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ASSESSMENT OF STRENGTH AND DURABILITY FACTORS OF CONCRETE WITHMETAKAOLINANDMARBLEDUST

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Abstract:

Concrete is the building industry's most commonly used material. Since 1990, the global production of concrete has grown significantly. A lot of natural contamination is included in the production of concrete mix since it involves the emission of CO2 gas. Various supplemental cementitious materials, such as silicon oxide exhaust, fly ash, slag, rice husk, and metakaolin, are being used as the industry shifts to environmentally friendly techniques. High Strength Concrete (HSC) can be produced with improved workability, durability, strength and reduced penetrability because to the use of these components. In its anhydrous calcined form, metakaolin (MK) is made from the clay mineral kaolinite.Concrete has been substituted in three separate ways in this experiment. In the first scenario, 0% and 10% Metakaolin (MK) are considered separately. In the second scenario, the percentage of marble dust (MD) in the sample is 0%, 10%. As a third option, both MK and MD are utilised to their full extent. Concrete made in these three ways was compared with ordinary grade M30 to determine its compressive, tensile, and flexural strengths. An acid and alkaline assault on concrete has been predicted by conducting a durability analysis using the Rapid Chloride Migration Test (RCMT). According to the findings, the compressive and tensile strength of MK has increased, whereas the strength of the other materials has decreased. Flexural strength is improved in all three cases compared to standard concrete. MK and MD in conventional concrete have been found to reduce chloride ion penetration, leading to the conclusion that the durability of concrete has increased.

Keywords — Metallurgy, tensile strength, tensile and compressive strength, and durability.

Introduction

-In emerging countries, the demand for Portland concrete has grown dramatically. Cement prices have risen as a result, pushing up the overall cost of building. Alternatives to cement have been proposed to lower the cost and consumption of cement while maintaining the same strength and durability of the final product. Metakaolin and marble dust were two of the many possibilities tested in this investigation.Metakaolin is a clay mineral that is formed when kaolinite is calcined anhydrous. Kaolinite is the primary mineral used in the production of porcelain. China clay is another substance that contains

Chemicals	Percentage (%)
SiO_2	62.62
Al_2O_3	28.63
Fe_2O_3	1.07
MgO	0.15
CaO	0.06
Na_2O	1.57
K_2O	3.46
TiO_2	0.36
LOI	2.00

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lot of kaolinite. High-purity kaolinite deposits and paper sludge waste can both be used to obtain metakaolin. Metakaolin has the chemical formula Al2O3.2SiO2.2H2O. Both Table 1 and Table 2 provide a breakdown of the chemical and physical properties of metakaolin.

Property	Value
Physicalshape	Powder
Fineness	700-900 m^2/kg
Color	White/gray
Specificgravity	2.5
Specificsurface	8-15 m^2/g

Marble Dust is yet another waste product that is produced in excess. " According to estimates, millions of tons of marble dust have been produced by mining. Due to the purity and unadulterated nature of this marble dust in cement, it has become a popular substitute for this material. Discharging all of this marble dust into the environment now could have serious consequences for the environment in the future. India, the third-largest marble exporter in the world, produces a lot of marble dust as a result. As a result, this can be used in cement to reduce costs without sacrificing its structural integrity, while also benefiting the environment. concretesamplescontainingfluctuatingextents ofMetakaolin(MK)andFlyashdebrisatincreased temperatures.Each sample was subjected to temperatures of 200, 400, 600, and 800°C before being examined. Concrete contained MK percentages of 5, 10, and 20%, whereas fly ash residues had MK percentages of 20, 40, and 60%. Metakaolin and Fly ash trash made up 20% of the aggregate in concrete. Compressive strength of 85 MPa was found in the entire batch of concrete samples tested. Assuming room temperature conditions, cement and concrete samples demonstrated a limited penetrability to chloride particles. The chloride penetrability of Metakaolin mix was lower than Fly ash and Portland concrete mix at standard temperature. Concret samples have shown greater chloride porosity under normal temperatures. At 200°C and 400°C, mortar proved to be more chloride-porous than concrete, but the ratio of mortar to concrete, chloride penetrability was significantly lower than at normal temperature. Squanders like initiated Fly ash detritus, Iron Oxide, and Metakaolin were investigated for their potential as supplemental cementitious materials by HemantChauhan and colleagues (2011). Mineral admixtures with OPC bond were used to prepare 5 solid combinations, which were then used to test the compressive strength of concrete cube samples at 3,7, 14, 28 and 56 days. Until OPC was replaced by metakaolin as much as 42 percent, it had a vitality of up to 40.67 N/mm2. During the 56th day, the water cement percentage was between 0.40 and 0.55, and it lost its vitality. Methods for 42 percent concrete substitution using mineral admixtures such as fly powder (30 percent), Metakaolin (10 percent) and press oxide (10 percent) were deemed practical, according to them (2 percent).

Properties	**Testresults**
SpecificGravity	2.63
Colour	White
Form	Powder
Odour	Odourless
MoistureContent(%)	0.60
Sieve	0.90mm
Hardness	3onMohr’sscale
Waterabsorption	0.97%

Chemicalc ompound	Test value of MDPin%	Standard ofNaturalceme ntContent(%)
Calciumoxide(CaO)	55.09	31-57
Silicadioxide (SiO_2)	0.48	22-29
Magnesium oxide(MgO)	0.40	1.5-2.2
Ironoxide(Fe_2O_3)	0.12	1.5-3.2
Aluminum dioxide(Al_2O_3)	0.17	5.2-8.8
Sodium oxide(Na_2O)	0.20	-
Potassium oxide(K_2O)	0.06	-
Sulfurtrioxide(SO_3)	0.06	-
Loston ignitionin %	43.48	-
Total amount	100	-

Testresultsoncement

S.No.	Test	Result	ISCode	AcceptableLimit

1	Specific gravity	3.16	IS:2386:1963	3-3.2
2	Standardc onsistency	6mmat 34%w/c	IS:4031:1996	w/cratio 28-35%
3	Initial andFinal settingtime	45mins and 10hou rs	IS:4031:1988	Minimum 30mins and notmorethan 10hours
4	Fineness	3%	IS:4031:1988	<10%

Testresultsoncoarseaggregates

S. No.	Test	Result	ISCode	AcceptableLimi t
1	Fineness modulus	6.15	IS:2386:1963	6-8mm
2	Specificgravity	2.9	IS:2386:1963	2-3.1mm
3	Porosity	46.83%	IS:2386:1963	<=100%
4	Voidsratio	0.8855	IS:2386:1963	Anyvalue
5	Aggregate impactvalue	37.5	IS:2386:1963	<45%
6	Bulkdensity	1.5 g/cc	IS:2386:1963	<45%
7	Aggregate crushingvalue	26.6%	IS:2386:1963	<45%

Testresultsonfineaggregates

S. No.	Test	Result	ISCode	Acceptable Limit
1	Fineness modulus	4.305	IS:2386:1963	<3.2 mm
2	Specific gravity	2.43	IS:2386:1963	2-3.1mm
3	Porosity	36.6%	IS:2386:1963	<=100%
4	Voidsratio	0.577	IS:2386:1963	Anyvalue
5	Bulkd ensity	1.5424 g/cc	IS:2386:1963	
7	Bulking ofsand	3%	IS:2386:1963	<10%

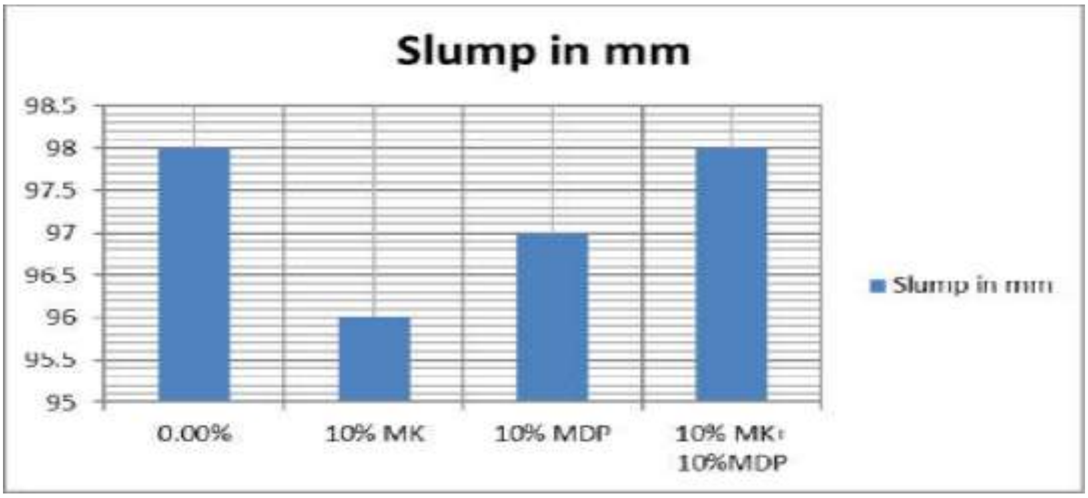
IIconcreteTests

ForM30GradeConcrete

A. TestsonFreshConcrete

1. SlumpConeTest

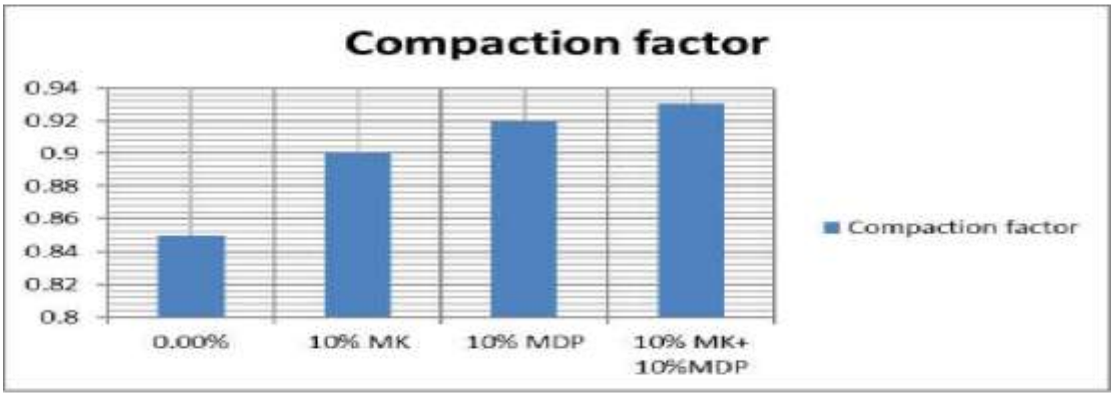
S.No	%Replacement	Slump (mm)
1	0	98
2	10%MK	96
3	10%MDP	97
4	10%MK+10% MDP	98



2. **CompactionFactorTest**

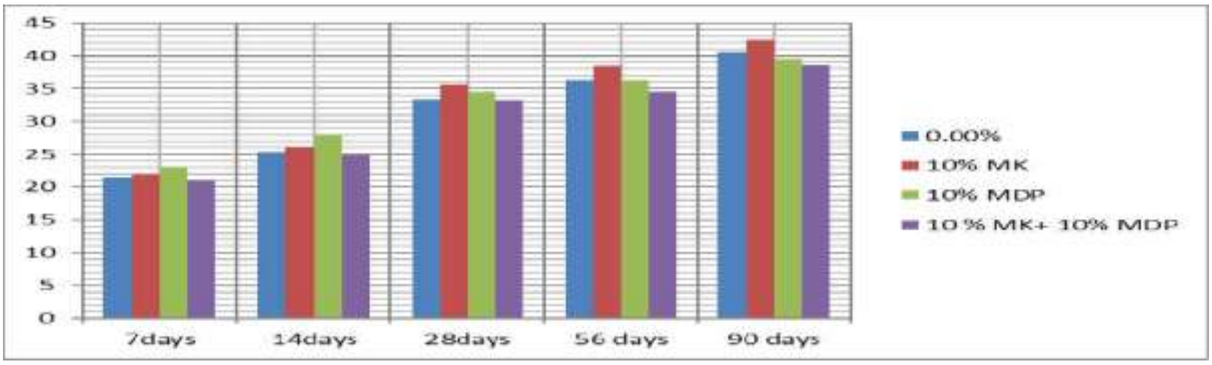
S.No	%Replacement	Slump (mm)
1	0	0.85
2	10%MK	0.9
3	10%MDP	0.92
4	10%MK+10% MDP	0.93

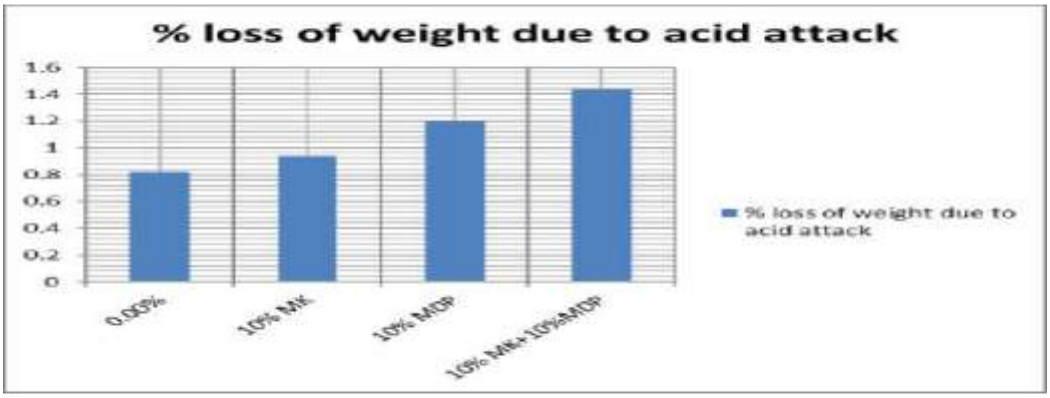
B. **TestsonHardenedConcrete**

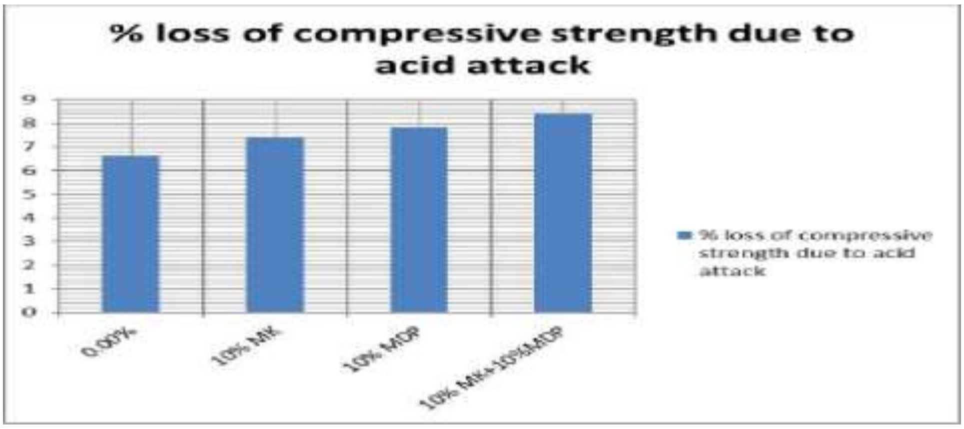


1. CompressiveStrength

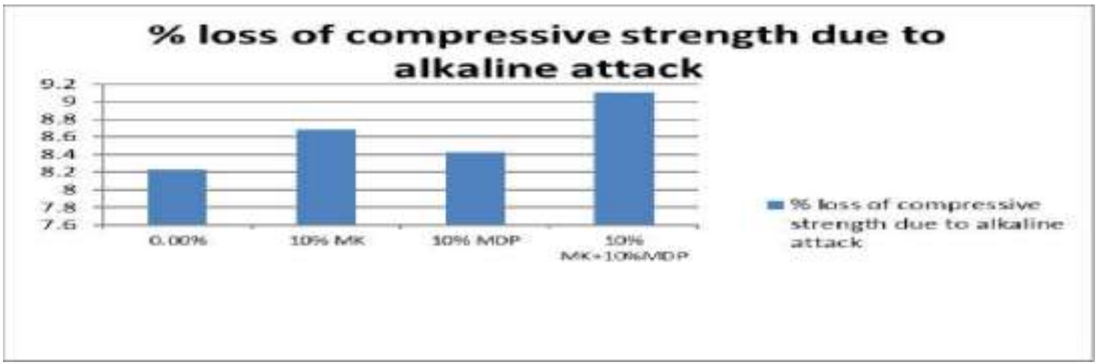
S.No.	%Replacement	Compressivestrengthof Concrete				
		7days	14 days	28days	56days	90days
1	0	21.5	25.3	33.42	36.28	40.55
2	10%MK	22	26	35.6	38.52	42.5
3	10%MDP	23	28	34.6	36.3	39.5
4	10%MK+10% MDP	21	25	33.2	34.6	38.6







Sl. No	% replacement	Initial weight ofcube after28daysc uringingrams	Finalweightof cubesafter90 dayscuringin grams	%lossof weightdue toalkalineattack	Compressive strength ofcube after28dayscuring	Compressive strength ofcubesafter 90dayscuring	%loss ofcompressivestrengthdue toalkalineattack
1	0.00%	2286	2259	1.2	99.55	91.36	8.23
2	10%MK	2340	2306	1.44	100.19	91.5	8.68
3	10%MDP	2280	2244	1.6	102.016	93.43	8.42
4	10%MK+ 10%MDP	2310	2268	1.84	100.47	91.33	9.1



CONCLUSIONS

The following findings can be drawn from the research described above:

I)Compared to other criteria, the replacement of cement with 10% MK delivers higher strength.

2). When 10% MDP and 10% MK are added to concrete, the strength of the material decreases.

3).Metakaolin and Marble powder were found to replace cement at a rate of 10% and 10%, respectively, in both cubes and cylinders. Compressive and split tensile strength begin to decrease with the addition of 10MK and 10 percent MP.When Metakaolin and Marble Powder are combined, it produces GREEN CONCRETE.

5). The production of MK and MDP does not produce carbon dioxide, which saves the environment.Results from the RCMT test reveal that concrete containing MK-MP has a very low rate of chloride ion penetration. 6. As a result, as the percentage of MK-MP in concrete increases, the raw penetration rate decreases.

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