

AN EXPERIMENTAL ANALYSIS OF STRENGTH CHARACTERISTICS OF CONCRETE USING FLY ASH, SILICA FUME AND GGBFS

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ABSTRACT

The production of cement results in emission of many green house gases in ecosystem, which might be answerable for worldwide warming. Hence, the researchers are presently cantered on use of waste cloth having cementing properties, which may be introduced in concrete as partial substitute of cement, without compromising on its strength and sturdiness, which allows you to result in lower of cement manufacturing for that reason discount in emission in green residence gases, further to sustainable control of the waste. The houses of concrete specifically depend on the materials used in concrete. The waste product like fly ash, silica fume, and ground granulated blast furnace slag which has cementitious residences was used as partial substitute material for cement. This thesis affords a look at on mechanical properties of concrete made with multi factor cement. Study consists of idea of multi combined cement exploits the useful characteristics of all pozzolanic materials in producing higher concrete. This thesis focussed not only on the strength and also producing the economical concrete.

Keywords- cement replacement, multi bending, mechanical properties

1. INTRODUCTION

Sustainability was a big issue that being concern in making a development. This is because sustainable development has become a key aspect in society, Economics and development. Sustainable development shall meet the needs of the present without compromising ability of future generation to meets their own needs. it also shows that development that going to be made to sustain the planetary resources by using them effectively without making unnecessary wastage. The usage of silica fume, fly ash and GGBS to

replace the cement, is because the production of the cement emits carbon dioxide gas to atmosphere. The cement industry is held accountable for some of the carbon dioxide emission, due to the fact the manufacturing of one ton Portland cement emits about one ton of carbon dioxide gas into the atmosphere. The emission of carbon dioxide will increase the effect of global warming due to the emission of greenhouse gasses. Among the greenhouse gasses, carbon dioxide contributes about 65% of global warming.

2. MATERIALS

In the present experimental investigation silica fume, fly ash and GGBFS are used in concrete mixes, as a partial replacement of cement. The following materials used in concrete.

- 53 Grade OPC
- Fine aggregate
- Coarse aggregate
- Water
- Silica fume
- Fly ash
- GGBFS

Physical properties of materials:

- 1) Normal consistency of cement= 32%
- 2) Fineness of cement= 4%
- 3) Setting times of cement

- Initial setting time= 45 min
Final setting time = 460 min
- 4) Specific gravity of cement= 3.1
 - 5) Soundness of cement= 6.9mm
 - 6) Compressive strength of cement= 49Mpa
 - 7) Fineness modulus of fine aggregate=2.6
 - 8) Specific gravity of fine aggregate= 2.20
 - 9) Fineness modulus of coarse aggregate= 6.15
 - 10) Specific gravity of coarse aggregate 2.65
 - 11) Specific gravity of silica fume=2.25
 - 12) Specific gravity of GGBFS= 2.9
 - 13) Specific gravity of fly ash= 2.7

Table 1: Chemical properties of materials

Constituents	SF	F ASH	GGBFS
SiO ₂	92.85	63	40
Al ₂ O ₃	0.61	44	13.5
Fe ₂ O ₃	0.94	6.4	1.8
CaO	0.39	8	39.2
MgO	1.58	0.5	3.6

3. EXPERIMENTAL PROGRME

The M30 grade concrete was prepared as per given in IS 10262-2009, The mix design details and percentage of replacement of levels of cement with silica fume, fly ash and GGBFS and quantities of materials.

Table 2: Mix proportions of M30

cement	FA	CA
1	1.5	2.5

Table 3: percentage of replacement levels of cement in concrete

Type of mix	Cement %	Silica fume %	Fly ash %	GGBFS %
Mix 1	70	10	10	10
Mix 2	70	15	7.5	7.5
Mix 3	70	20	5	5
Mix 4	70	7.5	15	7.5
Mix 5	70	5	20	5

Table 4: Quantities of materials in Kg/m³

TYP E OF MIX	Cem ent	Sili ca fu me	Fly ash	GGB FS	F A	C A
CO NV	450	0	0	0	70	11
Mix 1	315	45	45	45	70	11
Mix 2	315	67.5	33.75	33.75	70	11
Mix 3	315	90	22.5	22.5	70	11
Mix 4	315	33.75	67.5	33.75	70	11
Mix 5	315	22.5	90	22.5	70	11

4. RESULTS AND DISCUSSION

The presentation of results obtained from various tests conducted on concrete specimens cast with cement is replaced by different levels of fly ash, silica fume and GGBFS. The main objective of the research program was to understand the compressive strength, flexural strength and split tensile strength of concrete obtained using silica fume, fly ash and GGBFS as partial replacement for cement. The compressive strength, split tensile strength and flexural strength of concrete containing various % silica fume, fly ash and GGBFS at the age of 7, 28 are given in Table 5, 6, 7. The results of compression, flexural and split tensile tests are shown in graphical form in Figures 1, 2 and 3

Table 5: Compressive strength results

Type of mix	Compressive Strength N/mm ²	
	7 days	28 days
CONV	19.26	37.25
Mix 1	17.15	30.24
Mix 2	20.55	39.54
Mix 3	21.81	40.12
Mix 4	18.23	35.21
Mix 5	21.92	41.66

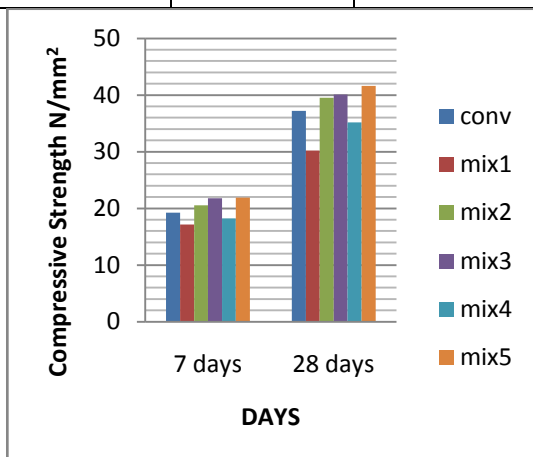


Fig 1 Compressive Strength

Table 6: Flexural Strength Results

Type of mix	Compressive Strength N/mm ²	
	7 days	28 days
CONV	3.9	5.7
Mix 1	3.8	4.7
Mix 2	4.1	6.2
Mix 3	4.3	6.3
Mix 4	3.86	5.1
Mix 5	4.5	6.6

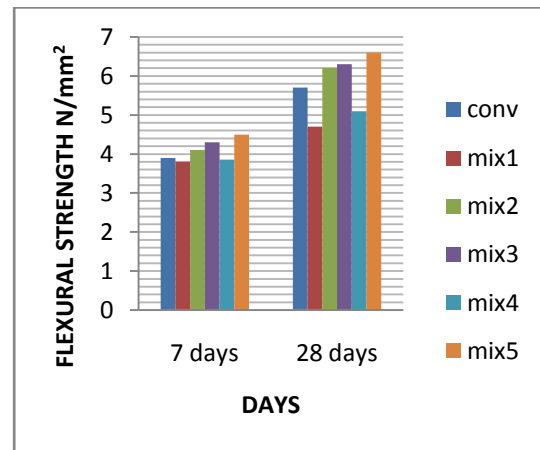


Fig 2 Flexural Strength

Table 7: split tensile strength results

Type of mix	Compressive Strength N/mm ²	
	7 days	28 days
CONV	3.7	5.2
Mix 1	3.5	4.9
Mix 2	3.8	5.4
Mix 3	4.0	5.5
Mix 4	3.6	5.1
Mix 5	4.3	5.7

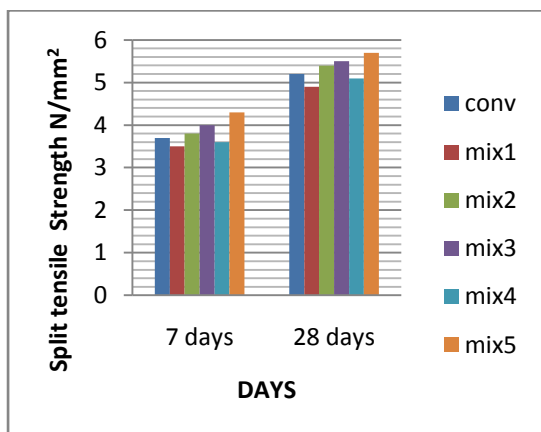


Fig 3 Split Tensile Strength

5. CONCLUSIONS

Based on this experimental study carried out on performance of silica fume, GGBS and fly ash concrete in comparison with normal concrete of design strength M30 following conclusion are drawn,

1. In compressive strength comparing to the conventional concrete Mix 1 and Mix 4 strengths are reduced. Mix 2, Mix 3 and Mix 5 strengths are increased.
2. The strength of Mix 4 is greater than Mix 1 and the strengths of Mix 2, Mix 3 and Mix 5 are gradually increased.
3. The Mix 5 getting highest compressive strength.
4. In flexural strength comparing to the conventional concrete Mix 1 and Mix 4 strengths are reduced. Mix 2, Mix 3 and Mix 5 strengths are increased.
5. The strength of Mix 4 is greater than Mix 1 and the strengths of Mix 2, Mix 3 and Mix 5 are gradually increased.
6. The Mix 5 getting highest flexural strength.
7. In split tensile strength comparing to the conventional concrete Mix 1 and Mix 4 strengths are reduced. Mix 2, Mix 3 and Mix 5 strengths are increased.

8. The strength of Mix 4 is greater than Mix 1 and the strengths of Mix 2, Mix 3 and Mix 5 are gradually increased.
9. The Mix 5 getting highest split tensile strength.

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