International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Green Concrete

[1]Mohammed Jawad Hussain Qureshi, [2]Tajamul Fayaz, [3]MD Akif Rasheed, [4]Abdul Malik Shuja

[1,2,3,4] Dept. of Civil Eng. GNDEC, Bidar, India -585403

ABSTRACT

The concrete which is made using wastes which is eco-friendly is called as Green concrete. Green concrete is a revolutionary topic in the history of concrete industry. It was first invented in Denmark in the year 1998. The CO2 emission related to concrete production, inclusive of cement production, is between 0.1 and 0.2 ton per ton of produced concrete. Since concrete is the second most consumed entity after water it accounts for around 5% of the world's total CO2 emission (Ernst Worrell, 2001). However, since the total amount of concrete produced is so vast the absolute figures for the environmental impact are quite significant. The solution to this environmental problem is not to substitute concrete for other materials but to reduce the environmental impact of concrete and cement. Usage of quarry rock dust along with fly ash and micro silica reported satisfactory properties. The potential environmental benefit to society of being able to build with green concrete is huge. It is realistic to assume that technology can be developed, which can have the CO2 emission related to concrete production. With the large consumption of concrete this will potentially reduce the world's total CO2 emission by 1.5 - 2%.There is a large potential in investigating the possible use of these for concrete production. Well- known residual products such as silica fume and fly ash May be mentioned.

Cement and Aggregates. Ordinary Portland cement (OPC) of 43 Grade conforming to IS:8112: 1989 [19] was utilized as binder with surface area of 3220 cm2 /g and specific gravity of 3.14. Typical chemical composition of OPC is given in Table 1. Samples of demolition waste were collected from MSW

1. STATEMENT ABOUT THE PROBLEM

Green concrete is a revolutionary topic in the history of concrete industry. Concrete is an environmentally friendly material and the overall impact on the environment per ton of concrete is limited. The paper covers the aspect on how to choose a material for green concrete. It presents the feasibility of the usage of by product materials like fly ash, query dust, marble powder/ granules, plastic waste and recycled concrete and masonry as aggregates in concrete. The use of fly ash in concrete contributes the reduction of greenhouse emissions with negative impacts on the economy. It has been observed that 0.9 tons of CO2 is produced per ton of cement production. Also, the composition of cement is 10% by weight in a cubic yard of concrete. Thus, by the use of green concrete it is possible to reduce the CO2 emission in atmosphere towards eco-friendly construction technique. To avoid the pollution and reuse the material, the present study is carried out. Thus, green concrete is an excellent substituent of cement as it is cheaper because it uses waste products, saving energy consumption in the production. The concrete is made with concrete wastes which are eco-friendly so called as green concrete. Over and above all green concrete has greater strength and durability than the normal concrete.

1.1 METHODOLOGY

1. To find out number of literatures on green concrete.
2. To study about the ingredients of green concrete.
3. Collection of various ingredients required for project from different outsources.
4. To design a concrete mix for M30 grade as per the Indian Standard Recommended method.
5. To cast cubes, beams &cylinders by using a various ingredient as per mix design.
6. 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.
7. To compare between conventional concrete and green concrete based on various parameters
8. To calculate the economy for green concrete.

1.2 MATERIALS TO BE USED IN THE PROJECT

- **Cement**: The Indian standard IS:456-2000 recommends the use of Portland pozzolana cement (blended cement) as well as mineral admixtures for concrete mixes provided that there are satisfactory data on their suitability, such as performance test on concrete containing them. In the present paper concrete mix design with blended cement is presented based on relevant latest I.S. codes.
- **Coarse aggregate**: The coarse aggregate from a local crushing unit having 12mm normal size well-graded aggregate according to IS was used in this investigation. The coarse aggregate procured from quarry was sieved through 20mm, 16mm, 12.5mm, 10mm and 4.75mm sieves. The

material passing through 12.5mmIS sieve is to be used in this investigation.

- **Fine Aggregate:** The fine aggregate was obtained from a Nearby river course. The sand obtained was sieved through all the sieves (i.e.4.75mm, 2.36mm, 1.18mm, 600µ, 300µ, 150µ). Sand passing through 4.75mm IS sieve is to be used.
- **Recycled Coarse aggregate**: Recycling of concrete is a relatively simple process. It involves breaking, removing, and crushing existing concrete into a
- material with a specified size and quality. See ACI 555 (2001) for more information on processing old concrete into recycled concrete aggregates. The quality of concrete with RCA is very dependent on the quality of the recycled material used. Reinforcing steel and other embedded items, if any, must be removed, and care must be taken to prevent contamination by other materials that can be troublesome, such as asphalt, soil and clay balls, chlorides, glass, gypsum board, sealants, paper, plaster, wood, and roofing materials.
- **Manufactured sand (M-Sand):** It is a substitute of river sand for concrete construction. Manufactured sand is produced from hard granite stone by crushing. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand (M-Sand) is less than 4.75mm.
- **Ground granulated blast furnace slag:** GGBS is obtained by quenching molten iron slag from a blast furnace in water or stream, to produce a glassy, granular product that is then dried and ground into fine powder. It can be used as filler and helps to reduce the total voids content in self compacting concrete.
- **Banana Fiber:** Banana fiber is a natural fiber with high strength, which can be blended easily with cotton fiber or other synthetic fibers to produce blended fabric & textiles. Banana Fiber also finds use in high-quality security/ currency paper, packing cloth for agriculture produce, ships towing ropes, wet drilling cables etc.
- **Plasticizers and Superplasticizers**: are also called high range water reducers. When added to concrete mixtures, they confer a number of properties including improve workability and strength. ... Plasticizers are also often used when pozzolanic ash is added to concrete to improve strength.

1. Preliminary Investigation

1.3.1 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	OBTAINEDVALUES
1.	Normal Consistency	---	29%
2.	Initial Setting Time	>30 Min	42 Min
3	Specific Gravity	3.10-3.20	3.15
4	Initial setting Time (min)	30	30 (minimum)
5	Fineness	<10%	0.8%
6	Final setting Time (min)	212	600 (minimum)

1.3.2 FINE AGGREGATE

Artificial sand passing through 4.75 mm IS sieve & retained on 150 microns

Table No. 2: Properties of Fine Aggregate

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

1.3.MIX DESIGN

(i). Stipulation for Proportioning Concrete Ingredients

(a) Characteristic compressive strength required in the field at 28 days grade designation — M 30
(b) Type of Cement: OPC 53 Grade confirming to IS 12269
(b) Maximum Nominal size of aggregate — 20 mm
(c) Shape of CA — Angular

(d) Workability required at site — 100 mm (slump)
(e) Type of exposure the structure will be subjected to (as defined in IS: 456) —Moderate
(h) Method of concrete placing: pump able concrete
(g) Type of fiber: banana fiber
(f) Ground granulated blast -furnace slag

(ii). Test Data of Material

The following materials are to be tested in the laboratory and results are to be ascertained for the design mix

(a) Cement Used: OPC 53 Grade Confirming to IS 12269
(b) Specific Gravity of Cement: 3.15
(c) Chemical admixture: *Super plasticizer confirming to IS 9103
* Water reducing admixtures (WRA)
(d) Specific gravity
Specific gravity of Fine Aggregate (sand) : 2.75
Specific gravity of Coarse Aggregate: 2.89
Specific gravity of Recycled Coarse Aggregate: 2.7
Specific gravity of Fine Aggregate (m-sand) :2.73
(e) Water Absorption
Coarse Aggregate: 0.4%
Fine Aggregate: 1.0%
Recycled Coarse Aggregate :4.50%
Banana fiber :11. 0%
(f) Free (surface) moisture
Coarse Aggregate: Nil
sand Fine Aggregate: Nil
Recycled Coarse Aggregate: Nil
Aggregate is assumed to be in saturated surface dry condition usually while preparing design mix.
(g) Seive Analysis
Fine aggregates: Confirming to Zone I of Table 4 IS – 383

Step-1 : Determining The Target Strength For Mix Proportioning

F'ck = fck + 1.65 x S
Where,
F'ck = Target average compressive strength at 28 days
Fck = Characteristic compressive strength at 28 days
S = Assumed standard deviation in N/mm2 =4. 5 (as per table -1 of IS 10262- 2009)
= 30 + 1.65 x 5 = 38.25 N/mm2
Note : Under control conditions if Target average compressive strength is achieved then at field the probability of getting compressive strength of 30 MPa is very high

Step-2 : Selection Of Water Cement Ratio

From Table 5 of IS 456, Maximum water-cement ratio = 0.45
Note : Do not start with w/c ratio above 0.45,even though the other desired results likeStrength, workability could be achieved.

Step-3: Selection Of Water Content

Maximum water content for 20 mm aggregate = 186 Kg (for 25 to 50 slump)
We are targeting a slump of 100mm, we need to increase water content by 3% for every 25mm above 50 mm i.e. increase 6% for 100mm slump
i.e. Estimated water content for 100 Slump = 186+(6/100) X 186 = 197 liter
Water content = 197 Water content = 197 liters
Add Water reducing admixtures (WRA) . :30 %
Water content = 197 -59.1 =137.9 liters

Step-4: Calculation Of Cement Content

Water-Cement Ratio = 0.45
Water content from Step – 3 i.e. 137.9 liters
Cement Content = Water content / "w-c ratio" = (137.9 /0.45) = 306.44 kg
From Table 5 of IS 456,
Minimum cement Content for moderate exposure condition = 300 kg/m3

306.44 kg/m3 > 300 kg/m3, hence, OK.
As per clause 8.2.4.2 of IS: 456
Maximum cement content = 450 kg/m3, hence ok too
Ggbs content =30%
Ggbs content = 91.86 kg

Step-5: Proportion Of Volume Of Coarse Aggregate And Fine Aggregate Content

From Table 3 of IS 10262- 2009, Volume of coarse aggregate corresponding to 20 mm size and fine aggregate (Zone I) = 0.60

Note 1: In the present case water-cement ratio is 0.45.So there will be no change in coarse
aggregate volume i.e. 0.60
Note 2: Incase the coarse aggregate is not angular one, then also volume of coarse
aggregate may be required to be increased suitably based on experience.

Step-6: Estimation Of Concrete Mix Calculations The mix calculations per unit volume of concrete shall be as follows:

1. Volume of concrete = 1 m3
2. Volume of cement = (Mass of cement / Specific gravity of cement) x (1/1000) =(214.58 /3.15) x (1/1000) = 0.0684 m3
3. Volume of ggbs= (Mass of ggbs / Specific gravity of cement) x (1/1000) = 0.0288m3
4. Volume of water = (Mass of water / Specific gravity of water) x (1/1000) = (137.9/1) x (1/1000) = 0.1379 m3
5. Total Volume of Aggregates = 1- (b+c) =1- (0.0684+0.0288) = 0.9028m3
6. Mass of coarse aggregates = d X Volume of Coarse Aggregate / Specific Gravity of Coarse Aggregate X 1000 = 0.9028 X 0.60 X 2.80 X 1000 = 1516.704kgs/m3
7. After removing 30%=1061.69 kg/m3
8. Recycled coarse aggregates 30%=1434.384-30%=455.014 kg/m3
9. Mass of fine aggregates = d X Volume of Fine Aggregate X Specific Gravity of Coarse Aggregate X 1000 = 0.9028 X 0.40 X 2.70 X 1000 = 972.024 kg/m3
10. Removing 30% of fine aggregates =682.64 kg/m3
11. M-sand 30% =292.384kg/m3

Step-7: Concrete Mix Proportions For Trial Mix

Mix Proportions For Trial Mix-1:
Cement = 214.58 kg/m3
Ggbs = 91.86
Water = 137.9 kg/m3
Fine aggregates = 682.64 kg/m3
Coarse aggregate = 1061.69 kg/m3
Water-cement ratio = 0.45
M-sand 30% =292.3814
Recycled coarse aggregates 30%=455.014 kg/m3

Note-1: Aggregates should be used in saturated surface dry condition. If otherwise, when computing the requirement of water, allowance shall be made for the free (surface) moisture contributed by coarse aggregate and fine aggregate. On the other hand, if the aggregates are already dry , the amount of water mixed should be increased by an amount equal to the moisture likely to be absorbed by the aggregates. Necessary adjustments are also required to be made in the mass of the aggregates. The surface water and percentage water absorption shall be determined according to IS 2386.

Correction in water content due to absorption or moist aggregates. The slump shall be measured and the water content and shall be adjusted for achieving the required slump based on trial, if required. The mix proportions shall be reworked for the actual water content and checked for durability requirements. Two more trials having variation of +/-10% of water cement ratio shall be carried out and a graph between three water-cement ratios and their corresponding strength shall be plotted to work out the mix proportions for the given target strength for field trials. However, durability requirement shall be met.

Conclusion

- In this concrete recycling use of waste material such as ceramic wastes, aggregates, so increased concrete industry's use of waste products by 20 TO 30%. Hence green concrete consumes less energy and becomes economical.
- The above experimental program leads to emphasize the effects of banana fibre and GGBS on properties of fresh and hardened banana fiber reinforced concrete. It is observed from the results that the presence of banana fiber increases the overall performance of the concrete.
- The above experimental program leads to emphasize the effects of banana fibre and GGBS on properties of fresh and banana fiber reinforced

green concrete. It is observed from the results that the presence of banana fiber increases the overall performance of the green concrete.

- The Optimum compressive strength of the designed concrete is achieved at mix M3 with upto 30% of cement is replaced with GGBS.
- It is evident from the results, that tensile and flexural strengths increase with increase in dosage of fibers
- The recycled aggregate concrete gives maximum compressive and tensile strength near to conventional concrete
- In the present study it can be concluded that among M1 M2 M3 mixes M3 can give satisfactory results in all engineering properties of concrete (fresh and hardened), with a replacement of 30% of cement with GGBS and using banana fibers at dosage of 1.5% by weight of cementitious materials.
- The super plasterer reduce the water cement ratio up to 50%

References

[1]. "Concept of green concrete using Construction Demolishment Waste As Recycled Coarse Aggregate" – International Journal of Engineering Trends And Technology – Volume 4 Issue 7 –July 2013 – ISSN: 2231- 5381

[2]. "Green Concrete: Efficient and Eco Friendly Construction Material" – Impact: IJRET Volume 2 Issue 2 Feb 2014 –ISSN(E):2321 – 8843

[3]. "Green Concrete For Sustainable Construction" – IJRET Volume 2 Issue 11 Nov2013 – ISSN (E) : 2319- 1163 ; ISSN(P):2321-7308

[4]. "To Study The Effect On Properties Of Concrete Of Marble Powder And Fly Ash By Replacement Of Cement" – SSRG-IJCE- Volume 3 Issue 7 July 2016- ISSN: 2348-8352

[5]. "Green Concrete" – IJIR Volume 3 Issue 1 2017 – ISSN: 2454-1362

[6]. "Environmental Lyfe Cycle Inventory OF Single Family Housing" – Gajda,JVanGeen, Martha G , Medgar l, SN2582a, Portland Cement Association , Skokie , PCA 2002

[7]. Marwan Mostafa * and Nasim Uddin January 2015 / Accepted: 11 March 2015 /Published: 18 March 201