STUDY ON FLEXURAL STRENGTH OF HIGH PERFOMANCE CONCRETE USING VARIOUS PROPOTIONS OF METAKAOLIN

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Abstract- Due to the growth of construction industry and major infrastructure project , there is a huge demand for cement as a building material and It also creates environmental problems ,some of them being increasing of CO2 and results emission of heat .Then there should be higher strength is to provided .The attempt has been made to compare, the 7days and 28 days compressive strength and Split tensile strength of concrete by using metakaolin with the normal concrete of M60 grade with maintaining water cement ratio.The objective of this study is to develop concrete with good strength.Thus the cement can be replaced by metakaolin which is artificial clay .That varying percentage of metakaolin is added as 5%,10%,15% to the concrete mixture in order to improve the performance of concrete. Blending these materials with ordinary Portland cement can improve the cementing and mechanical properties of cement .These days use of metakaolin is tremendously gaining popularity in partial replacement of cement due to its fineness in improving strength and parameters of mortars and concrete.

Keywords: Metakaolin,concrete, compressive strength and Split tensile strength.

1.INTRODUCTION

Concrete is basically a mixture of cement, fine and coarse aggregates. Concrete is an extraordinary and key structural material in human history. Concrete holds the credit of being the most widely utilized tailored or man-made material in the construction industry and will hold good for the years to come. High performance concrete is a concrete mixture, which possess high durability and high strength when compared to conventional concrete. This concrete contains one or more of cementious materials such as fly ash, Silica fume or ground granulated blast furnace slag and usually a super plasticizer. The term 'high performance' is somewhat pretentious because the essential feature of this concrete is that it's ingredients and proportions are specifically chosen so as to have particularly appropriate properties for the expected use of the structure such as high strength and low permeability. Metakaolin is a dehydroxylated form of the clay mineral kaolinite . stone that are rich in kaolinite are known as china clay or kaolin , tradionally used in the manufacture of porcelain.Considered to have twice the reactivity of most other pozzolans , metakaolin is a valuable admixture for concrete cement applications. Considered to have twice the reactivity of most other pozzolans , metakaolin is a valuable admixture for concrete cement applications . Replacing Portland cement with 8-20% (by weight) metakaolin produces a concrete mix , which exhibits favourbale engineering properties , including the filler effect , the acceleration of OPC hydration ,and the pozzolanic reaction occurs between 3and 14days

2.METHODS AND MATERIAL PROPERTIES

2.1Methodology:

Mix design of M60 concrete was done with various propotions of metakaolin. The curing was done for 7and 28 days , after the hardened tests of compressive ,flexural and tensile were made on specimen for the strength test**.**

2.2MATERIAL PROPERTIES

2.2.1Metakaolin

Metakaolin is a dehydroxylated form of the clay mineral kaolinite . stone that are rich in kaolinite are known as china clay or kaolin , tradionally used in the manufacture of porcelain. The particle size of metakaolin is smaller than of cement particles ,but not as fine as silica fume

The quality and reactivity of metakaolin is strongly dependent of the characteristics of the raw material used . Metakaolin can be produced from a variety of primary and secondary sources containing kaolinite

The T-O clay mineral kaolinite does not contain interlayer water. The temperature of dehydroxylation depends on the structural layer stacking order. Disordered kaolinite dehydroxylates between 530 and 570º , ordered kaolinite between 570 and 630ºC . Dehydroxylated disordered kaolinite shows higher pozzolanic activity than ordered

The adsorption surface properties of the metakaolins can be accomplished by inverse gas chromatography analysis

Considered to have twice the reactivity of most other pozzolans , metakaolin is a valuable admixture for concrete cement applications . Replacing Portland cement with 8-20% (by weight) metakaolin produces a concrete mix , which exhibits favourbale engineering properties , including the filler effect , the acceleration of OPC hydration ,and the pozzolanic reaction occurs between 3and 14days

Chemical composition	Metakaolin (%)
Silica (Sio_2)	54.3
Alumina (Al_2o_3)	38.3
Ferric oxide(Fe2o3)	4.28
Calcium oxide(Cao)	0.39
Magnesium oxide(Mgo)	0.08
Sodium oxide(Na_2o)	0.12
Potassium oxide(K_2o)	0.50
Sulphuric anhydride(So_3)	0.22
Loss on ignition(LOI)	0.68
Blaine (m^2/kg)	150000
Specific gravity	2.5

3.LITERATURE SURVEY

An extensive review was carried out to study the design of high performance concrete with metakaolin . The review also focuses on the strength and durability aspects of using HPC. Though there are a number of research papers available or lower grade of concrete using metakaoine only a limited number of publication are available on the HPC using metakaolin and structural behavior of reinforced concrete. The literatures pertaining to this topic are given below in brief

Prof. R.M. Sawant, Dr. Y.M. Ghugal-Volume - 4,Issue-12,pp- 08-14[1].Due to worldwide infrastructural development, since 20th century use of concrete has tremendously increased which resulted in heavy manufacturing of cement. Various types of pozzolonic materials viz.fly ash, silica fume, metakaolin, blast furnace slag etc. are available which has cementeous properties.Blending these materials with ordinary portland cement can improve the cementing and mechanical properties of cement.It can be concluded that the partial replacement of cement by metakaolin has a good influence on the strengths of the cement mortars and concrete. It increases strengths of all basic properties viz. compressive strengths, flexure strengths, split strengths, tensile strengths etc.

B. B. Patil, P. D. Kumbhar Volume-3 Issue-4 2009 March[2] Strength and Durability Properties of high performance concrete incorporating High Reactivity Metakaolin.Concrete is probably the most extensively used construction material in the world. The addition of mineral admixture in cement has dramatically increased along with the development of concrete industry, due to the consideration of cost saving, energy saving, environmental protection and conservation of resources. Mineral admixtures such as fly ash, rice husk ash, metakaolin, silica fume etc are more commonly used in the development of HPC mixes. The results of the study indicate that the workability and strength properties of HPC mixes improved by incorporating HRM up to a desirable content of 7.5% by weight of cement.

P.Dinakar,Pradosh K.Sahoo and G. Sriram Volume -4 Issue-2 2011[3] Effect of metakaolin content on the Properties of High Strength Concrete This study presents the effect of incorporating metakaolin (MK) on the mechanical and durability properties of high strength concrete for a constant water/binder ratio of 0.3.MKmixtures with cement replacement of 5, 10 and 15 %were designed for target strength and slump of 90 MPa and 100 ± 25 mm. From the results, it was observed that 10 % replacement level was the optimum level in terms of compressive strength. From the results, it was observed that 10 % replacement level was the optimum level in terms of compressive strength.The results shows that by utilizing local MK and cement designed for a low water/binder ratio of 0.3, high strength and high performance concretes can be developed and compressive strengths of more than 100MPa can be realized.

SanjayN.Patil1,AnilK.Gupta,SubhashS.DeshpandeVolume3,Issue7July2015[4]Metakaolin-pozzolanic material for cement in high strength concrete. The infrastructure development is an important aspect for the overall development of country. India is developing as a major hub for service industry, automobile industry and for which the infrastructure development plays an important role. The necessity of high strength concrete is increasing because of demands in the construction industry.

Shaikh Mohd Zubair1, S.S. Jamkar -2015 August[[5]Now a day's high performance concrete is

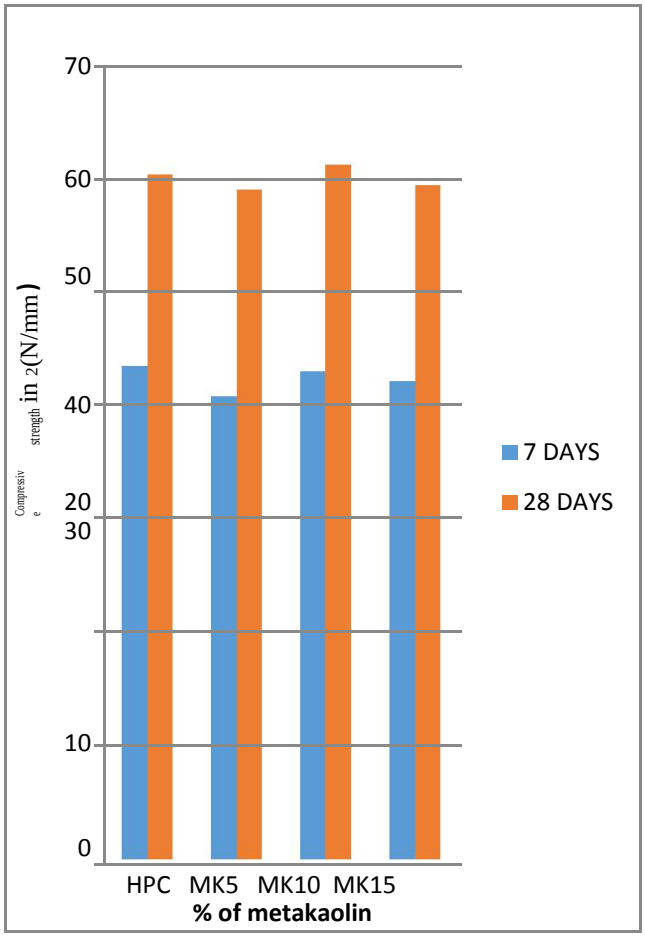
globally used in the infrastructure industry for strong and durable structure, to produced high performance concrete various supplementary cementitious material are used as mineral admixture. This research involves the use of Fly ash, Alccofine and Silica fume at various proportions to enhance the compressive strength of high performance concrete. the investigation was carried out by replacing 10% fly ash along with 17% of alccofine and 10% fly ash along with 17% of silica fume by weight of cementitious material. To cover a wide range of compressive strength of concrete various water binder ratio (W/b) of 0.25, 0.3 and 0.35 were used. The effect of various parameters such as percentage replacement of mineral admixture, water to binder ratio and corresponding compressive strength is studied on fresh and hardened state of concrete. The study mainly consisted of establishing relation between these parameters graphically. Investigation demonstrates that alcofine performs batter than that of silica fume along with fly ash in fresh and harden state

SudarsanaRao.Hunchate1,Sashidhar.Chandupalle2,Vaishali.G.Ghorpode3 and Venkata Reddy.T.C4 - 3, March 2014[6]High Performance Concrete (HPC) now a days used widely in the construction industry world wide. To produce HPC with normal ingradients we use mineral admixtures like Silica fume, fly ash and metakoline and workable agents Superplasticizers are also used. The usage of mineral admixtures in the concrete not only enhances its strength properties but also durability. The compressive strength are investigating finding the optimum use of mineral admixture(Silica fume of levels 0, 5, 10,15, 20 and 25% at 7 days and 28 days.

4.RESULT AND DISCUSSION

After testing the properties of fresh concrete mix on HPC, concrete cubes,cylinders, prisms were cast for studying the properties of hardened concrete .The following tests were carried out on hardened concrete of various HPC

S.NO	MIX	7Days	28Days
1	HPC	4.72	5.16
2	MK5	4.56	5.43
3	MK10	4.81	5.71
4	MK15	4.63	5.56



4.1Graphical representation of Flexural strength

S.NO	MIX	7Days	28Days
1	HPC	3.53	4.52
2	MK5	3.11	4.2
3	MK10	3.39	4.81
4	MK15	3.25	4.67

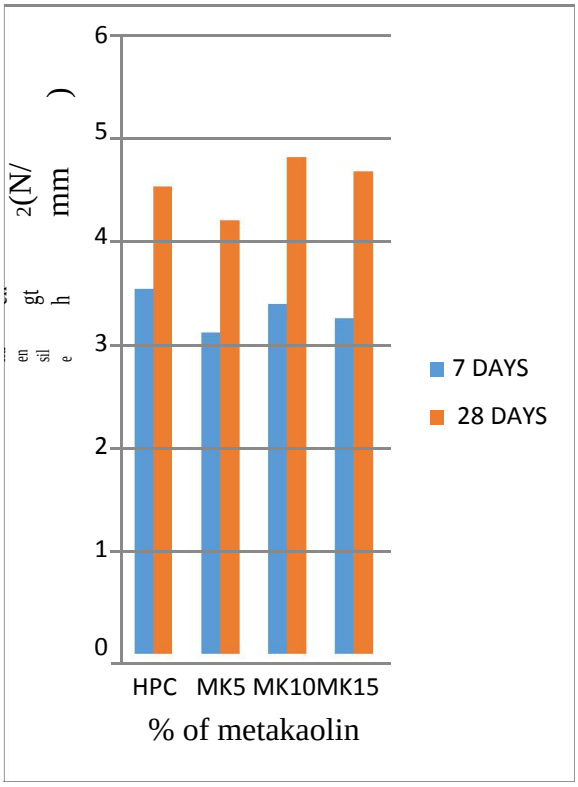


FIG: 4.2 Split tensile strength

5.CONCLUSION

- It can be concluded that the partial replacement of cement by metakaolin has a good influence on the strength of the cement mortar.
- The mineral morpology of both cement and metakaolin being identical contributes as a better binding material.
- It can be derived by use of 8%to 12% metakaolin by weight of cement with metakaolin from 1to 3% by weight cement.
- Cement replacement upto 10% with metakaolin leads to increase in compressive strength ,splitting tensile strength for both M60 grade
- There is a decrease in workability as the replacement level increase and water consumption was more for higher replacement.
- Use of metakaolin gives significant result on properties of concrete as compared to normal concrete.

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