Effect of Metakaolin On Compressive Strength Of Concrete

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Abstract- *Metakaolin is a cementitious material 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 structures like the underground structure undergo severe loss of compressive strength, use of metakaolin proves to be very useful to modify the properties of concrete. This paper deals with the properties of concrete with varying percentage replacement of metakaolin in M-25 greade of concrete. The mix M1,M2,M3 and M4 were obtained by replacing 0,5,10 and 15 percent mass of cement by Metakaolin. The test results indicated that admixture metakaolin when used at optimum quantity tends to increase the strength of the concrete mix when compared with conventional concrete.*

Keywords- Metakaolin, Compressive Strength, OPC.

I. INTRODUCTION

Concrete is the most widely used and versatile building material which is generally used to resist compressive force. By addition of some pozzolanic materials, the various properties of concrete viz, workability, durability, strength resistance to cracks and permeability can be improved. Many modern concrete mixes are modified with addition of admixture, which improve the microstructure as well as decrease the calcium hydroxide concentration by consuming it through a pozzolanic reaction.

Metakaolin is a pozzolanic material which is manufactured from selected kaolins, after refinement and calcination under specific conditions. It is a highly efficient pozzolana and reacts rapidly with the excess calcium hydroxide resulting from OPC hydration by a pozzolanic reaction, to produce calcium silicate hydrate and calcium aluminosilicate hydrates.

G.Murali and P.Sruthee[1](2012) studied that when metakaolin is used as a partial replacement for Portland cement, it tends to improve the compressive strength of concrete. **Vikas kumar and Rakesh kumar[2](2012)** investigated the effect of silica fume and metakaolin combination on concrete. They reported that the combination of these materials, the compressive strength of concrete and the workability both are improved. **P. Dinakar[3](2013)** reported on the behavior of a metakaolin on properties of high strength concrete.

II. EXPERIMENTAL INVESTIGATION

Materials

Cement:- In this experimental investigation ordinary Portland cement of 43 grade (JP cement) was used.

Fine Aggregates:- The fine aggregates used in this investigation was Narmada River sand passing through 4.75 mm sieve with specific gravity of 2.64. The percentage of passing is within the limits as Indian Standard Specification.

Coarse Aggregates:- Machine crushed broken stone angular in shape was used as coarse aggregates. Two fraction of coarse aggregates were used, 20mm size having specific gravity of 2.84, and 10mm size having specific gravity of 2.80.

Water:- Ordinary tap water clean, potable free from suspended particles and chemical substances was used for both mixing and curing of concrete.

MIX PROPORTIONS

Table 1 The mix proportion for different mixes M1,M2,M3 and M4 are given below.

Mix	Cement (kg/m^3)	Metakaolin (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	W/C
M1	372	0	698	1238	0.50
M2	352.40	18.6	698	1238	0.50
M3	334.80	37.20	698	1238	0.50
M4	316.20	55.80	698	1238	0.50

Grade of Concrete:- The mix proportion of this investigation was **1:1.87:3.32** and **M25** grade of concrete was adopted.

Preparation of Specimens:-

The strength characteristics of concrete with varying percentages of metakaolin were studied by casting cubes. The constituents of the concrete viz, cement, fine aggregate and coarse aggregate were mixed to appropriate proportions by adding water. Metakaolin is added to the different mix in varying proportions as a partial replacement for cement. Moulds for cube of size 150x150x150mm were prepared and concrete was poured into the mould layer by layer and vibrated thoroughly. The specimens were removed from the moulds after 24 hours and then the specimens were cured with water for 28 days.

Result and Discussions :-

It was found from the experimental results that the compressive strength has increased for the specimens with varying percentage of metakaolin as replacement for cement when compared with the conventional concrete. The test results obtained are presented in table 2.

Table 2 Compressive Strength

Mix	% of Metakaolin	Compressive Strength (N/mm^2)
M1	0	31.8
M2	5	35.35
M3	10	37.6
M4	15	32.7

Table 3 Compressive Strength

Mix	% of Metakaolin	Compressive Strength (N/mm^2)
M1	0	49.37
M2	5	52.16
M3	10	55.54
M4	15	49.74

It is observed that 10% replacement of cement with metakaolin increased the compressive strength of concrete by 21.3%. The other percentage of mrtakaolin such as 5 and 15 percentages also showed considerable increase in strength characteristics of the concrete when compared with the conventional concrete.

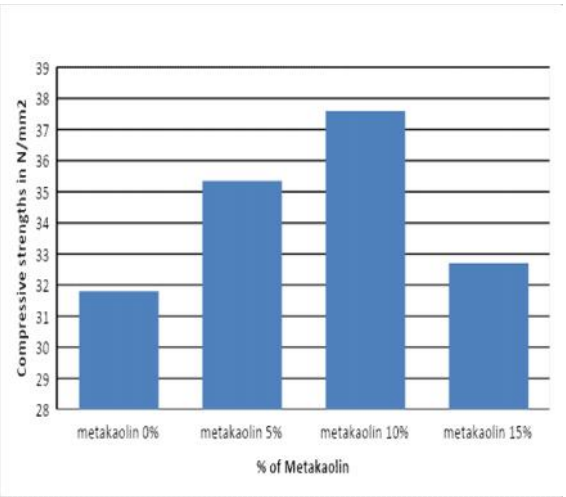

Figure 1. Testing of Specimens

III. CONCLUSION

The Admixture metakaolin when used at optimum quantity tend to increase the strength of the M20 concrete mix when compared with conventional concrete.

- The 28 days compressive strength of concrete generally increase with the metakaolin content upto its optimum content.
- 5% of metakaolin increased the compressive strength of concrete by 14%.
- 10% of metakaolin increased the compressive strength of concrete by 21.3%.
- 15% of metakaolin increased the compressive strength of concrete by 5.5%.

The Admixture metakaolin when used at optimum quantity tend to increase the strength of theM40 concrete mix when compared with conventional concrete.

- The 28 days compressive strength of concrete generally increase with the metakaolin content upto its optimum content.
- 5% of metakaolin increased the compressive strength of concrete by 8 %.
- 10% of metakaolin increased the compressive strength of concrete by 16 %.
- 15% of metakaolin increased the compressive strength of concrete by 7 %.

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