International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Research Paper

Effect on Concrete by Metakaolin and Manufacturing Sand as Alternatives

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ABSTRACT

This paper deals with the concrete mix of M25 grade with Manufacturing sand is used to replacing the Natural sand with 25 and 40 percent and Casting of Cylindrical concrete Specimens of 150 mm diameter and 300 mm in height to study the strength of concrete such as compressive and split tensile strength of concrete mix for 7 days, 28 days and 60 days with Metakaolin in 0 ,5, 10, 15 and 20 percentages and the concrete mix having ordinary Portland cement of 53 grade, increased strength of the concrete with workability of mix is compared with the normal concrete.

Keywords: Metakaolin, Concrete Mix, Workability, Compressive strength, Split tensile strength, Manufacturing Sand and Ordinary Portland cement.

1. INTRODUCTION

Manufacturing Sand is one of the alternative materials of the Natural Sand and is powder form of the crushed stone is having high amount of fines and this reduces workability of concrete. To reduce these fines water processing is adopted. By increasing population and industrial growth increases the demand of building materials. For this we have to use alternative materials and in this investigation we used Metakaolin as another alternative to replace portion of the cement.

This puzzolonic material of white in colour and it's purity improved by water processing and chemical compound forms and these are responsible for strength of concrete. This material added in different proportions to the 25% and 40 % of Manufacturing sand concrete and study the properties such as workability and strength characteristics of concrete.

2. LITERATURE REVIEW

1. Mr. Manu Vijay and Mr. Srivasthava HU in 2017 examined the effect of Metakaolin and manufacturing sand on concrete of M30 grade and reported that the materials of both improves the compressive strength, split tensile strength up to 15% of Metakaolin with M-sand.

2. Prof. NaadeemPasha, Muhammad Mehraj, Anil Kumar Mashyal, vedourata and Anand Bana Sode in 2016 examined the effect of materials Metakaolin and fly ash on mix of concrete and they reported that these materials improves the compressive strength, split tensile strength and flexural strength of concrete up to 20% Metakaolin at 5% Flyash.

3. A.V.S.Sai Kumar and Krishnarao examined the influence of the materials with cement such as quarry dust and Metakaolin on M40 grade of concrete in 2014 and they reported that at quarry dust of 25% and the Metakaolin of 10% increases the strength of concrete that is compressive strength, Tensile strength and Flexural strength of concrete.

3. MATERIALS

3.1. CEMENT:

In experimental investigation ordinary Portland cement of 53 grade (BHARATHI Cement) was used and this having Specific gravity of 3.15.

3.2. METAKAOLIN:

Which is a puzzolonic material is white in colour and having Specific gravity 2.46.

3.3. FINE AGGREGATES:

River sand is used as Fine aggregate in this investigation .This is collected from near and is passing through 4.75mm. This is having Specific gravity 2.65 and Fineness Modulus is 2.6.

3.4. MANUFACTURING SAND:

In this experiment manufacturing sand is taken as the alternative of River sand. This is collected from the local stone crushing units and having specific gravity is 2.66.

3.5. COARSE AGGREGATES:

Which is angular in shape and size about 20mm is taken for this investigation. This is having Specific gravity 2.77 and Fineness Modulus is 7.2

3.6. WATER:

Ordinary potable tap water available in laboratory was used for mixing and curing of concrete and is free from impurities and micro-organisms.

4. EXPERIMENTAL WORK AND TEST

4.1. MIX DESIGN:

Mix design is carried out for M25 grade of concrete by IS 10262:2009.The manufacturing sand of 25% and 40% and the Metakaolin is added in proportion 0, 5, 10, 15 and 20 percent. The mix proportion of concrete is water Content: cement content: fine aggregate: coarse aggregate is 0.50:1:1.752:2.985.

4.2. WORKABILITY OF CONCRETE:

Slump cone test is considered in this investigation to study the workability of concrete by means of slump. The slump of concrete is of true slump, collapse slump and shear slump. Collapse slump is indication of improper mix design and shear slump indicates the segregation of the constituents in the concrete mix so true slump is taken as suitable for concrete. Workability of concrete depends upon the factors like amount of water and cement content etc.

4.3. COMPRESSIVE TEST:

Concrete specimens are taken from the curing tank and placed for 24 hours for drying and then are placed in the CTM and tested to get the peak load at which the specimen fails. The testing period of specimens 7, 28 and 60 days, here load is applied gradually until the specimen fails.

Compressive stress at this breaking load=P/A

Where P=Breaking load,

A=Cross Sectional area of the specimen

4.4. SPLIT TENSILE STRENGTH TEST:

Splitting tensile strength is an indirect method used for determining the Tensile strength of concrete. Concrete specimens are placed in the CTM and load is applied gradually until the specimen fails that means specimen split in to two pieces.

Split tensile strength at this breaking load=$2P/\pi DL$

Where P=Spit tensile load,

D=Diameter of the specimen, L=Length of the specimen

5. TEST RESULTS AND DISCUSSION

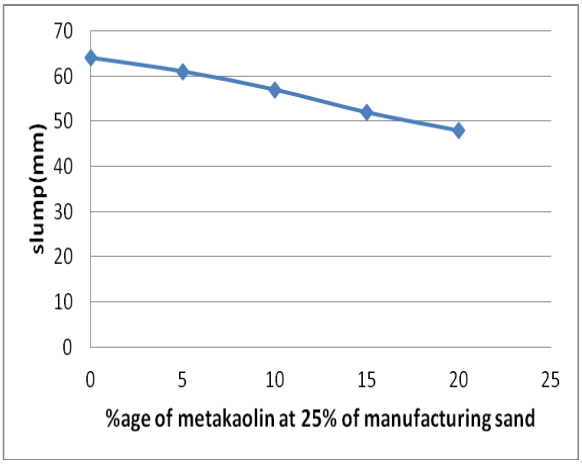
Tables for Concrete mix which shows fresh and hardening properties of concrete given below.

Table-1 Properties for Normal Concrete mix (or) without proportions of Metakaolin and Manufacturing sand

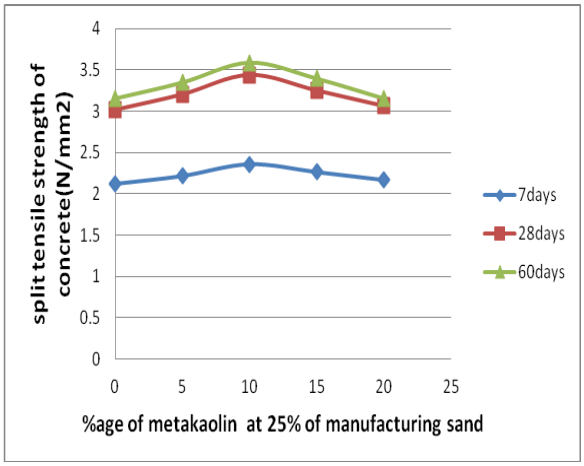
Workability Slump(mm)	Compressive strength (N/mm^2)			Split tensi le strength (N/mm^2)		
	7-DAYS	28-DAYS	60-DAYS	7-DAYS	28-DAYS	60-DAYS
69	20.182	29.037	29.992	1.980	2.829	3.018

Table-2: Properties for Concrete mix for various proportions of Metakaolin at 25% of Manufacturing sand

%0f Metakaolin	Workability Slump(mm)	Compressive strength (N/mm^2)			Split tensi le strength (N/mm^2)		
		7-DAYS	28-DAYS	60-DAYS	7-DAYS	28-DAYS	60-DAYS
0	64	21.117	30.557	31.500	2.122	3.018	3.159
5	61	21.880	32.036	33.000	2.216	3.206	3.348
10	57	22.635	33.764	35.084	2.357	3.442	3.583
15	52	21.880	32.255	33.198	2.263	3.253	3.395
20	48	21.126	30.727	31.689	2.169	3.065	3.159



Graph-1



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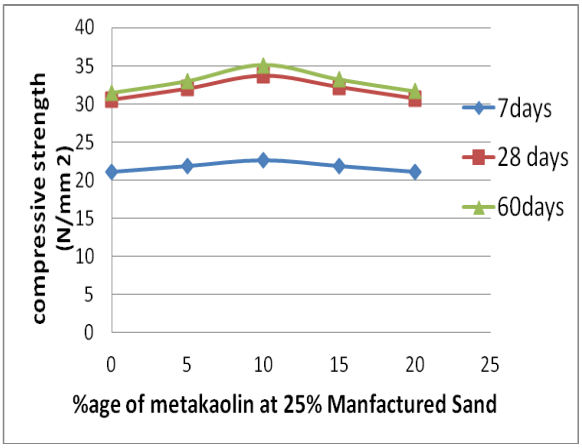
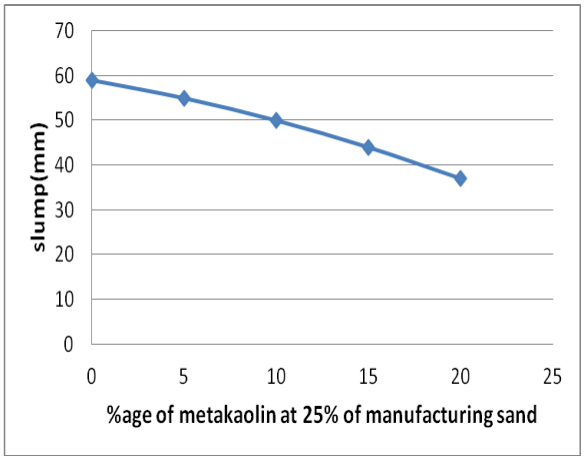


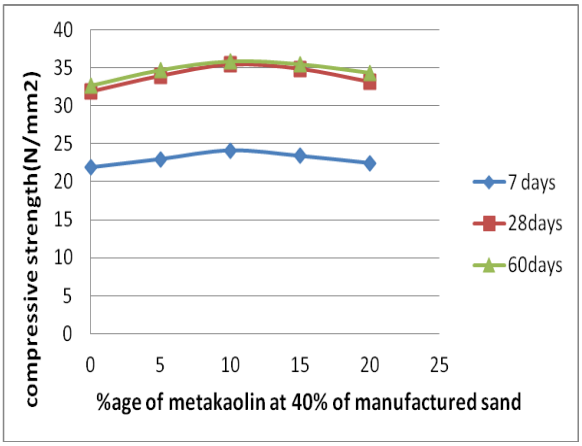
Graph-2



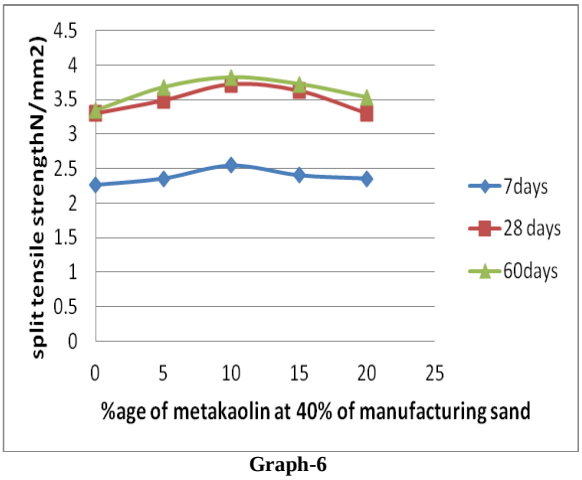
Graph-4

Table-3: Properties for Concrete mix for various proportions of Metakaolin at 40% of manufacturing sand

%0f Metakaolin	Workability Slump(mm)	Compressive strength (N/mm^2)			Split tensi le strength (N/mm^2)		
		7-DAYS	28-DAYS	60-DAYS	7-DAYS	28-DAYS	60-DAYS
0	59	21.880	31.877	32.632	2.263	3.300	3.348
5	55	22.974	33.953	34.688	2.357	3.489	3.678
10	50	24.114	35.424	35.839	2.546	3.725	3.819
15	44	23.389	34.858	35.462	2.405	3.631	3.725
20	37	22.446	33.160	34.329	2.357	3.300	3.536



Graph-5



Graph-6

6. CONCLUSION

1. The workability of concrete decreases with increasing percentage of Metakaolin at 25% and 40% of manufacturing sand content.
2. The %age of increase of compressive strength of concrete mix at 25% of manufacturing sand and 10% of Metakaolin is 12.154% for 7days, 16.279% for 28days and 16.977% for 60days respectively.
3. The %age of increase of split tensile strength of concrete mix at 25% of manufacturing sand and 10% of Metakaolin is 19.040% for 7days, 21.688% for 28days and 18.721% for 60days respectively.
4. The %age of increase of compressive strength of concrete mix at 40% of manufacturing sand and 10% of Metakaolin is 19.482% for 7days, 21.199% for 28days and 19.495% for 60days respectively.
5. The % age of increase of split tensile strength of concrete mix at 40% of manufacturing sand and 10% of Metakaolin is 28.585% for 7days, 31.671% for 28days and 26.540% for 60days respectively.

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How to cite this article: Tummala Suresh Babu et. al. Effect on concrete by metakaolin and manufacturing sand as alternatives. International Journal of Research and Review. 2018; 5(10):208-211.

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