

Study on Blended Cement Composites with 53 Grade OPC Composite for Marine Condition/Environment

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Abstract:- The paper presents the laboratory investigations carried out on Portland pozzolana cement (PPC) & Portland slag cement (PSC) both are blended cement (factory blended), 53 grade OPC concrete to study and compare the different parameters of concrete prepared from the above three types of cement and a comparison is made to ascertain the quality and performance of the concrete. The physical properties of ingredient materials were determined in accordance with IS specifications. The investigation is carried out for M30 grade of concrete mix with W/C ratio of 0.43,0.41,0.41 respectively. The design of concrete mix is carried out according to IS method. Tests are carried out for fresh concrete and hardened concrete according to IS code. It has been observed from experimental data that, the blended cement concrete is performing well when compared to conventional concrete. This is due to the fact that the effective diffusion coefficient of various cement particles. However study is to be carried out longer term to ascertain the strength behavior of concrete

Keywords: Blended Cement, Compressive Strength, Flexural Strength, Deterioration of Concrete, Sea Water

INTRODUCTION

Cement concrete is one of the largest construction material used by mankind. In terms of weight it stands second only to water. In terms of cost, generally it accounts for about 25% to 30% of the national budget. Concrete is the main material used for the infrastructure development of every country of the world. Amongst the solid wastes, the most prominent ones are fly ash, blast furnace slag, rice husk(converted to ash), silica fume and demolished construction materials. Such blending materials can be advantageously utilized either by mixing them directly in concrete or by mixing them while making cement to produce blended cements at the cement plant itself which inturn can be used in concrete making. Portland cements do not satisfy all the needs of the concrete industry; therefore, special cements have been developed by making some alterations in the Portland cement. One such innovative special cement developed is the Blended Cement. This cement is a modified Portland cement altered by blending with either rapidly cooled blast furnace slag or pozzolanic material like fly ash; thus the term blended cement was coined. The specifications for Portland pozzolana cement (PPC) conforms to IS 1489 Part I (fly ash based) and PART II (calcined clay based) and Portland slag cement (PSC) conforming to IS 455.

According to S.K. Kaushik Blended cement is hydraulic binders in which a part of Portland cement is replaced by other

hydraulic materials. Blended cements having both pozzolanic and latent hydraulic binder develop strength comparable to Portland cement. ACI Committee 226 [1990]⁶ defined fly ash in cement and concrete terminology as “the finely divided residue resulting from the combustion of ground or powdered coal, which is transported from the firebox through the boiler by flue gases”. Studies [Suneel *et al.*, 2001]¹⁰ on the effect of ground granulated blast furnace slag (GGBS) and on the properties of GGBS on fresh and hardened concrete made with GGBS shows that there is a slight retardation of setting of fresh concrete and there is a reduction in rate of hardening, strength gain, heat generation of fresh concrete

METHODOLOGY

Test on Ingredient Materials

The specific gravity, normal consistency, initial setting time, final setting time and compressive strength of cement, Sieve analysis and specific gravity test on fine aggregate, Sieve analysis and specific gravity on crushed stone aggregates of size 20mm and 12.5mm was also carried out as per B.I.S specifications

Curing of the Test Specimens

The specimens are stored in the laboratory atmosphere for 24hrs from the time of adding water to the ingredients. Temperature was maintained at 27±2°C. The specimens were removed from the moulds after 24hrs and kept immersed in clean water for the required age. Concrete exposed to marine environment may deteriorate as a result of combined effects of chemical action of sea water. The test specimen after curing for 28 days in normal water (potable water) were weighed and immersed in water diluted with 3% of sodium chloride (NaCl) by weight of water with required maintenance and the specimen were taken out of water on required age for testing.

Table 1: NaCl content in normal and sea water

Normal water	P ^H	7.38	----
	Cl ⁻	26.99mg/l	----
	Na ⁺	16.70mg/l	----
Sea water	P ^H	8.12	7.98
	Cl ⁻	19230mg/l	1864mg/l
	Na ⁺	10300mg/l	9810mg/l

Tests on Fresh Concrete

In the present investigation workability connected with physical quantity is correlated by slump, compaction factor and Vee-Bee, consistometer test. Slump test was conducted for all types of cement chosen grade M30 and results are tabulated in the table .

Table 2: Results of slump test

Grade of concrete	Water/cement ratio	Slump (mm)
O.P.C(53)	0.43	35
P.P.C	0.41	33
P.S.C	0.41	36

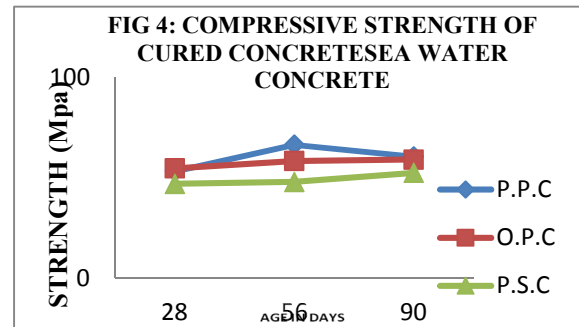
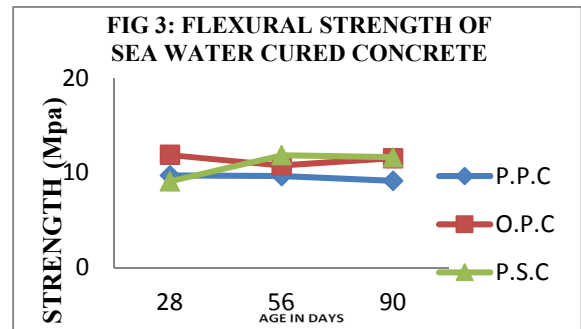
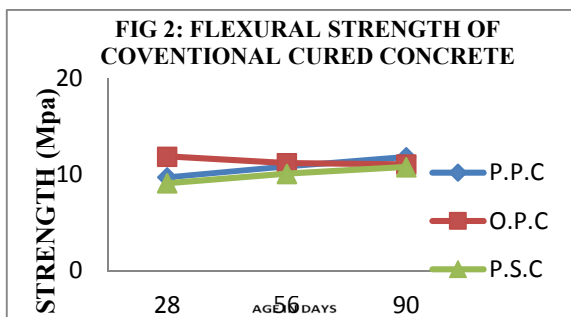
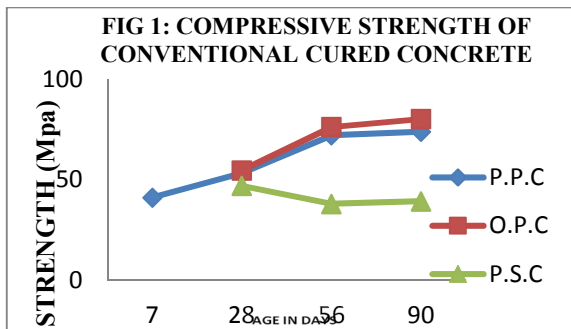
The results of compaction factor test and Vee-Bee consistometer test are listed in table below.

Table 3: Results of compaction factor test and Vee-Bee consistometer test

Type of cement	Grade of concrete	Water/cement ratio	Compaction factor	Vee-bee degree (sec)
O.P.C(53)	M30	0.43	0.90	16
P.P.C	M30	0.41	0.91	18
P.S.C	M30	0.41	0.89	15

Tests on Hardened Concrete:

On hardened concrete Compression and Flexural tests were conducted in accordance with BIS specifications at the age of 7, 28, 56 & 90 days to study the strength behavior of concrete produced with three types of cement. The test is conducted in UTM. The rate of loading was maintained at 5 kN/sec as per the requirements specified in the code of practice mentioned. Compressive strength Test (IS: 516 – 1969) Flexural Test (Modulus of Rupture Test; IS: 516 – 1969).



From the test results, it has been observed that the compressive strength of blended cement concrete marginally better than conventional cement concrete. This may be attributed to the secondary hydration reaction in the case of blended cement concrete leading to long term in strength. The results of resistance of concrete to sea water attack are reported in table. From the table it is evident that there is a loss in weight in any type of concrete resulting in the deterioration of concrete.

Table 4: Percentage loss in weight

Particulars	28 days	56 days	90 days
OPC(53)	0.601	0.605	1.986
PPC	0.084	0.123	0.387
PSC	0.193	0.253	0.665

It has been observed that, the blended cement concrete is performing well when compared to conventional concrete. This is due to the fact that the effective diffusion coefficient of various cements. However study is to be carried out longer term to ascertain the strength behavior of concrete

CONCLUSIONS

The compressive and Flexural strength of blended cement better than conventional Cement. This may be attributed to the slow pozzalonic reaction i.e. secondary hydration in case of blended cement. However long term studies are required to enquire at definite conclusion. There is a loss in weight and compressive strength in all the types of cements mixes indicating deterioration of cements in marine condition. However blended cement concrete performing well compare to conventional concrete. In sea water, well cured concrete containing Slag and pozzalona in cements usually perform excellent to OPC cement, because the former contain less uncombined calcium hydroxide after curing.

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