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An Experimental Investigation on Concrete Containing Meta kaolin and Kota Stone Powder

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Abstract - *The study reported in the paper presents experimental work on combined use of Meta Kaolin and Kota stone powder in concrete. The objective of the present study is to determine strength parameters of the concrete containing Meta kaolin and Kota stone powder. The experimental program consists of preparing concrete mixes with Meta kaolin as a partial replacement of cement (5%, 10% & 15%) and Kota stone powder partially replaced with sand (5%, 10% & 15%). The performance of the concrete mixes for compressive strength, flexural strength and Splitting tensile strength at various ages was investigated.*

Key Words: *Meta kaolin, Kota stone powder, Compressive strength, Flexural strength.*

1. INTRODUCTION

India is the one of the largest raw stone producers in the world. In various processes of shaping and cutting of stone a large amount of stone waste is generated. This stone waste dumped openly which is responsible for environmental pollution. Present study is focusing only a type of limestone known as Kota stone. During the process of cutting, finishing and polishing the powder of Kota stone is generated, that powder is used as a partial replacement of fine aggregate. . A lot of literatures have already proved that Meta kaolin is one of the mostly use cement supplementary material. Different literatures suggested different percentage of Meta kaolin as a cement replacement material but most of them suggested 5% to 10%. Taking clue from this in present study the replacement level of Meta kaolin is limited to 15% only.

2. Raw Materials Characteristics

Meta kaolin- Meta kaolin is obtained by the calcinations of pure or refined Kaolinite clay at a temperature between 6500 C and 8500 C, followed by grinding to achieve a finesse of 700-900 m^2/kg. Meta kaolin is a pozzolanic additive product which can provide many specific features. Meta kaolin is available in many different varieties and qualities. The purity will define the binding capacity or free lime.. When used in concrete it will fill the void space between cement particles resulting in a more impermeable concrete. Meta kaolin, is a relatively new material in the concrete industry, is effective in increasing strength.

Kota stone powder - Kota stone is the most commonly used building materials. The Industry's disposal of the Kota stone powder slurry material consisting of very fine particles. This Kota stone powder slurry having lime stone qualities because Kota stone is a fine grained variety of limestone. This Kota Stone Powder is neglected as waste in several factories.

Super plasticizer - Super plasticizer (Sika-Plastiment) was used @ 1% of weight of cement. Specific gravity of Sika-Plastiment is 1.12 (as per manufacturer).

3. CONTROL MIX

Control mix was designed as per IS 10262:2009. Typical Computations are given below:

Table -1: Control mix

S. No	Materials	Weight
1.	Cement	391Kg
2.	Coarse aggregate	1177 Kg
3.	Fine aggregate	692 Kg
4.	Water	168 Ltr
5.	Admixture (1 % of cement)	3.15 Ltr
6.	W/C Ratio	0.43

4. RESULTS

4.1 Slump variation of the specimen prepared with meta kaolin replacement ranging from 5% to 15% and the Kota stone powder replacement ranging the same as Meta kaolin. The variation shown in table 2 and chart 1

Table -2: Slump Variation

S. No	Meta kaolin	Kota Stone Powder			
		0%	5%	10%	15%
1.	5 %	56	55	53	52
2.	10 %	53	51	51	50
3.	15%	52	50	49	49
4.	0% (C.M)	55			

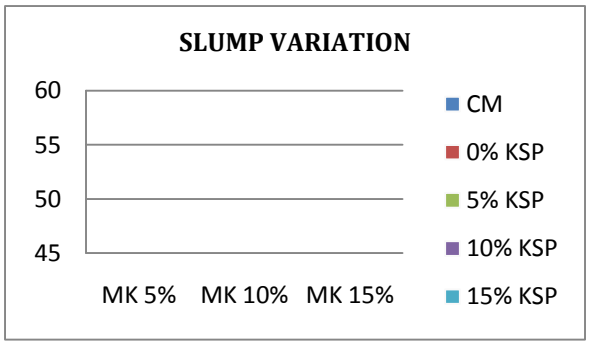

Chart -1 Variations in Slump

It is observed from chart 1 that with addition of Meta kaolin, slump decreased (from 56 mm to 52 mm) and it decreased again with addition of the Kota Stone powder in the mix.

4.2 Variation in Compressive Strength for the combination of Meta kaolin and Kota stone powder at the age of 28 days represented in table 3 and chart 2

Table -3: Variation in Compressive Strength (28 days)

S. No	Meta kaolin	Kota Stone Powder			
		0%	5%	10%	15%
1.	5 %	48.12	47.25	45.25	44.1
2.	10 %	51.32	50.21	46.7	46.76
3.	15%	49.01	48.22	48.32	45.12
4.	0%	47.89	46.55	45.25	43.3

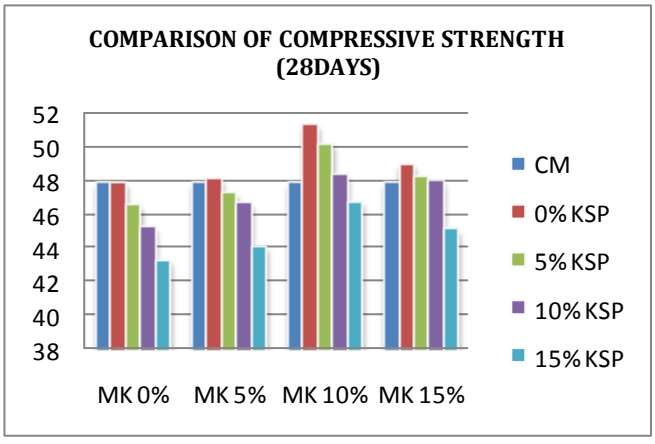

Chart -2: Variation in Compressive Strength (28 days)

After comparing the strength for various percentage of replacement it has been noticed that, with 0% Meta kaolin the strength with every replacement of KSP is lesser than the mix without KSP i.e Control mix. But with 5% to 15% replacement of Meta kaolin shows high compressive strength than the control mix, among all set of bar third bar (10% replacement of cement by meta kaolin) shows the maximum compressive strength with all percentage of KSP. Only 15% replacement of KSP exhibits quiet lesser compressive strength.

4.3 Variation in flexural Strength for the combination of Meta kaolin and Kota stone powder at the age of 28 days represented in table 4 and chart 3

Table -4: Variation in Flexural Strength (28 days)

S. No	Meta kaolin	Kota Stone Powder			
		0%	5%	10%	15%
1.	5 %	4.75	4.63	4.55	4.51
2.	10 %	4.87	4.73	4.65	4.58
3.	15%	4.81	4.67	4.59	4.53
4.	0%	4.62	4.57	4.48	4.26

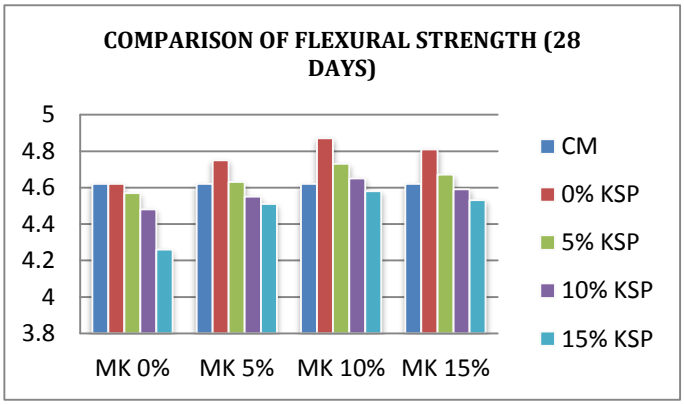

Chart -3: Variation in Flexural Strength (28 days)

The Flexural strength for various percentage of replacement of both the materials shown in chart 3 and it has been noticed that, with 10 percent of Meta kaolin the strength increases but with higher proportion of KSP reduces the strength continuously. The first set of bar (bar with 0% Meta kaolin) shows lesser flexural strength then control mix and other set of bars but the third set (bar with 15% Meta kaolin) shows higher strength among all the mixes. One thing is similar in all sets is that with increasing percentage of KSP the flexural strength decreases as well. With 0% Meta kaolin the strength with every replacement of KSP is lesser than the mix without KSP i.e Control mix. But with 5% to 15% replacement of Meta kaolin shows high flexural strength than the control mix, only 15% replacement of KSP exhibits quiet lesser flexural strength.

4.2 Variation in Split tensile Strength for the combination of Meta kaolin and Kota stone powder at the age of 28 days represented in table 5 and chart 4

Table -5: Variation in splitting tensile Strength (28 days)

S. No	Meta kaolin	Kota Stone Powder			
		0%	5%	10%	15%
1.	5 %	3.46	3.43	3.39	3.34
2.	10 %	3.55	3.49	3.48	3.47
3.	15%	3.49	3.47	3.42	3.37
4.	0%	3.42	3.35	3.27	3.22

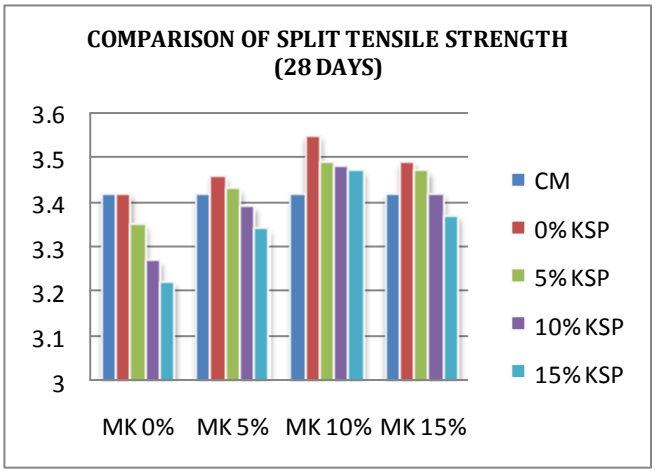

Chart -4: Variation in Split tensile Strength (28 days)

The first set of bar (bar with 0% Meta kaolin) shows lesser Split tensile strength then control mix and other set of bars but the third set (bar with 10% Meta kaolin) shows higher strength among all the mixes. One thing is similar in all sets is that with increasing percentage of KSP the Split tensile strength decreases as well. With 0% Meta kaolin the strength with every replacement of KSP is lesser than the mix without KSP i.e Control mix. But with 5% to 15% replacement of Meta kaolin shows high Split tensile strength than the control mix, only 15% replacement of KSP exhibits quiet lesser Split tensile strength.

3. CONCLUSIONS

The Value of slump decreases with increase of Meta kaolin content in the mix, and it again slightly reduces with increase in the content of Kota stone powder.

The compressive strength of mix is maximum at 10% replacement level of Meta kaolin, at 15% replacement of cement by Meta kaolin also having higher strength comparison to control mix. But the optimum strength of combination achieved with 10% replacement of cement with Meta kaolin and 5% replacement of fine aggregate with Kota stone powder

In the mixes with 5% to 15% Meta kaolin, if fine aggregate is partially replaced by Kota stone powder in the range 5% to 15%, then flexural strength at the age of 28 days is to be observed almost equals to Control mix or sometimes more or less than control mix. There is a variation lie between 1% or 2% hardly.

In the mixes with 5% to 15% Meta kaolin, if fine aggregate is partially replaced by Kota stone powder in the range 5% to 15%, then flexural strength at the age of 28 days is to be observed maximum with 10% Meta kaolin or 5% Kota stone powder.

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