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An Experimental Study on Durability of Concrete Using Fly Ash & GGBS for M30 Grade Concrete

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Abstract:- Concrete when subjected to severe environments its durability can significantly decline due to degradation. Degradation of concrete structures by corrosion is a serious problem and has major economic implications. In this study, an attempt has been made to study the durability of concrete using the mineral admixtures like Fly Ash & Ground Granulated Blast Furnace Slag (GGBS) for M30 grade concrete.Cube Specimens were casted and are immersed in normal water, sea water, H_2SO_4 of various concentrations and were tested after 7 days, 28 days & 60 days.

Keywords:- Cube Compressive Strength, Durability, Fly Ash, Ground Granulated Blast Furnace Slag

I. INTRODUCTION

Now-a-days the most suitable and widely used construction material is concrete. This building material, until these days, went through lots of developments. the most important part of concrete is cement. The production process of this raw material produces a lot of CO_2. The most effective way to decrease the CO_2 emission of cement industry, is to substitute a proportion of cement with other materials. these materials called supplementary cementing materials (SCM's). Usually used supplementary cementing materials are Ground Granulated Blast Furnace Slag (GGBS), Fly Ash (FA), Silica Fume (SF), Metakaolin (MK). The aim of this study is to get acquainted with these SCM's and to examine some features. The most interesting feature is to increase chemical resistance of concrete. In this study, an attempt has been made to study the durability of concrete using the mineral admixtures like Fly Ash & Ground Granulated Blast Furnace Slag (GGBS) for M30 grade concrete.cube specimens were casted and are immersed in normal water, sea water, H_2SO_4 of various concentrations and were tested after 7 days, 28 days & 60days.

II. LITERATURE REVIEW

Bilodeau and Malhotra [1] presented the results of investigations to determine the various durability aspects of high-volume fly ash concrete using eight fly ashes and two Portland cements from U.S. sources. Briefly, in high – volume fly ash concrete, the water and cement content are kept low at about 115 and 155 kg/m^3 of concrete, respectively, and the proportion of fly ash in the total cementitious materials content ranges from 55 to 60 percent.

KilinkaleF.M [2] investigated that Pozzolon cements are produced by adding pozzolons such as Silica fume, rice husk ash and blast furnace slag in 20% replacement for Portland cement. On the 28^{th} day of production, the produced specimens are stored in $MgSO_4.7H_2O$ solution and in HCl solution. The strengths are determined after the mortars are stored in solution for 56 days. The highest compressive strength occurs with silica fume in HCl

Chatveer and Lertwattanaruk [3] stated that agro-wastes from an electricity generating power plant were ground and used as a partial cement replacement. The durability of mortars under Sulphate attack including expansion and compressive strength loss were investigated. For parametric study, SCBA were used as a Portland cement replacement at the levels of 0%, 10%, 30%, and50% by weight of binder. The water-to-binder ratios were 0.55 and 0.65. For the durability of mortar exposed to Sulphate attack, 5% sodium Sulphate (Na_2SO_4) and magnesium Sulphate ($MgSO_4$) solutions were used..

Noor-ul Amen [4] reported the recycling of bagasse ash (waste product of sugar industries) as a cement replacement in concrete, which provides a satisfactory solution to environmental concerns associated with waste management. The impact of bagasse ash content as a partial replacement of cement has been investigated on physical and mechanical properties of hardened concrete, including compressive strength, splitting tensile strength, chloride diffusion, and resistance to chloride ion penetration. The results indicate that bagasse ash is an effective mineral admixture and pozzolan with the optimal replacement ratio of 20% cement, which reduced the chloride diffusion by more than 50% without any adverse effects on other properties of the hardened concrete.

III. EXPERIMENTAL INVESTIGATION

Mix design has been conducted for M 30 concrete making use of IS 10262:2009 code with normal constituents of concrete like locally available UltraTech OPC 53 grade cement. river sand and mechanically crushed 20 mm conventional granite. Fly Ash was procured from Vijayawada Thermal Power Station[VTPS], Vijayawada and Ground Granulated Blast Furnace Slag was procured from Vizag Steel Plant, Vizag.The experimental investigation is designated as follows:

S.No	Replacement Proprotions (%)	Mix Designation
1.	100% Cement	M1
2.	20% Flyash + 80% Cement	M2
3.	40% Flyash + 60% Cement	M3
4.	20% GGBS + 80% Cement	M4
5.	40% GGBS + 60% Cement	M5

IV. RESULTS AND DISCUSSIONS

4.1 Comparison of Compressive Strengths cured in normal water

The following tabular form presents the compressive strengths of various proportions of M30 grade concrete mix with various replacement levels of fly ash and Ground Granulated Blast Furnace Slag at 7 days, 28 days & 60 days which were cured in normal water.

Table 1:Cube Compressive Strength at 7 days, 28 days & 60 days

S.No	No.of days of curing	M1 (N/mm^2)	M2(N/mm^2)	M3(N/mm^2)	M4(N/mm^2)	M5(N/mm^2)
1.	**7 days**	**23.11**	**24.00**	**22.22**	**24.88**	**23.55**
2.	**28 days**	**39.66**	**39.55**	**36.88**	**39.11**	**37.33**
3.	**60 days**	**42.22**	**43.55**	**40**	**42.66**	**40.88**

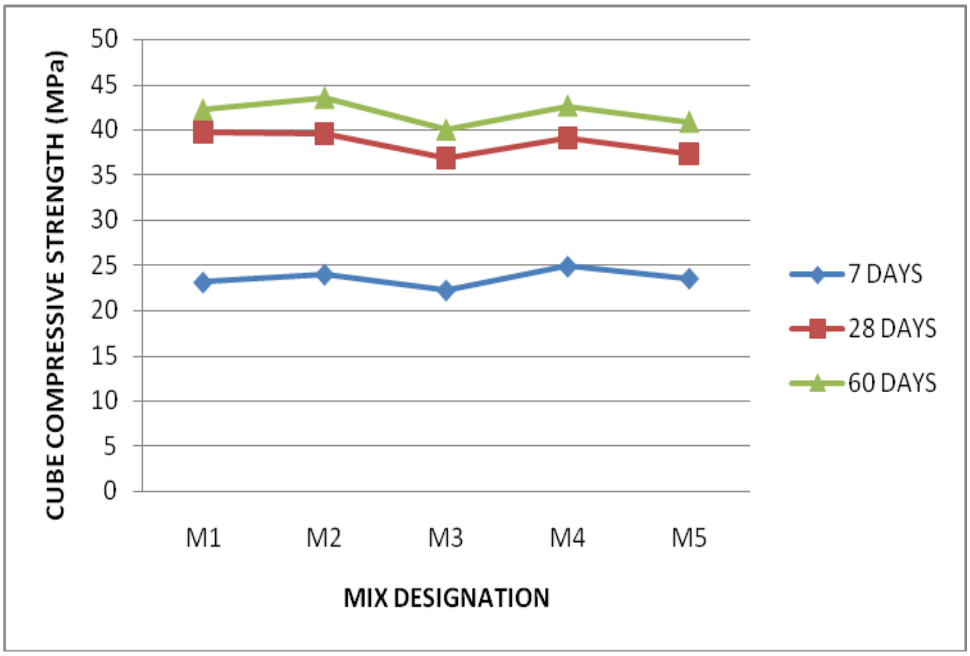

Fig: 1 Cube Compressive Strength (Mpa) cured in normal water

4.2 Comparison of Compressive Strengths cured in sea water

The following tabular form presents the compressive strengths of various proportions of M30 grade concrete mix with various replacement levels of fly ash and Ground Granulated Blast Furnace Slag at 7 days, 28 days & 60 days which were cured in normal water.

Table: 2 Cube Compressive Strength at 7 days, 28 days & 60 days

S.No	No.of days of curing	M1 (N/mm^2)	M2(N/mm^2)	M3(N/mm^2)	M4(N/mm^2)	M5(N/mm^2)
1.	7 days	17.77	18.66	16.44	18.22	15.55
2.	28 days	35.11	34.66	34.22	36	29.77
3.	60 days	34.22	31.11	32.88	36.88	30.66

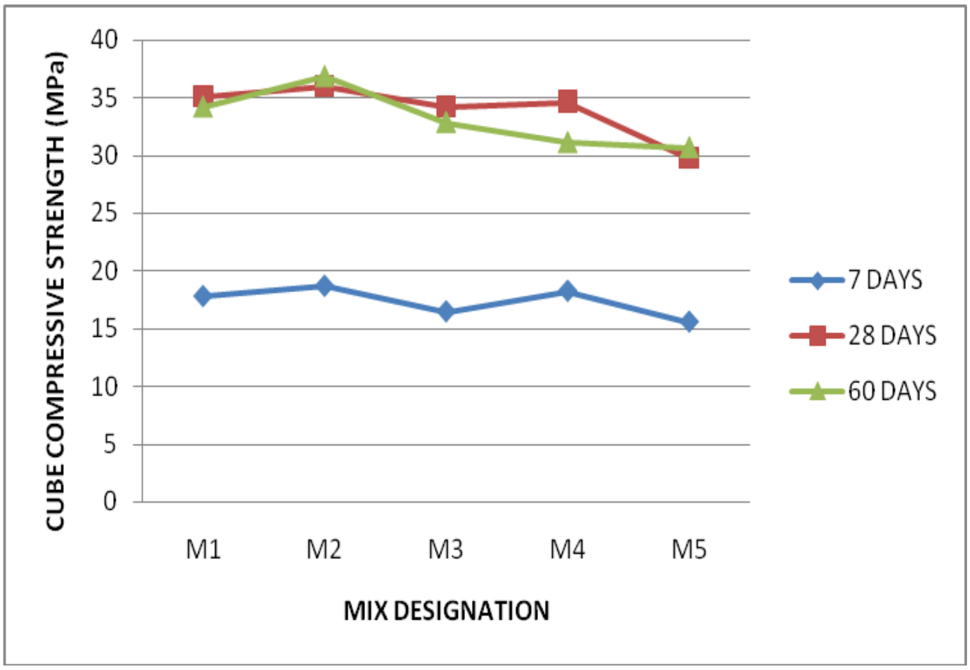

Fig: 2 Cube Compressive Strength (Mpa) cured in sea water

4.3 Comparison of Compressive Strengths cured in 1% H_2SO_4 solution

The following tabular form presents the compressive strengths of various proportions of M30 grade concrete mix with various replacement levels of fly ash and Ground Granulated Blast Furnace Slag at 7 days, 28 days & 60 days which were cured in 1% H_2SO_4.

Table: 2 Cube Compressive Strength at 7 days, 28 days & 60 days

S.No	No.of days of curing	M1 (N/mm^2)	M2(N/mm^2)	M3(N/mm^2)	M4(N/mm^2)	M5(N/mm^2)
1.	**7 days**	**24.88**	**28.00**	**26.22**	**25.33**	**24.00**
2.	**28 days**	**38.22**	**41.33**	**40.00**	**40.44**	**37.33**
3.	**60 days**	**40.44**	**44.22**	**40.88**	**45.77**	**42.00**

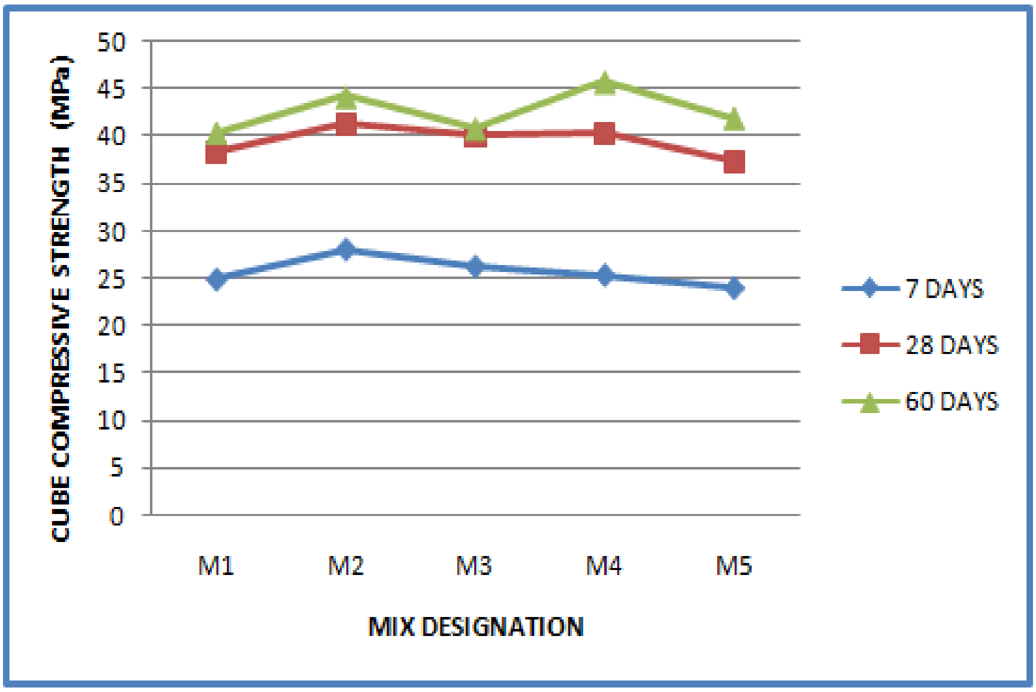

Fig: 2 Cube Compressive Strength (Mpa) cured in 1% H_2SO_4. Solution

Fig.3 Mixing of ingredients

Fig.4 Casting of Cube Specimens

Fig.5 cubes after casting

Fig.6 Cubes cured in normal water

Fig.8 Cubes cured in sea water **Fig.7 cubes cured in 1% H_2SO_4 solution**

V. CONCLUSIONS

1. The gain in early strength is compared to less in fly ash and GGBS concretes then conventional concrete
2. The results of fly ash and GGBS concretes when replaced with 20% of cement are more than compared to mix1 at the end of 7 days, 28 days and 60 days for normal water curing.
3. In sea water curing the GGBS when replaced with 20% of cement shows good response for durability criteria.
4. In 1% H_2SO_4 solution curing the Fly Ash when replaced with 20% of cement shows good response for durability criteria.

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