

Performance Evaluation of Concrete with Partial Replacement of Cement and Fine Aggregate Using Fly Ash and Copper Slag

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Abstract-This study presents the investigations of effect of fly-ash and copper slag on concrete. Cement is a costly material and is used extensively for construction works all over the world. Replacing a certain fraction of cement by fly-ash contributes to the strength of concrete due to its pozzolanic reactivity. The addition of slag reduces the rate of heat evolution and increases the resistance to chemical attack. The project aims at studying the influence of these two important industrial wastes on the compressive strength of concrete by using partially with 10%,20%,30% and 40% and 50% percentages. The optimum value of slag and fly-ash is found which gives largest compressive strength.

I. INTRODUCTION

Concrete is the most widely used construction material in the world, prized for its versatility, durability, and relatively low cost. However, the production of its key ingredient Portland cement is energy-intensive and a significant contributor to global carbon dioxide (CO₂) emissions. At the same time, the extraction of natural river sand, another major component of concrete, is depleting finite natural resources and causing adverse environmental impacts such as riverbed erosion and loss of aquatic habitats. To address these sustainability challenges, there is growing interest in developing eco-friendly alternatives. through the partial use of industrial by-products.

II. NEED

- To increase strength with low cost.
- To preserve natural resource of sand.
- To decrease co2 emission from cement manufacturing..
- Their incorporation into concrete mitigates disposal issues and reduces environmental pollution.

III. OBJECTIVE

- To Assess mechanical properties (compressive, tensile, flexural strength).
- To Determine optimal replacement levels for performance and workability
- Utilize industrial by-products to minimize waste and conserve natural resources.

EFFECT OF PARTIAL REPLACEMENT OF CEMENT BY FLY ASH:

- It reacts with calcium hydroxide in cement to form additional calcium silicate hydrate (C-S-H), enhancing the strength and durability of concrete.
- the initial strength is low. This pozzolanic reaction also makes the structure of concrete denser, resulting in decrease in water and gas permeability.

EFFECT OF PARTIAL REPLACEMENT OF SAND BY COPPER SLAG:

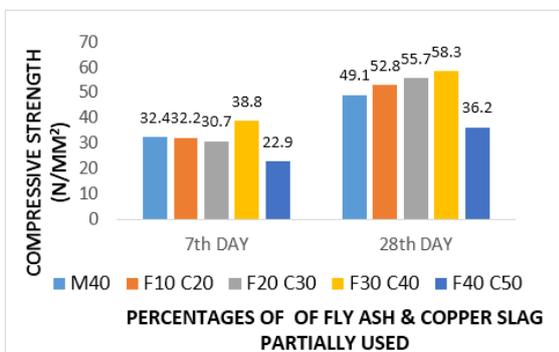
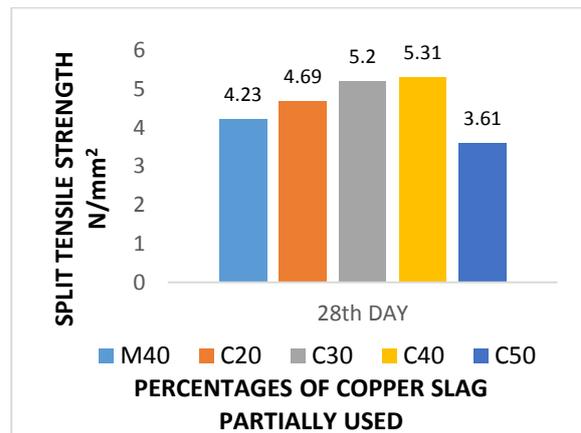
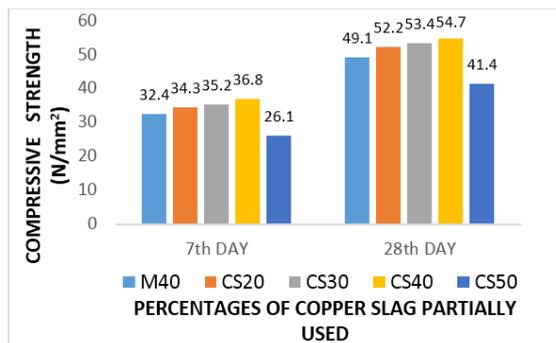
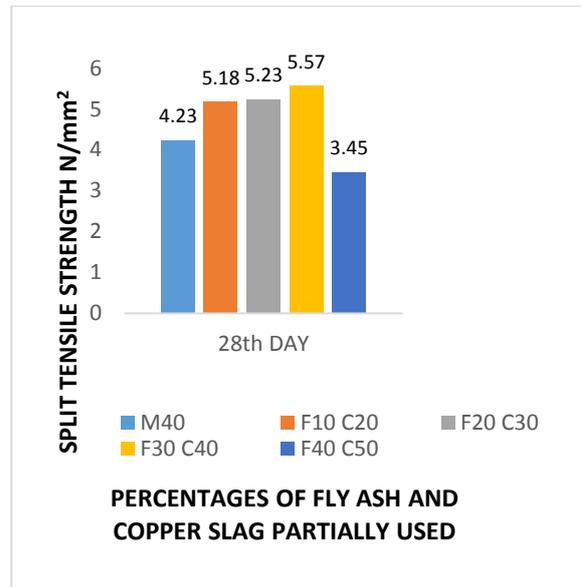
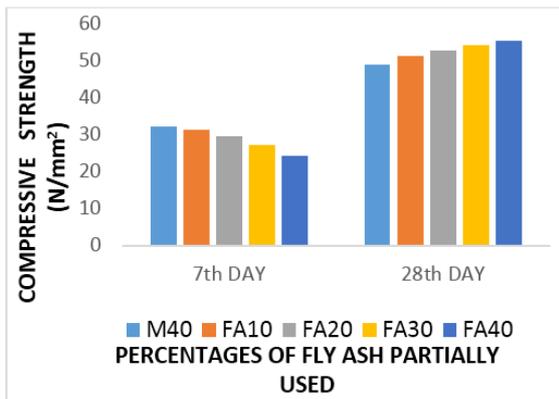
- The addition of slag reduces the rate of heat evolution and increases the resistance to chemical attack.
- Concrete with copper slag exhibits reduced water absorption and permeability, enhancing durability.

1-COMPRESSIVE STRENGTH OF CONCRETE:

Designation	MIX	7 th day (N/mm ²)	28 th day(N/mm ²)
M1	M40	32.4	49.1
A1	FA10%	31.5	51.4
A2	FA20%	29.7	52.8
A3	FA30%	27.2	54.3
A4	FA40%	24.3	55.5
B1	CS20%	34.3	52.2

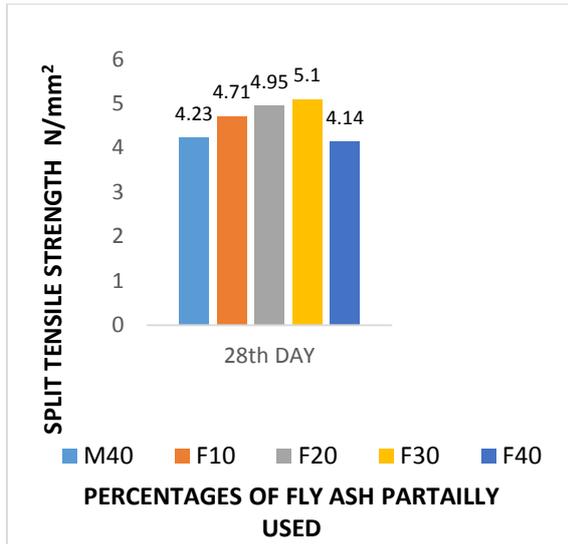
B2	CS30%	35.2	53.4
B3	CS40%	36.8	54.7
B4	C50%	26.1	41.4
C1	FA10 % CS20%	32.2	52.8
C2	FA20% CS30%	30.7	55.7
C3	FA30% CS40%	38.8	58.3
C4	FA40% CS50%	22.9	36.2

A6	FA20%	4.95
A7	FA30%	5.10
A8	FA40%	4.14
B5	CS20%	4.69
B6	CS30%	5.20
B7	CS40%	5.31
B8	CS50%	3.61
C5	FA10 % C20%	5.18
C6	FA20% CS30%	5.23
C7	FA30% CS40%	5.57
C8	FA40% CS50%	3.45



2-SPLIT TENSILE STRENGTH OF CONCRETE:

Designation	MIX	Flexural Strength 28 th day(N/mm ²)
M2	M40	4.23
A5	FA10%	4.71



IV. CONCLUSION

- By this project, I conclude that the strength of concrete increased by the Partial replacement of cement and fine aggregate by fly ash and copper slag. Fly ash replaces Portland cement, save concrete materials costs. Here we using OPC of 43 grade, class F fly ash, Copper slag, well graded coarse and fine aggregate.
- After conducting the tests of compressive strength on concrete with varying percentages of Fly Ash and Copper Slag, the following conclusions were obtained:
- Among different mixes 30% and 40% Partial Replacement Fly Ash and Copper Slag showed maximum workability, and obtained Compressive Strength of 58.3 MPa and Tensile Strength of 5.57 MPa.

V. ACKNOWLEDGEMENTS

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