EXPERIMENTAL INVESTIGATION ON TERNARY BLENDED CEMENT MORTAR

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***Abstract*—The manufacture of Portland cement is environmentally unfriendly because for each ton of cement produced, approximately the same amount of CO2, in addition to this, CH4 and NO, which are major greenhouse gases, are released into the atmosphere are also released into the atmosphere. Investigations have revealed that, replacing part of Portland cement by industrial by-products such as blast furnace slag and fly ash in cement mortar can contribute significantly to the reduce the emission of these greenhouse gases and also save energy. This study investigates the use of considerable volume of blended cement (Portland Pozzolana and Portland Slag Cements i.e. PPC & PSC) as the partial replacement for 53 Grade OPC in cement mortar. Investigations are carried out on 1:3 ratio of cement mortar with a water-cement ratio of 0.5. The percentage replacement of OPC varies combination to the control about 60%. A total of 168 specimens of the PPC/PSC/OPC mortar were cured in cubes of 70.7mm dimension for 28 days and the compressive strength and density determined. The results of the present investigation clearly indicate that the performance of blended cement mortar is better than that observed for 53 grade OPC cement mortar.**

Keywords—slag cement; pozzolonic cement; compression; density; mortar

I. INTRODUCTION

The responsibility of the construction industry is not only to provide quality construction but also to provide a clean environment . With the increase in industrialization and urbanization, the generation of industrial by-products is increasing. This is not only pollutes the environment but also causes a serious ecological and environmental imbalance due to disposal of industrial by- products.

Industrial wastes are creating environmental pollution in one or the other way. These industrial wastes if not taken care, can effect human health and rein the peace of society. Many efforts have been made by construction industry to utilize these industrial wastes in construction and thus reducing the environmental pollution load.

Many of the industrial wastes like red mud, fly ash, silica fume and foundry sand finding application in the construction industry. The fly ash, which is an industrial waste of the thermal power station where coal is used as a raw material, is causing havoc. Many people are suffering from respiratory diseases near the areas of thermal power station. Slag is one of the industrial wastes obtained from metallurgical industries (foundries). The slag generated in these foundries is presently used for land filling operations.

It is important for the society to minimize the volume of industrial wastes and especially that part which has to be disposed. This can be achieved by minimizing the production of industrial wastes, cleaner production as well as recycling and reuse of recycled materials in construction. The replacement of Portland cement by fly ash and slag reduces the volumes of Portland cements used, which is a major benefit. Besides fly ash and slag other waste materials like silica fume, rice husk ash and metakaolin may also be used as pozzolanic materials in the manufacture of environmentally friendly blended cement.

II. OBJECTIVE

The main objective of the this study is to present laboratory investigations relating to cement mortar produced from three different types of cements namely, blended cements (PPC, PSC), 53 grade OPC. An attempt has been made to compare different properties like density, strength etc. of 1:3 ratio of cement mortar made with three different types of cement.

III. EXPERIMENTAL PROGRAM

A. Materials used

Portland Pozzolonic Cement (PPC):

This is special blended cement, produced by inter-grinding of Ordinary Portland Cement clinker with higher strength & high quality processed fly ash based on norms set by BIS. This unique, value – added product has hydraulic binding properties not found in ordinary cements.

Portland Slag Cement (PSC):

Slag cement is a by-product of the iron – making process and is composed primarily of silica and calcium. In fine particle form, slag cement displays cementitious qualities similar to those of ordinary Portland cement.

B. Specimen details

The specimens used for the test included cement mortar cubes of 70.7 mm x 70.7 mm x 70.7 mm for compression test. Three specimens were tested for the required age and the average value was taken. The test was conducted for 28 days. The specimens were designated as various proportions for cement mortar of ratio 1:3 made with PPC, PSC and 53 grades OPC respectively.

C. Mix proportions

Sl.No	Mix ID	OPC (gm)	PPC (gm)	PSC (gm)	FA (gm)	Water (ml)
1	C_{100}	600	0	0	1780	300
2	$C_{90}S_{10}$	540	0	60	1780	300
3	$C_{80}S_{20}$	480	0	120	1780	300
4	$C_{70}S_{30}$	420	0	180	1780	300
5	$C_{60}S_{40}$	360	0	240	1780	300
6	$C_{50}S_{50}$	300	0	300	1780	300
7	$C_{90}S_{10}$	540	60	0	1780	300
8	$C_{80}S_{20}$	480	120	0	1780	300
9	$C_{70}S_{30}$	420	180	0	1780	300
10	$C_{60}S_{40}$	360	240	0	1780	300
11	$C_{50}S_{50}$	300	300	0	1780	300
12	$C_{80}P_{10}S_{10}$	480	60	60	1780	300
13	$C_{70}P_{10}S_{20}$	420	60	120	1780	300
14	$C_{70}P_{20}S_{10}$	420	120	60	1780	300
15	$C_{60}P_{10}S_{30}$	360	60	180	1780	300
16	$C_{60}P_{20}S_{20}$	360	120	120	1780	300
17	$C_{60}P_{30}S_{10}$	360	180	60	1780	300
18	$C_{50}P_{10}S_{40}$	300	60	240	1780	300
19	$C_{50}P_{20}S_{30}$	300	120	180	1780	300
20	$C_{50}P_{30}S_{20}$	300	180	120	1780	300
21	$C_{50}P_{40}S_{10}$	300	240	60	1780	300
22	$C_{40}P_{10}S_{50}$	240	60	300	1780	300
23	$C_{40}P_{20}S_{40}$	240	120	240	1780	300
24	$C_{40}P_{30}S_{30}$	240	180	180	1780	300
25	$C_{40}P_{40}S_{20}$	240	240	120	1780	300
26	$C_{40}P_{50}S_{10}$	240	300	60	1780	300

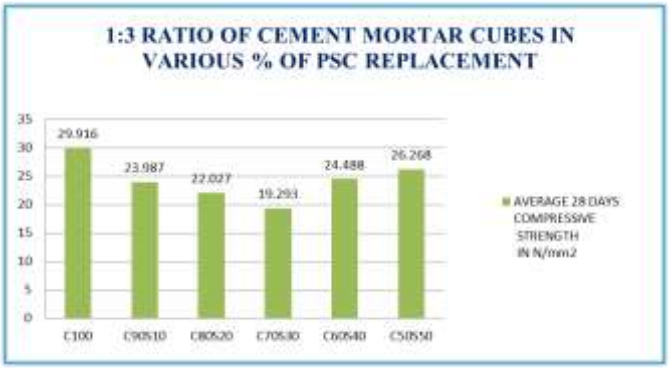
D. Tests on cement mortar

On hardened cement mortar, compression test was conducted as per BIS specifications.

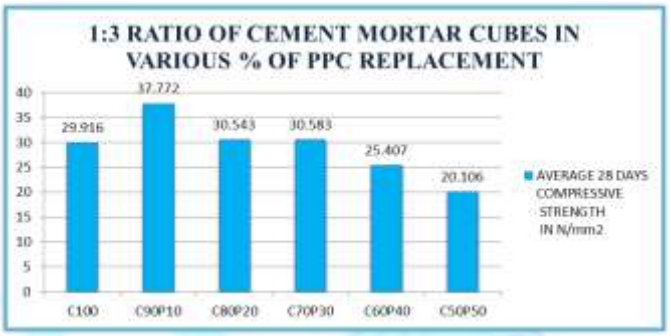
IV. RESULTS AND DISCUSSIONS

Compressive Strength on Cement Mortar

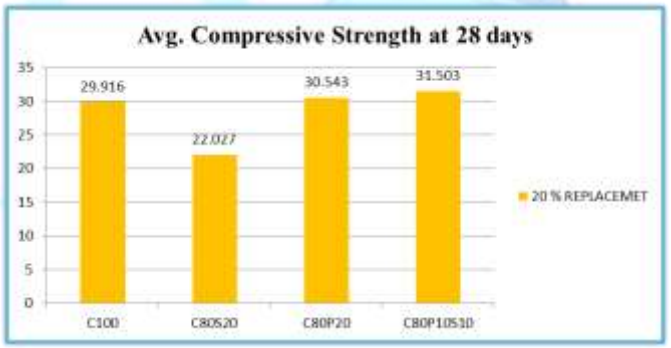
Compressive strength test is the most common test conducted on hardened cement mortar as it is an easy test to perform and also most of the desirable characteristic properties of cement mortar are qualitatively related to its compressive strength. The compression test is carried out on specimen cubical in shape. The cube specimen is of size 70.7 X 70.7 X 70.7mm.



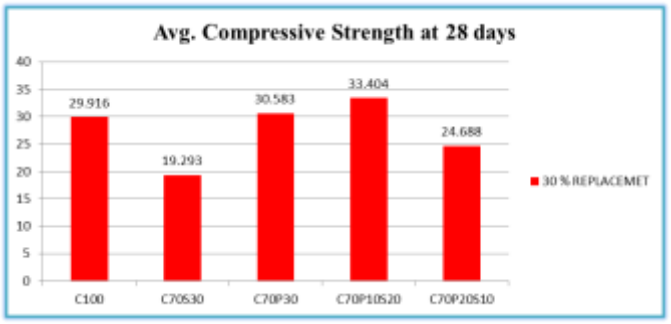
Various Percentage of PSC Replacement



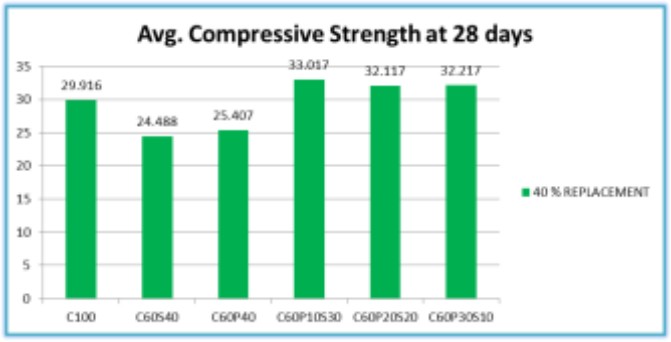
Various Percentage of PPC Replacement



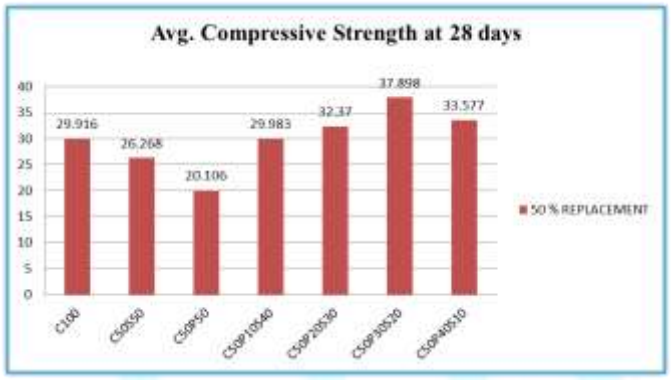
20 % Replacement in OPC



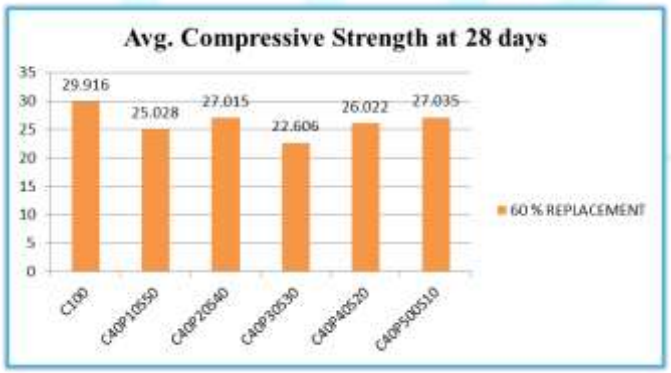
30 % Replacement in OPC



40 % Replacement in OPC



50 % Replacement in OPC



60 % Replacement in OPC

V. CONCLUSION

The results insure the effectiveness of mineral admixture cements like blended cements (PPC & PSC) to improve properties of mortar and to increase the resistance.

From the results it was came to known that the strength of mortar increases during the replacement of ordinary Portland cement by the combinations PPC and PSC by 50%

It is finally concluded that there is lesser possibility of adding combinations of PSC and PPC more than 60%.

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