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Green Concrete using Fly ash, Rice husk and Glass Aggregate

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ABSTRACT

Cement is the main ingredient of concrete which is the key material of construction. But cement is also hazardous for our environment because it emits huge amount of carbon dioxide as its by-product during its production. Therefore, need for its alternative options without compromising the strength has been reviewed. Green Concrete is a concrete in which one or more of its constituents are replaced by Eco-friendly material, which ultimately reduces environmental impact and better utilization of resources in Eco-friendly manner. In this paper, study of green concrete made with fly ash, rice husk and recycled glass aggregate which do not emit as much carbon dioxide as in case of concrete during manufacturing of cement has been presented. Results of study indicated that optimal proportion can replace major volume of cement that can protect our environment from its emission of green gases.

Keywords: Green Concrete, Conventional Concrete, Compressive Strength, Water Submerged Curing, Steam Curing.

I. INTRODUCTION

Green concrete should not be confused with its colour; it is a concept of using eco-friendly materials in concrete to make the construction more sustainable. It is a cheap to produce, because waste products are used as a substitute for cement and cost for the disposal of waste are avoided. In this case energy consumption in production is also lower in comparison to conventional concrete and it is more durable. We all know that natural resources are limited and it should be used more efficiently, so we can use waste products to produce new products or can be used as admixtures. It will protect environment from waste deposits. There are some inorganic residual eco-friendly products like stone dust, recycled glass aggregate, crushed concrete, marble waste, fly ash and rice husk *etc. t*hat can be used as an alternative of cement with low energy consumption and better binding properties. Many works has been done in the field of green concrete by mixing with fly ash and rice husk for partial replacement of cement [1]. In present study, fly ash, rice husk and recycled glass aggregate have been considered for the investigation of alternative materials as cement. Comparison of compressive strength with mix proportion has been studied and presented.

II. MATERIALS AND METHOD

Resource Efficiency is defined as use of earth's limited resource in a sustained manner while minimizing impact on environment. Basically it includes properties like recycled, renewable, efficient manufacturing process, locally available, re-manufactured, reusable or recyclable and durable. It allows us to create more with less and to deliver more output with less input. As we know energy is also comes under the resource so energy efficiency is very important. It is defined as reduction of amount of energy required to provide product and services. It mainly consists with the energy which is used during the production of concrete. Such type of materials are preferred whose requirement of energy is very low at the time of construction of the concrete [2]. Talking about another material that is water which is important and useful in construction and other types of work, so water conservation is also required in this time period because the water is limited and also decreasing day by day. In production of concrete we use generally that type of material that require less amount of water and also help to reduce water consumption in building materials. During production of concrete we have to use that material which can reduce the cost of concrete so that project becomes affordable and under budget.

Fly Ash of grade C618 has been used for the production of green concrete. It can be define as a very fine powder and having the property to travel far in air. It pollutes air and water, and creates respiratory problems when not properly disposed. It settles on leaves and crops in fields around the power plant and minimizes the yield. The residue contains 80 % fly ash and 20 % bottom ash, when pulverized coal is burnt to generate heat. Its appearance like cement powder and have mid-grey color. The use of fly ash has many advantages. Theoretically it is possible to replace 100% of Portland cement by fly ash, but more than 80% of cement replacing by fly ash need a chemical activator. Some Studies have found that the optimum replacement of cement is 30%. Fly ash can improve some properties of concrete, like durability etc. Because of less heat of hydration generation by fly ash, it is particularly well suited for mass concrete applications. So 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.

Rice husk is an alternative of cement in concrete construction. It is a by-product of rice paddy milling industries. It increases environmental pollution so it is the need to utilize it without creates harm to environment. Around the world about 100 million tons of rice paddy manufacture by-products are obtained. Its bulk density is 90 to 150 kg/m^3 which is very low. It has similar chemical composition like organic fiber such as Cellulose ($C_5H_{10}O_5$), Lignin ($C_7H_{10}O_3$), Hemicelluloses, SiO_2 and Holocellulose.

The method of heating can also bring changes in the overall chemical composition of the ash. So if we use Industrial Furnace then it will facilitate environmental and economic reasons. This method helps in producing the rice husk ashes with amorphous silica and cellular structure products in an easier way. The rice husk ash produced by this method is highly pozzolanic. The properties of the concrete are altered with the addition of rice husk are less heat of hydration which help in drying shrinkage, durability of the concrete mix and less permeability of concrete structure, which help in penetration of chloride ions. Thus avoiding the disintegration of the concrete structure and high increase in the chloride and sulfate attack resistance.

Recycled glass aggregate is a heavy demand of primary source of aggregate by concrete industries. Normally it is estimated that annual demand is 165 million tones, therefore it is a requirement of alternate source of

aggregate which can be found by waste material. So waste glass material can be use at the place of aggregate after recycling process and there are two other materials which is used in concrete that is alkaline solution in which Sodium Hydroxide having molecular weight of 40gm was used and the sodium silicate (Na2Sio3) to sodium hydroxide solution (NaOH) ratio used in this experiment was 1.5 and other material is the potable drinking water was used for the purpose of mixing concrete uniformly.

III. RESULT AND DISCUSSION

Several factors which enhances the suitability of green concrete in structures includes reduction in dead weight of a structure, good thermal and fire resistance, sound insulation. The traditional granite rock improves damping resistance of building. Reduction of CO_2-emission by 30 % will lead to increase use of waste products by 20% and it also requires less maintenance and repair. No environmental pollution, sustainable development and good thermal resistant and fire resistant are the added advantages [4, 5]. The results of compressive strength test conducted on both conventional and green concrete after a span of 3 days, 7 days and 28 days are presented respectively in Table: 1, 2 and 3.

Table 1: Compressive strength test results of conventional concrete

S. No.	Curing Days		
	3 Days	7 Days	28 Days
Cube 1	9.9	15.7	24.8
Cube 2	10.7	15.2	25.9
Cube 3	10.8	15.5	25.2
Average Compressive Strength	10.46	15.47	25.3

Table 2: Compressive strength test results of green concrete (water submerged curing)

S. No.	Curing Days		
	3 Days	7 Days	28 Days
Cube 1	5.27	8.76	13.73
Cube 2	4.97	8.58	13.21
Cube 3	4.17	8.91	13.45
Average Compressive Strength	4.80	8.75	13.46

Table 3: Compressive strength test results of green concrete (steam curing)

S. No.	Curing Days		
	3 Days	7 Days	28 Days
Cube 1	16.2	23.1	27.8
Cube 2	16.0	22.8	27.7
Cube 3	15.8	23.2	27.5
Average Compressive Strength	16.0	23.03	27.67

Graph shown in Fig. 1 for 3 days compressive strength shows that strength of conventional concrete is 56.97% greater than green concrete if green water submerged curing is done and the strength of conventional concrete is 34.62% less than green concrete if the steam curing is done and strength gain by steam curing in comparison of water submerged curing is 70% greater in green concrete.

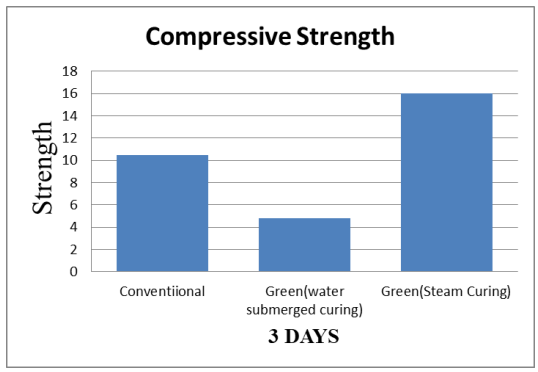

Figure 1: Analysis of Compressive strength test results after 3 days

Graph shown in Fig. 2 for 7 days compressive strength shows that strength of conventional concrete is 43.43% greater than green concrete if water submerged curing is done and the strength of conventional concrete is 32.82% less than green concrete if the steam curing is done and strength gain by steam curing in comparison of water submerged curing is 62% greater in green concrete.

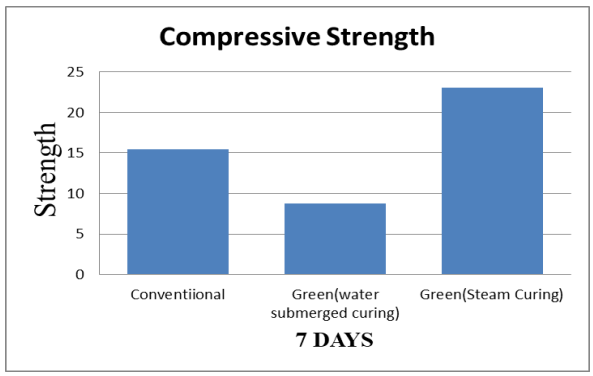

Figure 2: Analysis of compressive strength test results after 7 days

Graph shown in Fig. 3 for 28 days compressive strength shows that strength of conventional concrete is 46.79% greater than green concrete if water submerged curing is done and the strength of conventional concrete is 34.40% less than green concrete if the steam curing is done and strength gain by steam curing in comparison of water submerged curing is 51.35% greater in green concrete.

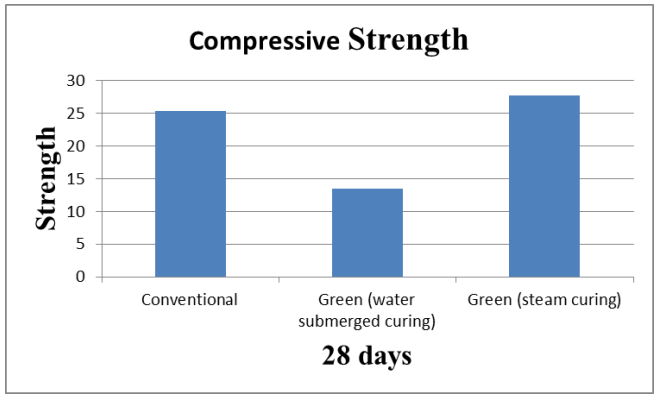

Figure 3: Analysis of compressive strength test results after 28 days

IV. CONCLUSION

The experimental result concludes that, the rate at which the compressive strength is gained by the green concrete (under water submerged curing) is less compared to the compressive strength of the conventional concrete (under water submerged curing). However, the compressive strength of the Green Concrete (under steam curing) is very high compared to the other methods of curing carried out. Here it is concluded that the strength gain by the green concrete cubes under steam curing is almost 9.4 % higher compared to the tests conducted on cubes in water submerged curing condition. Hence we can increase the trend for the greater use of fly ash, rice husk and recycled glass aggregates in construction. Use of green concrete in future will not only reduce the emission of CO_2 in environment and environmental impact but it is also economical to produce.

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