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Utilization of Waste Material to Make Green Concrete

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Abstract - *There are ample choices in regard to selection of materials in any type of construction. Due to growing interests in sustainable constructions, more sustainable materials are preferred by engineers and architects. To reduce consumption of natural resources , energy and pollution of the environment Green concrete capable for sustainable construction is characterized by applications of industrials wastes is used. Replacements of materials over nominal concretes is what makes green concrete more environmentally friendly concretes. Marble sludge powder, quarry dust, crushed concretes, ceramic waste ,rice husk ash and fly ashes are some of the materials used for making green concretes, a sustainable construction.*

***Key Words*: Green concrete, Greenhouse gas, Global warming, M-sand, sustainable construction.**

1. INTRODUCTION

Green concrete is a revolutionary topic in the history of concretes industry. This was first invented in Denmark in the year 1998.Green concretes is a concept in which considerations of environments into every aspect of the raw material manufacture over construction, mixtures design to structural designs, and durability is reviewed. Due to the use of recycled materials whereby avoiding the charges for the disposal of waste, less energy consumption and greater durability green concrete is often considered to be cheap to produces.

Sustainable constructions is focused on best practices which emphasize on long term affordability, durability and effectiveness unlike like normal construction practices which are guided by short term economics considerations, . At each stages of the life cycle of the constructions, it increases ease and quality of life, while minimizing the negative environmental impacts and increasing the economics sustainability of the constructions. The uses of resources through the whole life cycle of the construction process is minimized because green concrete play a vital role in achieving the sustainable construction. Having so much of advantageous has led to popularity in construction world and one of the emerging technologies in sustainable constructions.

Green concrete is a miracle of present and tools for the future when the natural's resources are on the verge of extinction.

2. OBJECTIVE OF WORK

Use of green concrete to reduce the impact on our environment by standard construction practices which are turning to be major pollutants in developing world.

2.1 Greenhouse gas emission

- Concrete is the second most consumed entity after water. In its production around 5% of the world's total carbon dioxide is emitted which is one of the greenhouse gasses responsible for global warming.
- Cement is used in concrete as one of the ingredients and it consists of limestone calcium carbonate (Calcium Carbonate $CaCO_3$)
- During manufacture of cement its ingredients are heated to about 800 to 1200˚C.
- During this process the carbon dioxide is driven off $CaCO_3 \rightarrow CaO + CO_2$
- Approximately 1 kg of cement releases about 900 gm. of carbon dioxide in the atmosphere.
- This CO_2 is affecting our environment to minimize its production we need to minimize the use of cement by finding its substitute.

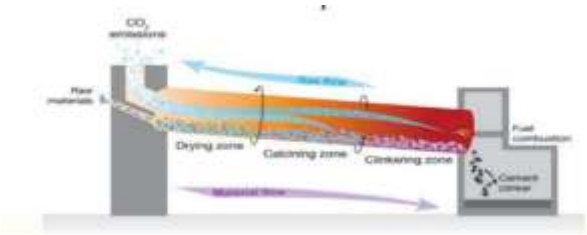

Fig 1. CO_2 emission

2.2 Reduction in naturally occurring materials

- Major ingredient in the production of concrete is aggregates without aggregate it is impossible to produce concrete.
- Aggregates are mined from the rock mine and the quantity in which concrete is produced there will be significant reduction in naturally occurring materials.

- As we have seen river sand is banned because it can destroy riverine vegetation, cause erosion, pollute water sources and reduce the diversity of animals. The coastal ecosystem and the dune system is affected by sand mining.
- So, we have to find its substitute of river sand. Currently we are using M sand.

Fig 2. Mining of aggregates

2.3 Disposal of construction & demolition waste

- 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 so we need to use these waste materials efficiently.

3. LITERATURE REVIEW

3.1 Concrete with Alternative Aggregates - Green Concrete (2019):

In this study it is found that the manufacturing of concrete and its production have a significant adverse impact on the environment. Portland cement is responsible for emission of about 7% of total global anthropogenic CO2. Coconut shells aggregates are potential candidate for the development of new composites because of their high strength and modulus properties. Approximate values of coconut shells density is 1.60 g/cm^3. The chemical compositions of the coconut shells are similar to wood. It contains 331% cellulose, 36.51% lignin, 29.27% and ashes at 0.61%. Concretes with glass aggregates is a material mixture that has a lot of potential but also a lot keeping it from reaching this potential. Any type of glass when broken down passes through #8 to #4 sieve. Glass concrete is the best aggregate alternative of the various components. They concluded that use of coconut shell as aggregate, Stone Crusher Waste as Fine Aggregates, Waste Plastic as Concrete Composite, Aggregate from Crushed Concrete, Post consumer Glass has a lot of potential with certain disadvantages likes there are problems due to the alkali silica reaction between the cement paste and the glass aggregate, which over time can lead to weakened concrete and decreased long-term durability.

3.2 Study On Properties of Concrete Using Over burnt Brick Chips and Demolished Concrete Waste As Partial Replacement Of Coarse Aggregate (2017):

In this paper partial replacement of coarse aggregate by over burnt brick chips and demolished concrete waste, with water cement ratio of 0.40 is used. The percentage replacement of coarse aggregate by over brick is varied from 10% to 50% while that for by demolished concrete waste is varied from 10% to 60 % at an interval of 5%. The compressive and split tensile strength of concrete up to 25% replacement of coarse aggregate by over burnt brick chips and that of up 35% replacement of demolished concrete waste reveals approximately same strength as compared to concrete made by conventional coarse aggregate.

Although it is found that the compressive and tensile strength of conventional concrete is always higher for both the case (i.e. in case of over burnt brick chips and demolished concrete waste.) but up to 255 and35% replacement of conventional coarse aggregate by over burnt brick chips and demolished concrete waste respectively the variation in these properties are very less. All the mixes of over burnt brick chips shows better performance in splitting tensile strength test as compared to demolished concrete waste mixes.

3.3 Study on concrete with partial replacement of cement by rice husk ash (2016)

In this paper it was investigated that rice husk ash can be used as cementitious material. It was assessed by conducting the physiochemical analysis of the ingredients and the influence of Rice Husk Ash on concrete properties (fresh state and hardened state). It was found from the chemical analysis conducted on Rice Husk Ash that it contains nearly 80% silica.

Hardened properties like compressive strength, split tensile strength and flexural strength properties were evaluated. A water absorption study was conducted to check efficiency in terms of water absorption From the experimental investigations it was found that optimum replacement of Rice Husk ash in cement was approximately 10% in terms of workability and strength. The emission of green-house gases can be reduced to a larger extent by the usage of Rice husk ash in concrete as a replacement for cement.

3.4 Reuse of ceramic waste as aggregate in concrete (2016)

In this paper coarse aggregates is replaced by Ceramic tile aggregate so it was found that the maximum compression strength is obtained when 30% of ceramic tile aggregate was replaced with coarse aggregate. The compressive strength for 10% and 20% replacement of Ceramic Tile Aggregate is not increased.

There is little variation when compared with normal concrete in terms of strength. The optimum result is obtained for 30% replacement of Ceramic tile aggregate with coarse aggregate. Proper utilization of ceramic tile waste can be achieved by addition of ceramic tile aggregates into coarse aggregate.

3.5 Incorporation of Waste Glass Powder as Partial Replacement of Fine Aggregate in Cement Concrete (2015)

In this research fine aggregate was replaced by glass powder. In their research 20% replacement of fine aggregates by waste glass showed 35% increase in compressive strength at 7 days and 30% increase in compressive strength at 28 days. Fine aggregates can be replaced by waste glass up to 30% by weight showing 8.5% increase in compressive strength at 28 days.

With increase in waste glass content, percentage water absorption decreases. With increase in waste glass content, workability if concrete mix increases and the average weight decreases by 5% for mixture with 30% waste glass content thus making waste glass concrete light weight.

3.6 Green Concrete: Efficient & Eco-friendly Construction Materials (2014)

In this review paper on green concrete it is concluded that the concrete is made with wastes which are eco-friendly are called as green concrete. How to choose a material for green concrete is covered in this paper. It has been observed that 0.9 tons of CO_2 is produced per ton of cement production.
Also the composition of cement is a 10% by weight in eco-friendly construction technique. Thus, to reduce CO_2 emission in the atmosphere towards eco-friendly construction technique green concrete should be used. A trend is increasing among engineers and architects for greater use of manufactured and recycled aggregates in construction.

3.7 Study on Strength of Concrete With Partial Replacement Of Cement With Quarry Dust And Metakaolin (2014)

In this paper it is investigated the effect of strength of concrete with partial replacement of cement with quarry dust and Metakaolin. They have stated that concrete is a composite material made from cement, water, fine aggregate and coarse aggregate. The paper is deals with partial replacement of cement with quarry dust and metakaolin which are having silica used as admixtures for making concretes.
They have investigated first quarry dust is made partial replacement of cement and found that 25% of partial replacement is beneficial to concrete without loss of standard strength of cement. They have made 25% partial replacement of cement with quarry dust as constant 22.5%, 5.0%, 7.5%, 10.0%, 12.5% metakaolin was made in partial replacement of cement and they had founded that quarry dust and metakaolin can be partially used as a replacement of cement.

3.8 Use of recycled coarse aggregate in concrete (2013)

In this paper benefits of green concrete is discussed. The utilization of waste products in the manufacturing of new products is a challenging job. The Natural Resources decreases in a short period and therefore the use of wastes products is necessary. There are a numbers of old buildings and structures which are demolished today. The reuses of that demolished debris are good solutions to the problem of an excess of wastes material. Aggregates plays important role in strength characteristic of concrete.

This paper focus on the possibilities of the use of recycled coarse aggregates concrete as a new structural material. Recycled coarse aggregates (RCA) obtained from crushed concrete rubble and different demolished works. Instead of being stored, it can be reused in the building industries. Recycled aggregates are comprises of crushed, graded inorganic particle which are obtained from demolition debris. The aim of this research project is to determine the strength characteristics of recycled coarse aggregate concrete by using different percentage of recycled aggregate in M45 Grade. The results with 40% use of recycled coarse aggregates gives workable, strong and green concrete.

3.9 The greening of the concrete industry (2009):

This paper summarizes the various efforts made to improve the environmental friendliness of concrete to make it suitable as a “Green Building” material. Foremost and most successful in this regard is the use suitable substitute for Portland cement, especially industrial waste, like fly ash, ground granulated blast furnace slag (GGBS), and silica fume. Also, suitable recycled materials as substitutes for concrete aggregate are gaining in importance, such as post-consumer glass, recycled concrete aggregate, tiers, etc.

By identifying specific properties inherent in various waste materials or byproducts, it is possible to add value to such materials and increase their chances of success in a market-driven economy of supply and demand. For e.g.,

pollution, this is a by-product of industries. Use of micro-silica with concrete decreases the air pollution. Also it silica fumes will increase strength of concrete since it decrease the voids in concrete.

3.10 Fly ash concrete: A technical analysis for compressive strength(2012)

Here the effect of Fly ash on concrete, it can be seen that 0% fly ash i.e. In concrete, if cement is not replaced by with fly ash, has maximum rate of compressive strength developments at 60 days and after it become nearly constant. 5% fly ash has maximum rate of compressive strength development up to the age of 21 days and then after its rate decreases. Strength development at later stage is negligible.

The rate of strength development is large up to 21 days for 10% fly ash and then after its rate becomes negligible for few days and after 28 days it increases uniformly. It also tells us about the properties of concrete like consistency of cement has increased with the addition of fly ash from 32% for 0% fly for 50% fly ash. It may be due to the increased specific surface area of cement and fly ash blend due to finer particles. The initial setting time has increased from 155 minutes for 0% fly ash to 250 minutes for 50% fly ash.

4. CONCLUSIONS

Construction industry has proven to be one of the leading sources of pollution in the environment. Drastic steps were taken to reduce the impact for a healthy living where concept of Green Concrete was introduced. The pollution impact due to construction has been reduced to a significant level.

Materials which were disposed made to be used in the concrete and a substitute of other components were tried to have an efficient form of concrete. Materials like glass and silica fumes were found to be good substitutes.

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