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Enhancement in Properties of Cement Mortar by using Iron based Material - Critical Review

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Abstract: ***The main constituents of cement mortar can give compressive strength up to a certain limit but the need of cement mortar in the construction industry are of higher compressive strength. Cement mortar is generally containing cement and fine sand and these are not capable to give us the desired strength. But these can alter the properties of cement mortar by using some additive in it. The iron-based waste is available in huge amount and these are a very good initiative to enhance the properties as well as to reduce the waste from the environment. There is rapid growth in the demand of iron and steel products which indirectly increases the production of waste material (i.e. Ground Granulated Blast-furnace Slag (GGBS), Fine Iron Powder (FIP) and Iron Swarf) These materials could not be decompose and affect the environment at very large scale. These waste materials may be recycled but using it as an additive in the cement mortar cause much less cost than the other method of recycling and the same time the strength of the mortar is also enhance. These iron based material cause to increase the properties of cement mortar as well as recycling the waste iron without any environmental effect. The Ground Granulated Blast-furnace Slag is using as additive in the cement mortar for enhancing its properties like compressive strength, reducing the drying shrinkage, heat of hydration, retard the setting time of cement. The Fine Iron Powder is also using in cement mortar and it also shows some alter in the properties of mortar. The compressive strength is decreased with increase in the amount of FIP on the other hand the flexural strength is increased with increase in the percentage of FIP.***
Keywords: Cement mortar, Blast furnace slag, Fine Iron Powder, Strength properties.

I. INTRODUCTION

The contribution of the construction and manufacturing industries is one of the seven dominant sectors as significant distributor for the increase of greenhouse gas.

The total greenhouse gas produce by buildings is 30% of the total production. Global warming and climate change due to the CO_2 emission is currently one of the most important issues in the world. One important source of CO_2 emission is from ordinary Portland cement (OPC) production. Development is needed everywhere, whether in life or in work. The development in construction industry is very rapid, as we are in the era of 21st century and the current aspect of researchers is totally concerned about the innovations in the construction and manufacturing industry with the concept of sustainability.

Iron slag is the waste produced during the processing of the pig iron this waste is generating because of the action of fluxes and gangue within the iron ore. Due to the composition of the iron slag this waste material is very useful in the enhancement of the strength properties of cement mortar.

As cement mortar mainly contains cement and fine aggregate and these materials are not sufficient to give desired strength without adding any additive in it. Many additives are using every day in the field of the research but the waste iron products are useful, as it gives waste management and on the same hand these give increment in the mortar properties. The cement mortar is a weak mixture of cement and fine aggregate which has low compressive strength and does not able to bear the heavy load acting on it. The aim of this study is to make the use of waste iron material in cement mortar. The waste iron material is act as a reinforcement and provide greater compressive strength to the cement mortar.

The iron-based material is generated from the steel industry. The demand in the steel industry affect the ecosystem in both direct and in indirect way. Directly by creating pollution indirectly by generating waste material like swarf, iron powder, etc. which are raising as a serious problem now a days.

These wastes might be recycled to effectly maintain the ecosystem. Pig iron is the most demanded iron in the industry and the main source to generate iron slag. The slag is the molten waste which is collected in separate chamber which are get into the form of slag by mixing different fluxes in the presence of pure oxygen.

Table. 1 Chemical Composition of blast furnance slag

Components of Blast Furnance Slag	Amount in Percentage (%)
Calcium oxide (CaO)	30-50
Silica Dioxide (SiO_2)	30-40
Aluminium Trioxide (Al_2O_3)	8-24
Magnesium Oxide (MgO)	1-18

II. LITERATURE INVESTIGATION

A. Nadeem et al.

Reported highlights upon the feasibility study for the utilization of granular slag as replacement of natural fine aggregate in construction applications (Masonry and plastering). Mortar split tensile strength increased in 1:3 & 1:4 mix proportions at 75% granular slag replacement by 15.97 & 16.0% respectively and in 1:5 & 1: 6 mix proportions the increase was observed 11.56 & 10.29 % at 50% replacement level. The increase in strengths at 100% replacement was noted as 6.08, 7.11 and 5.39% in 1:3, 1:4 and 1:5 mix proportions respectively and in 1:6 it was below 0.59% compared to 0%.

B. Humam et al.

The main problem with using converter slag in civil engineering is the possible presence of free lime; especially large-sized components of Heated undissolved limestone, because when it hydrates, its volume increases and this swelling can lift the top layers. The use of industrial by-products in mortar not only helps in reducing greenhouse gases but helps in making environmentally friendly construction materials. This study was undertaken to utilize large quantities of iron slag produced in India. So, this investigation explored the possibility of replacing part of fine aggregate with iron slag in mortar.

C. Bassam A. Tayeh, Doha M. Al Saffar

The effects of adding 10%, 20%, 30%, and 40% of waste IP as a natural sand replacement were assessed and compared. Waste iron are of two types: iron IP, which shows a similar particle size distribution to that of the sand used in making the samples, and fine iron powder (FIP), which contains fine particles. The compressive strength decreased with the increased amount of added IP in the mixtures, but it increased with the addition of 10% FIP and decreased gradually with the increased FIP level. By contrast, the flexural strength significantly increased with increased FIP in the mixtures.

D. Ishwar et al.

Substantial energy and cost savings can result when these industrial by-products will be used as partial replacements for the energy intensive Portland cement. The drawback in the use of GGBS concrete is that its strength development is considerably slower under the standard curing conditions than that of Portland cement concrete, although the ultimate strength is higher for the same water–cementitious ratio.

E. Chetan Khajaria, Rafat Siddique

As slag is an industrial by- product, its productive use grants a chance to relocate the utilize of limited natural resources on a large scale. Iron slag is a byproduct obtained in the manufacture of pig iron in the blast furnace and is produced by the blend of down-to-earth constituents of iron ore with limestone flux. The slags can be used as cement major constituents as they have greater pozzolanic properties.

III.DETERMINATION FROM LITERATURE REVIEW (DRAWBACK)

A. The review has brought the need for systematic investigation of use of cement mortar with various composition of waste iron material.

B. The waste iron by-products are easily available at cheap rate and may be used to enhancing the properties of cement mortar and preventing the environment from bad impact of it.

C. Majority of research work is carried out in the field of concrete, a few had done in the case of cement mortar. Research on waste material also very few as compared to the new material. There is may be due to lacking of awareness in using waste material.

D. The mixing proportion are still a query as it is not very user friendly.

IV. NEED OF PRESENT STUDY

The re-examine of literature had done to enlighten the importance of waste iron material in today's world and it shows very good influences in gaining desired strength with traditional cement mortar. Iron waste by-products are available in huge amount at every iron industry. With the use of these waste the cement mortar gets its strength as well the porosity of the cement mortar gets reduced up to a certain limit. As the iron has property of tensile strength so, therefore its waste must have the tensile strength properties, not actually same but might have somehow of the new one.

V. CONCLUSION

This paper furnishes the review of iron-based waste on enhancement of the strength of cement mortar. Annually thousand tons of iron slag is produced from the forging industry as a waste. Different amounts of waste iron-based additives are used in the mortar and gives a significant increment in its strength properties. As the above review indicates a critical need of utilization of iron waste in the mortar which are created by the iron industries and by utilizing the iron waste in the cement mortar, we get the solution to both, the increment in the compressive strength of the mortar as well the controlling of industrial waste which is a major problem of the ecosystem.

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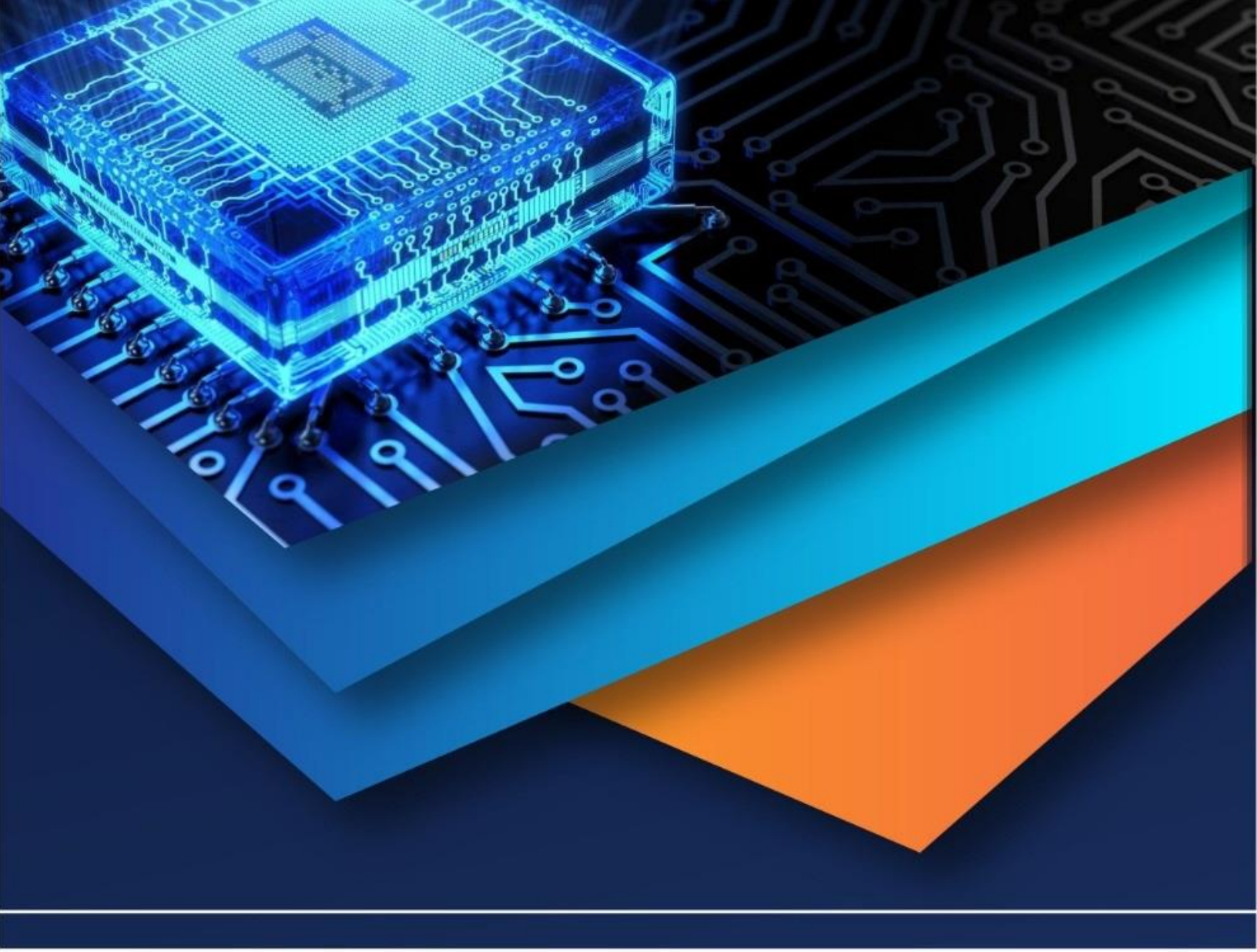

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