

A Study on Green Concrete

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Abstract: Green Concrete is a profound topic in the history of concrete industries. The concrete which is made up of waste materials that are eco-friendly is termed as green concrete. Concrete is accountable for CO₂ emission. Cement is one of the major constituent of concrete. The manufacturing of 1 ton of cement releases about 1ton of carbon dioxide in the atmosphere. CO₂ on the other hand is a greenhouse gas which is responsible for global warming. To reduce the impact of carbon emission released in the production of cement, cement is partially replaced by some cementitious materials. This paper will give a brief of the materials used in green concrete. It also covers the advantages and the need of green concrete for a sustainable built environment.

Keywords: Green Concrete, Fly Ash, Blast Furnace Slag, Marble Sludge Powder, Quarry Rock Dust, Silica Fume.

1. Introduction

Green concrete is a revolutionary topic in the world of concrete industries. It is a concrete which is made of eco-friendly wastes. This type of concrete was invented by Dr. WG in the year 1998 in Denmark. Green concrete is often considered to be cheap and economical to produce as it uses waste materials that are recycled; hence, it avoids the charges of the waste materials and consumes less energy. Cement is a major component of concrete.

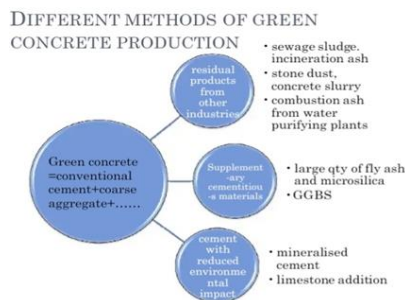


Fig. 1. Production of green concrete

The manufacturing of cement emits approximately 6% of cement carbon dioxide in the environment. By partially replacing cement by other eco-friendly materials such as fly ash, silica fumes, etc., the carbon emission can be controlled. Since, concrete is the second largest entity used in the world, its production causes huge impact on the environment. The solution for this problem is to reduce the carbon content from

the manufacturing of concrete. This can only be achieved when the traditional ingredients that are used to produce concrete will be replaced by waste materials which are not so harmful to the environment. Green concrete is accountable for creating a sustainable built environment as it uses industrial waste as its constituent materials. Green concrete is a conceptual technology that brings environment into concrete, considering all the possibilities from the raw ingredients used.

2. Related work

A. Literature review

1) *Experimental study on green concrete* (Vardhan Nagarkar, Sanket Padalkar, Samruddhi Bhamre, Akshay Tupe); 2017

Few experiments were conducted on the materials used for making conventional concrete like cement, fine aggregates, and coarse aggregates. The tests were meant to analyze the compressive strength, split tensile strength and flexural strength as well as durability of the concrete when partially replaced by materials like silica fumes. It was noted that green concrete came to have more strength and was more durable than conventional concrete and is more economical than conventional concrete. Also it suggested that the use of green concrete lowers the percentage of carbon emission in the atmosphere.

3. Why is green concrete needed?

Cement is the main ingredient in concrete and it consists of limestone. During the production of cement, the materials used are heated to at a temperature of 800 to 1000 degree Celsius. During this heating process, carbon dioxide is released. 1kg of cement approximately releases about 900gms of carbon dioxide. Thus, to reduce the release of carbon dioxide in the atmosphere, the use of green concrete came into existence.

In our country, the newest exciting trend is of “green buildings”. Green concrete as the name itself is eco-friendly as it is made up of the wastes generated by industries, which makes resource saving structures. Green concrete has a huge impact on sustainability. Green concrete is a technology which can reduce the carbon dioxide emission in the environment. Also, green concrete has higher strength and durability as compared to ordinary concrete. Traditionally used concrete is a cause for increasing greenhouse gas effect on environment. So, to reduce the effect of greenhouse gases green concrete is needed. Green

concrete contributes in improved strength and durability of structures as well as it is capable for sustainable development and also reduces the consumption of natural resources.

4. Materials used for green concrete

Green concrete is made up of waste materials which can be recycled. The materials used for producing green concrete are as follows:

A. Fly Ash

Fly Ash is a byproduct obtained during the functioning of coal fired power plants. It is composed of particles that are carried out of coal-fired boilers and is collected by electrostatic precipitators before the flue gases reach the chimneys. It is a widely used material. Only a few percent of fly ash is consumed in India and the rest is disposed off. Instead of disposing it, fly ash can be used in as partial replacement of cement in concrete production. Fly ash contains carbon and calcium content. So when used in place of cement it reduces the effect of carbon in the environment and also increases the durability of concrete.

B. Blast Furnace Slag

Blast Furnace Slag is a byproduct obtained from cooling of molten iron slag from a furnace in water or steam to obtain a glassy granular product which is then dried and grounded into a fine powder. The use of blast furnace slag in concrete increases its strength. As it is a byproduct of steel production its use in concrete is certified by LEED, making it sustainable to use.

C. Marble Sludge Powder

During the cutting of marble, 20-30% of marble becomes waste powder. This waste powder is known as marble sludge powder. Marble powder can cause severe effect on the environment. But when it is used as aggregates, I concrete its harmful effects are lowered making it sustainable.

D. Quarry Rock Dust:

It is defined as the residue waste material which is obtained after the extraction and processing of rocks. It is resistant to sulphate and acid and increases the strength of concrete due to its better interlocking.

E. Silica fumes:

Silica Fumes is a byproduct of manufacturing silica metal. The use of silica fumes is most benefited in concrete due to its chemical and physical properties. Concrete with silica fume have high strength and are very durable.

5. Comparison between ordinary and green concrete

1. Green concrete has greater corrosion resistance.
2. Green concrete has high ultimate strength and are more durable than ordinary concrete.
3. The compressive, split tensile strength of the concrete made by the use of quarry rock dust is more than

ordinary concrete.

6. Advantages of green concrete

1. The structures made with the use of green concrete lasts longer.
2. It gains strength faster.
3. It is fire resistant.
4. It is corrosion resistant.
5. It uses industrial waste which lowers the carbon emission.
6. The production of green concrete requires less energy consumption.
7. It reduces the dead weight of the façade.
8. It has good sound resistance.
9. It has good thermal resistance.

7. Limitations

According to some researches, green concrete can be made more durable by the use of stainless-steel reinforcement. But conjecture is that the use of stainless steel increases the cost of construction.

8. Scope

As the industries in India faces problems in disposal of wastes and green concrete being produced by the use of industrial wastes, it takes more time to settle as a replacement of ordinary concrete in India.

9. Conclusion

The ingredients used in the production of green concrete reduce the carbon emission in the atmosphere. Silica fume is responsible for air pollution, but when used in concrete as cementitious material, it reduces the air pollution and makes the concrete much more sustainable. Near about 5-15% of silica fume when used as partial replacement of cement led to increase in the strength of concrete. As it is finer than cement and more reactive to the concrete ingredients it helps in gaining strength faster in less time than ordinary concrete. Similarly, the use of ceramic wastes consumes less energy and makes the concrete production more economical. Green concrete is a technology that is a major step for the construction industries to implement toward achieving sustainable construction technique. Thus, it can be concluded that the use of green concrete helps in decreasing the harmful impact on the environment and also helps in the conservation of natural resources. Hence, it helps in minimizing the waste and encourages sustainability.

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