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Green Concrete

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Abstract: *Green concrete is a revolutionary topic in the history of concrete industry. This was first invented in Denmark in the year 1998. Green concrete has nothing to do with colour. It is a concept of thinking environment into concrete considering every aspect from raw materials manufacture over mixture design to structural design, construction, and service life. It is a type of concrete that is made with concrete waste, uses less energy in its production and produces less carbon dioxide than normal concrete. The substituted materials could be waste material that remain unused and maybe harmful (material that contains radioactive elements). This concrete should follow reduce, reuse and recycle technique or any two process in the concrete technology. The three major objective behind green concept in concrete are to reduce greenhouse gas emission (carbon dioxide emission from cement industry, as one ton of cement manufacturing process emits one ton of carbon dioxide), secondly to reduce the use of natural resources such as limestone, shale, clay, natural river sand, natural rocks that are being consumed for the development of mankind, thirdly to use waste materials of concrete that occupies large area of land for its storage that results in the air, land and water pollution.*

Keywords: *Green concrete*

I. INTRODUCTION

The size of construction industry all over the world is growing at faster rate. The huge construction growth boosts demand for construction materials. Aggregates are the main constituent of concrete. Due to continuously mining the availability of aggregates has emerged problems in recent times. To overcome this problem, there is need to find replacement to some extent

Nowadays, there is a solution to some extent and the solution is known as "Green Concrete". Green concrete has nothing to do with color. It is a concept of thinking environment into concrete considering every aspect from raw materials manufacture over mix design to structural design, construction, and service life. Green concrete is also cheap to produce because, waste products are used as partial substitute for cement, charges for the disposal are avoided, energy consumption in production is lower, and durability is greater. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently and the environment is protected from waste deposits

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Concrete wastes like slag, power plant wastes, recycled concrete, mining and quarrying wastes, waste glass, incinerator residue, red mud, burnt clay, sawdust, combustor ash and foundry sand. The CO2 emission related to concrete production, inclusive of cement production, is between 0.1 and 0.2 t per ton of produced concrete. However, since the total amount of concrete produced is so vast the absolute figures for the environmental impact are quite significant, due to the large amounts of cement and concrete produced. 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). The solution to this environmental problem is not to substitute concrete for other materials but to reduce the environmental impact of concrete and cement.

II. LITERATURE SURVEY

Vinita Vishwakarma et al (2017) have investigated the waste materials from agriculture, industries, bio-waste, marine waste and e-waste can be recycled and used as a supplementary green concrete material. The waste products can be reused directly as a partial substitute of cement and save the energy consumption during the production of cement. The author also analysed the waste materials such as rice husk ash (RHA), saw dust ash (SDA), rubber crump, plastic waste, coconut husk and shell, textile waste (sludge and fibre) etc recycle of such types of wastes can be used as an admixture to make the Green Concrete structures. This will reduce the quantity of cement used and CO2 emission and reduce the global warming. The concrete structures prepared from the waste materials have lower environmental impact through reduced CO2 emission and maintain all the specification of ‘‘Green Concrete”. For these inexpensive and environmentally friendly building materials, the scrap merchants should be educated and trained to segregate different types of waste to be used for the construction industries.

K.M.Liew et al (2017) have investigated the green concrete offers numerous
environmental, technical benefits and economic benefits such as high strength, increased durability, improved workability and pump ability, reduced permeability, controlled bleeding, superior resistance to acid attack, and reduction of plastic shrinkage cracking .They also studied the Green concrete comes in various forms such as high-volume fly ash concrete, ultrahigh performance concrete, geopolymer concrete, lightweight concrete to mention a few. On the other hand, green concrete exhibit numerous advantages such as improvement in concrete properties, low carbon footprint, conservation of natural resources. Utilization of green concrete in large-scale infrastructure projects globally should be promoted. The demand for green concrete in construction industry is spurred by increased regulations to reduce carbon footprint, limit greenhouse gas emission and limited landfill spaces.

Roushan Kumar et al (2017) have studied it is a concept of thinking environment into concrete considering every aspect from raw materials manufacture over mixture design to structural design, construction, and service life. This was first invented in Denmark in the year 1998. GREEN concrete has nothing to do with colour. Green concrete is very Often and also cheap to produce, because for example, waste products are used as a partial substitute for cement, charges. The replacement of traditional ingredients of concrete by waste materials and by products gives an opportunity to manufacture economical and environment friendly concrete. Partial replacement of ingredients by using waste materials and admixtures shows better compressive and tensile strength, improved sulphate resistance, decreased permeability and improved workability.

Nurdeen M. Altwair et al (2011) have investigated the flexural performance of green engineered cementitious composites (ECCs) containing high volume of palm oil fuel ash (POFA). The author also analysed some available experiments to monitor the flexural performance by curing the concrete using four-point bending test. The experimental results show the flexural performance was assessed after 3, 28, and 90 days. The results suggest that there is a corresponding reduction in the first cracking strength and flexural strength of the ECC beams with the increase of water–binder ratios and POFA content. The flexural deflection capacity tends to increase with an increase in both the water–binder ratio and POFA–cement ratio. After 28 days, asthe POFA/C increased from 0.4 to 1.2, the first cracking strength decreased from 7.7 to 5.3, 6.7 to 4.9, and 6.4 to 4.5 MPa at water–binder ratio of 0.33, 0.36, and 0.38, respectively.

Bambang Suhendro et al (2014) have investigated the 8 to 10 percent of the world's total CO2 emissions come from manufacturing cement. Green concrete is defined as a concrete which uses waste material as at least one of its components, or its production process does not lead to environmental destruction, or it has high performance and life cycle sustainability. Various efforts have been conducted by researchers to arrive at some alternatives that are able to significantly reduce high energy consumed and environmental impacts during fabrication process of cement. The cleaner technologies in concrete production, such as substituting relatively high percentage of cement by fly ash. Several efforts that have been done so far in implementing the concept of green concrete and material development of nano silica in Indonesia have also been reported.

III. METHODOLOGY

The following methodology was framed to incorporate all the aspects of the proposed thesis work:

- First step to collect and prepare the Demolition materials & Residual materials for making green concrete.
- Binder materials as Fly ash & Portland pozzolana cement are taken as per proportion.
- Sieve analysis and Grading of aggregates.
- Then preparation of green concrete at different proportions.
- Preparation of cubes with green concrete and
- The concrete mould kept in moist condition for 24 hours.
- After 24 hours the concrete kept under goes curing process.
- Testing the compressive strength of cubes at 7, 14 days and
- 28 days correspondingly

3.1 PERFORMANCE ANALYSIS

COMPRESSIVE STRENGTH OF CONCRETE

Objective

The compressive strength of concrete is given in terms of the characteristic compressive strength of 150 mm size cubes tested at 28 days (fck)- as per Indian Standards (ACI standards use cylinder of diameter 150 mm and height 300 mm). The characteristic strength is defined as the strength of the concrete below which not more than 5% of the test results are expected to fall.

Characteristic strength of concrete is the strength of concrete specimens casted and tested as per given code of practice and cured for a period of 28 days; 95% of tested cubes should not have a value less than this value.

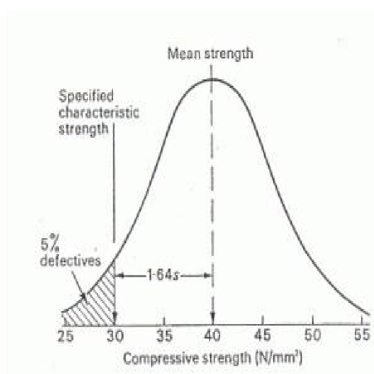

Fig. Normal Distribution curve on test specimens for determining compressive strength

Apparatus Required

The testing machine may be of any reliable type, of sufficient capacity for the tests and capable of applying the load at the specified rate. The permissible error shall be not greater than ± 2 percent of the maximum load.

Fig. Compression Testing Machine

The mould shall be of 150 mm size conforming to IS: 10086-1982.

Fig. 3: Moulds/ Cubes for Testing

Procedure

All materials shall be brought to room temperature, preferably 27 ± 3 oC before commencing the test.

Samples of aggregates for each batch of concrete shall be of the desired grading and shall be in an air-dried condition. The cement samples, on arrival at the laboratory, shall be thoroughly mixed dry either by hand or in a suitable mixer in such a manner as to ensure the greatest possible blending and uniformity in the material. Care being taken to prevent intrusion of foreign materials.

The proportions of the materials, including water, in concrete mixes used for determining the suitability of the materials available, shall be similar in all respects to those to be employed in the work.

The quantities of cement, each size of aggregate, and water for each batch shall be determined by weight, to an accuracy of 0.1 percent of the total weight of the batch.

The concrete shall be mixed by hand, or preferably, in a laboratory batch mixer, in such a manner as to avoid loss of water or other materials. Each batch of concrete shall be of such a size as to leave about 10 percent excess after moulding the desired number of test specimens.

Each batch of concrete shall be tested for consistency immediately after mixing, by one of the methods described in IS:1199-1959. Provided that care is taken to ensure that no water or other material is lost, the concrete used for the consistency tests may be remixed with the remainder of batch before making the test specimens. The period of re-mixing shall be as short as possible yet sufficient to produce a homogeneous mass.

Test specimens cubical in shape shall be 15 × 15 × 15 cm. If the largest nominal size of the aggregate does not exceed 2 cm, 10 cm cubes may be used as an alternative. Cylindrical test specimens shall have a length equal to twice the diameter. They shall be 15 cm in diameter and 30 cm long. Smaller test specimens shall have a ratio of diameter of specimen to maximum size of aggregate of not less than 3 to 1, except that the diameter of the specimen shall be not less than 7·5 cm for mixtures containing aggregate more than 5 percent of which is retained on IS Sieve 480.

The test specimens shall be made as soon as practicable after mixing, and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance. The concrete shall be filled into the mould in layers approximately 5 cm deep. In placing each scoopful of concrete, the scoop shall he moved around the top edge of the mould as the concrete slides from it, in order to ensure a symmetrical distribution of the concrete within the mould. Each layer shall be compacted either by hand or by vibration.

The test specimens shall be stored in a place, free from vibration, in moist air of at least 90 percent relative humidity and at a temperature of 27° ± 2°C for 24 hours ± ½ hour from the time of addition of water to the dry ingredients.

The ends of the specimen shall be capped before testing. The material used for the capping shall be such that its compressive strength is greater than that of the concrete in the core. Caps shall be made as thin as practicable and shall not flow or fracture before the concrete fails when the specimen is tested. The capped surfaces shall be at right angles to the axis of the specimen and shall not depart from a plane by more than 0·05 mm.

The bearing surfaces of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the specimen which are to be in contact with the compression platens.

In the case of cubes, the specimen shall be placed in the machine in such a manner that the load shall be applied to opposite sides of the cubes as cast, that is, not to the top and bottom.

The axis of the specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. No packing shall be used between the faces of the test specimen and the steel platen of the testing machine.

The load shall be applied without shock and increased continuously at a rate of approximately 140 kg/sq cm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained.

15.The maximum load applied to the specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

IV. CALCULATION

Calculation for nominal mix

Volume of cube : 0.15*0.15*0.15 =3.375*10-3 m3 (In wet condition)
(Take 1.52 times more volume in dry condition)

: 5.13*10-3 m3

Volume of cement	:	5.13*10-3*0.25 = 1.2825*10-3 m3
Unit weight of cement	:	1440 Kg/m3
Weight of cement for 1 cube	:	1.846 Kg
Weight of cement for 9 cubes	:	9*1.846 = 16.614 Kg (17 Kg approx.)
Unit weight of fine aggregate	:	1600 Kg/m3
Volume of fine aggregate	:	5.13*10-3*0.25 = 1.2825*10-3 m3
Weight of fine aggregate for 1 cube	:	1.2825*10-3*1600 = 2.052 Kg
Weight of fine aggregate for 9 cubes	:	2.052*9 = 18.486 Kg (18 Kg approx.)
Unit weight of coarse aggregate	:	1600 Kg/m3
Volume of coarse aggregate	:	5.13*10-3*0.5 = 2.565*10-3 m3
Weight of coarse aggregate for 1 cube	:	2.565*10-3*1600 = 4.140 Kg
Weight of coarse aggregate for 9 cubes	:	4.104*9 = 37.26 Kg (37 Kg approx.)

Calculation for glass mix

Weight of cement: 1.846 Kg

Weight of cement when 30% cement is replaced by glass :1.846*0.70 = 1.296 Kg

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Glass replaces cement			
% Replaces	Cube	Weight of cement (in kg)	Weight of glass (in kg)
30	1	1.846	0.550
30	9	16.614	4.950

Observation And Recording

Table 1 : Recordings during Compressive Test on Concrete

Sr. No.	Age of Cube	Cross Sectional Area(mm^2)	Load (N)	Compressive Strength (N/mm^2)	Avg. Compressive Strength (MPa)
1	3 days	22500	260000	11.555	11.703
2			250000	12.000	
3			260000	11.555	
4	7 days	22500	530000	23.556	23.565
5			520000	23.111	
6			540000	24.000	
7	28 days	22500	650000	28.899	29.185
8			660000	29.333	
9			660000	29.333	

Fig. Compression Testing Machine

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Calculation

The measured compressive strength of the cubes shall be calculated by dividing the maximum load applied to the cubes during the test by the cross-sectional area, calculated from the mean dimensions of the section and shall be expressed to the nearest 0.5 N/mm2. In determining the compressive strength, donot consider specimens that are manifestly faulty, or that give strengths differing by more than 10 percent from the average value of all the test specimens.

The average 3 Days Compressive Strength of given cement sample is found to be ….11.703……

The average 7 Days Compressive Strength of given cement sample is found to be …23.565..…..

The average 28 Days Compressive Strength of given cement sample is found to be …29.185..…..

Graph

Draw graph between Characteristics Compressive Strength of Concrete versus Time (Days).

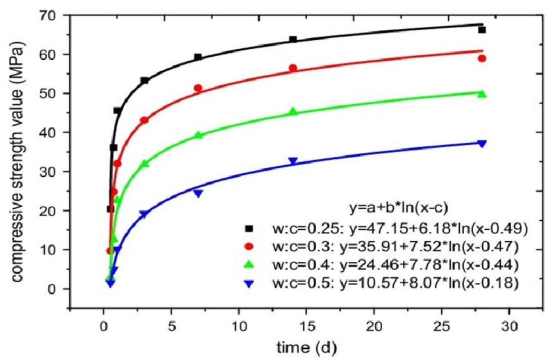

Fig. Plot of Characteristics Compressive Strength of Concrete versus Time (Days).

V. CONCLUSION

The overview of the present state of affairs regarding concrete types with reduced environmental impact has shown that there is considerable knowledge and experience on the subject. The Danish and European environmental policies have motivated the concrete industry to react, and will probably also motivate further development of the production and use of concrete with reduced environmental impact. The somewhat vague environmental requirements that exist have resulted in a need for more specific technical requirements, and the most important goal is to develop the technology necessary to produce and use resource saving concrete structures, i.e. green concrete. This applies to structure design, specification, manufacturing, performance, operation, and maintenance.

In 1994 cement industry consumed 6.6 EJ of primary energy, corresponding with 2% of world energy consumption. Worldwide 1126 Mt CO2 or 5% of the CO2 production originates from cement production. The carbon intensity of cement making amounts to 0.81 kg CO2/kg cement. In India, North America, and China the carbon intensity is about 10% higher than on average. Specific carbon emissions range from 0.36 kg to 1.09 kg CO2/kg cement mainly depending on type of process, clinker/cement ratio and fuel used.

The potential environmental benefit to society of being able to build with green concrete is huge. It is realistic to assume that the technology can be developed, which half the CO2 emission related to concrete production, and this can will mean a potential reduction of total CO2 emission by 2% (Obla 2009). Seventeen different energy efficiency improvement options are identified. The improvement ranges from a small percentage to more than 25% per option, depending on the reference case (i.e. type of process, fuel used) and local situation. The use of waste instead of fossil fuel may reduce CO2 emissions by 0.1 to 0.5 kg/kg cement (varying from 20 to 40%). An end-of-pipe technology to reduce carbon emissions may be CO2 removal. Probably the main technique is combustion under oxygen while recycling CO2 (Hendriks, 2004). However, considerably research is required to all unknown aspects of this technique.

REFERENCES

[1]. Glavind M. and Munch-Petersen C., ― Green'Concrete in Denmark‖, Structural Concrete, 1(1), March 2000.

[2]. Obla, K. H., ―What is Green Concrete? ‖, Point of view, The Indian Concrete Journal, 24(4):26-28, April 2009.

[3]. Green Globes, The Green Building Initiative, Portland, Oregon, http://www.thegbi.org/

[4]. Hendriks, C. A., Worrell, E., de Jager, D., Blok, K. and Riemer P., ―Emission Reduction of Greenhouse Gases from the Cement Industry‖, Conference Paper- Cement, 2004, http://www.ieagreen.org.uk/

[5]. Pravin K., Kaushik S.K. ―SCC with crusher sludge, fly ash and micro silica.‖ The Indian Concrete Journal. 79(8): 32-37, August 2005

[6]. Leadership in Energy and Environmental Design (LEED), U.S. Green Building Council, Washington, DC, http://www.usgbc.org/

[7]. Obla, K. H., ―What is Green Concrete? ‖, Point of view, The Indian Concrete Journal, 24(4):26-28, April 2009

[8]. Shahul Hameed, M. and Sekar, A. S. S., ―Properties of Green Concrete containing quarry rock dust and marble sludge powder as fine aggregate‖ ARPN journal of engineering and applied sciences, 4(4), June 2009.