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A REVIEW ON GREEN CONCRETE AND ITS STUDY AGAINST CONVENTIONAL CONCRETE BY REPLACING COARSE AGGREGATE WITH RCA

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ABSTRACT

Concrete is one of the most widely used manufacturing materials all over the world. It is a chief necessity that concrete is manufactured in an economic and eco-friendly ways. Conventional concrete is responsible for amount of carbon dioxide emission to some extent. So by replacing cement or fine aggregate or coarse aggregate by materials which cause harm to environment we not only reduce the problem of disposal of this material but also reduce carbon dioxide emission. Hence Green concrete is a concept of using eco-friendly material in concrete, to make the system more sustainable. In this project, we will be conducting concrete cube testing by replacing coarse aggregates with RCA(Recycled Coarse Aggregate) and analyze its compressive strength, tensile strength, load bearing capacities and its behavior under the Impact loading. With this, we will be conducting a comparative analysis of water/cement ratio, shrinkage capacity, bleeding and segregation in green concrete against the presently used conventional concrete.

Keywords- *Conventional Concrete, CO_2 emission, Eco-friendly, Green Concrete, Recycled Coarse Aggregate*

1. INTRODUCTION

Green concrete can be defined as the concrete with material as a partial or complete replacement for cement or fine or coarse aggregates. Green concrete has nothing to do with color. It is a concept of using eco - friendly materials in concrete, to make the system more sustainable. Green concrete was first invented in Denmark in the year 1998 but the application on this concept was done much earlier in developed countries of Europe and North America. It is a concept of thinking about environment into concrete considering every aspect from raw materials manufacturing over mixture design to structural design, construction and service life.

In recent years many problems have arise due to the use of conventional concrete. Some of these are -

- It is found that concrete manufacturing adds to more than 6% of the global carbon emissions.
- Decomposition of limestone releases 0.5 tones of CO_2 for every ton of limestone.
- The high energy consumption of the kiln produces additional CO_2 emissions.
- Total emissions due to manufacturing of cement vary from 0.7 to 1 ton CO_2 per ton of cement.

- Production of coarse aggregate includes extraction which adds harmful gases in the environment and reduces soil stability.

  Thus, a need for substitute was required to replace the coarse aggregate with an economical and eco friendly aggregate, that is, RCA.

2. MATERIAL/PRODUCT SELECTION CRITERIA

- **RESOURCE EFFICIENCY:** It includes properties like recycled content, renewable resource, locally available, efficient manufacturing process, refurbished or reusable or recyclable and durable.
- **ENERGY EFFICIENCY:** This mainly refers to the energy used for making concrete. Those material are preferred that require the minimal amount of energy at the time of construction of concrete.
- **WATER CONSERVATION:** Materials that help us to conserve water in landscape areas are preferred to be used at the time of construction and even help in reducing water consumption in production of building material**.**
- **AFFORDABILITY:** It is considered when building product life – cycle costs are comparable to conventional materials and are within a project – defined percentage of overall budget**.**

3. REPLACEMENT MATERIALS FOR GREEN CONCRETE

S.No.	TRADITIONAL INGREDIENTS	REPLACEMENT MATERIALS FOR GREEN CONCRETE
1.	Cement	Eco-cement, Sludge ash, Fly ash
2.	Coarse aggregate	Recycled aggregates, Waste ready mix concrete, Waste glass, Recycled aggregates with crushed glass, Recycled aggregate with silica fumes
3.	Fine aggregate	Fine recycle aggregate, Demolished brick waste, Quarry dust, Waste glass powder, Marble sludge powder, Rock dust, Pebbles, Artificial sand

TABLE 3.1- Suitable materials used commonly to replace ingredients of Conventional Concrete

4. LITERARTURE REVIEW

According to **Aiyewalehinmi E.O (2016)**[1], the purpose of green concrete is to recycle and reduce the amount of construction waste materials going into landfills and dumping pits. The study identifies about 15% - 20% of construction waste materials go into landfills and dumping pits. Using of which gives us same compressive strength as unadulterated aggregates at higher water/cement ratio.

From the studies conducted by **Abhijeet Baikerikar(2014)**[2], concrete is the main material for construction purposes billions of tons of naturally occurring materials are mined for the production of concrete which will leave a substantial mark on the environment. He emphasized recycling of waste and industrial byproducts to make environmentally friendly concrete, which can be called as green concrete

Chirag Garg(2014)[3] contributed that the Green concrete reduces the environmental impact and emphasized that the use of green concrete embodied low energy costs, lower green house gas emission, and low maintenance cost leading to sustainable construction materials. Furthermore, as far as resource conservation is concerned, the reuse of post consumer wastes and industrial byproducts used as a partial replacement for Portland cement clinker makes concrete more durable and eco-friendly as well. Green concrete is the major alternative to reduce this CO_2 emission. Green concrete is the best alternative because it saves energy; make use of waste and also cheap. The mechanical properties like strength, and durability of green concrete found quite more than that of normal concrete.

Due to growing interest in sustainable development, engineers and architects are motivated more than ever before to choose materials that are more sustainable. **Prof. Ashok Admute(2017)**[4] mentioned that the selection of material for concrete is more sustainable and minimizes environmental impact. Cement production accounts for more than 6% of all CO_2 emission which is a major factor in the world's global warming (Greenhouse gas). India is the third largest cement producer in the World and one of the largest consumers of cement per capita in the world. Rough figures are that India consumes about 1.2 Ton/year/capita, while as World average is 0.6 Ton/year/capita. CO_2 emissions from 1 ton of concrete produced vary between 0.05 to 0.13 tons. 95% of all CO_2 emissions from a cubic meter of concrete are from cement manufacturing. He affirmed that the formation of modular conventional concrete is harmful at some extent due to emission of harmful gases majorly carbon dioxide emitted during the formation of cement. Though becomes necessary to reduce that emission by any means. Therefore, Various types of concrete are being developed to reduce these emission using waste product from various sector and recyclable material like fly ash, moorum, Blast furnace, slag etc. As these waste materials are cheap, energy saving, easily available and has less-impact over Environment .To cope up with the production of pollution by cement, Green concrete proves to be a technological way that can counter the use of cement to some extent. Therefore by using green concrete, emissions like greenhouse gases, CO_2 can be reduced that subsequently reduce the negative impact of concrete over environment.

S.No.	TESTS	STANDARD VALUES	OBTAINED VALUES
1	Specific gravity	2.5-3.0	2.90
2	Water absorption	0.5%-1.0%	1.0%
3	Grading zone	I-IV	II

TABLE 4.1 -Properties of Course Aggregate (20mm size coarse aggregates confirming to IS 383 – 1970).
(**Prof. Ashok Admute(2017)[4]**)

The green concrete concept derives from saving of various natural resources without compromising with the future generation needs, durability, low cost, recycle and reuse of waste materials without wasting space, time and money on their disposal **Pushpendra Kr. Sharma(2018)[5]** say that the cement is the main ingredient material and worldwide cement production adds approximately 6% Carbon Dioxide (CO_2), a green house gas to the worlds global warming. India being largest consumer of cement per capita and the world's third largest country for cement production. During manufacturing of cement, one ton of cement releases one ton of CO_2 which can be minimized by replacing some other cementitious material or reusing concrete and then the concrete so developed can be termed as the green concrete.

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 this is the focus of a recently started large Danish research project, where 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, the performance, operation and maintenance.Cement and concrete may have an important role to play in enabling Denmark to fulfil its obligation to reduce the total CO2 emission by 21% compared to the 1990 level before 2012, as agreed at the Kyoto Conference.

Shailendra Tiwari(2015)[7] summarizes the efforts underway to develop the eco friendly and environmentally safe concrete in line to produce a green concrete. First set of the tests conducted on green concrete were for workability to ascertain its applicability in respect of conventional concrete. Then after Compressive strength test, Flexural strength test and Abrasion test were conducted on the samples. It is found that the strengths of green concrete are comparable to the conventional concrete with relatively lesser cost. Because of light weight,

economical costing, ease in handling etc. the green concrete is recommended for light weight civil engineering structures.

5. CONCLUSION

The review study concludes that though there are plenty of waste materials that may be used as the part ingredients of conventional cement without affecting its strength much yet it needs a detailed study of life cycle analysis with all its affecting parameters taken in to account so as not to compromise with its quality during optimization with respect to environmental factors.

Thus, the use of waste materials in construction purposes and getting rid of disposal problems is a kind of Sustainable Environmental Management keeping the various needs of future generations to come in mind through saving our natural resources.

- Green concrete in construction helps to reduce environmental damage.
- Green concrete reduces emission of CO_2.
- It helps in utilization of waste material.
- Raw materials are locally available which helps in reduction of transportation cost.
- Raw materials can be acquired at cheaper cost.
- Green concrete can withstand upto 2400^oF.
- Green concrete has greater resistance to corrosion and acid rain.
- Green concrete reduces the overall consumption of cement.

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