



Effect of Mechanical Properties on Metakaolin as Partial Replacement of Cement

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Abstract—

To reduce the amount of cement in concrete supplementary material are used. For this purpose metakaolin is replaced by 0%, 5%, 10%, 15% & 20% by the weight of cement. Water binder ratio is taken 0.45 for M-20 & M-25 grade of concrete. Various tests were conducted in the research which showed the results of the same percentage at the different of 0%, 5%, 10%, 15% & 20% for the time period of 28 days curing as a substitution of cement by metakaolin on flexural strength and split tensile strength.

Keywords: Metakaolin, water cement ratio, Flexural Strength, Split Tensile Strength

1. INTRODUCTION

Marble has been usually used as a building material, sculpture since the ancient times. The marble industries dispose the marble powder material, consisting of very fine powder which finally results in constitutes that causes diverse environmental issues. Marble blocks are cut into smaller blocks so as to give them the specified class form. Throughout the cutting method regarding twenty fifth the initial marble mass is lost within the type of dust. Currently a day's marble waste is one in all the causes of environmental issues round the world. Therefore, most consumption of marble waste in numerous industrial sectors, significantly the development, agriculture, glass and paper industries would facilitate to shield the surroundings. Concrete is that the principally normally used construction material within the civil construction work as a result of its high structural strength and stability. Concrete may be a varied mixture of cement, coarse mixture, fine mixture and water. Mixture cannot simply sure the strength of concrete however additionally have an effect on the durability and performance of concrete.

2. MATERIAL USED

2.1 Cement: Portland Pozzolana cement (PPC) is used in this research work.

2.2 Sand: Sand is available near Narmada River. This sand is used for the above research work.

2.3 Natural aggregate: 20 mm natural coarse aggregate is used having a specific gravity of 2.72.

2.4 Metakaolion: In this experiments metakaolin having particle size less than 90 micron was Used. Chemical composition of glass powder is as follows

Table 2.1: Physical composition of Metakaolin

Physical	Properties
Bulk Density (g/cc)	0.5461 (When packed)
Color	White
Specific Gravity	2.30

Table 2.2: Chemical composition of Metakaolin

Chemical	Composition
SiO	50% - 55%
Al ₂ O ₃	38% - 42%
CaO	1% - 3%
TiO ₂	0.8 - 1.2
Na ₂ O	<1%
Fe ₂ O ₃	0.2 - 0.5

K ₂ O	<1%
MnO	<0.5%
MgO	<0.1%
Loss on Ignition	Max 1.5%

3. EXPERIMENTAL WORK AND TEST

3.1 Flexural Test:

The mould is prepared for beams used in the bending test having a size of 0.10mX0.10mX0.50m. After preparing beams rest on the flexural testing machine and load is applied. After applying load the value noted from the dial gauge. Bending strength determine at 28 days

3.2 Split Tensile Strength:

The mould is prepared for cylinder used in the tensile test having a size of 0.15m diameter and 0.30m height. After preparing cylinder rest on the compression testing machine and load is applied. After applying load the value noted from the dial gauge. Tensile strength determine at 28 days

4. TEST RESULTS

4.1 Flexural Strength Results:

The below table shows the flexural strength for different percentage of MK which is vary from 0%-20% for M-20 & M-25 Concrete.

Table 4.1: Flexural Strength Result after 28 days

S. NO.	MK (%)	28 days Flexural Strength (M-20)	28 days Flexural Strength (M-25)
1	0	2.45 MPa	3.86 MPa
2	5	2.85 MPa	4.20 MPa
3	10	3.35 MPa	4.72 MPa
4	15	3.15 MPa	5.10 MPa
5	20	2.90 MPa	4.80 MPa

4.2 Split Tensile Strength;

The below table shows the split tensile strength for different percentage of MK which is vary from 0%-20% for M-20, M-25 & M-30 Concrete.

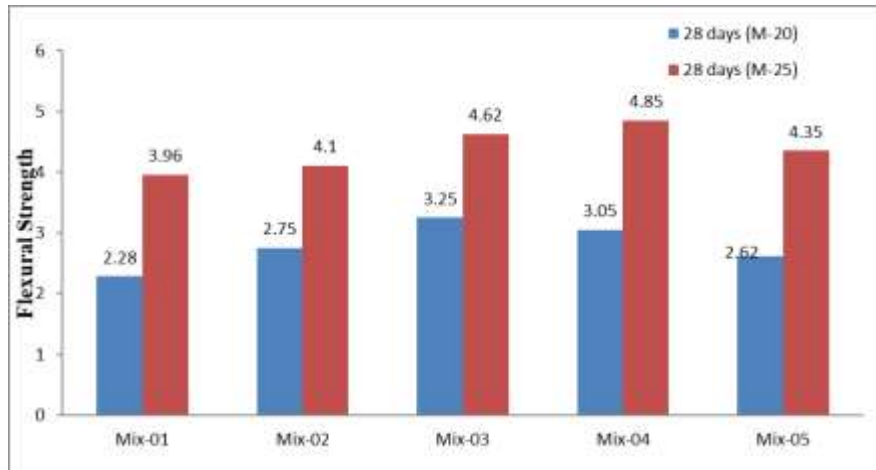
Table 4.2 Split Tensile Strength Result

Mix Design	% MK	28 days Tensile Strength (M-20)	28 days Tensile Strength (M-25)
Mix-01	0	3.38	4.95
Mix-02	5	3.71	5.65
Mix-03	10	4.25	6.35
Mix-04	15	4.01	6.15
Mix-05	20	3.95	5.95

5. DISCUSSION ON TEST RESULTS

5.1 Flexural Strength:

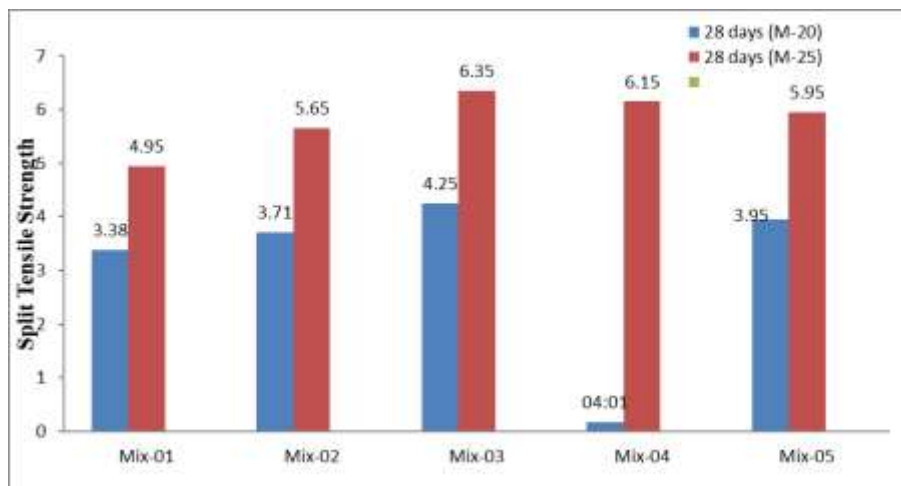
From the graph 1 it is conclude that 28 days flexural strength 36.73% increases for M-20 concrete when percentage upto 10%. After that strength decreases when percentage of MK increases. From the graph 1 it is conclude that 28 days compressive strength 32.12% increases for M-25 concrete when percentage upto 15%. After that strength decreases when percentage of MK increases.



Graph: 1. Flexural Strength in N/mm²

5.2 Split Tensile Strength Test:

From the graph 2 it is conclude that 28 days split tensile strength 25.73% increases for M-20 concrete when percentage upto 10%. After that strength decreases when percentage of MK increases. From the graph 2 it is conclude that 28 days split tensile strength 28.28% increases for M-25 concrete when percentage upto 10%. After that strength decreases when percentage of MK increases.



Graph: 2. Split Tensile Strength in N/mm²

6. CONCLUSIONS:

Based on the various tests conducted on concrete with varying proportion of MK the results were obtained and discussed in previous chapter from which the following conclusions are drawn.

1. It is conclude that 28 days flexural strength 36.73% increases for M-20 concrete when percentage upto 10%. After that strength decreases when percentage of MK increases.
2. It is conclude that 28 days compressive strength 32.12% increases for M-25 concrete when percentage upto 15%. After that strength decreases when percentage of MK increases. .
3. It is conclude that 28 days split tensile strength 25.73% increases for M-20 concrete when percentage upto 10%. After that strength decreases when percentage of MK increases.
4. It is conclude that 28 days split tensile strength 28.28% increases for M-25 concrete when percentage upto 10%. After that strength decreases when percentage of MK increases.

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