Analytical Synthesis and Evaluation of the Effects of Sand Replacement with Slag on Concrete Strength Properties

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Abstract — This research aimed to determine the viability of slag as a sand replacement and its subsequent effects on concrete's strength properties. At 40% replacement of iron slag give optimum strength of M-30 mix design. 40% iron slag as coarse aggregate in concrete offers good results of the compressive strength as in sample A3 with aggregate (natural aggregate=60%) & (iron slag =40%) targeted compressive strength reached in 28 days. Proposed model is reliable for prediction of compressive strength evaluation for modified concrete and A3 sample give higher value of R2. The early age strength gain is higher as compared to later ages of 40% of fine aggregate is replaced by iron slag.

Keywords: Sand Replacement, Slag, Concrete Strength Properties

I. Introduction

The history of the use of iron and steel slag dates back a long way. European Slag Association (2006) has reported the earliest reports on the use of slag, wherein it is mentioned that Aristotle used slag as a medicament as early as 350 B.C. All through history use of slag has ranged from the novel to the usual including cast cannon balls in Germany (1589), wharf buildings in England (1652), slag cement in Germany (1852), slag wool in Wales (1840) concrete in Germany (1892) slag bricks made from granulated slag and lime in Japan (1901) according to Iron and Steel (2007). In the past, the application of steel slag was not noticeable because enormous volumes of blast furnace slag were available. Through awareness of environmental considerations and more recently the concept of sustainable development, extensive research and development has transformed slag into a modern industrial product that is effective and beneficial.

II. Results

A. General: -

1) Slump Test Results In Iron Slag in Concrete M-30

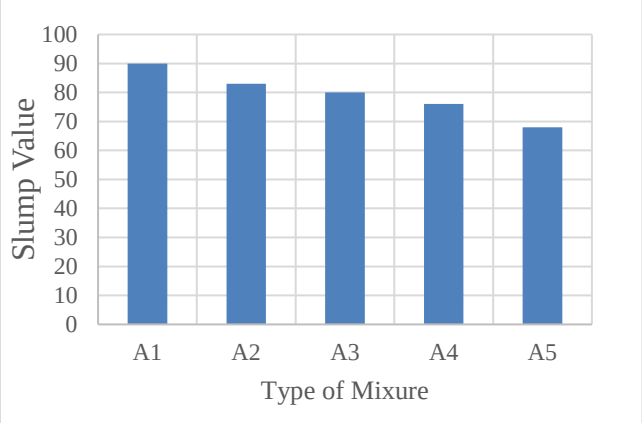
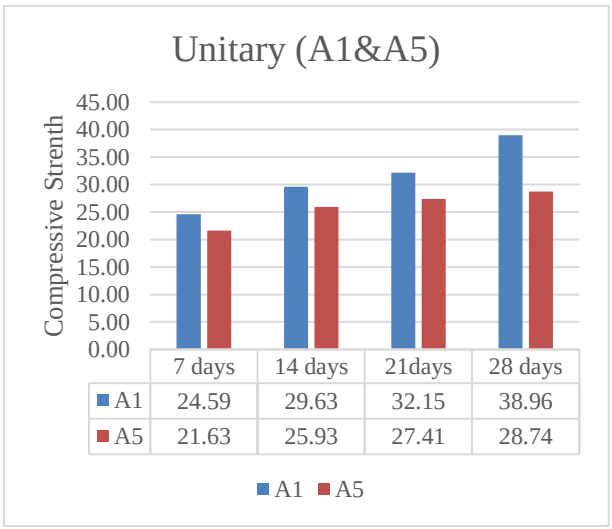
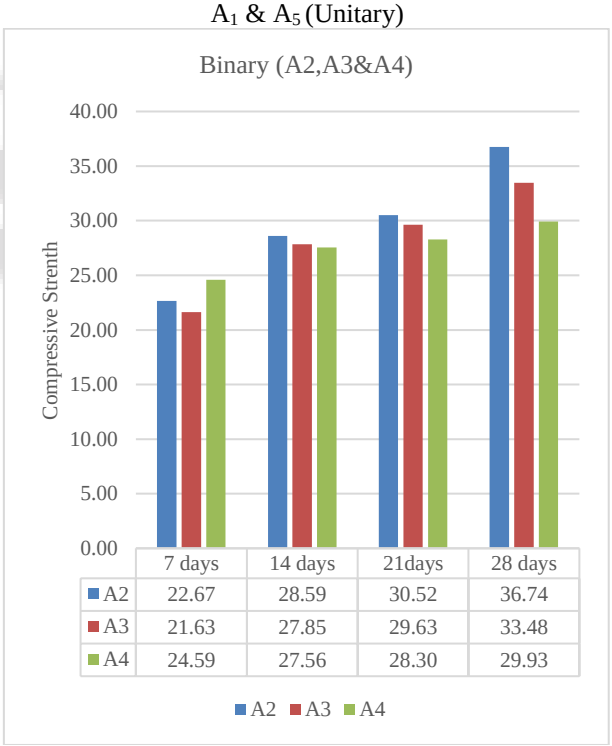


Fig. 1: Slump Test Results in Iron slag in Concrete M-30



A_1 & A_5 (Unitary)



A_2, A_3 & A_4 (Binary)

Fig. 2: Compressive strength of concrete with various percentage combinations of IRON SLAG at different curing ages.

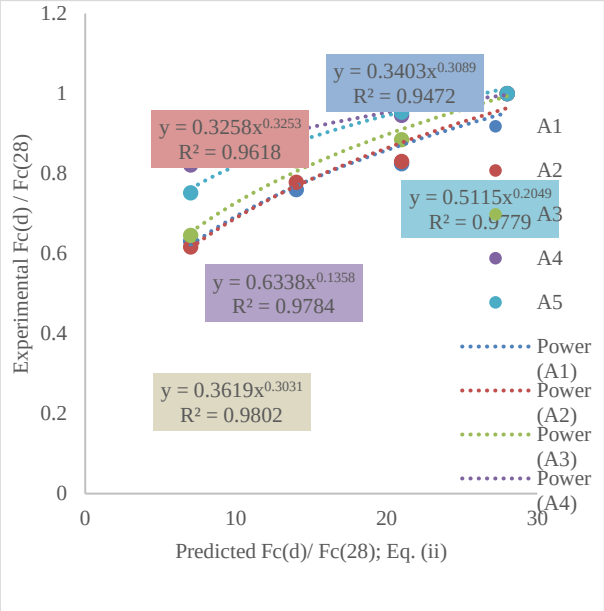


Fig. 3: Compressive strength normalizes at 28days as a function of curing age in days for A_1, A_2, A_3, A_4, & A_5

III. CONCLUSION:

The practicability of iron slag as a replacement for natural fine aggregate in concrete was analyzed in the present study. The effects of varying particle sizes were also examined. To develop a regression-based model, the experimental results of compressive strength from different curing days were used. The results of the empirical model generated for concrete were compared with various existing strength predictive models to evaluate the compressive strength at any given curing age. Based on the experimental results and their statistical analysis, the following conclusions were drawn:

- As the content of waste concrete aggregate increases, the slump value decreases.
- As the content of waste concrete aggregate increases, the compressive strength decreases.
- The Compressive strength tends to increase with increase percentages of iron slag in the mix.
- At 40% replacement of iron slag give optimum strength of M-30 mix design.
- 40% iron slag as coarse aggregate in concrete offers good results of the compressive strength as in sample A3 with aggregate (natural aggregate=60%) & (iron slag =50%) targeted compressive strength reached in 28 days.
- Proposed model is reliable for prediction of compressive strength evaluation for modified concrete and A3 sample give higher value of R2.
- The early age strength gain is higher as compared to later ages of 40% of fine aggregate is replaced by iron slag.

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