Universal Impex
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Metakaolin

Metakaolin is a scientifically processed reactive allumino silicate pozzolan formed by calcining purified clay in an externally fired rotary kiln. Metakaolin react with Calcium Hydroxide at ordinary temperature to form Calcium Silica & Calcium Alluminate Hydrates, unlike other natural pozzolan, Metakaolin is a water process to remove unreactive impurities, producing excellent reactive material. A thermally structured ultrafine pozzolan replaces industrial by product such as Silica Fume - Micro Silica, one of the widely used mineral admixtures, without compromising the end result. The particle size of Metakaolin is significantly smaller than cement & blending leads to enhance the property of cement.

Key Benefits

- Increased Compressive & Flexural Strength
- Excellent Workability- Produce Pump able concrete
- Reduced Rapid Chloride Permeability & Shrinkage
- Control of Alkali-Silica Reactivity
- Enhance concrete properties by using with late Reactive pozzolan such as Fly Ash, GGBS etc
- Enhance properties of Portland Cement
- Improved Appearance in GFRC or architectural Concrete

Uses of Metakaoline

- High performance, high strength,high grade and lightweight cement.
- Precast concrete for architectural, civil, industrial and structural purposes.
- Fiber cement and ferrocement products, ceramic product.
- Glass fiber reinforced concrete, Steel crimp fibre reinforced concrete
- Mortars, stuccos, repair material, Swimming pool plasters
- Precast concrete and tiles.
- Dry mix ,render and plastering
- Ready mix concrete
- Floor screeds
- Manufactured repetitive concrete product
- Shotcrete application

PHYSICAL PROPERTIES	
Appearance	**Off-white**
Brightness (ISO,%)	**75-76**
Moisture	**1 %Max**
Lime Reactivity (Chapelle Test)	**740-,000mg/gm**
pH (10% solids)	**5.0-6.0**
Specific Gravity	**2.65**
Bulk Density, kg/It	**0.4-0.5**
Blaine value (cm2/g)	**17,000-22,000**
Refractive Index	**1.62**

CHEMICAL ANALYSIS (Mass %)	
$Si0_2$	**50.0 - 2.0 %**
Al_20_3	**40.0 - 45.0 %**
Fe_20_3	**0.7 %(Max)**
$TI0_2$	**0.7 (Max)**
Cso	**0.09 % (Max)**
MgO	**0.03 % (Max)**
NaZO	**0.10 % (Max)**
K_20	**0.03 % (Max)**
LOI (Loss on Ignition)	**0.5-2%**

The metakaoline is a highly reactive pozzolan that reacts with calcium hydroxide produced from free lime during the hydration of metakaoline cement, forming calcium silicate and alumino silicate hydrates. These cementitious products supplement the binding action in concrete. This formulation provides increased density, resulting in reduced porosity and permeability and increased chemical resistance. In many ways, the pozzolanic reaction is similar to that with fly ash, but with metakaoline the finer particle size and higher surface area enables the pozzolan to react much faster and more frequently

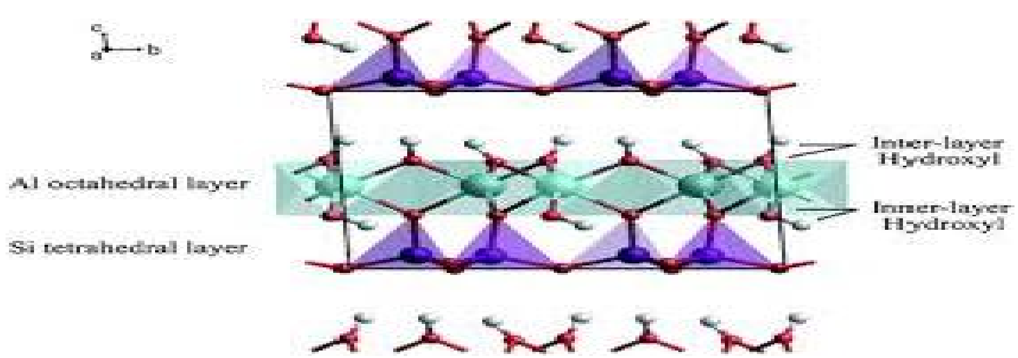

Table 1 Various Mix proportion of Metakaolin Blend Cement

Sr. No	Material	MK (0%)	MK (4%)	MK (6%)	MK (8%)
1	Ordinary Portland Cement (Kg/m^3)	500	480	470	460
2	Metakaolin (Kg/m^3)	00	20	30	40
3	Artificial Sand (Kg/m^3)	907	907	907	907
4	Coarse Aggregate (20mm) (Kg/m^3)	614	614	614	614
5	Coarse Aggregate(10mm) (Kg/m^3)	409	409	409	409
6	Water	145	145	145	145
7	Viscocreate 1%(Kg/m^3)	5	5	5	5
8	Water Binder Ratio	0.29	0.29	0.29	0.29

Compressive Strength Test

Compressive strength of concrete was determined in accordance with Indian Standards IS: 516 –1959 (Reaffirmed 1999) Edition 1.2 (1991-07) [9]. This involved applying direct compressive loads to the test specimens in the vertical direction at a constant rate of 150 KN per minute. Tests were conducted after 3, 7, 28,56 days of curing. The results obtained are shown in Table 1.

Water Permeability Test

Depth of penetration of water was obtained by DIN 1048 method. The equipment was installed onleveled ground. The compressor for test was of 5 bars capacity. The air dried concrete cubes (150 mm) were mounted on the table with suitable rubber gaskets below the cubes. The surface was roughened for about 100 mm diameter with wire brush before placing for test. The M.S.Plate was kept on the cube and the bolt was tightened on the cube. The pressure of 5 bars was maintained for 72 hours. The compressor was switched off and the pressure was released. All the cubes were splitted under concrete testing machine with the help of splitting device provided with equipment and the maximum and minimum water penetration level was observed.The average value was found out s shown in Table 2

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Table 4.1 Compressive Strength Result of Metakaolin Blend Concrete

Sr. No	Type	Cube ID	Cube mass (kg)	Strength (MPa)	Avg. Strength in (MPa
1	C.C.	CC1	9.10	92.00	91.10
2		CC2	9.13	91.00	
3		CC3	9.13	90.40	
1	4% MK 85	A54	9.13	101.00	100.36
2		A55	9.12	97.73	
3		A56	9.10	102.35	
1	6% MK 85	A39	8.96	104.15	104.11
2		A40	9.08	104.82	
3		A41	9.00	103.36	
1	8% MK 85	A18	9.05	109.20	112.00
2		A19	9.04	115.00	
3		A20	9.00	112.04	

Table 4.2 Water Permeability of Concrete with percentage variation of MK85

Sr. No	Type	Cube ID	Age (Days)	Penetration Depth (mm)	Avg. Penetration Depth (mm)
1	C.C.	CC1	56	22	23.00
2		CC2	56	23	
3		CC3	56	24	
1	4% MK 85	MK41	56	10	11.67
2		MK42	56	12	
3		MK43	56	13	
1	6% MK 85	MK61	56	8	8.67
2		MK62	56	9	
3		MK63	56	9	
1	8% MK 85	MK81	56	7	6.67
2		MK82	56	6	
3		MK83	56	7	

Effect of Percentage Replacement of Metakaolin on Compressive Strength :

The variation of compressive strength of with varying percentage of Metakaolin (0, 4, 6, and 8%)is shown in Figure 1. The compressive strength increases was about 9.23 MPa for 4 % Metakaolin, 12.98 MPa for 6 % Metakaoline and 20.87 MPa for 8 % Metakaolin. The increase in compressive strength due to the addition of Metakaolin by weight of cement are 10.13%, 14.24 % and 22.90% respectively as compared to compressive strength of control concrete (CC) specimen.

Effect of percentage replacement of Metakaolin on water permeability :

Figure 2 shows the variation of depth of penetration of water with Metakaolin content variation from 4%, 6%and 8 % . The depth of penetration reduces by 11.33mm, 14.33mm and16.33 mm respectively as against for the increase of Metakaolin) content by 4%, 6%and 8 % content respectively. The decrease in depth of penetration with the increase in Metakaolin content due to filling effect of the Metakaolin). The percentage reduction in the depth of water penetration comparison with control concrete specimen (cc) are as 49.26 %, 62.30% and 71.00% respectively as against for 4% ,6% and 8 % Metakaolin content .

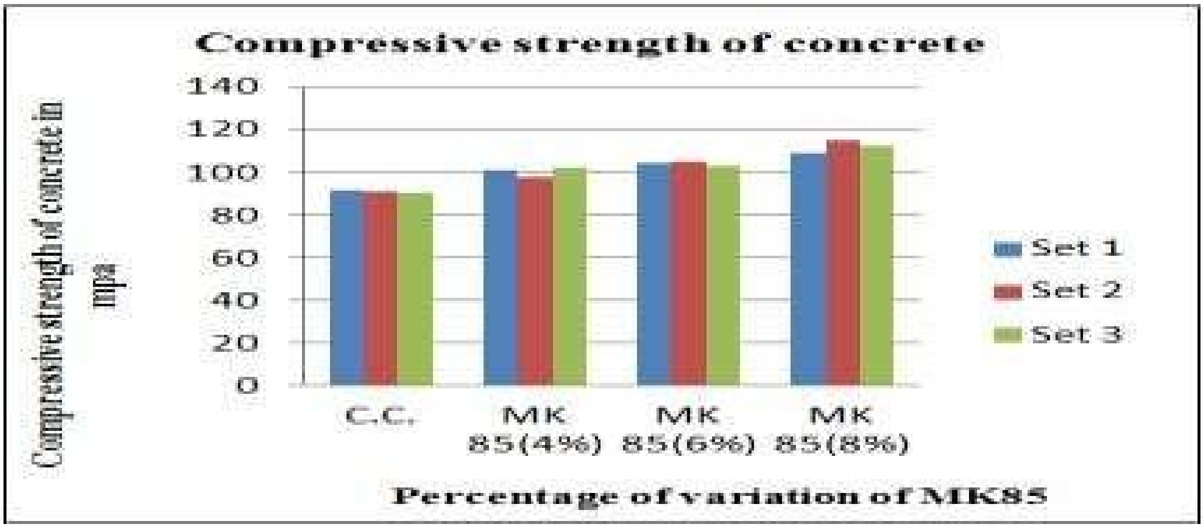

Fig. 1 Compressive Strength of concrete with percentage variation of Metakaoline

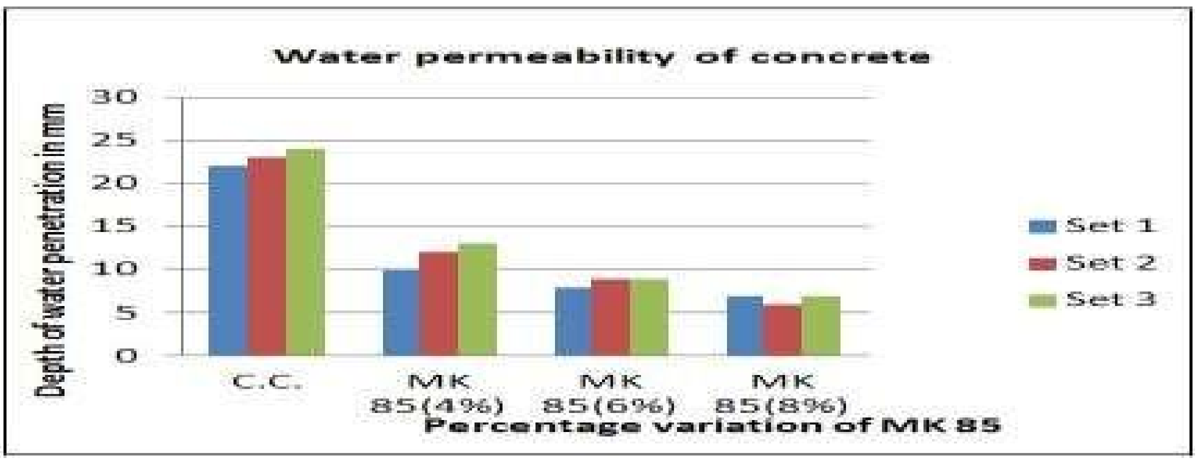

Fig. 2 Depth of water penetration of concrete with percentage variation of Metakaoline

CONCLUSION

- **The compressive strength of HGC increases with the replacement of Metakaolin.**
- **The compressive strength of HGC increases from 10.13 % to 22.90 % for replacement of cement from 4 %to 8% of metakaoline by weight of cement.**
- **The experimental results show that by adding of metakaoline water permeability depth of penetration reduces by about 71%.**
- **From the results, it is concluded that metakaoline clay is the good material for producing high grade concrete for any structural engineering works.**