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To Study the Electrical Properties of Concrete by Partial Replacement of Aggregate

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***Abstract*—The aim of this research paper is to study about Physical, Mechanical, Dielectric and insulating properties of concrete with partial replacement of aggregate. In this experimental study, silica floor and rangoli is used as an replacement which are collected from Chaitanya electromagnetic company. The Coarse aggregates are replaced with 60% partially by silica flour and rangoli respectively. In this experimental study, four combination with cement is made namely M_1 M_2 M_3 and M_4. In which proportion M_1 contain nominal mix of M40 grade, M_2 is 60% replacement of aggregate by rangoli,M_3 is 60% replacement of aggregate by silica flour. And M_4 contains total replacement of aggregate by silica flour and rangoli. BDV Test, Compression Test and Resistivity is measured for above combination . All this proportions are cured and tasted at the age of 7 and 28 days. The test results are shows that test sample had true slump and compression strength, electrical properties i;e Resitivity and Breakdown voltage test values are more in M_3 combination. So that M_3 can be used Industrial as well as Electrical and Mechanical engineering field.**

***Index Terms*— Silica flour, BDV test, compressive strength test, mix proportion.**

I. INTRODUCTION

In past so many years, the cement or concrete is used only in civil engineering construction work, but application of cement with replacement of some derivatives of concrete for the industrial as well as after multidisciplinary were totally ignored. This experimental study is made to find out the use of cement with other composition, for construction as well as electrical and mechanical engineering field. The possibility of using silica flour and rangoli as substitute for coarse aggregate which serves as one of the possible solution in industrial use of cement and also by using this type of material with replacement of aggregate makes the specimen less porous. The objective of experimental investigation is to evaluate the compressive strength and electrical properties of concrete with above combination for further use in Industrial, Electrical and Mechanical Field

II. LITERATURE REVIEW

H. Layssi, P. Ghods, A. R Alizadeh, and M. Salchi [1] studied the resitivity of concrete and effect of

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microstructure properties like pore size distribution , interconnectivities for measuring the resistivity (ρ). According to him, the electrical resistivity of any material is defined as capability to withstand against the transfer of ions when subjected to an electric field.

R.B. Polder [2] investigate the test methods for on site measurement of resitivity of concrete. The porosity and temperature are inversely proportional to the resistivity of concrete.

O. Sengul[3] studied the use of electrical resistivity as an indicator for durability. The shape of aggregate decide the durability of concrete. As reported in authors investigation, type of aggregate also affect the electrical properties of insulator .The comparative study between crushed limestone aggregate and gravel which shows that crushed limestone gives higher values. Gravel was rounded shape and having durability of concrete.

G. B. Welch, A. J. Camichael, D. E. Hattersley [4] investigate the compressive strength, tensile strength, and other properties of epoxy concrete. The test results showed that ultimate compressive strength is ranging from 7,000 psi to 13,000 psi and tensile strength is more than 1200 psi.

J. F. Lataste, C. Sirieix, D. Breysse, and M. Frappa [5] demonstrated that crack detection in reinforced concrete structure by electrical resistivity. For this author used four-probe square array principle and depth of crack is measured, that is depth of crack has directly relation with resistivity. A couple of assumption and conclusion in Lataste et al's work may not be adopted with rality.

Wilson J. G, Whittington H. W [6] investigate the variation in the electrical properties of concrete with change in frequency. The effects is measured in the microwave frequency range from 7 to 13 GHz. The dielectric constant and loss factor of concrete were measured with respective frequencies with w/c ratio 0.50. From this author conclude that dielectric constant of concrete varies at different frequencies. The dielectric constant and loss factor has inverse relation with frequency.

J. B. Nah. kang, Y. D. Chung, M. C. Ahn, D. K. Bae and T.K.Ko [7] study on the breakdown voltage characterization of insulation gases for developing a high voltage superconducting apparatus.

*M. Gunasekaran[*8*]* investigate the polymer concrete as high voltage insulator. Polymer concrete is mixture of aggregate and fillers bound together by low viscosity resin. It is commonly used for corrosion resistant, and high strength material in civil engineering.

J. E. Schroeder, Y. Zletin, T. C. Cheng, Wu, J.H. Dunlup[9] developed the design of polysil dc insulstor. The PC is few times cheaper than porcelain which is manufactured at very high temperatures.

S.Stocks [10] studied the performance assessment of non-ceramic overhead line insulator.

III. RESEARCH METHODOLOGY

A. Material

i) Ordinary Portland Cement (OPC53 grade) is confirming from BIS specification IS:12269-1987

ii)Aggregates-Two types of aggregates are used they are fine aggregate and coarse aggregate. In which coarse aggregate of size 20mm and fine aggregate of size 10mm was used for study.The fine aggregate is natural sand from river which is confirming from IS 383-1970.

iii)Water-The clean, potable water available in the laboratory is used for mixing as well as curing.

iv) Silica flour and Rangoli- It is sourced from Chaitanya electronics Compony, Aurangabad. The both material has excellent fire resistant property and it playing vital role in industry.

B. Mix design and Proportion

The main of this research is to study about mechanical, physical, electrical properties of concrete with some composition. The volumetric batching of mix ratio 1: 1.38: 2.41 is adopted for study. The cube specimen is prepared of size 100X100X100 mm and categorized into four groups, M_1,M_2,M_3,M_4. in which M_1 contain nominal mix of M40 grade, M_2 is replacement of aggregate by rangoli ,M_3 is replacement of aggregate by silica flour and M_4 contains total replacement of aggregate by silica flour and rangoli.All the roportions are cured and tasted at the age of 7 and 28 days

Table I. shows that mix proportion of material. In order to make cube specimen in which cement in ,Silica Flour ,Rangoli is in Kg/m3. The all samples are water cured and tasted at the age of 7 and 28 days.

IV. RESULT

The three type of testings are conducted on specimen after 7 and 28 days The three testings are

I. Compression Strength test in (N/mm2)

TABLE I. MIX PROPORTION OF MATERIALS

Sr NO	Sample	W/C	Cement (Kg/m3)	Silica Flour (Kg/m3)	Rangoli (Kg/m3)	Sand (Kg/m3)	CA (Kg/m3)	
							10mm	20mm
1	M1	0.4	450	-	-	623.63	433.98	650.97
2	M2	0.4	450	-	650.97	623.63	433.98	-
3	M3	0.4	450	650.97	-	623.63	433.98	-
4	M4	0.4	450	326	326	623.63	433.98	-

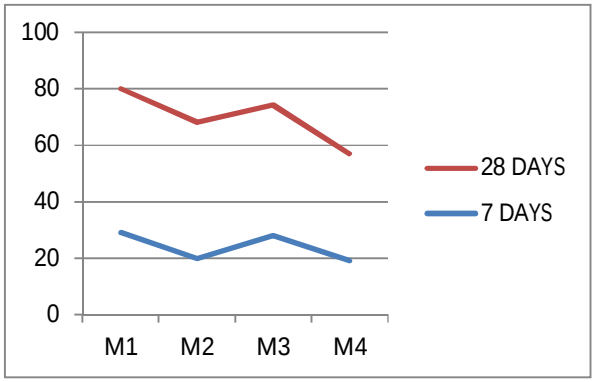
I. Resistivity (MΩ/mm)
II. BDV (KV/mm)

The test specimen for Resistivity and BDV testing are send to Crompton Greaves Limited, Aurangabad. The results are as follows:

TABLE II. TEST RESULTS OF EACH SPECIMEN

Sr no.	Type of specimen	Comp.strength N/mm^2		Resistivity KΩ/mm	BDV KV/mm
		7 Day	28 Day		
i	M1	29	51	23	2.94
ii	M2	20	48	23	3.53
iii	M3	28	46.33	25	5.73
iv	M4	19	38	20	1.23

The table II shows that test results of each specimen
The following graph.1 is plot as specimen on X-axis and compressive strength of specimen at the age of 7 and 28 days
The following graph.1 is plot as specimen on X-axis and compressive strength of specimen at the age of 7 and 28 days.Y-Axis shows compressive strength in N/mm^2



V. CONCLUSION

From above experimental results, the conclusion as follows:

1) The M_3 concrete sample is having higher resistivity, Dielectric i;e Break down voltage and Compressive strength than other concrete sample. So M_3 can be used in Electrical and Mechanical Engineering Field.
2) M_3 concrete has resistance to tracking and erosion of 5.73 KV/mm. This can be used as an electrical insulator for clean, pollution free area.
3) The profile improvement should results in better field performance.
4) From this experimental investigation it is also conclude that, we can use it for building prevention i;e Insulation of building from electrical current or natural electrical stroke.

5) By Resistivity measurement method the gives the value of moisture content ,crack detection, corrosion measurement and setting time measurement.

VI. Acknowledgement

The testing of the specimen is carried out at Crompton Greaves Ltd. Author thanks to Chaitanya electromagnets for providing material for specimen, especially Mrs.Paranjape for their help in test station maintenance.

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