Experimental & Analytical Study of Mechanical Properties of Concrete with MKC

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ABSTRACT

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

The mechanical properties of concrete like compressive strength, split tensile strength and flexural strength are enhanced with the addition of metakaolin. The gain of strength of metakaolin concrete with age is much more compared to that normal concrete. Thus metakaolin can be used in the production of concrete to achieve high strength. Using proper admixture in mix gives high variation in result, like early strength, high workability and water reduce.

In this work metakaulin are used varying percentage of replacement of cement, its used as cementations material in concrete. In this work we was used 0 to 25 % of replacement by weight of cement at interval of 5 % and study behavior mechanical properties of concrete.

Also for validation we was developed short python coding program for compressive strength, split tensile strength, & flexure strength

Key Word:- Metakaulin, Compressive strength, Split tensile strength, & Flexure Strength

INTRODUCTION

The production of Portland cement is not only costly and energy intensive, but it also produces large amount of carbon emission. The production of one to of Portland cement produces approximately one ton of CO_2 in the atmosphere. Limestone is a raw material available in nature; it is primary need for production of cement material. Earlier it was used directly to form silica flume mortar as a binding material in construction.

Supplementary cementitious materials are often used to reduce cement contents and improve the workability of fresh concrete, increase strength and enhance durability of hardened concrete. SCMs used in the manufactured concrete products industry as well as a review of blended cements. There are various types of supplementary cementitious material as fly ash, silica fume, slag cement, metakaolin, rice husk ash, coconut shell etc. Out of these metakaolin is used to investigate the mechanical properties of concrete by various experiments.

Metakaolin is refined kaolin clay that is fired under carefully controlled conditions to create an amorphous aluminosilicate that is reactive in concrete. Like other pozzolans (fly ash and silica fume are two common pozzolans), metakaolin reacts with the calcium hydroxide (lime) byproducts produced during cement hydration.Metakaolin is a dehydroxylated form of the clay mineral kaolinite. Rocks that are rich in kaolinite are known as china clay or kaolin, traditionally used in the manufacture of porcelain. The particle size of metakaolin is smaller than 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: High purity kaolin deposits, Kaolinite deposits or tropical soils of lower purity, Paper sludge waste (if containing kaolinite), Oil sand tailings (if containing kaolinite).

Aim & Objective

An experiment investigation was carried out to evaluate strength of concrete cured by using Metakaolin at normal curing condition.

1. Prepare concrete mix for conventional concrete also for M 30
2. Study behavior of conventional concrete and M30 grade of concrete with Metakaulin with varying percentage by replacement of weight of cement.
3. Study Mechanical properties of metakaulin concrete.

4. Develop short python coding program for validation of strength.

System Development

In this chapter we are dealing with mix design of concrete as per IS recommendation. Mix proportion of M35 grade concrete has been design under the guidance of IS 456-2000.

The Indian standard (IS 10262-1982) is followed to design the mix for M35 grade concrete with above parameter.

In M30 grade, the concrete mix with Metakaolin is 0, 5, 10, 15, 20 & 25 % of the cement content.

For determining the influence of Metakaolin in the concrete, the following parameters were selected,

Grade of concrete = M30,

Water/cement ratio = 0.43

% replacement of cement with metakaolin =0, 5, 10, 15, 20, 25.

Compressive strength, Splite tensile & Flexure Strngth= 28 days.

Following instruction of test programs we have design M30 grade concrete mix using 0%, 5%, 10%, 15%, 20%, 25% metakaolin with replacement of cement as binding material.

Table No.1 Mix design of M30

MATERIAL	MIX FOR 1 m^3 (kg)	FOR 0.031 m^3 (kg)
W/C	0.43	
Cement	380	11.54
Crush Sand	881	27.31
Aggregate	1135	35.18
Water	163	5.05
Admixture	4.56	-

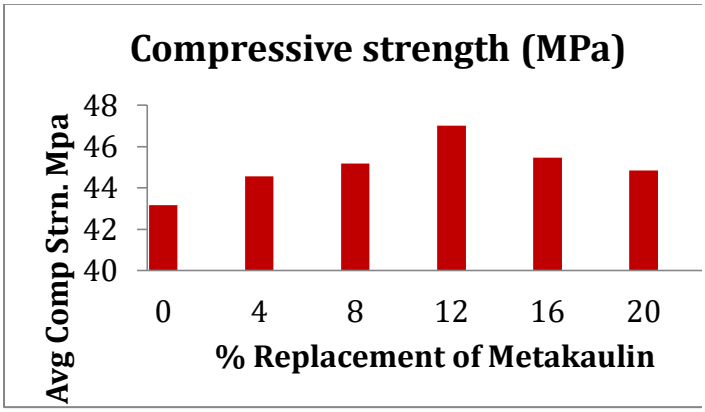

Fig.1. Cube Testing

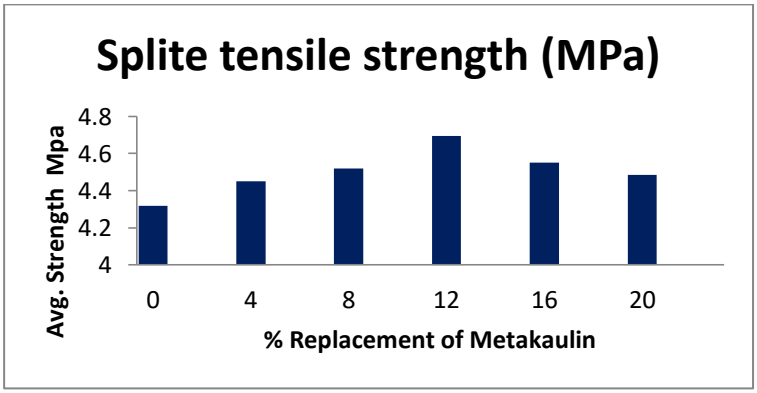

Fig-2 Test result of 28 days Cylinder

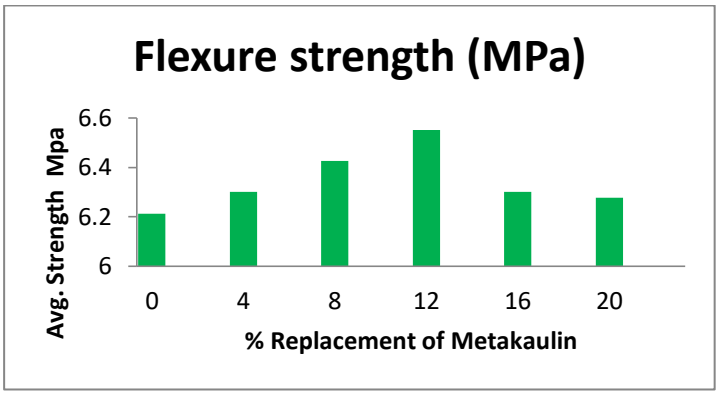

Fig-3. Test result of 28 days Beam

CONCLUSION

1. Due to addition of Metakaolin, quantity of cement reduced.
2. Make cement concrete more dence and thus improve durability.
3. The mechanical properties of concrete like compressive strength, split tensile strength and flexural strength are enhanced with the addition of metakaolin.
4. Cement replacement up to 12%with metakaolin leads to increase in compressive strength foe M35 grade of concrete and from 16% there is decrease in compressive strength. Therefore the optimum dose of metakaolin for achieving higher compressive strength is 12%.
5. The splitting tensile strength increase about 12% replacement level of metakaolin , then decrease with increase in the metakaoline percentage. Therefore optimum dose of of metakaolin for achieving higher split tensile strength is 12%.
6. The gain of strength of metakaolin concrete with age is much more compared to that normal concrete. Thus metakaolin can be used in the production of concrete to achieve high strength.

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7. Using proper admixture in mix gives high variation in result, like early strength, high workability and water reduce.
8. We have developed short coding program in python and also check strength, coding used to find strength of cube, cylinder & beam.

Scope for Future Work

The present work has good scope for future research. Some of the research areas are as follows:

- Investigation of ductility characteristics of MKC with steel fibers for potential application in seismic design and construction
- Behaviour under creep and shrinkage.
- Behaviour of mechanical and physical properties of MKC at low temperatures.

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