around larger particles as shown in figure 5, which result in micro cracks and these cracks may be responsible for reduction in strength or damaging the concrete (Figure 6) by changing the chemical nature of thecement paste and of the mechanical properties of the concrete

Table 1.3 Chemical Composition of cementing materials

Composition(% by mass)	Cement	Glass Powder
Silica(SiO2)	20.2	72.5
Alumina(Al2O3)	4.7	0.4
Iron Oxide(Fe2O3)	3.0	0.2
Calcium Oxide(CaO)	61.9	9.7
Magnesium Oxide(MgO)	2.6	3.3
Sodium Oxide(Na2O)	0.19	13.7
Potassium Oxide(K2O)	0.82	0.1
Sulfur Trioxide(SO3)	3.9	-
Unit Weight, Kg/m3	3150	2579
Specific Gravity	3.15	2.58

2.1 Literature Review

2.1.1An Investigation on the Strength Properties of Steel Fiber Reinforced Concrete

Produced with Glass Powder as Pozzolana (Dr. K.B. Prakash**,** B.R. Patagundi) It has been estimated that several million tons of waste glasses are generated annuallyWorldwide. The key sources of waste glasses are waste containers, window glasses, and windowScreen, medicinal bottles, liquor bottles, tube lights, bulbs, electronic equipment etc. Only aPart of this waste glass can be used in recycling. The remaining waste glass cannot be used forAny purposes. But recently the research has shown that the waste glass can be effectively usedIn concrete either as glass aggregate (as fine aggregate or as coarse aggregate) or as a glassPozzolana. The waste glass when grounded to a very fine powder shows some pozzolanicProperties. Therefore, the glass powder to some extent replaces the cement and contributes forthe strength development. In this experimentation, an attempt has been made to study theCharacteristic strength properties of steel fiber reinforced concrete produced by replacing theCement by waste glass powder in various percentages like 0%, 10%, 20%, 30%, and 40%.

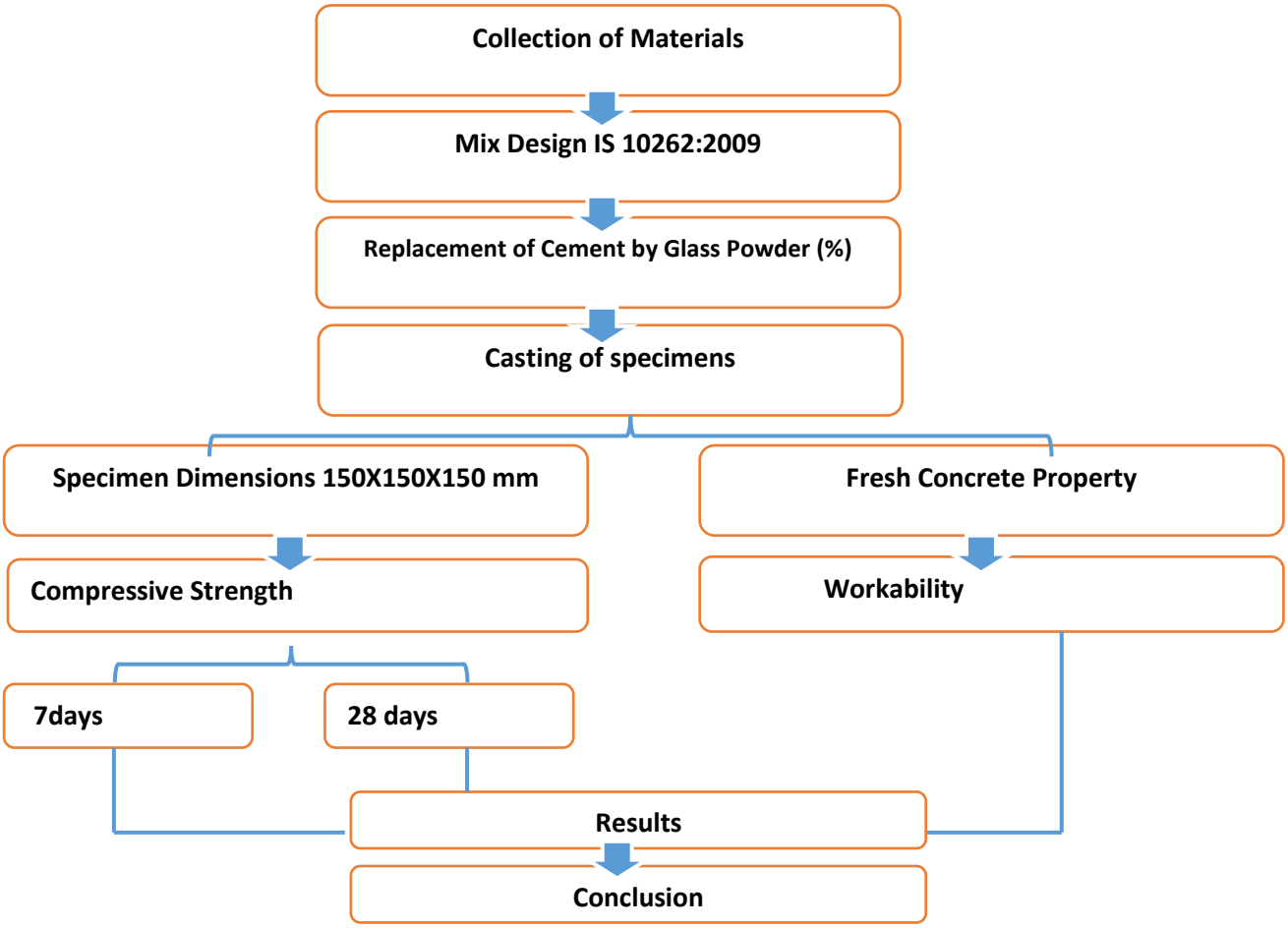
2.1.2 Influence Of A Fine Glass Powder On Strength Of Concrete Subjected To Chloride Attack (M.N.Bajad, C.D.Modhera and A.K.Desai)

In this paper, an attempt has been made to find out the strength of concrete containing wasteGlass powder as pozzolona. Cement replacement by glass powder in the range 5% to 40% inIncrements of 5 percentages has been studied. Replacement of 20% cement by glass powderWas found to be beneficial when concrete was subjected to chloride attack.

2.1.3. Use of waste glass in cement mortar (Bhandari. P.S, Tajne. K.M)

In this paper, a parametric experimental study for producing mortar blocks using fine andCoarse waste glass is presented. Mechanical properties of mortar blocks having various levelsof fine glass (FG) and coarse glass (CG) replacements with fine aggregate (FA) areInvestigated. The test results show that the replacement of Fine aggregate by Fine Glass at levelof 20% by weight has a significant effect on the compressive strength of the mortar blocks asCompared with the control sample because of Pozzolonic nature of FG. Results indicatePozzolonic reactivity of this waste and open possibilities for the use of this material in mortars.The use of waste glass aggregate usually reduces the water demand. With the addition of wasteGlass aggregate, density of mortar increases. With the addition of waste glass aggregate,Compressive strength of mortar decreases. Crushed waste glass aggregate have irregular shapesThan local sand. The reduction of mortar strength can be attributed to the high-water cementRatio and absence of rough surface of waste glass aggregate, which is essential for bonding andStructuring of fresh mortar.

III. METHODOLOGY



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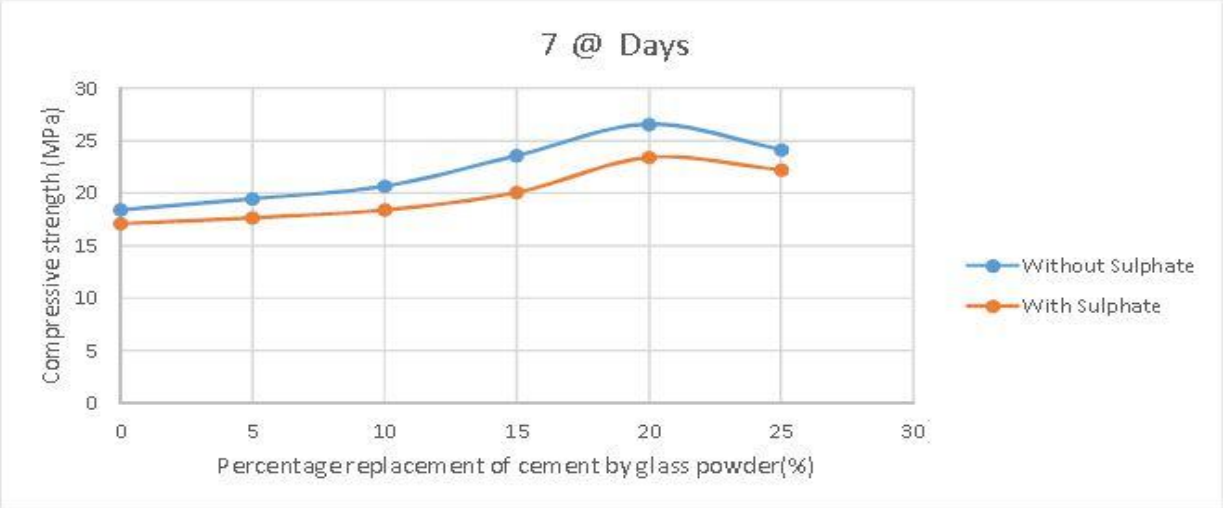
IV. RESULTS

4.1Table:Overall results of Compressive Strength with and without Subjecting Sulphate Attack for 7 Days

Mix Designation	Replacement of cement by glass powder(%)	Concrete without subjecting to Sulphate attack		Concrete with subjecting sulphate attack 28 days		Decrease of Compressive Streangth when subjected to Sulphate attack (%)
		Compressive Streangth (MPa)	Increase or decrease in compressive Streangth w.r.t ref.mix (%)	Compressive Streangth (MPa)	Increase or decrease in compressive streangth w.r.t ref.mix (%)	
1	0(Ref Mix)	18.4	----------	17.1	----------	7.3
2	5	19.47	5.8	17.66	3.3	6.8
3	10	20.66	12.3	18.4	7.6	6.3
4	15	23.57	28	20.66	17.3	5.7
5	20	26.57	44	23.39	37	5.2
6	25	24.155	31	22.22	29	7.05

Graph:Percentage replacement of cement Vs Compressive Strength 7 days



4.2Table: Overall results of Compressive Streangth with and without Subjecting Sulphate Attack for 28 Days

Mix Designation	Replacement of cement by glass powder(%)	Concrete without subjecting to Sulphate attack		Concrete with subjecting sulphate attack 28 days		Decrease of Compressive Streangth when subjected to Sulphate attack (%)
		Compressive Streangth (MPa)	Increase or decrease in compressive Streangth w.r.t ref.mix (%)	Compressive Streangth (MPa)	Increase or decrease in compressive streangth w.r.t ref.mix (%)	
1	0(Ref Mix)	24	----------	22.8	----------	5
2	5	27.6	15	26.22	15	5
3	10	29.6	23	28.7	26	3.4
4	15	31.33	30	29.7	30	5.2
5	20	32.43	35	31.12	36	4.03
6	25	29	24	27.9	22	6.06

Graph:Percentage replacement of cement Vs Compressive Strength 28 days

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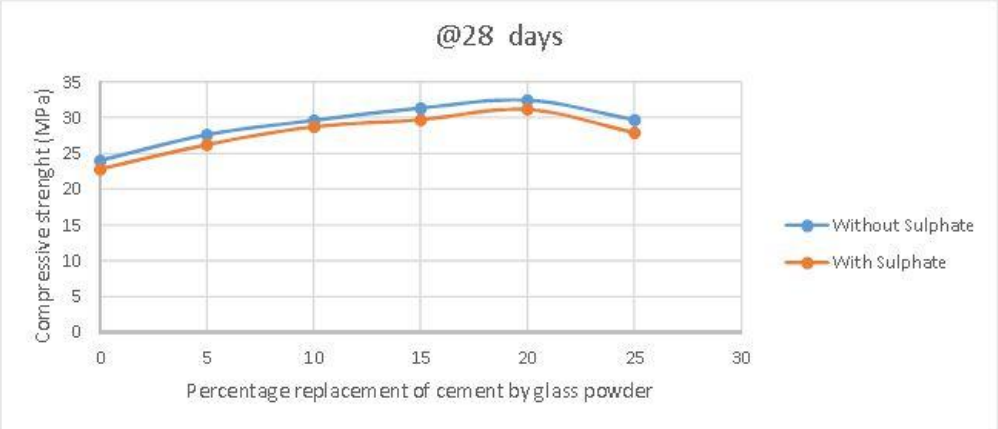

IV. CONCLUSIONS

1) At the replacement of 20% of cement by Glass powder attained Maximum strength as compared to that of normal concrete.
2) For Maximum Strength Purpose, the replacement of Ordinary Portland Cement by Glass Powder is Feasible.
3) Actually the Workability of Concrete is decreased because of Glass Content in Ordinary Portland cement;with the help of Super Plasticizer increase the Workability of concrete.
4) The Strength Properties were changed when concrete produced by replacing of Ordinary Portland cement by Glass powder was subjected to Sulphate attack.
5) The Glass Powder was used in Different Proportion to check the Maximum Strength of concrete.
6) Grading curve of both sand and glass powder is uniform and sand falls within limits of Zone-3.
7) After put 20% waste glass powder into concrete the early compressive strength of concrete is reduced.

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