International Journal of Advanced Engineering and Technology
ISSN: 2456-7655; Impact Factor: RJIF 5.54
www.newengineeringjournal.com
Volume 1; Issue 2; May 2017; Page No. 27-29

Green concrete by using high volume slag, recycled aggregate, recycled water to build eco environment

[1] Nayana AY, [2] S Kavitha

[1] M.Tech Scholar, Department of Civil Engineering, ACSCE, Bengaluru, India, Karnataka, India
[2] Assistant Professor, Department of Civil Engineering, ACSCE, Bengaluru, Karnataka, India

Abstract
Manufacture and using of Ordinary Portland cement used in concrete industry produces 2.5 billion tons of CO_2. Hence several researches are focused on use of waste materials which is having cementing properties, which can be added as a partial replacement of cement in concrete without compromising strength and durability of concrete. This decreases the consumption of cement thus reduction in carbon emission. GGBS is a byproduct, which is obtained by manufacturing of iron, which may be used as partial replacement of cement in concrete. In response to the global warming issues, green concrete for construction is an essential requirement. In the present project, an attempt is made to produce the green concrete by using the by-product GGBS, recycled aggregates and recycled water to reduce the carbon footprints. Firstly, cement is replaced by GGBFS 60%, 70%, 80% by weight and 100% recycled aggregate and 100% recycled water is used. Grade of the concrete is M25. As water is the primary requirement in the world, by using recycled water scarcity of water may be reduced and also Disposal of demolished material is a big issue. Hence recycled aggregate in concrete can be useful for environment protection. This project provides mechanical properties of concrete prepared with ordinary Portland cement and green concrete.

Keywords: GGBS, recycled aggregate, recycled water

1. Introduction
Green concrete is defined as the concrete with material as a partial or complete replacement for constituents of concrete such as cement, fine aggregate, coarse aggregate and the replacement materials should be waste material. Concrete which uses waste material as at least one of its components and production process does not lead to negative environmental impacts. In order to produce a green firstly cement is replaced concrete with GGBS, coarse aggregate is replaced with recycled aggregate and water is replaced with recycled water.
Cement production generates an average world carbon emission of 0.81kg CO_2 per kg cement produced due to calcinations of raw materials and combustion of fuels. In order to reduce the environmental hazards alternative raw materials will be used, it will reduce the emission of greenhouse gases.
Ground granulated blast furnace slag is a by-product which is obtained during the quenching of molten iron. Replacement of cement by slag is best way to produce green concrete at the same time it also reduces the CO_2 emission.
Due to modernization, demolished materials are dumped in land. It is not used for any purpose; this affects the fertility of land. As per CPCB, in India, 48 million tons of solid waste is generated, out of which 14.5 million tons from construction sector. Only 3% of these wastes is utilized for embankment. Hence by using these recycled aggregates in concrete leads to environmental protection.
In order to reduce the CO_2 emission, cement is replaced with GGBS, Coarse aggregate replaced with recycled aggregate and portable water is replaced with recycled water.

2. Experimental investigation
The basic components of "Green Concrete" is cement, GGBFS, M sand, recycled aggregate, recycled water and super plasticizer

2.1 Cement
Cement is the main constituents of concrete and it act as a binding material. Ordinary Portland cement 53 grade confirming to the specifications of IS: 12269-1987 was used. Properties of OPC 53grade are given in below table 1.
Table 1 Physical properties of Ordinary Portland Cement 53grade

Table 1

S. No.	Properties	Test methods	Test values
1	Specific gravity	Specific gravity bottle (IS 4031 Part-4)	3.12
2	Fineness of cement	Sieve test on 90µ sieve (IS : 4031 Part-1)	4%
3	Initial setting time	Vicat Apparatus (IS : 4031 Part-5)	35min
4	Final setting time		220 min

2.2 GGBFS
GGBFS means ground granulated blast furnace slag is a byproduct of pig iron which is obtained by rapid quenching of slag. The chemical composition of blast furnace slag is same as cement clinker. The main advantage of using GGBS is to reduce the unit water content necessary to obtain same slump in fresh concrete Properties of GGBS are given in below table 2.

Table 2: Properties of GGBS

S. No.	Properties	Test values
1	Specific gravity	2.8
2	Fineness of GGBS	2.2%

2.3 Fine aggregate

Aggregate which passes through 4.75mm sieve are called fine aggregate. The aggregates used were confirming to zone II according to IS: 383-1970. Properties of fine aggregates are given in below table 3.

Table 3: Physical properties of fine aggregates

S. No.	Properties	Code of reference	Results
1	Specific gravity	IS : 2386-1963 (Part-3)	2.6
2	Fineness modulus	IS : 383-1970	3.1
3	Bulking of sand	IS : 2386-1963 (Part-3)	7%

2.4 Coarse aggregate

Aggregate which passes through 20mm sieve and retained on 4.75mm sieve are used. The aggregates used were confirming IS 383:1970. Properties of coarse aggregates are given in below table 4.

Table 4: Properties of coarse aggregate

Sl. no	Properties	Code of reference	Results
1	Specific gravity	IS : 2386-1986 (Part-3)	2.65
2	Water absorption	IS : 2386-1986 (Part-3)	0.29%
3	Fineness modulus	IS : 2386-1963 (Part 1)	2.7
4	Impact value	IS : 2386-1986 (Part 3)	13.7
5	Los angle abrasion	IS : 2386-1986 (Part 3)	22.94

2.5 Recycled aggregate

Properties of recycled aggregates are given in below table 4.

Table 5 Physical properties of recycled aggregate

Table 5

Sl. no	Properties	Code of reference	Results
1	Specific gravity	IS : 2386-1986 (Part-3)	2.45
2	Water absorption	IS : 2386-1986 (Part-3)	0.31%
3	Impact value	IS : 2386-1986 (Part 3)	33.2%
4	Los angle abrasion	IS : 2386-1986 (Part 3)	35.5%

2.6 Super plasticizer

Super plasticizer are the new version of plasticizer, now a days super plasticizers are most commonly used admixtures, chemical composition is different from normal plasticizer. In the resent investigations GLENIUM B233 is used

2.7 Mix proportions for different mix for 1m3 concrete

Table 6: Mix proportions for different mix for 1m3 concrete

Sl. No	Materials	NC	Mix 1	Mix 2	Mix 3
1	Cement	311	124	93	62
2	GGBS	0	187	218	249
3	Coarse aggregate	1220	1220	1220	1220
4	Fine aggregate	766	766	766	766
5	Water	140	140	140	140
6	Super plasticizer	6.22	5.22	5.22	5.22

3. Results

3.1 Compressive strength

The compressive test were carried to the specimen of 150mm X 150 mm X 150 mm after 7, 14, 28 days of curing with Compressive Testing Machine of 2000 kN capacity. A test result is average of three specimens and the maximum strength is average of 28 days curing.

Table 7: Compressive strength for different mix proportions

	Average compressive strength in N/mm2		
	7 days	14 days	28 days
Mix 1	18.81	27.33	30.26
Mix 2	18.12	22.44	26.17
Mix 3	13.23	19.20	20.40
Mix 1	10.72	15.33	17.37

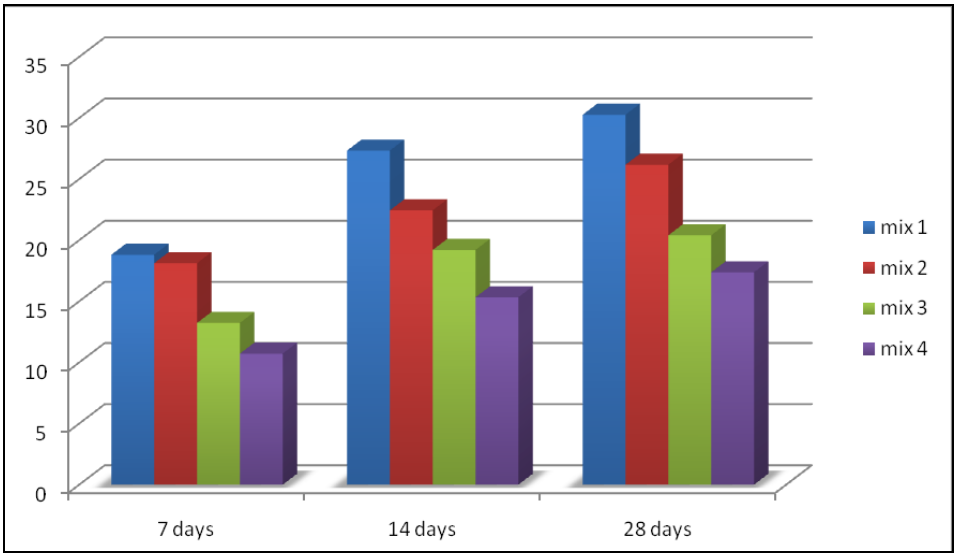

Fig 1: Compressive Strength

3.2 Tensile strength

Concrete is strong in compression and weak in tension. Tension will creates crack in concrete. Tensile

Table 8: Tensile strength for different mix proportions

	Average tensile strength in N/mm2		
	7 days	14 days	28 days
Mix 1	2.00	2.68	3.01
Mix 2	1.79	2.46	2.77
Mix 3	1.53	2.15	2.44
Mix 1	1.34	1.99	2.23

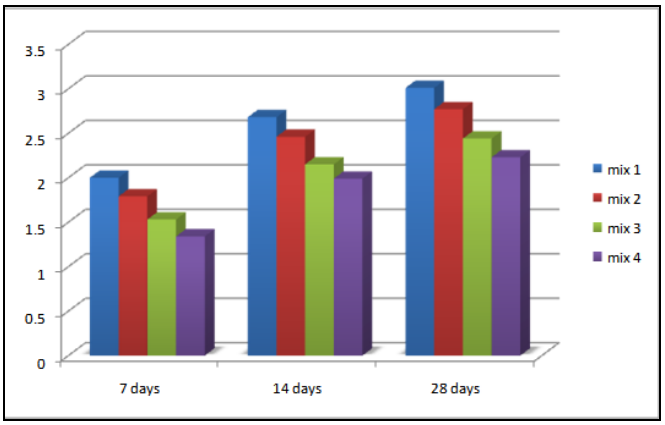

Fig 2: Tensile strength

3.3 Flexural strength

Table 9: Flexural strength for different mix proportions

	Average flexural s strength in N/mm2		
	7 days	14 days	28 days
Mix 1	2.99	4.47	5.02
Mix 2	2.7	4.11	4.69
Mix 3	2.43	3.85	4.15
Mix 1	2.13	3.41	3.86

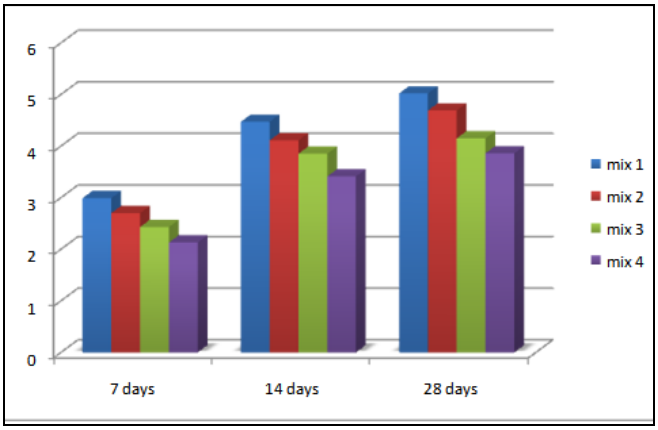

Fig 3: Flexural strength

4. Conclusions

- Considering the resent global warming issues, need for eco materials is revolutionary requirement. Hence, in the resent investigation Cement is replaced with 60% GGBS, 70% GGBS and 80% GGBS and coarse aggregate is replaced with recycled aggregate and water is replaced with recycled water to produce the green concrete.
- The compressive strength of green concrete for 60% replacement is 13.51 % less, 70% replacement is 32.6% less, 80% replacement is 42.6 % less when compared to Normal concrete.
- The tensile strength of green concrete for 60% replacement is 7.9 % less, 70% replacement is 18.9 % less, 80% replacement is 25.9 % less when compared to Normal concrete.
- The flexural strength of green concrete for 60% replacement is 6.6 % less, 70% replacement is 17.3% less, 80% replacement is 23.10 % less when compared to Normal concrete.
- So we concluded that 60% replacement is adoptable for the usage as the replacement of the normal concrete since there is less variation of strength between both the NC and 60%GGBS replaced concrete

5. References

1. Mette Glavind, Christian Munch-Peterson, Jesperr S.Damtoft, Anette Berrig. Green Conscrete in Denmark.
2. Peter Duxson, John L Provis, Grant C. Luckey, Jannie S.J van Deventer. The role of inorganic polymer technology in development of green concrete, cement and concrete research. 2007; 37:1590-1597.
3. Jagmeet Singh, Harpreet Singh, Rajindervir Singh, Portland Slag Cement Using Ground Granulated Blast Furnace Slag (GGBFS), IJREAS. 2015; 5(11):47-53.
4. Vijaya Gowri T, Sravana P, Srinivasa Rao P. Studies On Strength Behaviour Of 0High Volume Of Slag Concrete, IJRET. 2014; 3(4):227-238.
5. Kavitha S, Dr T Felix Kala, "Evaluation of strength behavior of SCC using alccofine and GGBS as partial replacement of cement", Indian journal of science and technology. 2016, l9(22).
6. Etxeberria M, Vazquez E, Mari A, Barra M. Influence Of Amount Of Recycled Coarse Aggregates And Production Process On Properties Of Recycled Aggregate Concrete, cement and concrete research. 2007; 37:735-742
7. Mr. Tushar R Sonawane, Prof. Dr. Sunil S. Pimplikar. Use of recycled aggregate concrete, IOSR-JMCE, 52-59.
8. Micheal J. Gibbis, Peter Soyka and David Conneely, $C0_2$ emissions from cement Production.
9. Kavitha S, Felix kala T. Effect of bamboo fiber in self compacting concrete partially replacing cement with ggbs and Alccofine "International Journal of Civil Engineering & Technology. 2017; 8(3):158-166.