INFLUENCE OF HIGH REACTIVE META KAOLIN ON FLEXURAL STRENGTH OF CONCRETE

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Abstract- The present study is directed to understand contribution of High reactive Meta kaolin on flexural strength of high strength concrete. Experimental investigation was carried out over water cement ratio varying from 0.32 to 0.40. OPC replaced by HRM raging from 5-15% by the weight. For all mixes compressive strength was determined at 28 days. It was observed that the optimum replacement percentage is not a constant one but it depends on water cement ratio of the mix. Test result reveals that w/c ratio 0.38 produces compressive strength nearly equals to target mean strength for all replacement levels. It also improves flexural strength of concrete for all replacement levels.

Keywords-High strength concrete, High reactive meta kaoline, Flexural strength, super plasticizer etc.

1.0 INTRODUCTION

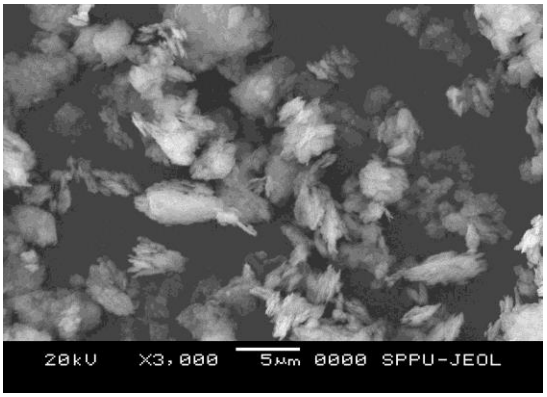
A newly developed high-reactivity metakaolin (MK) is additional cementing materials for high-performance concrete. Metakaolin formed by giving thermal treatment to purified kaolinite clay at a different temperature range precisely to drive off the chemically bound water in the interstices of kaolin and killing the crystalline structure, ultimately converts the material to the MK phase, which is an amorphous alumina silicate. MK advances concrete performance by reacting with calcium hydroxide to form secondary C-S-H. MK hold both pozzolanic and micro filler characteristics reported in literature, (Poon et al. 2001; WildandKhatib1997; Wild et al. 1996). It can be used successfully for the development of high strength self compacting concrete using mathematical modelling (Dvorkin et al. 2012). From the literature the less test analysis and data are available for the performance of the commercially available MK and Indian cements for high strength concrete in the India, (Basu2003;Basu et al. 2000, Pal et al. 2001, Patil and Kumbhar2012). The objective of the present research was to explore the effect of using HRM obtained commercially as pozzolana on the development of high strength concrete designed for a very low w/c ratio 0.38 and its behaviour under flexure.

2.0 EXPERIMENTAL INVESTIGATION

An experimental program was designed to produce a high strength concrete by adding several combinations of MK. The materials used and the experimental procedures are described in the following sections.

2.1 MATERIALS

The following materials were employed:
The cement used in all mixture was normal OPC (53grade) conforming to IS: 12269 (BIS 1987). Commercially available MK was used as mineral additive. The Scanning electron microscopy pattern of the MK used in this study is shown in Fig. 1.Good quality aggregates have been procured for this investigation. Crushed granite with nominal grain size of 20 mm max. and well-graded river sand of maximum size 4.75 mm were used as coarse and fine aggregates, respectively. The specific gravities of aggregates were determined experimentally. The coarse aggregates with specific gravities of 2.65, whereas the fine aggregate had specific gravity of 2.60.
Commercially available MYK SAVEMIX SP111 based high range water reducing admixture (SP) was used in all the concrete mixtures.



. Fig.1 Image 5µm

2.2 EXPERIMENTAL PROCEDURES

Trials mixtures were prepared to obtain target strength of 68.25 N/mm for the control mixture at 28 days and the

water/binder ratio for all the mixtures were kept constant at0.38. The details of the mixtures for the study are presented in Table1. Four different mixtures (MK0, MK5, MK10 andMK15) were employed to examine the influence of low water to binder ratio on concretes containing MK on the mechanical and durability properties. The control mixture (MK0) did not include MK. In mixtures MK5, MK10 and MK15, cement content was partially replaced with 5, 10, and15 % MK (by mass) respectively. The binder consists of cement and MK.

Table 1Mix Proportion

Mix Designation	% replacement of OPC	Deflection of beam (mm)	Design Compressive strength, N/mm²	Flexural strength, N/mm²	Average Flexural strength, N/mm²
MK5	5%	0.8	68.25	7.50	7.60
MK5	5%	1.2	68.25	7.70	
MK5	5%	0.7	68.25	8.20	
MK10	10%	0.8	68.25	8.2	8.183
MK10	10%	0.4	68.25	8.4	
MK10	10%	0.7	68.25	7.95	
MK15	15%	1.4	68.25	7.715	8.825
MK15	15%	2.4	68.25	8.82	
MK15	15%	2.2	68.25	9.94	

2.3 MIXING AND CASTING DETAILS

All the materials were mixed using a pan mixer. The materials were fed into the mixer in the order of coarse aggregate, cement, MK and sand. The materials were mixed dry for 2 min. Subsequently three-quarters of the water was added, followed by the Super plasticizer and the remaining water while mixing continued for a further 5 min in order to obtain a homogenous mixture.

The following specimens were cast from each mixture:

- Three 150 x 150 x150 mm cubes for the compressive Strength.
- Three 100 x 100 x 500 mm beams for the flexural strength

3.0 TEST RESULTS AND DISCUSSION

The Cube and Beam specimens were water cured for 28 days and tested under UTM. The result obtained are shown in Table 2

The result shows that increase in flexural strength more than 10% of design compressive strength also increase in deflection indicates enhancement in bending property.

Table 2 Flexural strength of High strength concrete of w/c ratio 0.38

Mix Designation	Water (Kg/m^3)	Cement (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)
MK0	167.5	441	673.56	1117.83
MK5	167.5	418.95	673.56	1117.83
MK10	167.5	396.90	673.56	1117.83
MK15	167.5	374.85	673.56	1117.83

4.0 CONCLUSION

The following conclusion can be drawn from the current study.

(a) Using MK as a partial replacement for cement decreased the plastic density of the mixtures.

(b) The results shows that by utilizing local MK and cement designed for a low water/binder ratio of 0.38 high strength concretes can be developed

(c) The concrete produced provides considerable flexural strength for all replacement levels.

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