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# A Review Paper on Green Concrete

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**Abstract—***Green concrete is nothing but concrete made with eco friendly waste Construction industry is growing rapidly and new technologies have evolved very fast to cater different difficulties in the construction industry. Among all materials used in the construction industry concrete is main material for construction puposes. Billions of tons of naturally occurring materials are mined for the production of concrete which will leave a substantial mark on the environment. Green Concrete is capable for sustainable development by the application of industrial waste to reduce the consumption of natural resources and energy etc. Use of such materials saves approximately 20% of cements. It improves economy of construction. Nowadays recycling of waste and industrial by products gaining popularity to make concrete as environment friendly material and the concrete can called as green concrete. This review paper will give us a brief idea about advantages and disadvantages of green concrete.*

**Keywords***: Green Concrete, Recycled Aggregates, Quarry Dust, Recycled Aggregate Concrete, silica Fume.*

## 1. 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 colour. This is a concept of eco friendly way in mass concreting. The constituent of this concrete does'nt correspond to carbon footprint and give healthy environment to all. 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.

## 2. LITERATURE REVIEW

Garg and Jain (2014), studied on green concrete: efficient & eco-friendly construction materials. It presents the feasibility of the usage of by product materials like fly ash, quarry dust, marble powder/granules, plastic waste and recycled concrete and masonry as aggregates in concrete. It concluded that, it focuses on known benefits and limitations of a range of manufactured and recycled aggregates. Use of concrete product like green concrete in future will not only reduce the emission of CO2 in environment and environmental impact but it is also economical to produce. Dhoka (2013), carried out "green concrete: using industrial waste of marble powder, quarry dust and paper pulp" The green concrete is prepared by using industrial waste of marble powder, quarry dust with proper proportions". The versatility of green concrete& its performance derivate will satisfy many futureneeds. Wangchuk et.al. (2013), studied that green concrete for sustainable construction. It 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. Marble sludge powder, quarry rocks, crushed concrete and fly ashes are some of the materials used for making green concrete, a sustainable construction. With green concrete technology we can save the natural materials.

## 3. RAW MATERIALS USED IN GREEN CONCRETE

**Fly ash**: - Fly ash is finely divided residue resulting from the combustion of powdered coal and transported by flue gases and collected by electrostatic precipitation. Fly ash is most used pozzolanic material all over the world. The volume of fly ash produced is about 75 million tons per year, the disposal of which has become a major concern. Only About 5% of the total fly ash is utilized in India, the remaining of which has to be disposed. Instead of doing so, it can be utilized in a major way. Portland cement (PC) concrete is the most popular and widely used building materials. Due to the restriction of the manufacturing process and the raw materials, some inherent disadvantages of Portland cement are still difficult to overcome. There are two major drawbacks with respect to sustainability. About 1.5 tones of raw materials is needed in the production of every ton of PC, at the same time, about one ton of carbon dioxide (CO2) is released into the environment during the production.

**Marble sludge powder**:- 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.

**Quarry rock dust** :- Quarry Rock Dust can be defined as residue, tailing or other non-valuable waste material after the extraction and processing of rocks to form fine particles, less than 4.75mm. Quarry dust is made while blasting, crushing, and screening coarse aggregate. Quarry dust has rough, sharp and angular particles, and as such causes a gain in strength due to better interlocking. Quarry rock dust concrete experiences better sulphate and acid resistance and its permeability is less, compared to that of conventional concrete. However, the water absorption of Quarry Rock Dust concrete is slightly higher than Conventional Concrete.

**Recycle aggregate**:- recycled coarse aggregates showed that physical and mechanical properties are of inferior quality and improvement in properties was observed after washing due to removal of old weak mortar adhered on its surface. The influence of natural coarse aggregates replacement (50 and 100%) with recycled coarse aggregate on various mechanical and durability properties of hardened concrete were discussed and compared with controls at different w/c ratio. Improvements in all the engineering properties of hardened concrete were observed using washed recycled coarse aggregates. The compressive strength of 28-day hardened concrete containing 100% washed recycled aggregate was slightly lower (7%) than concrete prepared with natural aggregates.

**Ground Granulated Blast Furnace Slag**

It is an excellent cementitious material. Slag is obtained by crushing molten iron slag which is nothing but a byproduct of iron and steel making from a blast furnace in water or steam, to make a granular glassy product that is then dried and grounded into a fine powder. Similar to fly ash, even GGBFS generates less heat of hydration. GGBFS is also responsible for improving durability as well as mechanical properties of concrete.

## 4. IMPACT ON ENVIRONMENT DUE TO CONCRETE

About 0.9 tons of carbon dioxide is produced for every 1 ton of cement produced. Carbon dioxide is one of the green house gases which are responsible for global warning. Major ingredient in the production of concrete is aggregates without aggregates it is impossible to produce concrete. Aggregates are mined from the rock mines and the rate with which concrete is produced there will be significant reduction in naturally occurring materials. Disposal of construction and demolition waste has become a major problem these days, according to the report of Technology, Information, Forecasting, Assessment Council the total amount of waste from construction industry is estimated to be 12 to 14.7 million tons per annum. Out of which 7.8 million tons are concrete and brick waste. Because of increasing problems of these wastes many countries have started researches to use these materials as source.

**TABLE 1: REPLACEMENT MATERIALS FOR GREEN CONCRETE**

| S. No. | Traditional Ingredients | Replacement Materials for Green Concrete |
|---|---|---|
| 1. | Cement | Sludge ash, fly ash, etc. |
| 2. | Coarse aggregates | Silica fume, waste glass, etc. |
| 3. | Fine aggregates | Fine recycled aggregate, demolished brick waste, quarry dust, waste glass powder, marble sludge powder, rock dust and pebbles, artificial sand, waste glass, fly ash and micro silica, bottom ash of municipal solid waste. |

## 5. USE OF RECYCLED AGGREGATES:

Construction and Demolition disposal has emerged as a major problem in all over the world. In USA, approximately 135 million tons of Construction and Demolition waste is generated annually. Wastes' arising from construction and demolition constitutes one of the largest streams within the European Union and many other countries. It is now widely accepted that there is significant potential for reclaiming and recycling demolished debris for use in value added applications to maximize economic and environmental benefits. As a result recycling industries grew up. Many governments throughout the world have now introduced various measures aimed at reducing the use of primary aggregates and encouraging reuse and recycling, where it is technically, economically, or environmentally acceptable. Recycling industries in many parts of the world converts low value waste into secondary construction material such as aggregate grades, road materials and aggregate fines. While accepting the need to promote the use of Recycled Concrete Aggregate (RCA) in wider applications, it must be remembered that the aggregate for concrete applications must meet the requirements set in relevant specifications for its particular use. The gap between these interests has to be reduced in steps that are manageable and the use of RCA in structural concrete has to be promoted gradually. Similarly considerable attention is required to the control of waste processing and subsequent sorting, crushing, separating and grading the aggregate for use of the concrete construction industry. In addition, there is an urgent need for legislative or regulatory measures to implement sustainable Construction &

Demolition waste management strategy and encourage recycling for use in value added applications. A number of different processes are possible for the crushing and sieving of Construction & Demolition waste. Such material often contains foreign matter in the form of metals, wood, hardboard, plastics, papers etc. Hence, a process scheme has to be adopted which removes large pieces of these materials, mechanically or manually, before crushing and thorough cleaning of the crushed product.It has been reported that there is a loss in compressive strength of concrete when recycled aggregates are used for production of concrete as direct replacement to natural aggregates. Therefore it can be used as partial replacement to natural aggregates.

The lower compressive strength recorded for concrete produced with recycled aggregate was due to higher water cement ratio, which was required to facilitate mixing due to absorption of the recycled fine particles. Recycled aggregate concrete will have higher water absorption than conventional concrete it is mainly due to adhered mortar with recycled aggregates.

Recycled aggregate concrete will have slightly higher drying shrinkage; this is mainly because of increase in water/cement ratio. Recycled aggregate concrete has better resistance to carbonation it is mainly due to porous recycled aggregates and presence of old mortar attached to crushed stone aggregate. Recycled aggregate concrete provides better resistance to freezing and thawing than concrete produced by mixing natural aggregates. For concrete producers, the use of coarse RCA is unlikely to pose any problem in the production of concrete that is stable in the fresh state and able to develop properties comparable to the corresponding Normal Aggregate Concrete in hardened state. This is of great importance to reduce inhibition of concrete specifiers and producers towards using RCA. The key engineering and durability properties of RCA concrete are similar to corresponding Normal Aggregate Concrete, providing the mixes are of equivalent strength achieved through adjustment in the w/c ratio. Overall, the practical benefits resulting from the current work are not only on environmental and economical fronts, but they could also provide the construction industry with technical information on a marketable product, which is presently under-utilized.

## 6. USE OF QUARRY DUST

Common river sand is expensive due to excessive cost of transportation from natural sources. Also large-scale depletion of these sources creates environmental problems. As environmental transportation and other constraints make the availability and use of river sand less attractive, a substitute or replacement product for concrete industry needs to be found. River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. In such a situation the Quarry rock dust can be an economic alternative to the river sand. Quarry Rock Dust can be defined as residue, tailing or other non-voluble waste material after the extraction and processing of rocks to form fine particles less than 4.75mm. Usually, Quarry Rock Dust is used in large scale in the highways as a surface finishing material and also used for manufacturing of hollow blocks and lightweight concrete prefabricated Elements. Use of Quarry rock dust as a fine aggregate in concrete draws serious attention of researchers and investigators. In the recent past good attempts have been made for the successful utilization of various industrial by products (such as fly ash, silica fume, rice husk ash, foundry waste) to save environmental pollution. In addition to this, an alternative source for the potential replacement of natural aggregates in concrete has gained good attention. As a result reasonable studies have been conducted to find the suitability of granite quarry dust in conventional concrete. The utilization of Quarry rock dust which can be called as manufactured sand has been accepted as a building material in the industrially advanced countries of the west for the past three decades. As a result of sustained research and developmental works undertaken with respect to increasing application of this industrial waste, the level of utilization of Quarry Rock Dust in the industrialized nations like Australia, France, Germany and UK has been reached more than 60% of its total production. The use of manufactured sand in India has not been much, when compared to some advanced countries. The durability of quarry dust concrete under sulphate attack is higher compared to conventional concrete.

The durability of quarry dust concrete under acid action is also better than conventional concrete. The effects of quarry dust on the elastic modulus property are good with conventional concrete containing natural sand. The fine quarry dust tends to increase the amount of super plasticizers needed for the quarry mixes in order to achieve the rheological properties. Replacement of natural sand with Quarry Rock Dust, as full replacement in concrete is possible. However, it is advisable to carry out trial casting with Quarry Rock Dust proposed to be used, in order to arrive at the water content and mix proportion to suit the required workability levels and strength requirement. However, more research studies are being made on Quarry Rock Dust concrete necessary for the practical application of Quarry Rock Dust as Fine Aggregate.

## 7. ADVANTAGES OF GREEN CONCRETE

- Much change is not required for the preparation of green concrete compared to conventional concrete.
- Reduces environmental pollution.
- Have good thermal and acid resistance.
- Compressive and split tensile strength is better with some materials compared to conventional concrete.
- Reduces the consumption of cement overall.
- Green concrete is economical compared to conventional concrete.

## 8. DISADVANTAGES OF GREEN CONCRETE

- Structures constructed with green concrete have comparatively less Life than structures with conventional concrete.
- Compressive strength and other characteristics are less compared to conventional concrete.
- Water absorption is high.
- Shrinkage and creep are high compared to conventional concrete.
- Flexural strength is less in green concrete.
- The materials to build such buildings can be hard to find especially in urban areas where preserving the environment is not the people's first option. So shipping these materials can then cost a lot than a standard building.

## 9. CONCLUSIONS

- There is significant potential in waste materials to produce green concrete.
- 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.
- The cost per unit volume of concrete with waste materials like quarry dust is lower than the corresponding control concrete mixes.
- A detail life cycle analysis of green concrete by considering various parameters is very much necessary to understand the resultant concrete properties

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