REUSING OF GLASS POWDER AND INDUSTRIAL WASTE MATERIALS IN CONCRETE

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Abstract

A huge amount of concrete is consumed in the construction work. A good quality concrete is mixing of cement, fine and coarse aggregates, water and admixtures as needed to obtain an optimum quality and economy. In this study investigation were carried out on compressive strength, split tensile strength and water absorption of M-40 grade of concrete mixes with 20% constant replacement of waste glass powder in cement and partial replacement of waste foundry sand in fine aggregate. From the test results, strength are achieved very less on 7th and 14th das but it increases on the 28thday. High strength values found at 40% replacement level in strength parameters.

Keywords: *waste glass powder, waste foundry sand, eco-friendly, concrete mix.*

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1. INTRODUCTION

The most of developing countries are facing disposing of waste materials using for landfill, this causes environmental problems. Industrial waste is a byproduct from the production of (ferrous and non-ferrous) casting industries. Industrial wastes are more then 2-3 times reused and recycled in casting process, after that 25-30% losses its strength so that it is disposed to landfill.

The glass powder is generated by waste glasses. The waste glass powder is increases strength of concrete, because glass powder content high percentage of silica. The major disadvantage is the cracking and swelling due to alkali-silica reaction. So many reaches concluded that 20% replacement level achieved good strength. So in this investigation glass powder used as 20% constant replacement in cement and industrial waste material used as partial replacement such as 0%, 10%, 20%, 30%, 40% and 50% in fine aggregate in concrete by using M40 grade.

1.1 Glass Powder

Basically waste glass powder is made from the waste glass material that cannot be recycle or reuse due to the high cost of recycling. Waste glass powder is being used for land fill. Due to environmental problem, researches try to use the waste glass powder in to the concrete to create a new material to use in construction field. Researcher found that the main material composition of glass powder is silica which is a constituent of cement also. The use waste glass powder in concrete creates a problem due to Alkali-Silica reaction. The reaction between alkalis in ordinary Portland cement and silica in aggregates and waste glass powder form silica gel.

1.2 Industrial Waste Material

Used foundry sand (UFS) is a waste material, comes from ferrous and non-ferrous metal cast industries. The metal cast industries yearly use an approximate 100 million tons of foundry sand for manufacture. This foundry sand is been recycled and reused the sand several times, due to this reason reduction in strength about 25% to 30%. It is then removed as waste material in foundry industries. The disposed waste foundry sand is then used for land filling. There are two types of foundry sand i.e. Green sand (clay bonded system) and chemical bonded sand.

2. EXPERIMENTAL MATERIALS

2.1 Cement

The OPC 53 grade Birla super cement is used in this investigation and physical properties of cement are shown in table 1.

Table-1: Physical Properties

Properties	Results
Specific Gravity	3.14
Normal Consistency	33%
Final Testing Time	260 min
Initial Testing Time	45 min
Fineness Modulus	5%

2.2 Fine Aggregate

Grading of fine aggregate are shown in Table 2.

Table-2: Grading of Fine Aggregate

A	B	C	D	E	F
4.75mm	22	2.2	2.2	97.2	90-100
2.26mm	30	3	5.2	94.8	75-100
1.18mm	100	10	15.2	84.8	55-90

600µ	250	25	40.2	59.8	35-59
300µ	500	50	90.2	9.2	8-30
150µ	72	7.2	97.2	2.6	0-10
pan	30	3	100	-	-

Note: A = IS Sieve
B = Weight Retained in gms
C = % Weight Retained
D = Cumulative % Weight retained
E = Cumulative % Passing
F = Standard Requirement for Zone II as Per IS 383:1970

2.3 Coarse Aggregate

In this investigation we have used 20mm down size for coarse aggregates and they are tested as per IS 2386. The results are shown in table 3

Table 3: Sieve Analysis Test

M	N	O	P	Q	R
1	20 mm	120	2.4	2.4	97.6
2	12.5mm	4418	88.36	90.76	9.24
3	10 mm	404	8.08	98.84	2.26
4	4.75mm	50	1	99.84	0.26
5	Pan	-	-		-

Note: M =Sl. No.
N = IS Sieve
O = Weight Retained in gms
P = % Weight Retained
Q = Cumulative % Weight Retained
R = Cumulative % Passing

2.4 Industrial Waste Material

Physical properties of Industrial waste material shown in Table 5

Table-5: Physical Properties

Property	**result**
Specific property	2.75
Water absorption	0.45%
Moisture content	0.1%
Fineness Modulus	2.74

2.5 Glass Powder

Physical properties of glass powder shown in table 4

Table-4: Physical Properties

Physical properties of glass powder	Results
Specific gravity	2.73
Median particle size(µ)	90µ
Moisture content (%)	0.1%

3. RESULT AND DISCUSSIONS

3.1 Compressive Strength Test

The compressive strength test was carried out on cube specimens of 150 x 150 x 150 mm size prepared in accordance with I.S: 516-1959 at 7,14 and 28 days using compression testing machine. The details of the seven different specimens are as given in Table 6 and chart 1

Table-6: Compressive strength Values

Mix Designation	7 days	14 days	28 days
CC	26.31	39.47	43.86
A0	26.47	39.71	44.13
A10	28.86	41.22	45.81
A20	30.03	43.64	48.49
A30	35.36	47.51	52.79
A40	36.51	50.55	56.17
A50	31.27	46.90	52.12

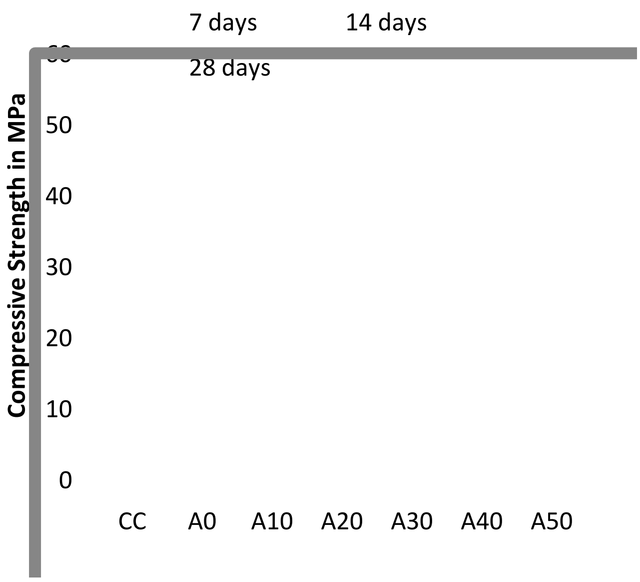

Chart-1: Compressive Strength Values

Note:
CC = Conventional Concrete
A0 = 20% Glass Powder + 0% Industrial waste
A10 = 20% Glass Powder + 10% Industrial waste
A20 = 20% Glass Powder+20% Industrial waste
A30 = 20% Glass Powder+30% Industrial waste
A40 = 20% Glass Powder+40% Industrial waste
A50 = 20% Glass Powder+50% Industrial waste

3.2 Split Tensile Strength

The test results of split tensile test are as shown in Table 6. Fig 2 shows the variation of split tensile strength with various curing periods. It can be see that the split tensile strength of concrete at 7, 14 and 28 days increases initially as the percentage of replacement of waste glass powder and waste foundry sand increases and becomes maximum at a percentage around A40.

Table-7: Split Tensile Strength Values

Mix Designation	7 days	14 days	28 days
CC	2.55	3.67	4.16
A0	2.27	3.77	4.28
A10	2.95	3.91	4.21
A20	2.83	4.69	4.53
A30	3.62	4.65	5.42
A40	3.73	4.81	5.86
A50	2.97	4.41	4.82

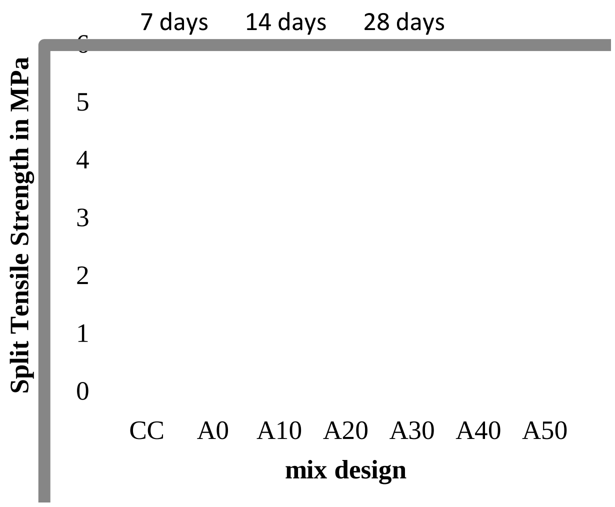

Chart-2: Split Tensile Strength Values

3.3 Water Absorption Test

The test results of water absorption test are as shown in Table 8 shows the variation of water absorption of different mix designations. It is seen from the water absorption test, as the percentage of replacement of waste glass powder and waste foundry sand increases, the water absorption ability of the specimen decreases and becomes least at a percentage around A50. So it can be said that, the concrete at A50 replacement level is durable against water absorption.

Table-8: Water Absorption Test

Mix Design	28 Days
CC	2.2
A 0	2.0
A 10	2.0
A 20	1.9
A 30	1.7
A 40	1.6
A 50	1.5

4. CONCLUSION

Paragraph comes content here. Paragraph comes content On the basis of experimental study in the form of strength and durability tests by constant replacement (20%) using waste glass powder as cement and partial replacement (i.e.0%, 10%, 20%, 30%, 40% and 50%) as natural fine aggregate. the production of concrete, the following conclusions are drawn:

1. The compressive strength of concrete at 7, 14 and 28 days increases initially as the percentage of replacement of waste glass powder and waste foundry sand increases and becomes maximum at a proportion around A40.
2. The split tensile strength of concrete at 7, 14 and 28 days increases initially as the percentage of replacement of waste glass powder and waste foundry sand increases and becomes maximum at a proportion around A40.
3. The water absorption of concrete at 28 days decreases gradually as the percentage of waste glass powder and waste foundry sand increases and becomes least at a proportion around A50.
4. Optimum replacement level for waste glass powder and waste foundry sand in place of ordinary Portland cement and natural fine aggregate respectively is found to be proportion of A40 from the consideration of strength and durability tests of concrete.

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