International Journal of Scientific Research & Engineering Trends
Volume 5, Issue4, July-Aug-2019, ISSN (Online): 2395-566X

Review on Properties of Concrete Using Silica Fume and Met kaolin as Partial Replacement of Cement

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***Abstract*- The replacement of cement by various mineral admixtures as supplementary cementing materials for concrete has gained a global attention in recent years. This replacement becomes efficient not only by increasing the strength and durability of the concrete but also reduces the usage of the ordinary cement thereby curtailing the environmental hazardous due to cement manufacturing industries. This paper reviews the work carried out on the use of silica fume (SF)and Metakaolin (MK) as supplementary cementing materials for the partial replacement for cement. The literature demonstrates that both Silica Fume and Met kaolin are effective and causes significant improvement in various properties of the concrete in both fresh and harden state.**

***Keywords*- Mineral admixtures as supplementary, Met kaolin**

I. INTRODUCTION

In civil engineering construction field concrete is one of the most commonly used construction material throughout the world. Its production is greatly increased worldwide. In the production of concrete no poisonous substances are emitted but emission of carbon dioxide Co2 gas is more in the production of cement clinker. This is making significant contribution to green house gases thereby causing environmental pollution. This is the only ecological disadvantage in the production of cement. This effect can be reduced by reduction of cement consumption by using supplementary cementations' materials (SCM's).

Supplementary cementations' materials (SCM's) are finely grounded solid materials which are used to part replacement of cement in concrete mixtures. SCM's may be naturally occurring, manufactured or man-madewaste. SCM's may posse's pozzolanic or latent hydraulic reactivity or combination of both of these.Pozzolan term refers to siliceous materials which are in finely divided form. In the presence of water pozzolonsreact with calcium hydroxide (CH) chemically to form cement compounds.

Pozzolans can be either natural or industrial origin. Natural pozzolans contains volcanic ash and diatomaceous earth. Some examples of artificial pozzolans are Metakaolin (MK), Silica Fume (SF), Fly ash (FA), Ground granulated blast furnace slag (GGBS),Rice husk ash (RHA). Metakaolin is obtained by thermal activation of ordinary clay and kaolinitic clay. It is processed with water to remove the impurities to make 100% reactive pozzolan. Silica fume is obtained from the effluent gases produced in the manufacturing of silicon metal and alloys. By using the supplement arycementing pozzolanic materials the strength parameters of concrete can effectively enhanced. Huge quantities of these by-products are wasted either in low-value applications such as landfills, road sub basesor simply disposed by stockpiling and ponding. Recent research has shown that blending of pozzolanic materials with Portland cement improves the several advantages such as lowering the heat of hydration, increased anticorrosion characters, impermeability, and durability of concrete.

II. LITERATURE REVIEW

M.antoni et al (2012) carried out a thermo gravimetric analysis for characterization of pozzolanas reaction by concrete containing MK and limestone. Paste samples 40 mg of pieces were used for testing. The paste sample with 30% Meta kaolin was showed an effective reduction in the calcium hydroxide even as early as day 1. But the blend with 60% total replacement (40% MK and 20% of limestone) shows a stronger reduction in CH content. Even it shows a nearly complete consumption of CH after only 7 days.

S. Durai et al (2013) presented the effect of silica fume and glass fibre in High Performance Concrete (HPC). In this study, High Performance Concrete mixes with silica fume of 0%, 10%, and 20% with addition of glass fibre of diameter 14µ and 12mm length at various percentages as 0%, 0.3%, and 0.6% by the volume of cement on M75 grade of concrete. The mix proportions of concrete had a constant binder of 0.26 and super plasticizer was added based on the required degree of workability. For each mix standard sizes of cubes, cylinders and prisms as per Indian Standards were cast and tested for compressive strength, split tensile strength and flexural strength at the age of 28 days. The addition of silica fume shows early strength gaining property and that of glass fibre control the cracking due to shrinkage. The results are satisfactory for the use of 10% silica fume and 0.3% glass fibre in producing High Performance concrete.

Himanshu Shukla et al (2014) presented the effect of metakaolin (as a partial replacement of port land pozzolona cement (PPC)) on strength of steel fiber reinforced concrete. An experimental investigation was carried out to evaluate the compressive and split tensile strength of steel fibre reinforced concrete made using PPC and 1% of steel fibre. The PPC replacement (with metakaolin) level varied between 10-16% by weight of cement at an interval of 1%. M-25 referral mix at 0.46 water cement ratio was used. The cube specimen and cylinder specimen were cast and tested for determination of compressive and split tensile strength of concrete at different replacement levels. It was observed that at 12% replacement level, compressive and split tensile strength increased substantially as compared to the referral concrete.

R. Madheswaran et al (2014) focused on the compressive strength performance of the blended concrete containing different percentage of silica fume and Fly Ash and steel fiber as a partial replacement of OPC. The cement in concrete is replaced accordingly with Silica fume content was use from 0% to 10%in the interval of 2% in weight basis and also fly ash content was use from 10% in weight basis. So to improve the strength of concrete steel fibers were added 0.5%, 1%, 1.5%, 2% by weight of steel fiber. Concrete cubes are tested at the age of 3, 7, and 28 days of curing. Finally, the strength performance of Fly ash and silica fume blended fiber reinforced concrete is compared with the performance of conventional concrete. From the experimental investigations, it has been observed that, the optimum replacement Fly ash and silica fume to cement and steel fiber without changing much the compressive strength is 10% -8 % & 1.5 % respectively for M25 grade Concrete.

Kamaldeep Kaur et al (2015) investigation was carried out on concrete containing metakaolin and polypropylene fibre at various proportions of 0%,7%, 8% and 9%of metakaolin and 0%, 0.2%, 0.5% and 0.8%of polypropylene fibres. Fly ash and superplasticizer has been added to improve the workability of concrete at a constant percentage i.e. 10% and 0.7% respectively. It has been observed that addition of MK and PPF showed considerable improvement in the strength of concrete. Further it has been observed that optimum gain in compressive strength is at 8% of MK and 0.8%of PPF.

Shashikant Dewangan, Nidhi Gupta (2016) carried out experiment on M 20 grade and M 50 grade of concrete in this concrete we have tested slump test. Vee bee test and Compacting Factor of concrete.

Shashikant Dewangan and Nidhi Gupta (2016) carried out experiment on M 50 grade of concrete in this concrete cement was replaced by metakolin in various percentages such as 5%, 10%, 15%, 20%, 25% concrete specimens containing metakaolin were studied for their compressive strength.

III. CONCLUSION

The utilization of the industrial by product and other natural minerals as supplementary cementitious materials has been investigated widely for recent years. The work reviewed demonstrates that both MK and SF is an effective supplementary cementitious materials and these materials are effective in consumption of Port landite and helps in early strength and has considerable effect in long term strength. Both SF and MK helps in filling the pore and thereby reducing pore structures in cement paste. The cost and environmental impact of the both MK and SF is comparatively less compared to OPC. Wider realization of the benefits of MK and SF in concrete will lead to greater demands and this will leads to cost effectiveness and reduces the environmental impacts due to cement industry.

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