GREEN CONCRETE : "ECOFRIENDLY MIX CONCRETE BY FLY ASH"

Prof.L.C. Gupta, Prof. S.S.Thawari, Prof.P.D.Satyan & Prof.P.Bhandari
Civil Engineering Department, PIGCE Nagpur, Maharashtra, (India).
Civil Engineering Department, PCE Nagpur, Maharashtra, (India).

ABSTRACT:

The concrete is made with concrete wastes which are eco-friendly so called as Green concrete. Green concrete is a revolutionary topic in the history of concrete industry. Concrete is an environmental 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. 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 CO_2 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 CO_2 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. Over and above all green concrete has greater strength and durability than the normal concrete.

There are many choices in regard to selection of materials in any type of constructions. Due to growing interest in sustainable construction, engineers and architects are motivated to choose the materials which are more sustainable. Green concrete capable for sustainable construction is characterized by application of industrial wastes to reduce consumption of natural resources and energy and pollution of the environment. Replacement of materials over nominal concrete is what makes green concrete more environmental friendly concrete. Fly ashes are some of the materials used for making green concrete, a sustainable construction. The challenge of the present century is to make a transition to the new form that can sustain the natural system. This requires a threadbare rethinking on ways and means of providing shelter and infrastructure for the community. Perhaps there is a necessity of making a concerted movement for developing innovative and alternative novel material for construction. Green Concrete is capable for sustainable development is characterized by application of industrial waste such as marble powder, quarry dust, wood ash, paper pulp, etc, to reduce consumption of natural resource and energy and pollution of the environment. Use of such waste material saves 14%-20% amount of cement. The concrete resistance to sulphate attack and alkali aggregate reaction is greatly enhanced. Application of green concrete is an effective way to reduce environment pollution and improve durability of concrete under severe condition. This trend in new cement and techniques will continue in all phases of infrastructure constructability and rehabilitation. The versatility of green concrete and its performance derivatives will satisfy many future needs.

KEY WORDS: Green Concrete, Eco-Friendly Concrete, Eco-Friendly Construction Material, Efficient Concrete, fly ash.

INTRODUCTION:

Green cement is an idea of utilizing eco-friendly materials in cement, to make the system more sustainable. Green cement is all the time and furthermore modest to deliver, on the grounds that for instance, squander items are utilized as an incomplete substitute for concrete, charges for the transfer of waste are maintained a strategic distance from, vitality utilization underway is lower, and toughness is more prominent. This concrete should not be confused with its colour.

Concrete has played significant role in the key development of the world for last one and half century. Concrete became widely popular material due to its versatility, excellent resistance to water, low cost, and availability of ingredients across the world (Mehta 2006).

Global warming is a key challenge for our planet and reducing the amount of energy intensive building materials such as Portland cement in the concrete is desirable as the Portland cement industry is one of the largest producers of carbon dioxide (Penttala 1997). The production of one ton of Portland clinker produces approximately one ton of carbon dioxide. The use of fly ash from the combustion of coal as a partially replacement of Portland cement can offset the emission of green house gas (Malhotra 2006). Extensive research on the replacement of Portland cement by fly ash has been conducted worldwide.

In the last fifteen years, many researchers investigated the use of High Volume Fly Ash (HVFA) in concrete to decrease the level of green house gases and to promote sustainability in concrete construction (Mehta 2009). The basic drawback to use of HVFA (fly ash replacement exceeding 40%) in concrete is the prolonged time of set and very slow strength development. At lower temperature, this drawback becomes more pronounced (Dodson 1981). The use of fly ash is limited to between fifteen percents to thirty percents. To eliminate above drawback the fly ash replaced by cement in the ratio 10%, 20% & 30% to the weight of cement. This project study condenses the different endeavors in progress to the improving the eco-friendliness of cement to make it appropriate as a "Green structure" material. Chief and best in such manner is the utilization reasonable substitutes for Portland concrete, particularly those that are by results of mechanical procedures, similar to fly fiery debris, ground granulated blast furnace slag. Likewise endeavors to utilize appropriatly the reused materials as substitutes for concrete aggregate having its importance, for example, reused concrete aggregates so forth.

AIMS AND OBJECTIVES:

Cement concrete, the most popular construction material, has its own problems. Firstly, cement production is highly energy intensive. It consumes approximately 4 GJ of energy per ton of cement production. Secondly, the cement production process results into emission of large amount of CO2, a green house gas. It is worth mentioning, here, that for every ton of Portland cement produced, 0.9 tonne of CO2 is released in the atmosphere. The ensuing research focused its attention on finding some solution to reduce the consumption of cement by replacing a percentage of it by fly ash, an otherwise waste by-product from thermal power plants.

PROJECT SIGNIFICANCE:

It is generally assumed that the performance of concrete is governed mostly by its compressive strength. Cracking has been reported as an important factor for the durability of concrete. In view of this the present study attempts to investigate the effect of replacement of cement by various admixtures like fly ash. They are mixed with cement in a ratio 10%, 20% & 30% of cement. The strength of concrete cube made to find out the compressive strength and conducting the acid test by using HCL & H_2SO_4.

MATERIAL AND METHODS:

The Portland Slag Cement was used in the investigation. The sand used throughout the experimental work was obtained from the executing process construction work. The characteristics of water were analyzed according to the standard methods for the examination of water. The different admixtures used are Fly ash (FA) in ratio 10%, 20% & 30%. These standard experimental procedures laid down in the standard codes, like IS, ASTM and BS codes were adopted for the determination of normal consistency, Initial and Final setting times, Soundness of Cement, Compressive Strength of cement mortar cubes and a total of 54 samples were tested. The various durability tests conducted were Acid test. The specimens were tested for compressive strength duly following the procedure prescribed in IS 516:1959 [10]. For Acid test the various samples prepared were immersed in water which contains 5% of HCL & H_2SO_4 in it by weight of water for 28 days.

Cement:

Ordinary Portland (53 grade) Portland cement available in the local market of standard brand was used in the investigation. Portland cement is the most commonly used type of cement in the world today. It A Study On Sulphuric Acid Attack On Concrete With Rice Husk Ash As A Partial Replacement Of Cement 45 was tested as per Indian Standards Specifications IS: 8112-1989. Its properties are Specific surface area = 3200 cm2 /gm; Normal Consistency=31%; Initial and Final Setting Times are 50, 180 min., Specific Gravity=3.10; Fineness of cement by sieving through sieve No.9 (90 microns) for a period of 15 min. = 2.8%; Soundness = 1.29 mm and Compressive strength of cement (28 days) = 53 MPa respectively.

Fine Aggregate:

The locally available natural river sand was used as fine aggregate. It was tested as per Indian Standard Specification IS: 383- 1970. Its fineness modulus is 2.74 and specific gravity is 2.6. The sand is free from clay, silt and organic impurities. These properties are Bulk Density (Kg/m3) in loose state 1600 kg/m3 and compacted density was 1750 kg/m3 . The fine aggregate conforms to standard specifications.

Course Aggregate:

Aggregates are hard inert filler materials mixed with a binding material like cement lime or mud in the preparation of mortar or concrete. Machine crushed angular granite metal of 20 mm nominal size from the local source is used as coarse aggregate. The various properties of course aggregate are, specific gravity, bulk density and fineness modulus of coarse aggregate were found to be 2.62, 1580 kg/m3 and 7.17 respectively.

Water:

Water is a key ingredient in the manufacture of concrete. The locally available potable water accepted for local construction is used in the experimental investigation after testing. The pH value7, Suspended matter mg/lit=220, Organic matter mg/lit=20; Inorganic matter mg/lit=150; Sulphate (SO4) mg/lit=30 and Chlorides (Cl) mg/lit=60.

Fly Ash:

Fly ash is a very fine powder and tends to travel far in air. When not properly disposed, it is known to pollute air and water, and causes respiratory problems when inhaled. When it settles on leaves and crops in fields around the power plant, it lowers the yield. When pulverized coal is burnt to generate heat, the residue contains 80% fly ash and 20% bottom ash. Fly ash produced in Indian power stations are light to mid-grey in colour and have the appearance of cement powder. Use of Fly ash concrete in place of PCC will not only enable substantial savings in the consumption of cement and energy but also provide economy.

Environmental benefits:

A. Increasing the life of concrete structures by improving concrete durability, besides exhibiting good workability and better strength.

B. Net reduction in energy use and green house gas emissions through cement industry.

C. Reduction in amount of coal combustion by-products that must be disposed in landfills.

D. Conservation of natural resources and materials.

E. More sustainable concrete industry.

CONCLUSION:

A. Fly ash is a by-product that can be used in concrete to obtain durability, cost, and environmental benefits.

B. The water absorption of green concrete is slightly higher than conventional concrete.

C. There are various means to achieve sustainable construction and one of the means is through green concrete.

D. Green concrete technology is one of the major steps that a construction industry can implement to achieve sustainable construction with various means as discussed above.

E. Green concrete Technology we can save the natural materials for future use or the generations to come and sustain it for good amount of time.

F. The usage of green concrete ensures sustainable development and it's gaining its popularity ever since its inception.

REFERENCES:

1. ACI Committee 363, (1984). "State –of-the-art report on high-strength concrete, ACI Journal, Proceeding 81(4), July-August, pp. 364-411.

2. Burg, R.G. and Ost, B.W. (1992), "Engineering properties of commercially available high strength concrete", RD 104-DIT, Portland Cement Association, pp. 55.

3. Malhotra,V. M. (2006), "Reducing CO2 emission – The role of fly ash and other supplementary cementatious materials" Concrete International, September 2006, pp. 42-45.

4. Mehta P.K., Reducing the Environmental Impact of Concrete. Concre. Inter. J., October, 30 61-66 (2001).

5. A.M. Pande and S.G.Makarande,(2013), "Effect of Rice Husk Ash on Concrete" , International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 , Vol. 3, Issue 1, January - February 2013, pp.1718-1723 .

6. Tarun R. Naik, ”Green Concrete Using Recycled Material”, Concrete International, July 2002, pp.45-49].

7. Zasiah Tafheem, Shovona Khusru and Sabreena Nasrin, “Environmental Impact of Green Concrete in Practice”, International Conference on Mechanical Engineering and Renewable Energy, 22- 24 December 2011. pp. 3.2-3.4 .

8. IS : 2770 (Part I) – 1967, Indian Standard Methods Of Testing Bond in Reinforced Concrete Part I Pull-Out Test, Reaffirmed 1997, BIS, New Delhi.

9. IS: 456:2000, Indian Standard Code for Plain and reinforced concrete-code of practice, 4th Revision, BIS, New Delhi.

10. IS: 3812:1981, Specification for fly ash for use as pozzolana and admixtures 3812(part1): 2003.

11. IS: 2386: Part I-1963 Methods of tests for aggregates for concrete.

12. IS: 12089:1987, Specification for granulated slag for the manufacture of Portland slag cement.

13. IS516:1959 Method of test for strength of concrete.