Partial Substitution of Cement by using Different Pozzolanic Materials and its effect on Blended Concrete

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ABSTRACT

In ancient period the construction work was largely carried out with help of industry mudstone that way the concrete is most important component used in the construction industry, due to urbanization the use of cement in the construction industry gets increased rapidly.Due to increasing demand for cement there is a lot of environmental impact of cement on our ecology. cement industry creating an environmental problem by emission of CO_2 during manufacturing of cement. So the researchers are more focusing towards the environment issue globally. Especially considerable effort have been taken worldwide using industrial waste and by product cement as complementary to improve the properties of cement concrete. These research work have been taken wood ash, metakaoline and rice husk ash with different ratios to partially replaced by concrete mixes to evaluate the blended concrete characteristics in normal curing.

Key words: *Wood ash, rice husk ash , metakaoline , strength ,blended concrete , Nacl.*

1. INTRODUCTION

Supplementary Cementious Materials (SCMs) are widely used in mortars and concretes in various proportions, particularly for reducing the amount of cement which lead to lower both initial and life-cycle costs of concrete structures. The most SCMs are by-product materials and the use of these materials leads to reduction in waste and savings in energy consumption required to produce cement and blended mix concretes. Most recently the production of multi-blended concretes (MBC) by incorporating industrial by-products/pozzolanic materials is becoming an active area of research due to their improved properties such as workability, long-term strength. **Hwang Chao-Lung (2011)** he was have suggested that the particle size of RHA in the 10–75 lm range exhibits satisfactory pozzolanic behavior. In other conditions, a residual RHA is produced with a lower quality due to high carbon content. The high carbon content leads to an increase in water demand and produces a darker color in mortar and concrete. However, the filler effect has been demonstrated as being even more pronounced than the pozzolanic effect. **Mehta [10]** has considered that since RHA's pozzolanic activity derives mainly from the internal surface area of the particles, the grinding of RHA to a high degree of fineness should be avoided. **G. Batis(2005)**the research work on metakaoline is focused on two main areas. The first one refers to the kaolin structure, the kaolinite to metakaolinite conversion and the use of analytical techniques for the thorough examination of kaolin thermal treatment, The second one concerns the pozzolanic behavior of metakaoline and its effect on cement and concrete properties.

2. MATERIALS

A. Cement

The cement was used OPC (Ordinary Portland Cement) (53 Grade) with a specific gravity of 3. 125.Initial and final setting time of the cement was 39min&546min, respectively, conforming to I.S-12269-1987.

B. Rice Husk Ash

RHA is a good super-pozzolans. Silpozz can be used in a big way to make special concrete mixes. There is a growing demand for fine amorphous silica in the production of special cement and concrete mixes, high performance concrete, high strength, low permeability concrete, for use in bridges, marine environments, nuclear power plants etc.

C. Wood Ash

Wood ash is the residue powder left after the combustion of **wood**, such as burning **wood** in a home fireplace or an industrial power plant. It is used traditionally by gardeners as a good source of potash.

D. Metakaoline

Metakaoline is a pozzolana, probably the most effective pozzolanic material for use in concrete. It is a product that is manufactured for use rather than a by-product and is formed when china clay, the mineral kaolin, is heated to a temperature between 600 and 800ºC.

E. Fine Aggregate

According to The Indian standards (IS: 383-1970), a good aggregate for concrete production must be sufficiently strong, durable and hard. The aggregate which passing 4.75mm IS filter and maintain on 75 Micron IS sieve is called" fine aggregates." River sand is commonly used building material. The aggregates have minimum voids percentages ranging from 31% to 32%.

F. Coarse Aggregate

The aggregate which passing 75mm IS sieve and entirely retained from 4.75mm IS sieve is called coarse aggregate. Rude its collection is very important role plays in concrete. Its concrete performances such as drying, shrinkage, permeability resistance and frost resistance.

3. EXPERIMENTAL PROGRAMME

The samples were prepared with different combinations of blended concrete mixes start with 8% M.K and 6% W.A, 10% R.H.A replacement with OPC. The concrete mix is designed for M_{30} concrete with a ratio of normal concrete is 1:1.92:3.58. The major constituents of SCMs (Supplementary cementitious materials) are silicon dioxide, aluminum oxide where as silicon dioxide is present. The mechanical properties such as were measured for the Different curing (Normal curing and Nacl curing) period of 7, 28 and 56, 90 days.

4. CHEMICAL PROPERTIES OF SCMs(Supplementary cemtious materials)

TABLE. 1. (CHEMICAL PROPERTIES)

S .NO	M.K (%)	W.A (%)	R.H.A (%)
SiO_2	40.34	4.10	86.00
Al2o3	13.61	1.62	5.40
Fe2o3	1.12	0.62	1.10
Mgo	3.75	1.60	1.00
Ion Ignition	-----	41.64	-----
K2O	0.94	-----	3.66

5. PHYSICAL PROPERTIES OF SCMS

TABLE. 2. (PHYSICAL PROPERTIES)

S.NO	M.K	W.A	R.H.A	C.A	F.A
Specific gravity	2.91	2.55	1.85	2.68	2.66
Fineness	90	90	90	>4.75	75

6. CONTROL SPECIMENS

The required number of test specimens comprised of 150 ×150 × 150 mm cubes and 150 × 300 mm cylinder and 100 x 100 x 500 mm control prism were cast at room temperature of 20°C TO 22°C,demolded after 1 day and then cured under controlled water temperature of 27° TO 29°C until the age of 28,56,90 days. The details of the tests performed are given below.

i. ***Compressive Strength:*** The compressive strength has been done as per Code IS 516 (IS 2000) at different maturity periods of 28, 56, 90 days to obtain information about rate of gain or loss of strength in different cases

Fig.1: Compression Test

$$\text{Compressive Strength} = P/A \text{ N/mm}^2$$

Where: P = load (KN)

A = area of cube (mm^2)

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TABLE. 3. COMPRESSIVE STRENGTH WITH DIFFERENT PERCENTAGES

Mixes		Compressive strength of concrete	
		28 days	56 days
M0		38.02	43.57
P1	M1(6%W.A+8%M.K)	42	45.02
	M2(12%W.A+8%M.K)	36.87	43.03
	M3(18%W.A+8%M.K)	36.43	44.1
P2	M4(6%R.H.A+8%M.K)	53.84	54.84
	M5(12%R.H.A+8%M.K)	46.27	48.15
	M6(18%R.H.A+8% M.K))	46.5	47.86
P3	M7(12%R.H.A+10%W.A+8%M.K)	30.37	36.6
	M8(18%R.H.A+10%W.A+8%M.K)	19.52	34.41

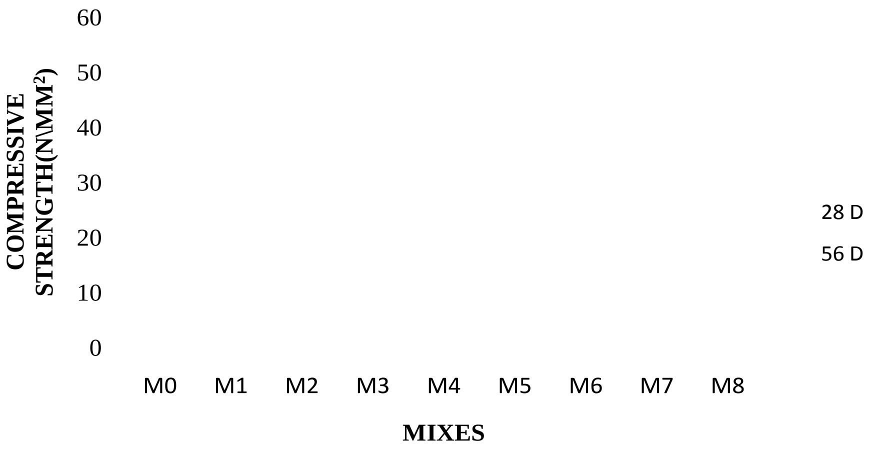

Fig.1. compressive strength with different days

ii. Split tensile strength

The split tensile test were conducted as per IS 5816:1999.The size of cylinder is 300mm length with 150mm diameter.

Split tensile strength = $2P/(\pi DL)$ N/mm^2

Where: P=split tensile load, (KN)

D=diameter of the cylinder

L =length of cylinder

TABLE. 4. SPLIT TENSILE STRENGTH

MIX		SPLIT TENSILESTRENGTH	
		56 days	90 days
Normal Concrete		6.97	7.5
P1	M1	7.35	8.43
	M2	6.05	7.65
	M3	6.35	8.12
P2	M4	7.66	9.28
	M5	5.7	6.76
	M6	6.13	7.41
P3	M7	2.8	4.5
	M8	2.88	3.07

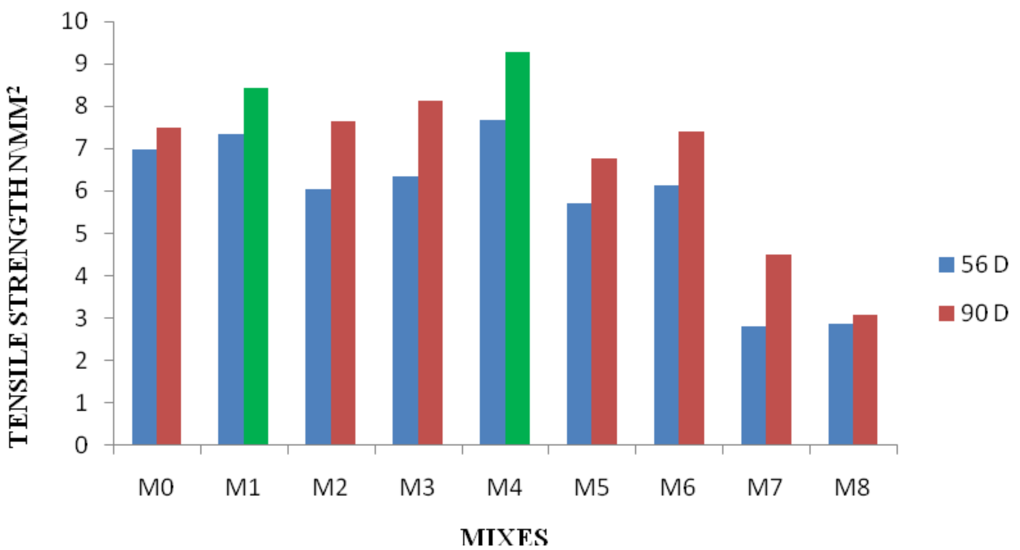

Fig.2. Split Tensile Test(CTM)

iii. Flexural Strength

Prisms having dimensions of 100X100X500 mm were used for thistest. The simply supported prism was loaded at 1/3 rd points keeping the span as 450 mm and was tested on Universal Testing Machine of 2000 KNcapacity. The flexural strength is calculated in by using the followingequation.

Flexural Test(UTM)

Flexural strength - PL/bd^2

TABLE. 5. FLEXURAL STRENGTH

		FLEXURAL STRENGTH	
		56 days	90 days
M0		4.23	6.281
P1	M1	5.410	9.472
	M2	4.81	5.1
	M3	3.870	4.631
P2	M4	11.740	14.531
	M5	5.87	8.249
	M6	6.09	12.69
P3	M7	8.01	10.8
	M8	9.49	11.24

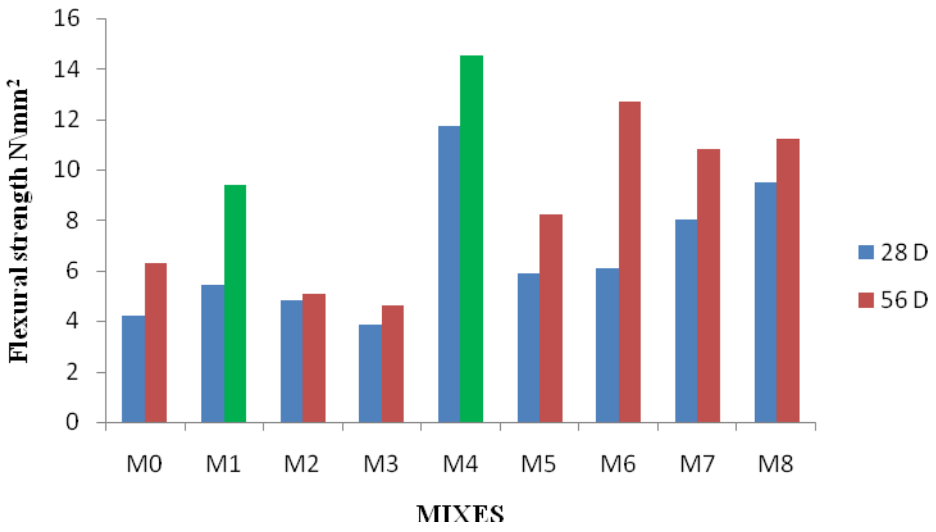

Fig.3. FLEXURAL STRENGTH

7. CONCLUSION

1. Phase 1. 8% MK(Metakaoline) and 6% WA(Wood ash) replacements are showing good results in all mechanical properties of these blended concrete.
2. Phase 2. 8%MK and 6% RHA (Rice Husk Ash) replacements are showing good results in all properties of concrete.
3. Phase 3 these case mechanical properties of the concrete is decreased due to large replacements in concrete.
4. These study will be showing up to 15% replacements of pozzolanic materials in blended concrete is show good results.

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