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Experimental Investigation of Acid Attack on Concrete with Marble Powder and Green Sand as Fine Aggregate Replacement

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Abstract--In this research, there is a need to recognize suitable alternative material in place of river sand. Thus the locally available and less expensive material Metakaolin, Green sand and Marble powder has been accepted as alternative material for natural sand. The purpose of this is to study the durability property of concrete with the replacement of fine aggregate. Concrete mix of M40 with Marble powder and green sand replacement of 5%, 10%, 15% and 20% with fine aggregate and Metakaolin replacement is about 5% by weight of cement. Cubes, Cylinders and beams are to be casted, cured for the respective mix proportions and the strength characteristics of concrete such as compressive strength, split tensile strength and flexural strength and durability of cube concrete at 28 days, 56 days and 90 days to be performed. The suitability of the replacement materials for fine aggregate has been assessed by comparing its strength and durability properties with that of conventional concrete.
KeyWords--High Strength Concrete, Metakaolin,Micro-structure study.

I. INTRODUCTION

In recent years, it is becoming more and more difficult to dispose of great quantities of waste materials into the ground. Hence, there is a great need to utilize various industrial waste products in appropriate manner in construction industry to reduce health and environmental problems. Recycling of green sand and marble powder can save energy, reduce the need to mine virgin materials, and may reduce costs for both producers and end users. Use of these industrial wastes in construction offers to enhance green sustainable construction. In this project by adding green sand and marble powder as partial replacement for fine aggregate, metakaolin also used as partial replacement by adding with the cement.

Initiatives have been taken on a global and national level to regulate waste management. Regulations have become increasingly rigorous and consequently, options which are still rarely used at present, such as minimizing or recycling waste, are becoming economically attractive. All recycling and reuse of waste products involves research aimed at acquiring a full understanding of such products in order to determine suitable and specific applications. Foundry sand is high quality silica sand with uniform physical characteristics. Foundries attempt to reuse as much of sand as possible within the foundry process itself, but eventually a fraction becomes spent and unsuitable for further foundry processes.

II. LITERATURE REVIEW

Amritpal Kaur et al.,(2015) studied the strength and durability properties of concrete with partial replacement of cement with metakaolin and marble dust. The partial replacement of cement has been done at 0%,3%,5%,9%,12%,13% with MK (Metakaolin) and 0%,10% (constant) with MP (Marble Powder). Result shows that there is a gain of strength with the addition of MK and MP. The percentage of metakaolin and marble powder increases it decreases the rate of penetration of chloride ions. It is concluded that the Use of Metakaolin and Marble powder give green concrete

Dr Srinivasu K et al., (2014), made a review on the use Metakaolin in cement mortar and concrete. The test report showed that the cement replacement with 20% Metakaolin gave maximum enhancement in pore refinement of pastes and compressive strength got reduced when Metakaolin addition went beyond 30% as cement replacement. The viscosity and shear stress improved when Metakaolin was replaced to 10% and 15%respectively. It was reported that the durability property like resistance to chloride ion penetration was increased when replacement up to 0%, 4%, 6% and 8% were made.

Pathariya Saraswati C et al (2013) studied the use of waste foundry sand as a partial replacement by fine aggregate in concrete. An experimental study is carried out on a concrete containing waste foundry sand in the range of 20%, 40%, and 60% by weight for M-25 grade concrete(PPC). Compressive strength increases on increase in percentage of waste foundry sand as compare to traditional concrete. In this study, maximum compressive strength is obtained at 60% replacement of fine aggregate by waste foundry sand. Split tensile strength decrease on increase in percentage of waste foundry sand.

Sanjay N Patil et al.,(2013), carried out an investigation on Metakaolin–Pozzolanic material for cement in high strength

concrete. Metakaolin became an ample ingredient in the production of concrete for strength more than M40. The test results indicated that the use of Metakaolin resulted in the reduced pore size in cement paste and transformed many finer particles into discontinuous pores. It was also observed that the compressive and flexural strength increased. There has been reduction in the water permeability and efflorescence. Further, it was found out that Metakaolin produced better shrinkage and crack control.

Patil B B (2012), presented a thesis about the Strength and Durability Properties of High Performance Concrete incorporating High Reactivity Metakaolin. The desired workability was achieved with optimum Metakaolin of 7.5% and super plasticizer of 0.73%. The 28 days test of cube compression test indicated that concrete with 5%, 7.5% and 10% showed increase in strength the durability characteristics like chloride ion penetration and sulphate attack were also studied. The 7.5% addition of High Reactivity Metakaolin (HRM) has given enhanced resistance to chloride attack. The 7.5% addition of High Reactivity Metakaolin in cement has also enhanced the resistance to sulphate attack. The compressive strength of concrete incorporated with 7.5% HRM was reduced only by 6.01% as compared with the reduction of strength of control mix specimen by 9.29%.

Gurpreet Singh (2012), carried out an experimental research on the effects of waste foundry sand (WFS) as partial replacement of sand on the strength and permeability of concrete. The natural sand has been replaced with 0%, 5%, 10%, 15%, and 20% by WFS by weight. In this study, five concrete mix proportions with and without Waste Foundry Sand were made. Compression test and splitting tensile strength test were carried out to evaluate the strength properties of concrete at the age of 7, 28 and 91 days. In case of durability property, Permeability test was performed on all five mix proportion at the age of 28 and 91 days. From the experiments it was observed that partial replacement of sand with WFS (up to 15%) increased the strength properties of concrete. Maximum increase in compressive strength, splitting tensile strength and modulus of elasticity of concrete was observed with 15% WFS, both at 28 and 91 days. Based on the results it was suggested that WFS can be suitably used in making structural grade concrete.

III. MOTIVATION STUDY FROM THE REVIEWED LITERTURE

The reviewed literature shows that the increasing replacement of green sand and the marble powder gives the increase in the durability strength of the concrete. The addition of the metakaolin with the cement makes the concrete as the resistance of the sulphide attack. The percentage of metakaolin and marble powder increases it decreases the rate of penetration of chloride ions. The literatures also showed that the concrete produced better shrinkage and the crack control.

IV. CONCLUSION

In this present study, the Ordinary Portland Cement is to be replaced with Metakaolin, a similar pozzolanic material by 5% weight of cement. The river sand is then replaced with Green sand and Marble powder by 0% to 20% by weight with very increase in 5% by weight of sand. The water cement ratio is to be kept as 0.4. Superplasticizer is added to improve the workability of the concrete. Acid attack test, Porosity and Sorpitivity test are to be performed along with the compression test and flexural test. Further the variation in the micro structure in each mix are to be performed using Scanning Electron Microscopy.

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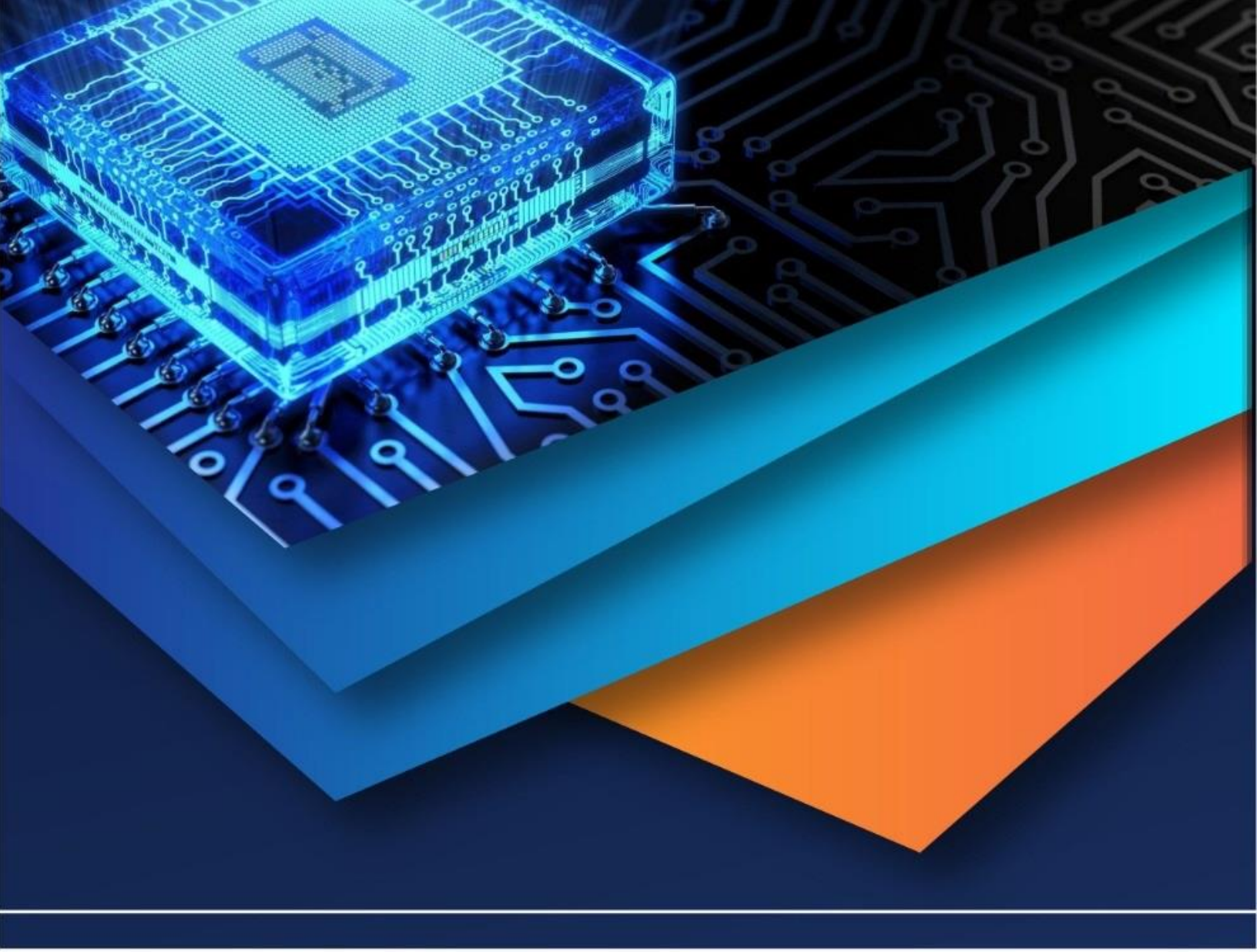

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