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Durability Study of Cement Mortar Replaced By Bottom Ash and Green Sand as a Fine Aggregate

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Abstract: ***The main purpose of this paper is to study the durability of cement mortar by using the bottom ash and the green sand to replace natural fine aggregate in the cement mortar products. In this study use high water cement ratio to conduct the experiment, in which the weight ratio of water/cement is 0.55 with the superplasticers 2.5%. The experiment uses bottom ashfine aggregates, which passes through 4.75mm sieve, and natural sand of the same size as the aggregate. The study shows that, based on the 1:3 cement/aggregate weight ratio while the bottom ash and the green sand is to be varied in proportion 10%, 20%, 30% by its weight of natural fine aggregates in cement mortar. Mortar compressive strength, split tensile strength, porosity, water absorption studies will be carried out and the best combination is to be selected based on the mortar strength.***
Keywords: water to binder ratio, superplasticers, green sand, bottom ash.

I. INTRODUCTION

A. General

Durability of a material, in general in defined as the service life of a material under given environmental conditions. A number of potentially destructive influences may interact with the mortar, these include water, frost, soluble salts and temperature change.Mortar is a material having tiny spaces through which liquid or air may pass.

Following factors are to be considered

1) The durability of mortar depends largely on the movement of water and gas enters and moves through it.
2) In general, as the cement content increases so will durability.
3) Mixing is one of the most important stages in the process of making mortar because the workability and strength of mortar depend so much on the way it is mixed and on the amount of water added to the mix.
4) highly depend on the water cement ratio, water absorption and pore structure.

In other case, the availability of natural fine aggregate is considerably minimum and cost of sand is more. Research made to replacement on fine aggregate to minimize its need. In this project, utilize two material as a replacement of fine aggregate such as bottom ash and green sand.

The coal ash collected at bottom of furnace is called bottom ash. Bottom ash particles are physically coarse, porous, glassy, granular and grayish in colour. Bottom ash particles forms up to *25%* of the total ash while fly ash forms the remaining *75%*. Bottom ash along with unutilized fly ash is disposed off in ponds spread over acres of land.Foundry sand is high quality silica sand with uniform physical characteristics. It is a byproduct of ferrous and nonferrous metal casting industries, where sand has been used for centuries as a molding material because of its thermal conductivity. Industry estimates that approximately 100 million tons of sand are used in production annually of that 6 - 10 million tons are discarded annually.Environment concerns are increasing day by day and land fill space is declining, therefore it becomes essential to initiate the effort to utilize the bottom ash and green sand. Bottom ash and green sand has the appearance and particle size distribution similar to the natural fine aggregate i.eriver sand. Owing to the fact that in many areas of the world there exists a shortage of natural aggregates, the utilization of ash produced in power generation plants is receiving increased attention.

The utilization of industrial waste or secondary materials has minimized dumping or disposal of waste materials causes environmental and health problems. Therefore, recycling of waste materials is a great potential in concrete industry. For many years, by-products such as bottom ash, green sand were considered as waste materials. These material is effectively replaced by fine aggregate, hence reduce the use of fine aggregates. Mortar is to be prepared with such materials varying proportion and strength is to be calculated after desirable curing period.

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II. REVIEW OF LITERATURE

Min-Jen Yang has investigatedthe Effects on Strengths of Cement Mortar When Using Incinerator Bottom Ash as Fine Aggregate. The study shows that based on the 1:2 cement/aggregate weight ratio, Incinerator bottom ash fine aggregates mortar, unit weight around 1.8 g/cm3, is 20% lighter natural fine aggregate mortar, unit weight around 2.2g/cm3. The Incinerator bottom ash fine aggregates mortar can only reach 60%-70% the compressive strength of natural fine aggregates mortar. Direct tensile strength and flexural tensile strength tests are 15% and 30% of compressive strength respectively, due to the irregular strength development, which does not follow general concepts, such as low W/C ratio and mineral admixtures will not necessarily help in strength development in Incinerator bottom ash fine aggregates mortar.

NorathirahBtRadzihas investigated the Effect of coal bottom ash on the properties of cement mortar such as workability, chemical characteristics and pozzolanic activity are presented. Coal bottom ash (CBA) were utilized in partial replacement for fine aggregates and cement respectively in the range 10%, 20% and30%. Kapar coal bottom ash satisfies the requirement of ACI 213 for fine lightweight aggregate because it has 100% passing the No.4 sieve size (5.tm). The result of compressive strength and degree of hydration shown the 10% replacement has the highest pozzolanic activity due to hydration processed. The workability using bottom ash replacement showed that bottom ash has much higher water absorption ratio as compared to the natural sand since the workability decreased with the increasingly of bottom ash replacement.

Augustine UchechukwuElinwa has evaluated on the use of spent foundry sand (SFS) in the production of concrete has been carried out. The material SFS, was properly characterized and used in proportions of 0 %, 10 %, 20 %, 30 % and 40 % by weight of fine aggregate and cured under laboratory conditions for up to 90 days. The results obtained showed that the SFS used satisfied the ACI Code of practices on the use of SFS, and also has pozzolanic properties. The work also confirmed that SFS can substantially reduce the effects of absorption in concrete to about 8 % to 28 %, when cured for 90 days and at different replacement levels. This is good for durability of concrete. However, the compressive strength decreased as the replacement levels increased and performed optimally at 10 % replacement.

Chamundeswari has investigated the strength and other durability factors by using foundary sand as a partial replacement in concrete. Foundry Sand can be used as a partial replacement of cement or as a partial replacement of fine aggregates or total replacement of fine aggregate and as supplementary addition to achieve different properties of concrete.In the present study, effect of foundry sand as fine aggregate replacement on the compressive strength, of concrete having mix proportions of 1:1.39:1.69 was investigated. Fine aggregates were replaced with three percentages of foundry sand. The percentages of replacements were 10, 20 and 30 % by weight of fine aggregate. Tests were performed for compressive strength, split tensile strength and modulus of elasticity for all replacement levels of foundry sand at different curing periods (7-days & 28-days).

III. ABOUT PROJECT

Cement mortar and concrete also have some setbacks such as, delayed hardening, low tensile strength, large drying shrinkage and low chemical resistance. The motivation of this study is to evaluate the durability characteristics of hardened cement mortar by using various supplementary materials.

In the present investigation, the feasibility of using cement mortar by replacing with materials such as bottom ash and green sand will be examined experimentally. This study is done to overcome the following,

A. To reduce the emission of CO_2 of cement.
B. To reduce dredging of natural sand from river.
C. Utilizing the industrial waste or by product and to protect environment.
D. Minimize the need of natural fine aggregate

This project deals with the replacement of fine aggregate by bottom ash and green sand in cement mortar. In this research, both admixture are use in proportion from 10%, 20%, 30% replaced by mass of natural sand in control mix. In this phase, literature review, collection of material and material properties were studied. In second phase various combination of mix proportion will be studied. The suitable water cement ratio is to be found by trial and error method. Mortar thermal resistance of mortar, split tensile strength, porosity, water absorption studies will be carried out and the best combination is to be selected based on the mortar strength.

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IV. CONCLUSION

The reviwed literature review shows that the workability using bottom ash replacement showed that bottom ash has much higher water absorption ratio as compared to the natural sand since the workability decreased with the increasingly of bottom ash replacement. The XRF testing shown the bottom ash is safely to be used since this material is not harmful and classified as a pozzolanic material. As a conclusion, the presence of bottom ash as sand replacement in cement mortar increased the quantity of water. The weak microstructure obtained with the use of bottom ash is responsible for the decrease in compressive strength. While up to 10% of sand replacement with this admixture will give optimum strength and for further replacement of foundry sand other binding enhancing admixtures to be used. Since percentage of silt and clay is much more than the normalriver sand, hence it is affecting the bonding property of mortar.

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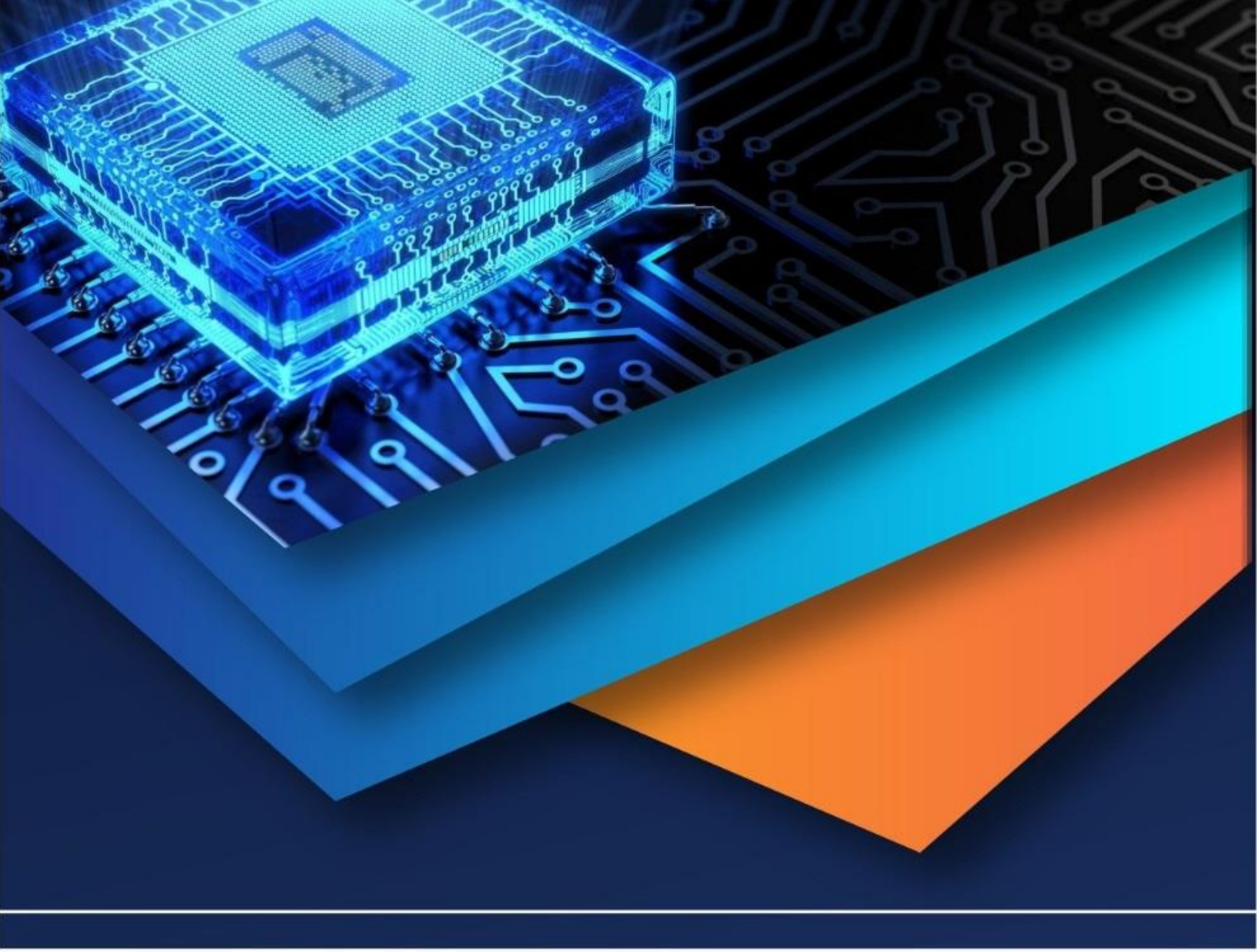

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