isrjournals

International Journal of Advanced Research in Civil,Structural,Environmental and Infrastructure Engineering and Developing

Volume: 3, Issue: 1,Special Issue: 1 ,Apr,2018 ,ISSN_NO: 2320-723X

WASTE GLASS POWDER AS POLZZOLANIC MATERIAL IN CONCRETE.

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ABSTRACT-

Million tons of waste glass is being generated annually all over the world. Once the glass becomes a waste it is disposed as landfills, which is unsustainable as this does not decompose in the environment. Glass is mainly composed of silica. Use of milled(ground) waste glass in concrete as partial replacement of cement could be an important step toward development of infrastructure systems. When waste glass is milled down to micro size particles, it is expected to undergo pozzolanic reactions with cement hydrates, forming secondary calcium silicate hydrates(C-S-H). In this research chemical properties are glass were evaluated. Chemical analysis of glass and cement samples was determined using x-ray technic and found minor differences in composition between clear and coloured glasses. Flow and compressive strength tests on mortar and concrete were carried out by adding 0-25% ground glass in which water to be binder(cement+glass) ratio is kept the same for all replacement levels with increase in glass addition mortor flow was slightly increased while a minor effect on concrete workability was noted. The compressive strength test results indicated that recycled glass mortar and concrete gave better strength to control samples. A 20% replacement of cement with waste glass was found convincing considering cost and the environment.

1) INTRODUCTION

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 glass with different forms in various fields. One of its significant contributions is to the construction field where the waste glass was reused for concrete production. Many efforts have been made to use waste glass in concrete industry as a replacement of course aggregate, fine aggregate and cement. Its performance as a course aggregate replacement has been found to be non-satisfactory. Because of strength regression and expansion due to alkali- silica reaction. The research shows that there is strength loss due to fine aggregate substitution also. So the glass can be used as partial replacement of cement to increase the strength of concrete. Several industrial by-products have been used successfully as SCMs, including a silica fume, ground granulated blast furnace slag and fly ash. These materials are used to create blended cements which can improve concrete durability, early and long term strength, workability and economy. Motor samples were prepare to evaluate the flow and strength properties. Further more, compressive strength of concrete cube samples were also determined by crushing it. In addition the study discussed the packing and pozzolanic effect of glass by using superplasticizer in selected motor samples.

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2) MATERIALS

The materials used in present work are as follows

* Glass powder
* Silica fumes
* Fly ash
* Ordinary portland cement (OPC)
* Fine aggregates
* Coarse aggregates

GLASS POWDER:

The glass powder used in the present experiment is taken from the market which is resistance to chemical attack.

SILICA FUME:

Silica fume is a highly reactive pozzolanic material and it is a by product from the production of silicon.

It is very fine powder and it is available in a water slurry form.

FLY ASH:

It is also known as pulverised fuel ash and it is one of the coal combustion products.

OPC:

It is the most common cement used in general concrete construction where there is no exposure to sulphates in the soil or ground water.

FINE AGGREGATES:

Naturally available sand from the river bank is taken for the present experiment.

The most common constituent as sand is silica.

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Usually it is in the form of quartz which is chemically inert and hard.

COARSE AGGREGATES:

These all the particles whose size is greater than 4.75mm in the diameter.

They can either be in form primary, secondary or recycled sources.

Physical properties of fine aggregates

Bulk specific gravity(SSD)	2.55
Absorption capacity(%)	1.66
Fine modulus(FM)	2.65
Field moisture content	0.68

3) METHODOLOGY:

* A nominal mix of the concrete of proportion 1:2:4 was adopted for the present experiment.

* The test were conducted in two series .

* The first series 30% of pozzolana were used as partial replacement of cement.

* In second series 15% of pozzolana were used as a partial replacement of cement.

* Eleven number of standard cubes of size 150*150*150mm were cast to measure the compressive strength of concrete.

The tests were conducted in the experiment:

To study the properties of concrete the following tests were conducted.

1. Normal consistency test.

2. Compressive strength test.

3. Capillary absorption test.

4) NORMAL CONSISTANCY TEST:

Normal consistency of different binder mixes determined by using the procedure referring to IS4031: part 4(1988):

5) PROCEDURE:

* 300gm of sample coarser than 150mm sieve is taken.

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* Approximate percentage of water added to sample and mixed methodologically for 2-3 min.

* After applying oil to the surface of mould, paste was filled in the vicat's apparatus.

* Release quickly the needle allowing it to sink in the paste and note down the penetration reading when the needle become stable.

* If the penetration reading is less than 5-7mm, prepare the paste again with more water and repeat the above procedure until the needle penetrate to a depth of 5-7mm.

* The percentage of water with which the above situation is satisfied is called a normal consistency.

6) COMPRESSIVE STRENGTH TEST:

* For each series 5 set were cast to determine the compressive strength.

* Each set comprises of eleven standard cubes oout of which nine cubes were cast to measure the compressive strength after 28 days.

* The size of the cube is as per IS code 10086-1000.

8) CAPILLARITY ABSORPTION TEST:

* Out of eleven standard cubes, two cubes were retained to measure capillary absorption coefficients after 28 days.

* The sample was dried in oven at 105^0C until constant mass was obtained.

* Sample was cool down to room temperature for 6 hours.

* The side of the sample was coated with the paraffin.

* The sample was exposed to water on one side by placing it on a pan filled with water.

* The water in the pan was kept about 5mm above the base of the specimen.

* The weight of the sample was measured at 15 to 30 minutes intervals.

* The capillary absorption coefficient was calculated by using the formula: k=Q/A* sqrt (t)

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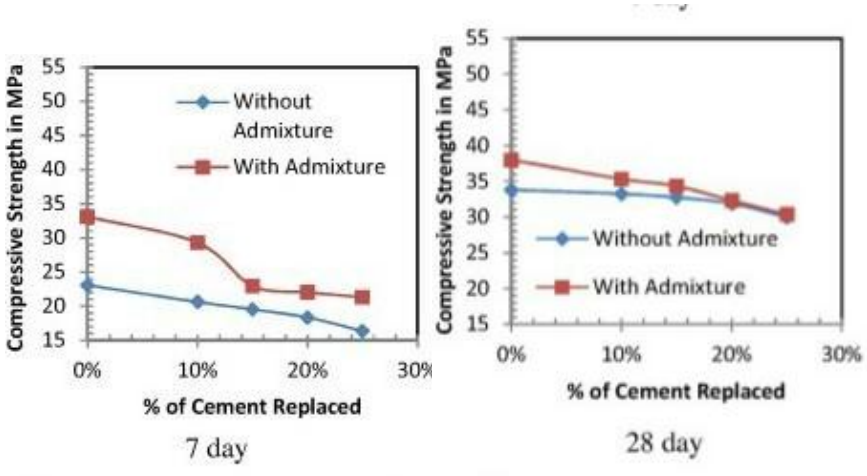
9) RESULTS AND DISCUSSIONS:

1. Normal consistency:

Normal consistency of binder mixes were tabulated below:

Mix	Description	Cement(g)	Silica fume(g)	Fly ash(g)	Glass powder(g)	Consistency(%)
MC	CEMENT	300	0	0		31.2
MCS	MC with 15% SF	255	45	0	0	36.67
MCF	MC with 15% FA	255	0	45	0	38.3
MCF 1	MC with 15% GP	255	0	0	45	37.2
MCG 2	MC with 30% GP	210	0	0	90	38.5

2. COMPRESSIVE STRENGTH WITH AGE:



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3. CAPILLARY ABSORPTION:

The capillary absorption coefficient for the eleven mix designs is as follows:

DESIGN MIX	28 days($k*10^{-3}$ cm/s)
MC1	3.02
MCS1	1.65
MCF1	1.52
MCG11	2.85
MCG12	1.73

10) CONCLUSION:

* The smaller particle size of the glass powder has high compressive strength in the concrcete mix.

* Glass powder produces denser matrix which improves the durability property of the concrete.

* The coefficient of the capillary absorption test also indicates that incorporation of finer glass powder improves durability.

* It can be concluded that 30% of glass powder of size less than 100 micron meter could be included as cement replacement in concrete without any unfavourable effect.

* Use of waste glass for construction products: Legislative and technical issues by(R.K.Dhir,M.D.New lands, J.E.Halliday(Eds)).

* Recycling of industrial wastes in ceramic manufacturing: State of art and glass case studies.

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