EXPERIMENTAL STUDY ON GREEN CONCRETE

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Abstract: Conventional concrete is responsible for amount of carbon-dioxide emission to some Extent. So to reduce the emission, various types of concrete are developed using waste products from industries and agricultural use like blast furnace slag, silica fume, fly ash which requires low Amount of energy and also cause least harm to the environment. Green concrete is a new technology developed now days to reduce the effect on environment by production of cement. Cement contains high amount of carbon-di-oxide which harms the environment drastically, so by replacing the cement by various materials which causes harm to the environment we not only reduce the problem of disposal of these materials but we reduce the emission of carbon-di-oxide from cement and as a result of which we reduces the negative effect on environment.

Keywords - Green Concrete, Silica fume, Demolished Brick Aggregate, CO_2 Emission, Eco-Friendly concrete.

I. INTRODUCTION

Color has nothing to do with green concrete. It is a concept of thinking and environment into an every aspect of the raw materials manufacture over construction, mixture design to structural design, and durability. Green concrete is very often considered to be cheap to produce due to the use of recycled material whereby avoiding the charges for the disposal of waste, less energy consumption and greater durability.

While a normal construction practices are guided by short term economic considerations, sustainable construction is focused on best practices which emphasize on long term affordability, durability and effectiveness. At each stage of the life cycle of the construction, it increases ease and quality of life, while minimizing the negative environmental impacts and increasing economic sustainability of the construction. Any infrastructure designed and constructed in a sustainable way minimizes the use of resources through the whole life cycle of the construction process in which the green concrete play a vital role in achieving the sustainable construction. Having so much of advantageous has led to popularity in construction world and one of the emerging technology in sustainable construction. Green concrete is miracle of present and tool for future when the natural resources are on the verge of extinction.

Due to growing interest in sustainable development, engineers and architects are motivated more than ever before to choose materials that are more sustainable. Selection of material for concrete is more sustainable and minimizes environmental impact. Cement production accounts for more than 6% of all CO_2 emission which is a major factor in the world's global warming (Greenhouse gas). India is the third largest cement producer in the World and one of the largest consumers of cement per capita in the world. Rough figures are that India consumes about 1.2 Ton/year/capita, while as World average is 0.6 Ton/year/capita. CO_2 emissions from 1 ton of concrete produced vary between 0.05 to 0.13 tons. 95% of all CO_2 emissions from a cubic meter of concrete are from cement manufacturing.

Cement is the one of the major component of the concrete. The production of one ton of cement releases one ton of a CO_2 into the atmosphere. CO_2 is known to be greenhouse gas that contributes to the global warming. The reduction in CO_2 emission from a concrete can be achieved with a partial replacement of cement by the various supplementary cementitious materials. The use of these cementitious materials has resulted in an improvement of the properties of concrete.

So to reduce this environmental impact green concrete plays a vital role. By using recycled materials or waste materials which are harmful to the environment as a replacement of cement such as fly ash, silica flume, etc. we can reduce the CO_2 emission from concrete as well as it reduces the environmental impact on earth. As a result of which green concrete is one of the major tool in the future when the natural resources are on verge of extinction.

II. OBJECTIVES

1) To study the effect of silica fume on the environment.
2) To study the effectiveness of concrete by partial replacement of cement by silica fume.
3) To determine the strength of new mix design concrete of grade M40.
4) To determine the various test results like compression test, flexural test & split tensile test.
5) To find the optimum percentage of silica fume in cement so that we can achieve maximum strength by increasing percentage as 5%,10%,15%,20%.

III. METHODOLOGY

- To find out number of literature on green concrete.
- To study about the ingredients of green concrete.
- Collection of various ingredients required for project from different outsources.
- To design a concrete mix for M40 grade as per the Indian Standard Recommended method.
- To cast cubes, beams & cylinders by using a various ingredients as per mix design.
- To test the casted cubes, beams & cylinders for strength after 7, 14, 28 days of curing respectively by performing various test like compressive test, flexural test & split tensile test.
- To calculate the economy for green concrete.
- To compare between conventional concrete and green concrete based on various parameters.

EXPERIMENTAL WORK:-

3.1 CEMENT

Ordinary Portland cement grade 53, manufactured by Birla .super confirming to IS 12269 – 2013.

Table No. 1: Properties of Cement

Sr. No.	TESTS	STANDARD VALUES	OBTAINED VALUES
1.	Normal Consistency	-	29%
2.	Initial Setting Time	>30 Min	42 Min
3.	Specific Gravity	3.10-3.20	3.15
4.	Fineness	<10%	0.8%

3.2 FINE AGGREGATE

Artificial sand passing through 4.75 mm IS sieve & retained on 150 micron confirming to IS 383 – 1970.

Table No. 2: Properties of Fine Aggregate

Sr. No.	TESTS	STANDARD VALUES	OBTAINED VALUES
1.	Specific Gravity	2.50-2.80	2.53
2.	Water Absorption	1%-2%	1.2%
3.	Grading Zone	I-IV	II

3.3 COARSE AGGRGATE

20mm size coarse aggregates confirming to IS 383 – 1970.

Table No. 3: Properties of Course Aggregate

Sr. No.	TESTS	STANDARD VALUES	OBTAINED VALUES
1.	Specific Gravity	2.50-3.00	2.90
2.	Water Absorption	0.5%-1.0%	1%
3.	Grading Zone	I-IV	II

3.4 DEMOLISHED BRICKS

Demolished bricks were collected from the demolished building of age 50 years. The collected sample were broken manually into pieces of size passing through 4.75mm IS sieve and retained on 150 micron IS sieve.

Table No. 4: Properties of Demolished Brick Wastes

Sr. No.	TESTS	STANDARD VALUES	OBTAINED VALUES
1.	Specific Gravity	1.80-2.0	1.96
2.	Water Absorption	28%-30%	30%

3.5 MICRO SILICA

Silica fume used was confirming to ASTM – C (1240 – 2000) and was supply by “ELKEM INDUSTRIES” was name Elkem – Micro Silica 920 D. The silica fume is used as a partial replacement of cement.

Table No. 5: Properties of Micro Silica

Sr. No.	PROPERTIES	STANDARD VALUES
1	Specific Gravity	2.2
2	Bulk Density	576 (Kg/m3)
3	Size (Micron)	0.1-0.2

3.6 MIX DESIGN

Mix design was done based on IS 10262 – 1982 & IS 456 – 2000 for M40 grade of concrete.
Following shows the mix proportion of concrete per m^3

- Cement Content : 430.00 Kg
- Fine Aggregate : 717.50 Kg
- Coarse Aggregate : 1233.66 Kg
- Admixtures (BSF) : 5.16 Kg
- W/C Ratio : 0.35
- Cement : Fine Aggregate : Coarse Aggregate
  1 : 1.66 : 2.93

3.7 EXPERIMENTAL PROCEDURE

The specimen of standard cube of 150mm*150mm*150mm and standard cylinder of 300mm*150mm and prism of size 100mm*100mm*500mm were used to determine the compressive strength, split tensile strength and flexural strength of concrete.

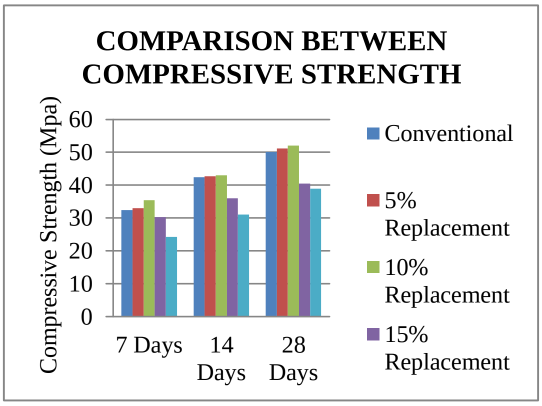
IV. TEST RESULTS & DISCUSSION

4.1 Compression Test

The test was carried out confirming to IS 516 – 1959 to obtain compressive strength of concrete at the age of 7, 14, 28 days. The cubes were tested using Compression Testing Machine (CTM) of capacity 2000 KN.

Table no. 5: Results of compression test

% SILICA	% BRICK AGGREGATE	COMPRESSION STRENGTH (MPa)		
		7 DAYS	14 DAYS	28 DAYS
0%	0%	32.45	42.38	50.11
5%	50%	33.03	42.73	51.18
10%	50%	35.40	43.03	52.07
15%	50%	30.29	36.00	40.50
20%	50%	24.29	31.11	38.88

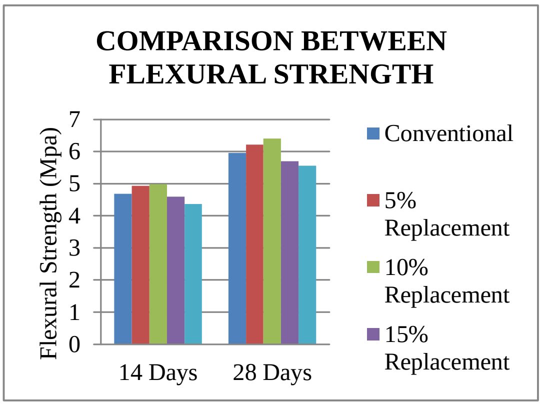


4.2 Flexural Test

The test was carried out confirming to IS 516 – 1959 to obtain flexural strength of concrete at the age of 14 & 28 days. The cubes were tested using Universal Testing Machine (UTM) of capacity 600 KN.

Table no.6: Results of flexural test

% SILICA	% BRICK AGGREGATE	FLEXURAL STRENGTH (MPa)	
		14 DAYS	28 DAYS
0%	0%	4.68	5.96
5%	50%	4.93	6.21
10%	50%	4.98	6.40
15%	50%	4.59	5.70
20%	50%	4..37	5.56

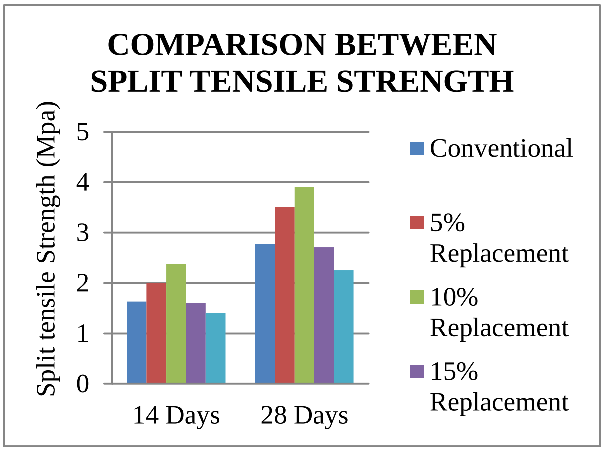


4.3 Split Tensile Test

The test was carried out confirming to IS 516 – 1959 to obtain flexural strength of concrete at the age of 14 & 28 days. The cubes were tested using Universal Testing Machine (UTM) of capacity 600 KN.

Table no.7: Results of split tensile test

% SILICA	% BRICK AGGREGATE	SPLIT TENSILE STRENGTH (MPa)	
		14 DAYS	28 DAYS
0%	0%	1.63	2.78
5%	50%	2.00	3.51
10%	50%	2.38	3.90
15%	50%	1.60	2.71
20%	50%	1.40	2.25



V. COST ANALYSIS

Cemet	320/50kg
Coarse aggregate	625/MT
Fine aggregate	750/MT

Table no.8: Cost of production of 1m^3 of concrete.

% SILICA	%BRICK AGGREGATE	TOTAL COST (Rs.)
0%	0%	4061.15/-
5%	50%	3654.50/-
10%	50%	3517.10/-
15%	50%	3380.10/-
20%	50%	3242.10/-

VI. CONCLUSION

Silica fume is a material which may cause air pollution; this is the byproduct of some industries. Addition of micro silica in cement reduces the air pollution and makes concrete more sustainable; as well as the optimum replacement of cement with silica 5% to 15% leads to increase in strength whereas the 20% replacement leads to decrease in strength of concrete.
Silica fume is finer than cement and more reactive to concrete ingredients so it increases the normal consistency of cement and achieves more strength in less time as compare to conventional concrete.
By replacing the fine aggregate with demolished brick waste, there is no significant effect on any strength of concrete, but the overall cost of concrete reduces up to 20% so economically the concrete is more economical than conventional concrete.

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