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Experimental Investigation On The Properties Of Cement Concrete Partially Replaced By Phosphogypsum And Carbon Fiber

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Abstract- *Phosphogypsum is a by-product of phosphate fertilizer plants and chemical industries. As is contaminated with the impurities that impair the strength development of calcined products, it can be used as partial replacement of cement. The present paper deals with the experimental investigation on compressive strength characteristics of partially cement replaced phosphogypsum Concrete using 0%, 10%, 20%, 30% and 40% replacement with water-binder ratio of 0.45. The strength characteristics are studied by casting and testing cube specimens for 7,14 and 28 days it is shown that a part of ordinary Portland cement can be replaced with phosphogypsum to develop a good and hardened concrete lead to drastic reduction not only in the compressive strength. There is a huge growing requirement of building materials in india due to existing housing shortage. To meet this challenge, India requires innovative, energy efficient building materials for strong and durable housing in fast track method of construction at affordable cost. Carbon fiber also important replacement material in civil engineering. Because it is very light weight material and also very strong material. Its five time stronger than steel fiber. We are decided to replace the carbon fiber with 0%,0.5%,1%,1.5%,2%,2.5% as a admixture in cement. It helps to increase the compressive and tensile strength.*
Keywords- *phosphogypsum, water-binder ratio, carbon fiber, light weight, strong material.*

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I. INTRODUCTION

Concrete is a composite material composed of fine and coarse aggregate bonded together with fluid cement (cement paste) that hardens (cures) over time. The strength and quality are dependent on the mixing proportions. In India, the cost of cement during 1995 was around Rs. 1.25/kg and in 2005 the price increased approximately three times. In order to combat the scarcity of cement and the increase in cost of concrete under these circumstances the use of recycled solid wastes, and industrial by-products like fly ash, blast furnace slag, silica fume, rise husk,phosphogypsum ,etc. came into use. The use of above mentioned waste products with concrete in partial amounts replacing cement paved a role for (i)modifying the properties of the concrete,(ii) controlling the concrete production cost,(iii) to overcome the scarcity of cement, and finally (iv) the advantageous disposal of industrial wastes.The thing in this we are going to use phophogypsum, and carbon fiber for the partial replacement of cement.

II. MATERIAL USED

2.1 PHOSPHOGYPSUM

After the reaction of the sulfuric-acid on phosphate rock, the phosphogypsum is a by-product in the wet process. Phosphogypsum is the second largest pollutant. At present, in India, only about 12% of phosphogypsum is being utilized from the massive amount produced. The proper utilization of phosphogypsum is required to disposal problems. The first reason phosphogypsum wasn't used for construction products in India was that it contained small quantities of silica, flurorine, and phosphate (P205) as impurities impair the strength

development of calcined products. The lack of consumption possibility of phosphogypsum causes landfill problem and environmental pollution. Therefore, it will be worth it if phosphogypsum will be used.

Fig.1Phosphogypsum

Table.1 Chemical composition of phosphogypsum

SI.No	CHEMICAL COMPOSITION	PERCEENTAGE (%)
1	CaO	38.2
2	SiO_2	3.92
3	SO_3	35.3
4	MgO	0.49
5	R_2O_3	3.60
6	PO_4^{3-}	18.49
7	Others	1.00

2.2 .CARBON FIBER

Carbon fibers are derived from polyacrylonitrile, but for even higher conductivity of copper. Carbon fiber properties depend on the structure of the carbon used. Carbon fiber is lighter and stiffer than any other fiber. The nature of a carbon fiber is very light, rigid, and strong. This is why most weight critical perfomance products are being manufactured with carbon fiber. Applications where a small amount of flexibility is desired, carbon fiber has a relatively small flex window. Typically they come defined as standard, intermediate and high modulus fibers.

Fig.2Carbon fiber

III.EXPERIMENTAL PROGRAM

3.1 Cement-The cement used was dalmia cement ordinary Portland cement (53- grade cement). The cement was procured from local markets and in one lot to maintain uniformity throughout the investigation. specific gravity of cement-3.12.

3.2 Fine aggregate-The available sand confirming to IS 383:1970 is employed as fine aggregate within the present investigation. According to IS 2386-1963, the specific gravity noted was 2.90.

3.3 Coarse aggregate- locally available in market coarse aggregate was choosen. 20mm is the highest nominal size of coarse aggregate.According to IS 2386-1963, the specific gravity noted was 2.75.

3.4 Water- For various operation like curing and mixing tap water was used.

Fig.3Laboratory test photos

IV.MIX DESIGN

In this investigation concrete mix design M30 was designed based on IS 10262-2009. This code presents a generally applicable method for selecting mixture proportion. The quantity of material used in this project details andmix design are given below in table 2.

Table.2 Mix proportion

Properties	Cement	Fine aggregate (FA)	Coarse aggregate (CA)	W/C
Quantity (kg/m^3)	433	714.6	1153.8	195
Ratio	1	1.65	2.66	0.45

V. METHOD OF EXPERIMENT

It is important that the constituent material of concrete remain uniformaly distributed within the concrete mass during the various stages ogf handling and that full compaction is achieved, and making sure that the full compaction like consistency, mobility and compatibility are in conformity with relevant codes of practice. The tests were carried out accordance with relevant IS standards. The aggregates were tested for physical properties such as specific gravity and particle distribution test. All the mixes were prepared by mixing the concrete in laboratory mixer with water. The sixze of cube used are 150 mm x 150 mm x 150mm for the compressive test. For tensie strength test the size of cylinder used are 150 mm x 300mm. There are several tests conducted to achieve the objectives, which is compressive and tensile test. The curing process was carried out for 7, 14 and 28 days in water at room temperature to let the concrete in the moist state as long as possible so that the hardening orocess happens in moderate in order to achieve maximum strength.

Table.3 Quantity required for conventional concrete

S.No	Property	Quantity(kg/m^3)	
		Per cube	Per cylinder
1	Cement	1.46	2.29
2	Fine aggregate	2.30	3.63
3	Coarse aggregate	3.94	6.20
4	w/c ratio	0.66	1.03

Table.4 Quantity required for phosphogypsum

S.No	Replacement Percentage	Quantity(g/m^3)	
		Percube	Per cylinder
1	10% of PG	146	225
2	20% of PG	292	458
3	30% of PG	438	688
4	40% of PG	584	1370

Table.5 Quantity required for carbon fiber

S.No	Replacement Percentage	Quantity(g/m^3)	
		Per cube	Per cylinder
1	0.5% of CF	7	11
2	1% of CF	15	22
3	1.5% of CF	22	34
4	2% of CF	29	46
5	2.5% of CF	36	57

VI.RESULTS AND DISCUSSIONS

The results of the compressive test of various concrete mixes at the age of 7,14 and 28 days are given in table.

6.1.COMPRESSIVE STRENGTH TEST

Table.6 Compressive strength for conventionl concrete

Days	Average Compressive Strength in N/mm^2		
	7 days	14 days	28 days
Conventional Concrete	24.37	30.00	37.50

Table.7 Compressive strength for various percentage of phosphogypsum in cement concrete

Phosphogypsum %	Average Compressive Strength in N/mm^2		
	7 days	14 days	28 days
10%	24.83	30.00	38.20
20%	25.28	31.12	38.90
30%	23.46	28.88	36.10
40%	21.32	26.24	32.80

Fig.4 Compressive strength test – Laboratory photo

Table.8 Compressive strength for various percentage of carbon fiber

Carbon fiber (%)	Average Compressive Strength in N/mm^2		
	7 days	14 days	28 days
0.5%	25.87	31.84	39.80
1%	28.01	34.48	43.10
1.5%	31.46	38.72	48.40
2%	27.69	34.08	42.60
2.5%	23.85	29.36	36.70

Table.9 Compressive strength for various percentage of phosphogypsum with 1.5 % of carbon fiber

P.G + 1.5% C.F	Average Compressive Strength in N/mm^2		
	7 days	14 days	28 days
10%	26.26	32.32	40.40
20%	27.04	33.28	41.60
30%	25.54	31.44	39.30
40%	21.06	25.92	32.40

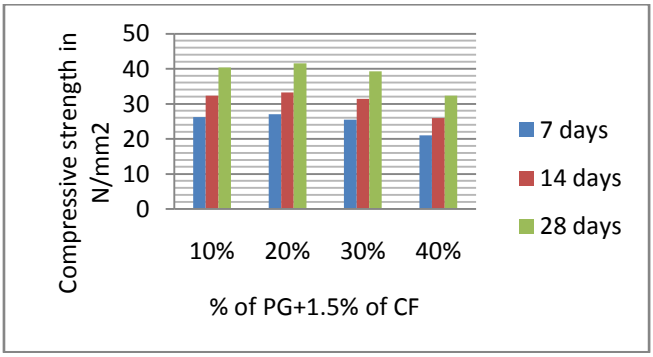

Fig.5 Compressive strength for various percentage of phosphogypsum with 1.5 % of carbon fiber

6.2.TENSILE STRENGTH TEST

Table.10 Tensile strength for conventionl concrete

Days	Average Tensile Strength in N/mm^2		
	7 days	14 days	28 days
Conventional Concrete	1.356	1.92	2.26

Table.11 Tensile strength for various percentage of phosphogypsum in cement concrete

Phosphogypsum %	Average Tensile Strength in N/mm^2		
	7 days	14 days	28 days
10%	1.57	1.94	2.42
20%	1.33	1.64	2.05
30%	1.13	1.39	1.74
40%	1.06	1.30	1.63

Table.12 Tensile strength for various percentage of phosphogypsum in cement concrete

Carbon fiber (%)	Average Tensile Strength in N/mm^2		
	7 days	14 days	28 days
0.5%	1.89	2.33	2.91
1%	2.09	2.58	3.23
1.5%	2.23	2.74	3.43
2%	1.93	2.38	2.97
2.5%	1.87	2.30	2.88

Table.13 Tensile strength for various percentage of phosphogypsum with 1.5 % of carbon fiber

P.G + 1.5% C.F	Average Tensile Strength in N/mm^2		
	7 days	14 days	28 days
10%	2.01	2.48	3.10
20%	2.47	3.04	3.80
30%	1.82	2.24	2.80
40%	1.73	2.14	2.67

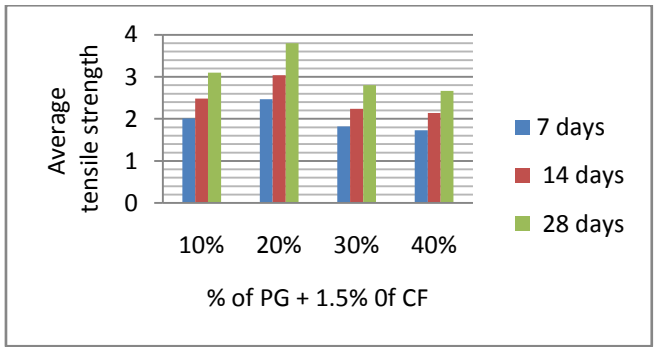

Fig.6 Tensile strength for various percentage of phosphogypsum with 1.5 % of carbon fiber

VII. CONCLUSION

This Project is to replace one industrial waste (phosphogypsum) materials and fiber material (carbon fiber) to use in the concrete. By the waste materials the environment can be effect, by adding we can reduce it. Here that we are going to conclude the addition of waste materials we can utilize the waste materials. Then the carbon fiber is added instead of cement to resist the salt content and increase the flexural and tensile strength. In this work, 20% of phosphogypsum with 1.5% of cabonfibre adding term in cement concrete gives high compressive strength (41.60MPa) compare to other various percentage and also increase the tensile strength (3.80MPa). The carbon fiber first percentage (0.5%) gives similar strength to the conventional concrete.

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