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A REVIEW PAPER ON STRENGTH PROPERTIES OF CONCRETE BY PARTIALLY REPLACING CEMENT WITH TERNARY MATERIALS NAMED AS A75.

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Abstract — *Concrete a composite material made from cement, water, fine aggregate and coarse aggregate. The worldwide production of cement has greatly increased since 1990. Production of cement results in a lot of environmental pollution as it involves the emission of CO2 gas. Supplementary cementitious materials (SCM) are finely ground solid materials that are used to replace a portion of the cement in a concrete mixture. But present researchers are in interest of finding new cement materials by waste materials or waste products produced from industries which are harmful to environment. The aim of study is partial replacement of cement with A75(silica fume metakaolin) and determine the compressive strengths for all mixes at the age levels of 24 hours , 7 days and 28 days. Besides the compressive strengths other properties like compaction factor, slump and water absorption of concrete are determined for five mixes of concrete. The other test for beam and cylinder also should be noted and compare the split tensile strength and flexural strength results.*

Keywords- Supplementary cementitious materials (SCM), silica fume , metakaolin, A75.

I. INTRODUCTION

Concrete is a widely used construction material for various types of structures due to its structural stability and strength. The Ordinary Portland Cement (OPC) is one of the main ingredients used for the production of concrete and has no alternative in the civil construction industry. Unfortunately, production of cement involves emission of large amounts of carbon-dioxide gas into the atmosphere, a major contributor for green house effect and the global warming, hence it is inevitable either to search for another material or partly replace it by some other material. The increasing scarcity of raw materials and an urgent need to protect the environment against pollution has accentuated the significance of developing new building materials based on industrial wastes. Silica fume is one such waste generated from Ferrosilicon industries and is creating unmanageable disposal and utilisation problems due to its potential to pollute the environment.

Metakaolin (MK) is one of the recently developed supplementary cementing materials for high-performance concrete. It is produced by calcining purified kaolinite clay at a specific temperature range to drive off the chemically bound water in the interstices of kaolin and destroy the crystalline structure, which effectively converts the material to the MK phase, which is an amorphous aluminosilicate. Silica fume is much more reactive than fly ash or any other natural pozzolana. The reactivity of pozzolana can be quantified by measuring the amount of $Ca(OH)_2$ in the cement paste at different times.

II. LITERATURE REVIEW

Various work has been carried out using silica fume and metakaolin. Here review of papers has been conducted on the mix proportion, mechanical and durability properties of Concrete. The various research work carried out are as follows.

N. K. Amudhavalli , Jeena Mathew (1) studied M35 grade concrete with partial replacement of cement by silica fume by 0, 5, 10, 15 and 20%. In this paper authors has presented detailed experimental study on Compressive strength, split tensile strength, flexural strength at age of 7 and 28 days and also found the effect of acid attack on durability of concrete and the loss in percentage as compared with the normal concrete. They take water binder ratio of 0.36 and weigth of super plasticizer was estimated as 0.65% of weigth of binder. Total 30 cubes , 30 cylinders and 30 prisms of size (150 mm x 150 mm x 150 mm) , (300 mm x 100 mm) and (150 mm x 150 mm x 750 mm) respectively . Suitability of silica fume has been discussed by replacing cement with silica fume at varying percentage and the strength parameters were compared with conventional concrete.

Dilip Kumar Singha Roy, Amitava Sil Studied on the nature of silica fume and its influence on the properties of fresh and hardened concrete. In this paper , an attempts to be made on the strength parameters of concrete made with the use of silica fume in place of cement. It should also be noted the various properties of fresh as well as hardened concrete like strength , durability , permeability and cohesiveness. There will be little works also been carried out on the low graded cement like M 20 , M 25 in which cement is partially replaced by silica fume.

Debabrata Pradhan, D. Dutta (2013)(3) studied that the different mechanical properties of concrete like compressive strength, compaction factor, slump including silica fume. In this paper different percentage of silica fume are used for cement replacement at constant eater cement ratio of 0.50. there was five different mixes used to perform the experiments. The cement replacement level of silica fume are 0% ,5% ,10% ,15% ,20% at fixed water cementinious material ratio keeping other mix design parameters constants. 100 and 150 mm cubes are used to determine the compressive strength for all mixes at the age of 24 hours, 7 days and 28 days.

Prof. Vishal s. Ghutke, prof. Pranita s. Bhandari(4) studied that the main objective of this research work is to determine the optimum replacement percentages which can be suitably used under the Indian conditions. To fulfill the objective various properties of concrete using silica fume have been evaluated. Further to determine the optimum replacement percentage comparison between the regular concrete and concrete containing silica fume is done .It has been seen that when cement is replaced by silica fume compressive strength increases up to certain percentage (10% replacement of cement by silica fume).But higher replacement of cement by silica fume gives lower strength. For this study, M 20 grade of concrete and two water cementitious ratios are used (w/cm 0.5, w/cm 0.6), the quantities of materials used for two w/cm ratio are worked out. Four types of concrete mix are prepared, the first one (type I) was conventional concrete (0% Silica Fume) with w/cm ratio 0.5, the second one (type II) was conventional concrete (0% Silica Fume) with w/cm ratio 0.6, the third (type III) was combination of Portland cement and various % of silica fume (5%, 10%,15%, 20% and 25%) with w/cm ratio 0.5 and the fourth one (type IV) was combination of Portland cement and various % of silica fume (5%, 10%,15%, 20% and 25%) with w/cm ratio 0.6.

P Rattish-Kumar, C B K Rao(2013) (5) studied that The program consisted of designing silica fume concrete mixes for too normal strength grade concretes with various percentages of silica fume contents from 0 -50% (as partial replacement for cement) in increments of 10%. The program consisted of designing silica fume concrete mixes for too normal strength grade concretes with various percentages of silica fume contents from 0 -50% (as partial replacement for cement) in increments of 10%. M15 and M20 grades of concrete were designed based on the above method incorporating Reduction Factor with various percentages of silica fume contents up to a maximum of 50% in the cement plus silica fume content of a particular mix. 120 Cube specimens were cast and tested for compressive strength at 7 and 28 days for the time grades of silica fume concretes and for five different replacements.

Eric Opoku Amankwah, Mark Bediako, C. K. Kankam (6) studied that the paper presents results of a study on concrete mixes containing two types of calcined clay pozzolanas obtained from Mankranso and Tanoso for structural application. Mankranso sample is labeled Type I whilst Tanoso also labeled as type II.Both clay samples were analysed to determine their physical and geotechnical properties whilst the chemical composition of the calcined clay samples analysed.Portland cement was replaced with 0%-25%Type I and 0-30% of Type II pozzolanas to formulate binder pastes and concretes. Setting times and normal consistency test were determined on the formulated binder paste. Three grades of concrete (25N/mm^2, 30N/mm^2 and 40N/mm^2) containing pozzolana were prepared and their workability, density, compressive strength and flexural strength investigated against the plain concrete. This study recommends up to 20% clay pozzolana content of both Types I and II for concrete grades of 25N/mm^2, 30N/mm^2 and 40N/mm^2.

III. SUMMARY OF LITERATURE REVIEW

To summarize the review of research works on concrete containing ternary material , the following observations are made.

1. M15 and M20 grades of concrete were designed based on the above method incorporating Reduction Factor with various percentages of silica fume contents up to a maximum of 50% in the cement plus silica fume content of a particular mix. It is observed that the strength gain between 7 and 28 days of concrete containing silica fume is higher than concrete without silica fume.
2. Metakaolin is a cementitious materials used as an admixture to produce high strength concrete and is used for maintaining the consistency of concrete. In the case where insufficient or poor curing concrete structure like the underground structure which undergo serve loss of compressive strength, use of metakaoline proves to be very useful to modify the properties of concrete.
3. Concrete containing ternary material like silica fume and meta kaoline and found that tests carried out on standard specimens gives an average value of M30 in compression for M20 and tensile strength of 6MPA and a flexural strength of 8 To 10 MPa. The results well complied with results of most of the researchers.

IV. CONCLUSION AND FUTURE WORK

In this paper I have focused on possibility of getting high strength concrete by replacing various materials which are mainly ternary materials. From above review I can easily see the lots of opportunity in concrete with use of ternary materials. This work will clear my view on understanding the concrete in a better way to get more and more strength and it will help me in getting more strength by using A75 which is one of the ternary material including 75% as meta kaoline and 25% as Silica fume as a main inters. We can also made such kind of different materials with using more and more combination of cementatious materials.

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