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Green Concrete or Eco-Friendly Concrete

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ABSTRACT

The construction industry is growing rapidly and new technologies have emerged to face different difficulties in the construction industry. Among all materials used in the construction industry concrete is main material for construction purposes. Nowadays recycling of waste and industrial byproducts is gaining popularity to make concrete environment-friendly material thus this concrete is called as ***Green Concrete. Green concrete*** *is an advanced topic in the history of the concrete industry. The recycling of waste and byproducts attracts an increasing interest worldwide due to the high environmental impact of the cement and concrete industries. Normal concrete is manufactured using sand and stones, but lightweight concrete can be made by using industrial by-products and hazardous solid wastes such as expanded fly ash, slag, sludge, etc. Fly ash increases concrete strength, improves sulfate resistance, decreases permeability, reduces the water ratio required, and improves the workability of the concrete. Thus, by the use of green concrete, it is possible to reduce the* CO^2 *emission in atmosphere towards eco-friendly construction technique. Thus, green concrete is an excellent substituent of cement as it is cheaper, because it uses waste products, saving energy consumption in the production. Due to growing interest in sustainable construction, engineers and architects are motivated to choose the materials which are more sustainable.*

Keywords: Green Concrete, Fly Ash, Quarry Dust, Recycled Aggregate.

1. INTRODUCTION

The concrete is made with concrete wastes which are eco-friendly so called as Green concrete. The other name for green concrete is resource saving structures with reduced environmental impact **for e.g.** Energy saving, Co^2 emissions, waste water. 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 a 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 color. Green concrete is also cheap to produce because, waste products are used as a partial substitute for cement, charges for the disposal are avoided, energy consumption in production is lower, and durability is greater.

Further, by replacing cement with fly ash, micro silica in larger amounts, to develop new green cement and binding materials, increases the use of alternative raw materials and alternative fuels by developing or improving cement with low energy consumption. At each stage of the life cycle of the construction, it increases ease and quality of life, while minimizing the negative environmental impacts and increasing the economic sustainability of the construction. Any infrastructure designed and constructed in a sustainable way minimizes the use of resources through the whole life cycle of the construction process in which the green concrete play a vital role in achieving the sustainable construction.

2. ENVIRONMENTAL BENEFITS TO USING GREEN CONCRETE

Green concrete is part of a movement to create construction materials that have a reduced impact on the environment. It is made from a combination
of an inorganic polymer and 25 to 100 percent industrial waste. Here is a list of 4 benefits
to using green concrete.

- **Lasts Longer**
  Green concrete gains strength faster and has a lower rate of shrinkage than concrete made from Portland cement. Structures built using green concrete have a better chance of surviving a fire (it can withstand temperatures of up to 2400 degrees on the Fahrenheit scale). It also has a greater resistance to corrosion which is important with the effect pollution has had on the environment (acid rain greatly reduces the longevity of traditional building materials). All of those factors add up to a building that will last much longer than one made of ordinary concrete.
- **Uses Industrial Waste**
  Instead of a 100 percent Portland cement mixture, green concrete uses anywhere from 25 to 100 percent fly ash. Fly ash is a byproduct of coal combustion and is gathered from the chimneys of industrial plants (such as power plants) that use coal as a power source. Hundreds of thousands of acres of land are used to dispose of fly ash. A large increase in the use of green concrete in construction will provide a way to use up fly ash and hopefully free many acres of land.
- **Reduces Energy Consumption**
  If you use less Portland cement and more fly ash when mixing concrete, then you will use less energy. The materials that are used in Portland cement require huge amounts of coal or natural gas to heat it up to the appropriate temperature to turn them into Portland cement. Fly ash already exists as a byproduct of another industrial process so you are not expending much more energy to use it to create green concrete. Another way that green concrete reduces energy consumption is that a building constructed from it is more resistant to temperature changes. An architect can use this and
  design a green concrete building to use energy for heating and cooling more efficiently.
- **Reduces CO^2 Emissions**
  The manufacturing of green concrete releases has up to 80 percent fewer CO^2 emissions. As a part of a global effort to reduce emissions, switching over completely to using green concrete for construction will help considerably.

3. MATERIAL/PRODUCT SELECTION CRITERIA

Overall material/product selection criteria:

• **Resource Efficiency:** Resource efficiency basically includes properties like recycled content, natural or renewable, resource efficient manufacturing process, locally available, salvaged/refurbished or remanufactured, reusable or recyclable and durability.

• **Indoor Air Quality:** Indoor air quality (IAQ) is enhanced by utilizing materials that meet the following properties: low or non-toxic, minimal chemical emission, moisture resistant and healthfully maintained.

• **Energy Efficiency:** This mainly refers to the energy used for making the concrete. Those materials are preferred that require the minimal amount of energy at the time of construction of the concrete.

• **Water Conservation:** Materials that help us and conserve water in landscaped areas are preferred to be used as construction save water at the time of construction or even help reduce water consumption in building materials.

• **Affordability:** Affordability can be considered when building product life-cycle costs are comparable to conventional materials or as a whole, are within a project-defined percentage of the overall budget.

4. REPLACEMENT MATERIAL FOR GREEN CONCRETE

Sl No.	TRADITIONAL INGREDIENTS	REPLACEMENT MATERIAL FOR CONCRETE
1	CEMENT	MUNICIPAL SOLID FLY ASH,SLUDGE ASH,RECYCLED GLASS ,SILICA FUME
2	COARSE AGGREGATES	RECYCLED AGGREGATE , WASTE READY MIX CONCRETE, WASTE GLASS
3	FINE AGGREGATES	FINE RECYCLED AGGREGATE, DEMOLISHED BRICK WASTE, QUARRY DUST, MARBLE POWDER WASTE

FLY ASH AS CEMENTITIOUS MATERIAL

Fly ash is a very fine powder and tends to travel far in the air. When pulverized coal is burnt to generate heat, the residue contains 80% fly ash and 20% bottom ash. Fly ash produced in Indian power stations are light to mid-grey in color and have the appearance of cement powder.

Use of Fly ash concrete in place of PCC will not only enable ample savings in the consumption of cement and energy but also provide economy. It is theoretically possible to replace 100% of Portland cement by fly ash, but replacement levels above 80% generally require a chemical activator. Moreover, fly ash can improve certain properties of concrete, such as durability. Because it generates less heat of hydration, it is particularly well suited for mass concrete applications. Fly ash use in concrete improves the workability of plastic concrete and the strength and durability of hardened concrete. Generally, fly ash benefits concrete by reducing the mixing water requirement and improving the paste flow behavior.

FLY ASH

Chemical Properties of Fly Ash

Sl. No.	Test Conducted	Values (%) Observed	per IS:1320-1981 Requirement as
1	Loss of Ignition	2.32	5.0(max)
2	Silica as SiO2	42.04	SiO2+ Fe2O3+ Al2O3=70
3	Iron as Fe2O3	4.40	-
4	Alumina as Al2O3	33.60	-
5	Calcium as CaO	12.73	-
6	Magnesium as MgO	0.00	5.0
7	Sulphate as SO3	0.40	3.0
8	Chloride	-	
9	Lime Reactivity	4 N/mm2	4.5

FLY ASH AGGREGATES

Several lightweight concrete aggregates can be produced from fly ash. In addition to the use of furnace bottom ash in concrete masonry, pellets of fly ash can be bound by thermal fusion or chemically, using cement or lime. Such materials have many desirable properties. These fly ash aggregates have a specific gravity range of 1.20–1.47, a bulk density range of 650–790 kg/m3 and very high absorption from 16–24.8%. These properties showed very positive results for using fly ash as aggregates.

QUARRY DUST/STONE CRUSHER WASTE AS FINE AGGREGATES

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. The use of alternate materials for sand in construction works need attention with respect to their availability and applicability. The use of quarry dust sometimes causes an increase in the quantity of cement required to maintain workability. Quarry rock dust concrete experiences better sulfate and acid resistance and its permeability are less,

compared to that of conventional concrete. However, the water absorption of Quarry Rock Dust concrete is slightly higher than Conventional Concrete.

The use of quarry sand is generally limited due to the high cement paste volume needed to obtain an adequate workability of concrete.

Physical Properties of Quarry Rock Dust

Property	**Quarry Rock Dust**
Specific gravity	2.54-2.60
Bulk relative density (kg/m3)	1720-1810
Absorption (%)	1.20-1.50
Moisture content (%)	Nil
Fine particles less than 0.075 mm (%)	12-15
Sieve analysis	Zone II

RECYCLED CONCRETE AND MASONRY AS AGGREGATES

Coarse recycled concrete and masonry (RCM) are graded aggregates produced from sorted and clean waste concrete and masonry typically for road soubise applications. The material may contain small quantities of bricks, gravel, crushed rock or other forms of stony material as blended material. Fine recycled aggregates may also be referred to as
crushed concrete fines. The shape grading and excessive amount of fines may impact the workability, bleeding rate, finish ability and susceptibility to plastic cracking of concrete.

MARBLE WASTE AS FILLER MATERIAL

Marble has been commonly used as a building material since ancient times. Disposal of the waste materials of the marble industry, consisting of very fine powders, is one of the environmental problems worldwide today. However, these waste materials can be successfully and economically utilized to improve some properties of fresh and hardened properties of mortar and concrete.

5. SCOPE IN INDIA

Green concrete is an innovative topic in the history of the concrete industry. Concrete is an essential thing for developing country like India which greatly needs a continuously expanding infrastructure. India is the second largest producer of cement in the world. Being produced in huge quantities in India, the concrete industry has a considerable part in the net CO^2 emissions from the country. The net CO^2 emissions from the construction agency are greater than any other industry. Use of green concrete can help us reduce a lot of wastage of several products. Various non-biodegradable products can also be used and thus avoiding the issues of their disposal.

6. CONCLUSION

There is a need for the sustainable construction. Thus for achieving sustainable construction concept of green concrete is adopted. Green concrete technology is one of the major steps that a construction industry can implement to achieve sustainable construction with various means as discussed above. With Green concrete Technology, we can save the natural materials for future use or the generations to come and sustain it for good amount of time. With the time, the virgin material will deplete and so the cost of the material will increase which will add to more cost for the construction but if we use waste materials for construction the virgin materials will become a sustainable material and as well the cost will be reduced. With waste material as an alternative we can help reduce the environmental problems and protect the naturally available materials for future generations as well. Green concrete has reduced environmental impact with reduction of the concrete industries CO^2 commissions by 30%. Green concrete is having good thermal and fire resistant. In this concrete recycling use of waste material such as ceramic wastes, aggregates, so increased concrete industry use of waste products by 20%. Hence green concrete consumes less energy and becomes economical in use.

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