ISSN: 2278-4632
Vol-10 Issue-12 No.03 December 2020

METAKAOLIN BASED ANALYSIS OF STEEL FIBRE REINFORCED CONCRETE

JAYASHREE BHUYAN
Assistant Professor, Dept. of Civil Engineering, Aryan Institute of Engineering & Technology, Bhubaneswar
SUBHRALINA SINGH
Assistant Professor, Department of Civil Engineering, Raajdhani Engineering College, Bhubaneswar, Odisha

MANGALASHRITA PARIDA
Department of Civil Engineering, NM Institute of Engineering and Technology,Bhubaneswar , Odisha

Abstract:
The necessity of metakaolin in steel fibre reinforced concrete to enhance the strength properties of concrete. In the present day construction industry needs of finding effective materials for increasing the strength of concrete structures. Hence an attempt has been made in the present experimental investigations to study the effect of addition of steel fibre at a dosage of 1.5% of the total weight of concrete as fibres. Metakaolin was used at 8% of the total weight of cement as metakaolin, and the addition of steel fibres at 1.5% and 8% of metakaolin. Experimental investigation was done using M40 mix and tests were carried out as per recommended procedures by relevant codes. The results were compared with control concrete it was observed that concrete blocks incorporated with steel fibre increased its compressive strength by 8.91% and tensile strength by 26.94%. Metakaolin and steel fiber blocks exhibited an increase in flexural strength of concrete in 58.28%.

Keywords: Fibre reinforced concrete, Flexural strength, Metakaolin, Steel fibre, Tensile strength

INTRODUCTION

In the Roman age there was of animal fat, milk, and animal blood as an admixture used in concrete for improvement of strength. Application of natural admixture and natural fibres, coconut coir, horse hair has been practiced since 1900. Use of admixtures of concrete in many form solid and liquid mainly solid admixture form obtained natural and artificial means in powder and fibre, mainly liquid admixture obtained in the form of chemical. Admixture in the form of HDPE, PP and steel fibres has been used now a days. Concrete in general weak in tension and good in compression. In this experimental investigation main focus on increasing the tensile strength of concrete by using hook ended steel fibers, as well as addition of metakaoline with steel fibres. The concept of composite materials came into being and fibre reinforced concrete was one of the topics of interest. There was a basic need to find a replacement for the asbestos used in concrete. In the previous studies HDPE, PP, steel and glass fibres were used in concrete, performed an investigation into new fibres reinforced concrete continues upto till date. The main goal of the investigator or concrete researchers is to improve the tensile strength and flexural strength of concrete. To optimize this serious defect partial incorporation of fibers is practiced. The experimental investigation performed on fibre reinforced concrete by numerous researchers in the last 20 years. Venue Malagavelli and Neelakanteswara Rao Paturu (2011), investi-gated the impact of cement bag waste (High Density Polyethylene (HDPE)) on concrete, and found that when the percentage of fiber in concrete was 3.5% its compressive and tensile strength increased considerably (Kandasamy and Murugesan, 2011). Murli *et al.* observed that the addition of waste materials like lathe waste, soft drink bottle caps, empty waste tins, waste steel powder from workshop at a dosage of 1% of the total weight of concrete as fibres. The lathe waste, empty tins, soft drink bottle caps was deformed into the rectangular strips of 3 mm width and 10 mm length, it was observed that concrete blocks incorporated wi th steel powder increased its compressive strength by 41.25% and tensile strength by 40.81%. Soft drink bottle caps reinforced blocks exhibited an increase in flexural strength of concrete by 25.88% (Murali *et al*., 2012). Ardeshana and

ISSN: 2278-4632
Vol-10 Issue-12 No.03 December 2020

Atul K Desai observed the Fibre Reinforced Concrete (FRC) is an ideal material for achieving these goals (Ardeshana and Desai Atul, 2012). Zainab and Enas (2010) observed that the mixture of iron filings and plastic waste materials could be used successfully as partialsubstitutes for sand in concrete composites (Venue Malagavelli and Neelakanteswara Rao Patura, 2011). Kandasamy and Murugesan (2011) added 0.5% by volume of polyethylene (domestic waste polythene bags) fiber to concrete and the cube compressive strength, increased by 5.12%, 3.84% and 1.63% respectively. Jadhao and Shelorkar (2013) observed that replacement of Metakaolin 8% of cement to increased compressive strength and decreased permeability (Jadhao and Shelorkar, 2013). Chitlange *et al.* (2010) observed that the increased flexural strength of concrete by using steel fibres. In the current investigation the effects on the properties of concrete when added hook steel fibres andMetakaolin were studied.

MATERIALS AND METHODS

Cement

Ordinary portland cement of 53 grades available in local market is used in the investigation. The cement used has been tested for various proportions as per IS 4031-1988 and found to be confirming to various specifications as per IS 12269-1987. The specific gravity was 2.96 and fineness was 3200 cm^2/g.

Coarse Aggregate

Crushed stone angular metal of 10 mm and 20 mm size from a local source was used as coarse aggregate. The specific gravity of 2.98

and fineness modulus 7.55 was found to be confirming to various specifications of as per IS: 383-1970 (Zainab *et al.*, 2011).

Fine Aggregate

Clean river sand was used as fine aggregate. The specific gravity of 2.98 and fineness modulus 3.05 was used in the investigation. It was procured from the Godavari river of Nashik. It was found to be confirming to various specifications of as per IS: 383-1970.

Meta-Kaolin

Metakaolin was Procured from 20 micron company Mumbai for this experimental work. The Metakaolin confirms to IS:456-2000.

Hook End Steel Fibre

It was procured from, Kasturi Metal Composite (P) Ltd. Amaravati. The company provided the material under the trade name of DURALFEX in accordance with ASTM-A820. The length of fibres 25 mm and diameter of fibres 0.4 mm and tensile strength was 1000 MPa according to specification.

Admixture

Dosage of EMCE PLAST BV as per following 200 g /50 kg of cement. The water used in preparing specimen and curing of the specimen was drinking water from NDMVSKBT college of engineering Nashik.

MIX PROPORTIONS

The concrete mix is designed as per IS 10262 – 2009, IS 456-2000 [12] and SP23 for the normal concrete. The grade of concrete which we adopted was M40 with the water cement ratio of 0.35.

TEST SPECIMENS

Cubes of size 150 mm X 150 mm X 150 mm, cylinders with 150 mm diameter X 300 mm height and prisms of size 100 mm X 100 mm X 500 mm were prepared using the standard moulds. The samples are cast using the four different combinations as control concrete, with metakaoline, with steel fibre, and with steel fibre and metakaoline. The samples are demoulded after 24 h of casting and kept in a water tank for 28 days curing. A total of 144 specimens is cast for testing the properties such as compressive strength, split tensile strength and flexural strength. The details of the specimen and their notations are given below in the Table 1.

RESULTS AND DISCUSSION

After the detailed experimental investigation of different strength parameters has been done, the following results have been found.

1. The specimen added with metakaolin and steel fibre have significant results over the

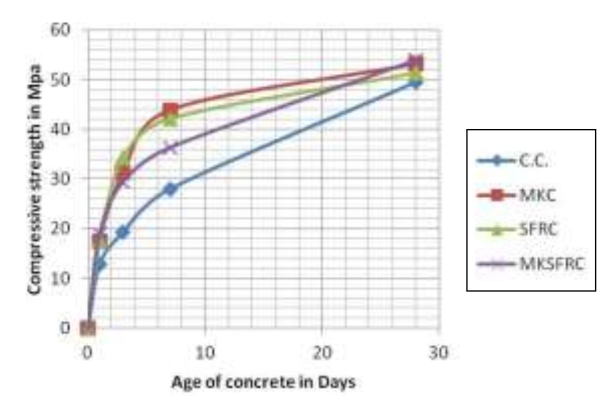
Table 1: Mix Proportion for M^3 (All Quantities of Material in kg)

S. No.	Particulars	Cement	FA	CA	SF	MK	W/B Ratio	Admixture
1.	CC	584	378	1267	-	-	0.35	2.34
2.	MKC	537	378	1267	-	47	0.35	2.34
3.	SFRC	584	378	1267	8.8	-	0.35	2.34
4.	MKSFRC	537	378	1267	8.8	47	0.35	2.34

compressive strength for the specimens MKC, SFC, MKSFC were found to be 7.36%, 3.82%, 8.91% respectively greater than that of control concrete, as, shown in Figure 1.

2. The specimens MKC, SFC, MKSFC also

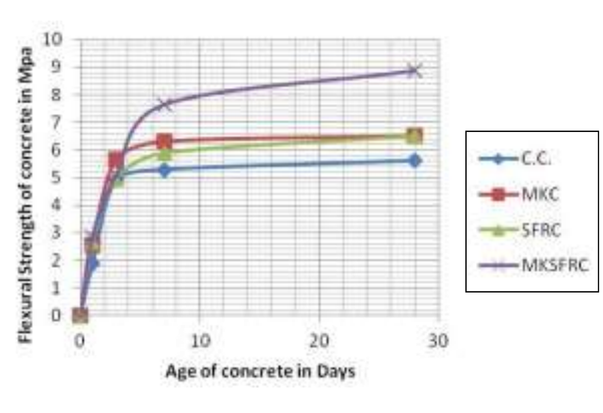
Figure 1: Variation of Compressive Strength of Concrete with Curing Period



has a positive effect on the split tensile property. The tensile strength of those specimens was found to be 5.58%, 15.86%, 26.94% greater than that of the control concrete and is shown in Figure 2.

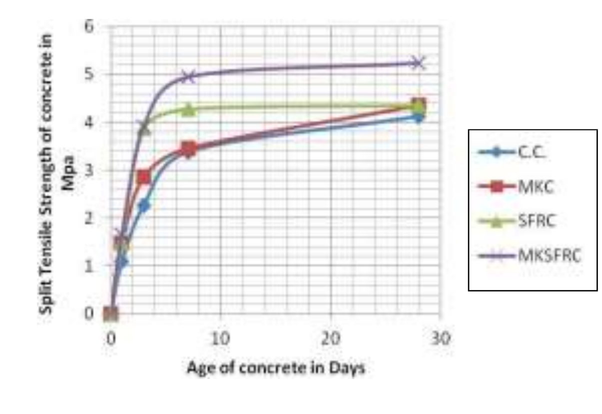
3. Similarly the flexural strength also has been

Figure 2: Variation of Flexural Strength of Concrete with Curing period



increased due to the addition of Metakaolin and steel fibre. The percentage increase of flexural strength of the specimens MKC, SFC, MKSFC was found to be 15.86%, 15.86%, 58.28%, respectively, as depicted in Figure 3.

Figure 3: Variation of Split Tesile Strength of Concrete With Curing Period



CONCLUSION

The following conclusions have been made based on the results obtained from the experimental investigation.

1. The specimen with steel fibre was found to be good in compression which had the compressive strength of 3.82 % more than the control concrete.

2. Split tensile strength was achieved with the addition of the steel fibre in concrete. The strength has increased up to 15.86 % when compared to that of the control concrete specimen.

3. In flexure the specimen with Metakaolin and steel fibre was found in the flexural strength increased by 58.28% that of the control concrete

REFERENCES

1. Ardeshana A L and Desai Atul K (2012), "Durability of Fibre Reinforced Concrete of Marine Structures", *International Journal of Engineering Research and Applications*, Vol. 2, No. 4, July-August, pp. 215-219
2. Chitlange M R, Bang R S and Pajgade P S (2010), "Strength Appraisal Of Artificial Sand As A Fine Aggregate in Steel Fibre Reinforced Concrete (SFRC)", *ARPN Journal of Engineering and Applied Sciences, Vol*. 5, No. 10, pp. 34-38
3. Jadhao P D and Shelorkar A P (2013), "Determination of the Durability Of Metakaolin Blend High Grade Concrete by Using Water Permeability Test", *IOSR Journal of Mechanical and Civil Engineering* (IOSR-JMCE)e-ISSN: 2278-1684 Vol. 5, No. 2 (Jan-Feb. 2013), pp. 35-39
4. Murali G *et al*. (2012), "Experimental investigation on Fibre Reinforced Concrete Using Waste Materials", *International Journal of Engineering Research and Applications*, Vol. 2, No. 2, March -April, pp. 278-283
5. Kandasamy R and Murugesan R (2011), "Fibre Reinforced Concrete Using Domestic Waste Plastics as Fibers*", ARPNJournal of Engineering and Applied Sciences*, Vol. 6, No. 3, ISSN 1819-6608.
6. Venue Malagavelli and Neelakanteswara Rao Patura, (2011), "Strength Characteristics of Concrete Using Solid Waste an Experimental Investigation", *International Journal of Earth Sciences and Engineering*, Vol. 4, No. 6, ISSN 0974-5904.
7. Zainab Z. Ismail and Enas a. Al-Hashmi (2011), "Validation of Using Mixed Iron and Plastic Wastes in Concrete", *Second International Conference on Sustainable Construction Materials and Technologies,* ISBN 978-1-4507-1490-7.
8. IS: 383-1970, Specification for Coarse and Fine Aggregates from Natural Sources for Concrete (Second revision).
9. IS 10262:2009, *Recommended Guidelines for Concrete mix Design*, BIS. New Delhi, India, 2009.
10. IS 456-2000, Specifications for Plain and Reinforced Concrete.
11. IS: 516-1959, "Method of Test for Strength of Concrete", *Bureau of Indian Standards*, New Delhi, India.
12. IS: 5816-1999, Method of Test for Splitting Tensile Strength of Concrete BIS, New Delhi.
13. IS: 9399 – 1979, "Specification for Apparatus for Flexural Testing of Concrete", BIS New Delhi.

