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STUDY ON STRENGTH AND DURABILITY PROPERTIES OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH GLASS POWDER AND FINE AGGREGATE WITH COPPER SLAG

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Abstract - In this project Study on Strength Properties of Concrete by Partial Replacement of Cement with Glass Powder and Fine Aggregate with Copper Slag is done. In this project cement is partially replaced with glass power in the ratio of 5%,10%,15%, Concrete tests compressive strength at the age of 7,28,56,90 days was obtained. Along Split tensile strength, Flexure strength at the age of 28 days was obtained. In this we want to conclude the optimum mix replacement. Taken the optimum mix of cement replaced with glass powder. In this project fine aggregate is partially replaced with copper slag in the ratio of varying 0%,10%,20%,30%,40%50%.In this project we are using ordinary Portland cement (53 grade),20mm size of coarse aggregate, Concrete gradeM30.In this project Durability tests Acid attack tests, Sulphate attack tests conducted .In acid attack test 5% H_2SO_4 solution used. In Sulphate attack test 5% Sodium Sulphate solution used. Duality tests conducted at the age of 28 days was obtained. The results show the Compressive strength of concrete.

***Key Words*: Cement, Fine aggregate, Coarse aggregate, Glass powder, copper slag, H_2SO_4, Sodium Sulphate**.

1. INTRODUCTION

A rapid growth in natural waste material Causes high rate of environmental pollution. So, it becomes mandatory to decrease or reuse the waste materials in order to save our environment from being polluted and also to reduce the cost. Suitable replacements can be done using waste materials so as to increase the strength of concrete. Waste materials such as marble powder and copper slag have a great impact on humans and as well as in the environment. Dumping of waste materials causes environmental and health problems, it also creates waste disposal problem. Therefore, recycling become important and must for the waste materials.

1.1 DURABILITY

Durability of concrete is to with stand action of chemical weathering and physical action is known as the corrosion of reinforcement in flexure members. Measuring the durability of concrete to determine its longevity in service is challenging Different types of durability tests are conducted concrete. In this project acid, Sulphate attack tests were conducted. In acid attack test 5%H_2SO_4 solution used. In Sulphate attack test 5% sodium Sulphate solutions are used.

1.2 HISTORY OF GLASS POWDER, COPPER SLAG

Copper slag is a bi product obtained during matte smelting &refining of copper. Copper slag is a blacky glassy particle and granular in the nature like sand. In concrete construction copper slag is used in sand replacement. Copper slag can also be used as a building material, formed into bricks. In sand blasting industry Copper slag is widely used.

The quantity of waste glass has slowly increased over the years due to the growing need and usage of glass products; this gives way for large quantity of glass waste. Most of these waste glasses can be recycled. At the same time today's annual global cement production has reached 2.8 billion tons, and is expected to increase to some 4 billion tons per year. The cement industry is facing challenges such as cost increases in energy supply, requirements to reduce CO2 emissions and the supply of raw materials in sufficient qualities. Window repair shops, glass decorative items, old tube lights, electric bulbs this are the sources of glass powder.

2. PROPERTIES OF THE MATERIAL

The physical properties of the materials used in the work are as follows:

Table -2.1: Physical properties of cement

Sl.no	Property	Value obtained
1	Specific gravity	3.15
2	Fineness modulus	97%
3	Initial setting time	99 min
4	Final setting time	260 min
5	Normal consistency	31.22%

Table -2.2: Physical properties of fine aggregate

Sl.no	Property	Value obtained
1	Specific gravity	2.7
2	Fineness modulus	2.60
	Grading zone	II

Table -2.3: Physical properties of coarse aggregate

Sl.no	Property	Value obtained
1	Specific gravity	2.8
2	Fineness modulus	7.01

Table -2.4: Physical properties of glass powder

Sl.no	property	Value obtained
1	Specific gravity	2.6
2	Fineness modulus	98%

Fig -2.1 Glass powder

Table -2.5: Physical properties of copper slag

Sl.no	Property	Value obtained
1	Specific gravity	3.45
2	Fineness modulus	3.84
3	Colour	Black

Fig -2.2 copper slag

2.1 H_2SO_4&Na_2SO_4

Sulphuric acid is a mineral acid molecular is a colorless, odorless syrupy liquid that is soluble in water, in a reaction that is highly exothermic.

Sodium Sulphate is the sodium salt of sulphuric acid. It is an important component compound of sodium. it is a white crystalline solid of formula Na_2SO_4.

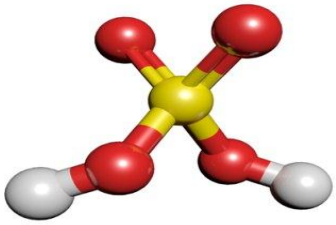

Fig -2.3 Structure of H_2SO_4

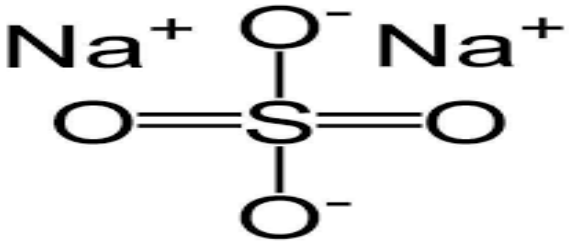

Fig-2.4 structure of Na_2SO_4

3. MECHANICAL PROPERTIES

Cement is replaced with Glass powder of about 5%,10%,15% respectively and comparison of nominal M30 concrete with glass powder-based concrete. Gp 5%, Gp10%, Gp15% means replacement of Glass powder with 5%, 10%, 15% respectively.

Table 3.1 Compressive strength results

Type of mix	7 days	28 days	56 days	90 days
Gp 0%	22.57	37.28	37.32	37.38
Gp 5%	24.17	38.34	38.36	38.41
Gp10%	27.4	40.82	40.94	41.02
Gp15%	23.57	35.97	36.00	34.01

Table 3.2 Split tensile strength, flexural strength results

Type of mix	Split tensile strength results @28 days	Flexural strength results @280 days
Gp 0%	2.42	3.9
Gp 5%	2.64	4.02
Gp10%	3.68	4.5
Gp 15%	2.54	4.05

By taking the optimum mix of Glass powder mix and further replacing of fine aggregate with copper slag in the ration of 10%,20%,30%,40%,50%.

Table -3.3 Compressive strength results

Type of mix	7 days	28 days	56 days	90 days
GP 0%+CS 0%	22.57	37.28	37.30	37.31
Gp 10%+CS10%	27.89	38.11	38.12	38.12
Gp 10%+CS20%	29.52	38.57	38.67	38.78
Gp10%+CS30%	30.2	40.63	40.64	40.64
Gp 10%+CS40%	32.3	42.35	42.67	42.70
Gp10%+CS 50%	26.25	35.47	35.47	35.48

Table -3.4 Split & Flexural strength results

Type of mix	Split tensile strength results @28 days	Flexural strength results @28days
GP 0%+CS 0%	2.42	3.9
Gp 10%+CS10%	2.47	4.19
Gp 10%+CS20%	2.86	4.40
Gp10%+CS30%	3.06	4.87
Gp 10%+CS40%	3.79	5.7
Gp10%+CS 50%	2.66	4.64

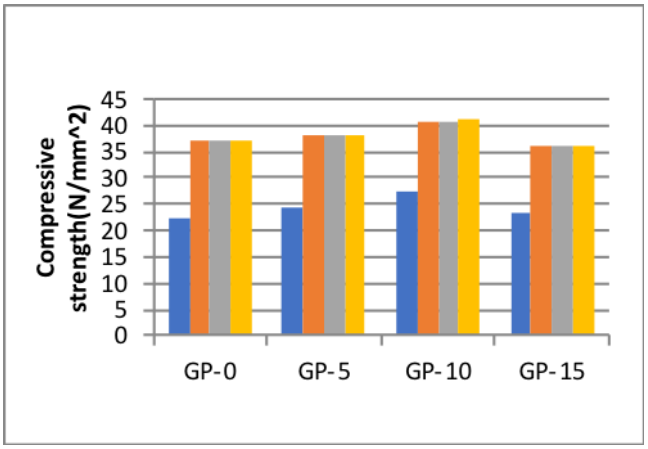

Chart-3.1 compressive strength of various mixes

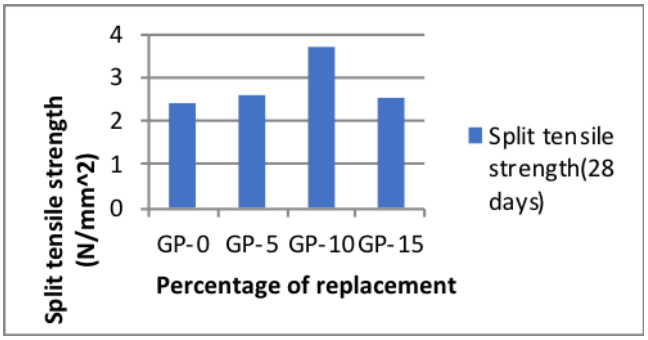

Chart-3.2split tensile strength of various mixes

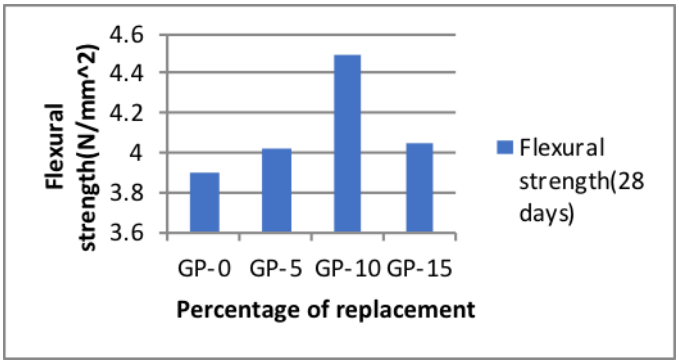

Chart-3.3 flexure strength of various mixes

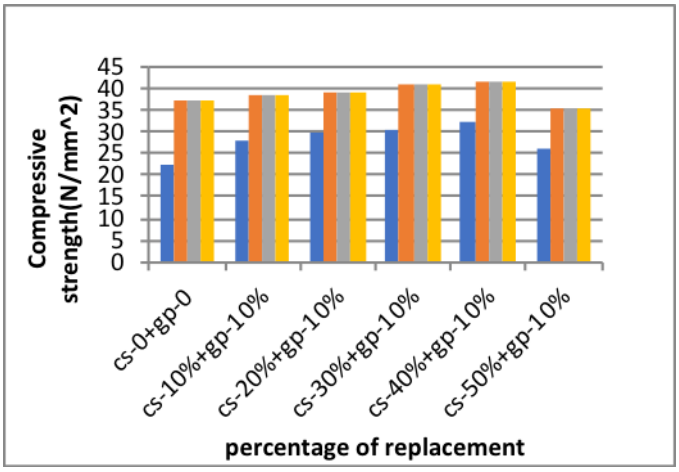

Chart -3.4 Compressive strength of various mixes

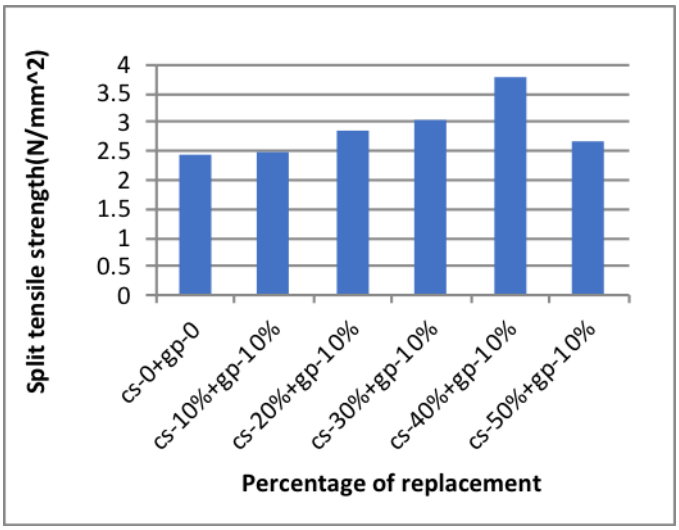

Chart-3.5 split tensile strength of various mixes

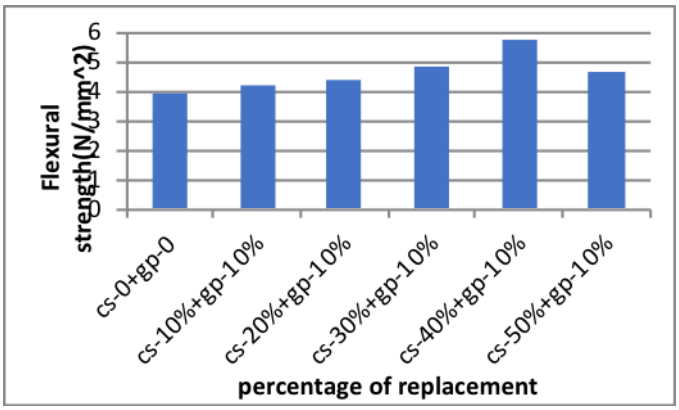

Chart-3.6 flexural strength of various mixes

4. DURABILITY PROPERTIES

Acid and Sulphate attack tests are conducted on the specimens of optimum of glass powder and copper slag. These tests are conducted by using solutions of H_2SO_4& Na_2SO_4respectively. The solutions are mixed 5% by weight of water which is used for curing. Then the cubes are immersed in acid and Sulphate water continuously for 28 days.

Optimum specimens -Gp10%+CS 40%

Table 4.1 compressive strength results of Acid attack and Sulphate attack test

Type of mix	Acid attack @28 days	Sulphate attack @28 days
Gp10%+CS 40%	34.12	35.62

5. CONCLUSIONS

The optimum compressive strength, split tensile strength, flexure strength was obtained in the ratio of10%.The percentage increase in Compressive strength of concrete when replaced with Gp-10% to the normalconcreteis7.02%.The percentage increase in Split tensile strength of concrete when replaced with Gp-10% to the normalconcreteis5.26%.The percentage increase in Flexure strength of concrete when replaced with Gp-10% to the normalconcreteis5.98%.Therefore, it can be concluded that Glass powder can be used as an alternative to Cement.

The compressive strength of concrete when replaced with Gp-10% and CS- 40% gives the maximum value. The percentage increase in Compressive strength of concrete when replaced with Gp-10% and CS-40% to the normal concrete is 9.01%. The percentage increase in Split tensile strength of concrete when replaced with Gp-10% and CS-40% to the normal concrete is 6.66%.The percentage increase in Flexure strength of concrete when replaced with Gp-10%andCS-40%to the normalconcreteis5.65%. Therefore, it can be concluded that copper slag can be used as an alternative to fine aggregate.

Durability tests conducted on optimum mix due to this test the compressive strength reduced. Acid attack on normal mix concrete the percentage loss of compressive strength will be24%. Sulphate attack on normal mix concrete the percentage loss of compressive strength will be 18%. Acid attack on optimum mix replacement of 10%glass powder 40% copper slag the percentage loss of compressive strength 24%.

Sulphate attack on optimum mix replacement of 10%glass powder 40%copper slag the percentage loss of compressive strength15%. Comparison of normal mix, optimum mix the loss of strength will be high in normal mix in both acid attacks, Sulphate attack. Comparative of acid and Sulphate attacks on concrete the loss of strength will be high in acid attack than Sulphate attack.

The cost of concrete production will be reduced and strength will increase. Hence it will be economical.

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