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BRIEF REVIEW ON BOTTOM ASH AS A PARTIAL REPLACEMENT OF FINE AGGREGATE IN ADDITION WITH PPF

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ABSTRACT

Bottom ash is a hazardous by-product from coal based thermal power plants. In this study fine aggregate in concrete mix has been replaced with bottom ash and Polypropylene fibre is additionally used to enhance the strength characteristics of concrete. The concrete mix design is done for M25 grade concrete. The mix is prepared for different combinations of 0%, 10%, 20% and 30% of replacement of sand by bottom ash with 0.5% of polypropylene fibre by total weight of the Cube. The mechanical properties were compared with control mix and it was found that the optimal combination as 30% bottom ash and 1.0% polypropylene fibre. Flexural strength was compared by testing beams of size 1.5 x 0.25 x 0.15m under two point loading. Results showed that there was no degradation of strength for beams with bottom ash as replacement for fine aggregates

Keywords— Bottom ash, Polypropylene fibre, Fine aggregate, Flexural strength.

INTRODUCTION

Concrete is a material synonymous with strength and longevity and it has been emerged as dominant construction material for the infrastructure needs of the twenty-first century. Concrete industry is drawing upon enormous natural resources. One day these natural resources will become extinct which compels for replacement of these materials with alternate materials. The search for a compatible material to replace sand in concrete become very vital in the light of the world facing serious problem due to the decreased availability of river sand. In India, over 70% of electricity generated is by combustion of fossil fuels, out of which approximately 61% is contrived by coal-fired plants. This results in the origination of around 100 ton of ash. Most of the ash has to be disposed of either dry, or wet to an open area serviceable near the plant or by grounding both the fly ash and bottom ash and mixing it with suitable amount of water and

pumping into artificial lagoon or dumping yards this brings out the pollution in water bodies and ruin of productive land. The untiring slackening of natural resources and the environmental imperils posed by the disposal of coal ash has approached appalling proportion such that the use of coal ash in manufacturing of concrete is imperative than a desire.

LITERATURE SURVEY

Satish Sharma [1] investigated to utilize bottom ash as part replacement of sand in concrete and manufacture of concrete blocks without flyash & with bottom ash for making solid blocks as per specification laid down in Indian Standard: 2185 using vibro compaction machine. Three different sources of bottom ash were used in concrete mix each @ 30%, 40% & 50% replacement by weight of sand for making concrete blocks. Comparative study of compressive strength of concrete at different age of curing, wet density, drying shrinkage is reported in this study. Concrete Blocks having bottom ash at 30% by weight of sand are found suitable for use in the manufacture of concrete blocks. Wet density is found to be lower in blocks containing bottom ash & dry shrinkage values are found well within the limits of specifications. M.P.Kadam [2] observed the compressive strength which was increased up to 20% replacement and after that compressive strengths were decreased from 30% to 100% replacement. The split tensile strength was increased for 10% to 30% replacement and after that it was decreased for remaining replacement. The flexural strength was increased for 10 %, 30 % replacement and after that it was decreased. The densities of hardened concrete linearly decreased as the replacement ratio of bottom ash was increased from 10% to 100% as compared to controlled concrete. It was found that the Modulus of Elasticity decreased in accordance with an increase in replacement of natural sand by bottom ash. The modulus of elasticity for 10 % replacement was increased by 1.55 % to 1.24% for 10% and 20 % replacement respectively. It is found that the permeability up to 30 % replacement, decreased and after that permeability was increased from 60 % to 100 % replacement.

T.Subramani [3] discussed the Strength of concrete containing bottom ash, fly ash and of glass at the ratio of 1:2:1.5 was high compared with that of the conventional mix. Cement replacement level of fly ash in concrete mixes was found to obtain higher value of the durability and strength. 40 % replacement of fly ash, cost is reduced up to 45 % on Cement by cost analysis. Glass is used as coarse aggregate to reduce the weight of concrete. Fine aggregate cost has been reduced by using bottom ash. A Jayaraman [4] investigated by addition of nano-Silica leads to a significance increase in the durability and characteristic strength of concrete. Remya raju [5] investigate the effect of use of coal bottom ash as partial replacement of fine aggregates, concrete properties such as splitting tensile strength test, compressive strength, flexural strength and modulus of elasticity and also the effect of micro silica having maximum compressive strength. Workability decreased with the use of coal bottom ash as a replacement of fine aggregate in concrete. Splitting tensile strength of concrete improved at percentages of replacement of bottom ash. The modulus of elasticity decreased with the use of coal bottom ash at all replacement

levels. Compressive strength of bottom ash concrete was increased compared to control concrete. Abhishek Sachdeva [6] evaluates the suitability of coal bottom ash as a partial replacement of fine aggregates in concrete. Morphology of the coal bottom ash shows irregular and a complicated texture of particles having rough surface resulting in the increase of inter particle friction, thus decreasing workability. Workability decreases with the increase in levels of sand replacement by coal bottom ash because bottom ash is more porous; therefore absorb more water than sand. A marginal decrease was observed, both in the compressive strength and flexural strength up to 20% replacement level. Therefore, 20% of fine aggregates may be replaced with coal bottom ash and a concrete with good strength may be produced with coal bottom ash in concrete. A decrease in strength of concrete with the increase in levels of fine aggregate replacement by coal bottom ash is due to the replacement of the stronger material with the weaker material. C.Mathiraja [7] utilize industrial waste in concrete as cement replacement and manufacturing sand as fine aggregate replacement. The workability of concrete made with fibre showed reduction in workability. The compressive strength of concrete containing bottom ash showed better strength when compared to other mixes.

Vikas R Nadig [8] studies the workability of bottom ash concrete reduces with the increase in bottom ash content due to the increase in water demand. The density of Bottom Ash concrete decreases with the increase in bottom ash content due to the low specific gravity of bottom ash as compared to fine aggregates. Splitting Tensile strength of sand replaced bottom ash concrete will be lower than normal concrete specimens at all the ages. Flexural strength of fine aggregate replaced bottom ash concrete will be lesser than normal concrete specimens at all the ages. Compressive strength of sand replaced bottom ash concrete will be lower than normal concrete specimens at all the ages. Strength characteristics of Bottom Ash Concrete can be improved by adding suitable fibers and incorporating other materials. Water absorption is more Bottom Ash Concrete compared to conventional concrete .Mohd Syahrul Hisyam bin Mohd Sani [9] presents the use of Washed Bottom Ash as fine aggregate in special concrete. The Washed bottom ash is a waste material that is taken from electric power plant and the source material is bottom ash and investigated the feasibility and potential use of washed bottom ash in concreting and concrete applications. Different concrete mixes with constant water to cement ratio of 0.55 were prepared with Washed Bottom Ash in different proportions as well as one control mixed proportion. The mechanical properties of special concrete with 30% Washed Bottom Ash replacement by weight of natural sand is found to be an optimum usage in concrete in order to get a favorable strength and good strength development pattern over the increment ages

. Mahapara Abbas [10] Studies coal bottom ash is used as partial replacement of sand and Waste limestone dust as partial replacement of cement in concrete. These two are the waste materials and their utilization in concrete proves economical. The result showed that at fixed water cement ratio the strength and durability increased initially at small percentages and later when the percentage of replacement is increased the strength and durability decreased. Pramod s. Patil [11] modifies concrete mix, with addition of plastic aggregate replacing conventional aggregate up to certain percentage gives strength with in permissible

limit. Rajendra P [12] presents the experimental result of flexural strength of Polypropylene fiber in concrete with natural and artificial sand. The Polypropylene fibers of different aspect ratios with different volume fractions by weight of cement were used for reinforcing the concrete. Concrete mix was prepared with natural sand as a normal mix and mix with optimum percentage of natural sand and artificial sand was used. Due to incorporation of fibers, considerable improvement in flexural strength was observed. Dr.T.Ch.Madhavi1 [13] investigated copper slag concrete with addition of polypropylene fibers showed considerable increase in strength. The maximum strength was achieved by replacing forty percent fine aggregate with copper slag. Further addition of copper slag reduces the strength and concluded 0.2% of polypropylene and 40% of copper slag is the most optimum value.

L.B. Andrade [14] investigates the influence of the use of coal bottom ash as a replacement for natural fine aggregates on the properties of concrete in the fresh state. Tests for water loss through bleeding, and the determination of the setting times and plastic shrinkage, were carried out in order to evaluate the material in the presence of bottom ash. The influence of the porosity of bottom ash on the potential water absorption and water loss of the material, as well as on the water consumption of concretes produced with bottom ash, is also discussed. The results showed that in the fresh state the concretes produced with the bottom ash are susceptible to water loss by bleeding and the higher the percentage of bottom ash used as a natural sand replacement the lower the deformation through plastic shrinkage. The results also showed that the setting time is affected by the presence of bottom ash in the concrete. M.V. Krishna Rao [15] addresses the shear and shear behaviour of polypropylene fibre reinforced fly ash concrete deep beams. The shear span to depth ratio of the beams used is 2.0. The test results indicate that compressive strength of concrete increases with the increasing percentage of fibre. There has been a significant increase in flexural and shear strengths of polypropylene fibre reinforced fly ash concrete, in all the mix proportions, as fibre content increased from 0% to 1.0%. However, the ultimate failure was observed to be gradual in all the beams.

J.A. Larbi and R.B. Polder [16] investigated the explosive spalling of pieces of concrete from the heated surface is considered to be the most dangerous effect of damage of concrete subjected to intense fire attack, especially when it occurs in restricted areas such as underground tunnels. Recent investigations have revealed that the amount of explosive spalling and the extent of cracking can considerably be reduced by use of suitable amount of polypropylene fibres. A good insight into the behaviour of the fibres when applied in concrete, especially when subjected to fire, can help optimize their use to reduce explosive spalling and integrated microscopic method consisting of stereomicroscopy and polarizing and fluorescent microscopy were used to assess the effectiveness of the poly propylene fibres in reducing explosive spalling in concrete elements subjected to fire attack. Rapid Chloride Migration test was also performed on standard specimens to establish whether the presence of the fibres might adversely affect the permeability and durability of the elements. Mazree Othuman Mydin [17] studies the impacts of volume fraction of polypropylene fibre on the bending behaviour of lightweight foamed concrete before and during exposing it to high temperature is experimentally studied. Effect of adding polypropylene

with different volume fraction on the flexural strength and pore structure of each considered density. The outcomes demonstrated that an increasing temperature had a detrimental influence on of lightweight foamed concrete property especially in a temperature range of 200 to 600 °C degrees. Light weight Foamed Concrete with higher density achieved higher bending resistance as it had smaller and more uniform voids compared to Light weight Foamed Concrete with lower density and higher loads were required to break it down. The larger content of Polypropylene fibre led to an increased amount of pores in concrete structure and at elevated temperature a larger number of cracks were induced due to evaporation of more fibers and replacement of them by air voids led to significant reduction in flexural strength of Light weight Foamed Concrete.

CONCLUSION

A brief study is made and to carry out experiment with four different Concrete mixes is prepared with 5% bottom ash and 0.5% polypropylene fibre, 15% bottom ash and 1% polypropylene fibre, 25% bottom ash and 1.5% polypropylene fibre and normal mix. As a result of literature survey, it has been concluded that the replacement of fine aggregates with bottom ash and polypropylene leads to conserve the natural resources and utilization of waste materials from coal fired power plant.

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