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GREEN CONCRETE: An Intelligent Alternative for a Better Sustainable Environment

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Abstract-*Around (8 to 10) % of the world's entire greenhouse or CO_2 emissions are obtained from processing cement. These greenhouse gases are liberated when limestone & clay are compressed & warmed up at high temperatures. Green concrete is explained as concrete that utilizes certain waste substances as one of its constituents, or such that the manufacturing procedure avoids the ambient damage to the environment, or it has peak performance & life cycle sustainability. This paper covers the comprehensive study, analysis & the research gaps of green concrete. It deals with the selection of raw materials and their feasibility while being used in green concrete. Such materials include fly ash, reprocessed concrete & masonry as aggregates in concrete & query dust. The usage of fly ash in concrete provides a deduction of CO_2 emissions without affecting the economy. It has been recorded that around 0.9 tons of CO_2 are manufactured per ton of cement produced. Hence, its usage isa much-needed step to reduce the CO_2 emissions in the atmosphere & to reduce the pollution in the upcoming years. Therefore, green concrete is an excellent alternative of cement because its economical uses waste substituents & also saves energy in the manufacturing process.*

Keywords: Green concrete, RDWM, RCM,BFS,

1.0 INTRODUCTION

The concrete that is obtained by utilizing wastes materials and also these substances are eco- friendly such type of concrete is known as Green concrete. It is one of the most growing topics in the construction field & it was innovated firstly in Denmark in 1998.

1.1 Urge To Minimize Co_2 Emissions

One of the main concerns across the globe is the conservation & environmental protection which is a big issue right now. After the World Earth Summit in Kyoto, Japan that inaugurated the urge to minimize CO_2 emissions on a massive scale (targeted before the 2010 emissions minimized by 21%) to neglect the disastrous global world, hence numerous industrial nations around the globe have admitted to work-out the rules that aids in the successful assignment of the protection & conservation of the environment (1). Around 8~10% of entire world CO_2 emissions, which accounts for the global climate alterations was not due to the pollution of vehicles or from bush/forest fires, however, it was due to the cement manufacturing process in the cement plant. These gases are liberated when the limestone & clay (i.e. the raw materials of cement) is crushed and heated in a furnace at a temperature of (±1500ºC). Every year, around 1.89 billion tons of cement (which accounts as a major constituent of concrete) have been manufactured worldwide.

1.2 Energy To Manufacture Structural Element

Since concrete is more environmentally friendly in contrast to wood, steel & aluminum. An illustration by, Struble & Godfrey [2] (2006) has differentiated the environmental impact created by an RCC beam & a steel beam that can bear the same moment (Fig.1) (appendix A). The energy needed to produce an RCC beam was evaluated to be 109 MJ while the energy required to fabricate the steel I-beam was found to be 237 MJ. It depicts that the energy required is half in an RCC beam however, concrete production is at a very large scale across the world with annual consumption of about 20,000 million metric tones in 2009[3], causing a huge impact on the environment

2.0 STUDY ON GREEN CONSTRUCTION MATERIALS

2.1 Coarse Aggregate

The aggregates vary infinitely with respect to their shape, size & grading. The coarse aggregates are graded between 5~40mm. Also, the difference in their shape & texture influences the void content & frictional properties of concrete [5]. Normally, the demand for coarse aggregates in concrete is more than 50%. These are the following source of coarse aggregates:

- Locally available fresh aggregate

- RDWM
- RCM
- BFS

a. Fresh Aggregate: These include stone quarry however they are not of excessive grade stone as granite, basalt, etc but they are of a beneath grade & hence it is used as a mix design of concrete or used for less characteristic strength.

b. RDWM: stands for recyclable demolition waste material i.e. waste produced by construction is huge & an estimate states that per capita waste generation generally ranges from 0.4-0.8kg /day /person. The waste distribution shows about 50% of demolition waste is a dump but for the sustainability of resources, the waste should be reused or recycled.

c. RCM: also known as recycled concrete material is also called crushed concrete which is similar to demolition waste. Chief reasons for RCM are the destruction of existing concrete pavement, building slabs & foundations, bridge structures, etc. Comprising of pointed agglomerates of squeezed standard aggregate & inured cement.

d. BFS: commonly known as blast furnace slag is generally a waste product from pig iron. Iron ore or remnant iron is minimized to a liquified condition by flaming coke fuel with limestone & dolomite. It consists mainly of silicates, aluminates & calcium- alumina-silicates.

2.2 Sand (Known As Fine Aggregate):

Some sources of sand are generally used & mentioned below:

- Unprocessed Sand (obtained from the river)
- Manufacture fine aggregate
- Reused Glass Aggregate
- BFS

a. Produced aggregate for Concrete: Normally sand if acquired from waterway bed although, this can be procured further by compressing stone from rocks. After crushing rock stone & sieving it in-between 40-6 mm size, & rest passing through 6mm is stone dust.

b. Natural aggregate Vs produced aggregate: Natural sand frequently holds unwanted mineral elements & pipeclay & effect of these substances on fresh as well as inured concrete is very dangerous. Hence it could increase the shrinkage & permeability & result in decreasing chemical resistance & compressive strength.

c. Recycled Glass Aggregate: It is formed when a molten mixture of sand, soda ash, and limestone is supercooled to form a rigid state [5]. Also known as glass cullet, is crushed material & is angular, flat & elongated in design.

d. BFS: It is already described under the coarse aggregate. However, in this type the BFS is broken down into fine aggregate to meet gradation specifications.

2.3 Fly Ash An Alternative For Cement:

It is a residue product that is obtained through the functioning of coal power plants. They are extremely even & totally spherical in shape. Its diameter ranges from 1-150m. Due to its composition it is further subdivided into Class C (high calcium FA) & Class F (low calcium FA).

a. Merits of utilizing fly ash as an alternative in concrete:

- Firstly, the use of fly ash as a portion substitute reduces cement & emission of CO_2.

- Usage of fine quality of fly ash has shown enhancement in durability of concrete.
- Few technical gains by the usage of fly ash in green concrete are:
  - Increased ultimate strength & reduced bleeding & shrinkage.
  - Enlarged durability & enhanced workability.

2.4 High Volume Fly Ash Concrete:

When the concrete mix contains 50% or more fly ash by mass of cementitious material then it is called as HVFAC [5]. It was observed that after replacing 50% or more cement by fly ash, it's possible to manufacture sustainable, high-performance concrete mix which shows high workability, ultimate strength & durability.

3.0 RESEARCH GAPS OBSERVED FROM THE LITERATURE REVIEW

Some of the research gaps that were observed from the following study are mentioned below:

- However green concrete seems to be a very propitious option instead of conventional concrete for sustainable development but the fundamental issue is its durability [5]. Durability of green concrete is less than the conventional concrete and as a result, it has less life. So, the question here is how to increase the durability of green concrete?
- Another field of research in this topic is about the split tensile strength [5]. It was observed that the split tensile strength of green concrete was less than conventional concrete and now the question here is that how it could be increased?
- Is there any building code for green concrete specifically that would depict the particular materials & mixture proportions? [10] The answer is no and because of which these outdated codes do not meet the required requirements for green concrete and as a result, this field is under research.
- One more question that is to be asked here is that is there any construction business practices with green concrete? [10] It is a cardinal concern that also acts as an institutional barrier for many countries & hence it needs to be researched in more detail so that this excellent alternative could be practised more worldwide & could result in a better sustainable future.

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