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A Study Effect on Mechanical Properties of Concrete by Partial Replacement of Natural Sand by Iron Slag

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Abstract: ***There are several types of industrial by-products and waste materials. The utilization of such materials in concrete not only makes it economical, but also helps in reducing disposal concerns. This experimental investigation were done to evaluate the mechanical and durability properties of M20 grades of concrete mixes, in which natural sand was replaced with waste Steel Slag. Natural sand was replaced with five percentage (0%, 5%, 10%, 15%, 20%) of WSS by weight. A total of five concrete mix proportions for M20 grade of concrete with and without WSS were developed. Compression test, splitting tensile strength test and flexural strength test were carried out to evaluate the strength properties of concrete after 7 days and 28 days. Test results showed that there is increase in compressive strength, flexural strength test and inclusion of waste Steel Slag (WSS) with a certain percentage of replacement. Quality of concrete in term of homogeneity and uniformity were also improved.***

Keyword: Utilization, Homogeneity ,Uniformity, Disposal, Economical.

I. INTRODUCTION

Throughout the world there is an increasing focus on the need to recycle and to more fully utilize by-products of manufacturing processes in an attempt to conserve our finite natural resources. Technical evaluation supported by field experience has shown that a by-product such as iron blast furnace slag has, in many applications, properties suitable to replace or supplement and improve traditional materials.

As there are many types of slag, it should be particularly noted that the term slag used throughout this booklet refers specifically to metallurgical slag produced in modern iron blast furnaces, ie; iron blast furnace slag and not basic oxygen steel slag or electric arc furnace slag which are steel furnace slags. As a by-product in the manufacture of iron, blast furnace slag is a renewable virgin material, i.e. slag has not been previously used but has been formed as part of the iron making process. As slag leaves the blast furnace in a molten form at 1500°C it is a homogeneous material free from foreign matter.

II. OBJECTIVE OF THIS STUDY

Although a system as briefly discussed above will not yield a perfect control with no variation in product quality, it will ensure that better-informed decision are made more often. These systems, no matter how sophisticated are only as good as their boundary conditions are will continually need human expertise. All metallurgical process control systems have the same objectives and are listed below:

A. Optimize product quality
B. Minimize energy consumption, or in general optimize environmental performance
C. Check the mechanical properties of concrete mix
D. Optimize energy and material flow around the plant in order to optimize overall plant throughput
E. Uses of waste material in beneficial manne

III. LITERATURE REVIEW

Ahmed S. Ouda et al. (2015) In their study, the effects of replacing sand by high percentages of basic-oxygen furnace slag on the compressive strength, bulk density and gamma ray radiation shielding properties of mortar have been investigated. Cement mortar of mix proportion 1:3 including various percentages of iron slag was designed.

Chetan Khajuria (2014) the environment problems are very common in India due to generation of industrial by-products. Due to industrialization enormous by-products are produced and to utilize these by-products is the main challenge faced in India. Iron slag is one of the industrial by-product from the iron and steel making industries.

Gurjeet singh, Sanjay Sangwan (2015) states that the study presents the experimental investigation carried out to evaluate effects of replacing fine aggregate with that of blast furnace slag on various concrete properties. The basic objective of this study was to identify alternative source of good quality aggregate because the natural stone quarries are depleting very fast due to rapid pace of construction activities in India

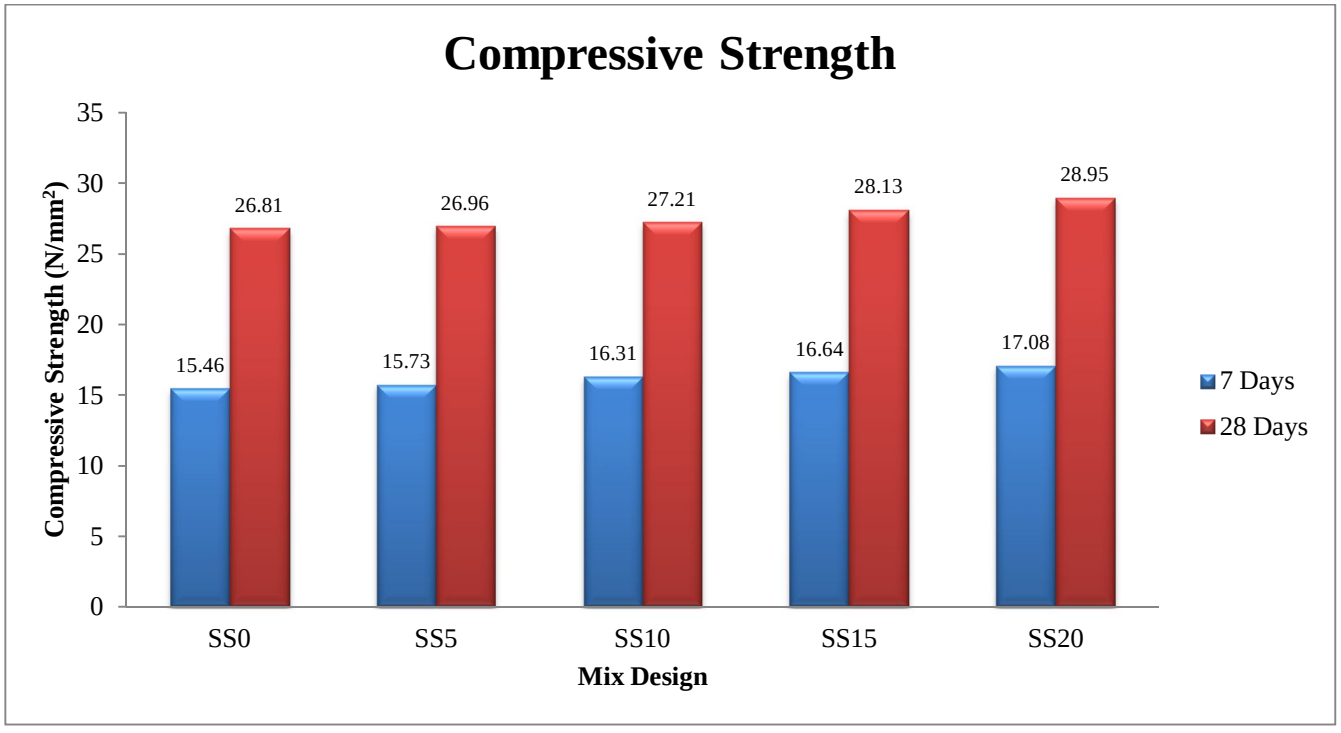
ShervinJahangirnejad et al. (2012) explained slag materials are by-products of metallurgical processes that include metals production from ore and refinement of impure metals. Air-cooled blast furnace slags (ACBFS) have been used for different pavement-related applications.

Sultan A. Tarawnehet. Al. (2014) in this study presents an evaluation of the physical and mechanical properties and characteristics of steel slag aggregate concrete in comparison with the typical crushed limestone stone aggregate concrete. He indicated that the added slag could work as accelerator at early age while at 28 days age, the effect is reduced. The fine slag replacement scores the highest effect.

IV. EXPERIMENTAL PROGRAM

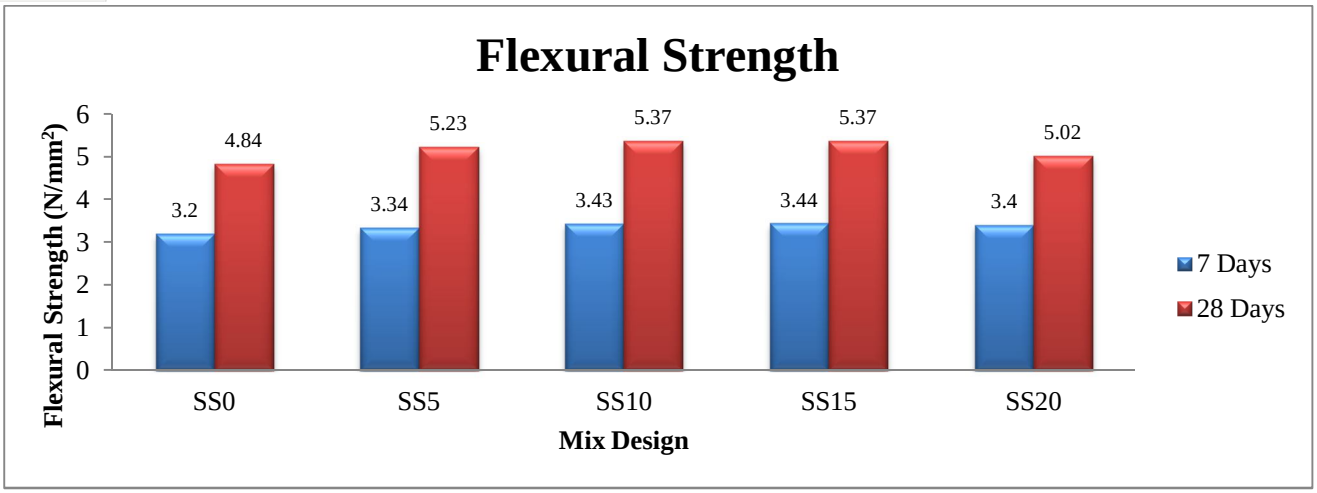
A. Compressive Strength Test

Test specimens of size 150mm x 150mm x 150mm were prepared for testing the compressive strength, the cubes are placed in machine in such a manner that the load is applied on the forces perpendicular to the direction of cast.Test results of compressive strength test at the age of 7 days & 28 days are given:



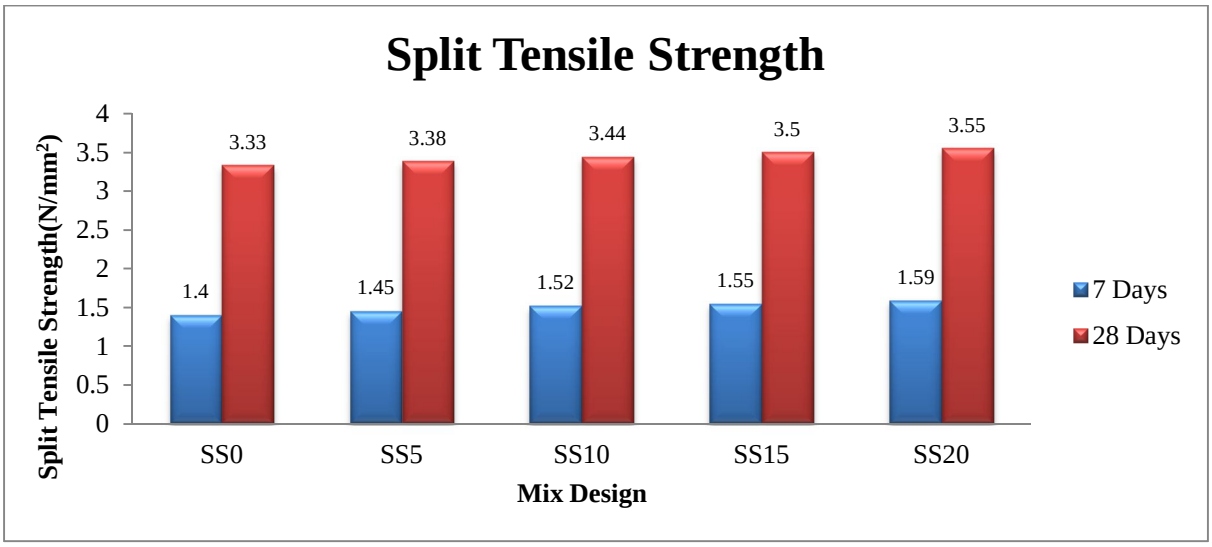
B. Flexural Strength Test

Beam samples measuring 500×100×100mm were moulded and stored in water for 28days before test for flexural strength.Two additional loading rollers were placed on top the beam. The load was applied without shock at a rate of 30 kg/minute.Test results of flexural test at the age of 28 days curing are given below:



C. Split Tensile Strength Test

Cylindrical concrete specimens of size 100mm diameter × 300mm long were moulded and stored in water for 28 days before testing for tensile splitting strength. The result obtained for various mixes at the curing age of 7 days and 28 days are represented in below tables:



V. CONCLUSION

A. The compressive strength, flexural strength and split tensile strength of normal concrete and concrete with Steel slag as partial replacements are compared and observed that the strength of the normal concrete is slightly lower than the Steel slag replaced concrete.

B. On the experimental study conclude that steel slag up to 20% as fine aggregate can be used in concrete mix as it achieve higher compressive strengths than minimum required as per MoRT&H specifications.

C. The mixes with replacement of Granulated blast furnace slag (GBFS) has a lesser rate of increase in strength from 7days to 28 days despite the fact that they have high initial strength, than the mixes with replacement.

D. The enhancement in compressive strength by mixing of Granulated blast furnace slag (GBFS) with 20% replacement is about 9.48% for 7 days curing and 7.39% for 28 days curing age.

E. In all replacement ratios, the flexural strength increases by the increase in slag ratio.

F. The enhancement in flexural strength by mixing of Granulated blast furnace slag (GBFS) with 20% replacement is about 8.02% for 7 days curing and 6.96% for 28 days curing age.

G. The split tensile strength increases with increase in percentage of steel slag up to 20% by weight of fine aggregate.

The enhancement in split tensile strength is about 11.95% for 7days curing and 6.20% for 28 days curing age.

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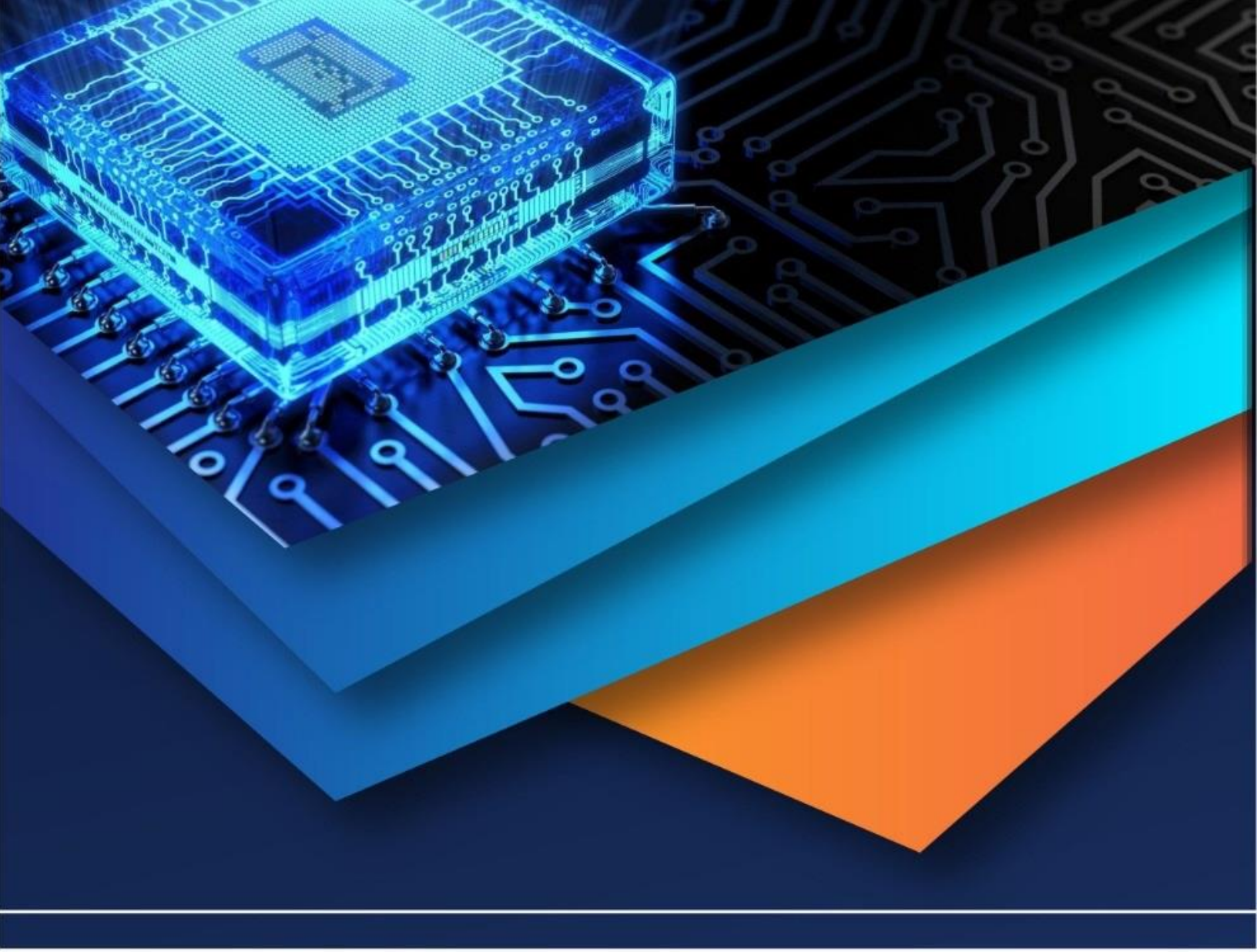

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