International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.01, February 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

GREEN CONCRETE: EFFICIENT & ECO-FRIENDLY CONSTRUCTION MATERIALS

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ABSTRACT

The concrete is made with concrete wastes which are eco-friendly so called as Green concrete. Green concrete is a revolutionary topic in the history of concrete industry. Concrete is an environmental friendly material and the overall impact on the environment per ton of concrete is limited. The paper covers the aspect on how to choose a material for green concrete. It presents the feasibility of the usage of by product materials like fly ash, query dust, marble powder/ granules, plastic waste and recycled concrete and masonry as aggregates in concrete. The use of fly ash in concrete contributes the reduction of greenhouse emissions with negative impacts on the economy. It has been observed that 0.9 tons of CO2 is produced per ton of cement production. Also, the composition of cement is 10% by weight in a cubic yard of concrete. Thus, by the use of green concrete it is possible to reduce the CO2 emission in atmosphere towards eco-friendly construction technique. To avoid the pollution and reuse the material, the present study is carried out. Thus, green concrete is an excellent substituent of cement as it is cheaper, because it uses waste products, saving energy consumption in the production. Over and above all green concrete has greater strength and durability than the normal concrete.

KEYWORDS: Concrete, Eco-Friendly Concrete, Eco-Friendly Construction Material, Efficient Concrete, Green Concrete.

I.INTRODUCTION

Green concrete is a concept of using eco-friendly materials in concrete, to make the system more sustainable. Green concrete is very often and also cheap to produce, because for example, waste products are used as a partial substitute for cement, charges for the disposal of waste are avoided, energy consumption in production is lower, and durability is greater. This concrete should not be confused with its color. Waste can be used to produce new products or can be used as admixtures so that natural resources are limited and used more efficiently and the environment is protected from waste deposits. Inorganic residual products like stone dust, crushed concrete, marble waste are used as green aggregates in concrete. Further, by replacing cement with fly ash, micro silica in larger amounts, to develop new green cements and binding materials, increases the use of alternative raw materials and alternative fuels by developing or improving cement with low energy consumption. Considerable research has been carried out on the use of various industrial by-products and microfillers in concrete. The main concern of using pozzolanic wastes was not only the cost effectiveness but also to improve the properties of concrete, especially durability. This paper summarizes the various efforts underway 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 substitutes for Portland cement, especially those that are by products of industrial processes, like fly ash, ground granulated blast 260 KislayBharti, Aman Kumar Sinha&Bumbum Kumar. Articles can be sent to editor@impactjournals.us furnace slag, and silica fume. Also efforts to use suitable recycled materials as substitutes for concrete aggregate are gaining in importance, such as recycled concrete aggregate etc.

II.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.

III.FLY ASH AS CEMENTITIOUS MATERIAL

Fly ash is a very fine powder and tends to travel far in air. When not properly disposed, it is known to pollute air and water, and causes respiratory problems when inhaled. When it settles on leaves and crops in fields around the power plant, it lowers the yield. 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 substantial savings in the consumption of cement and energy but also provide economy. The use of fly ash has a number of advantages. It is theoretically possible to replace 100% of Portland cement by fly ash, but replacement levels above 80% generally require a chemical activator. Studies have found that the optimum replacement level is around 30%. 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. The use of fly ash in concrete in optimum proportion has many technical benefits and improves concrete performance in both fresh and hardened state. 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. Refer Table 1 for the Chemical Properties of Fly Ash.

IV.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. Green Concrete: Efficient & Eco-Friendly Construction Materials 261 This article can be downloaded from www.impactjournals.us In the mid-1990s, Pacific Power conducted a feasibility study [2] of the production of sintered fly ash aggregates (Powerlyte) and examined the use of such aggregates in concrete production. Fly ash was palletized and fired at controlled temperature to produce synthetic coarse and fine aggregates. 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.

V.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 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. The use of quarry sand is generally limited due to the high cement paste volume needed to obtain an adequate workability of concrete. The amount of additional paste content depends on shape, texture, grading and dust content of the sand. The increase of water demand of concrete mixtures produced by the adverse effects of shape and texture of quarry sand can be mitigated using a high-range water-reducing admixture also. Both these remedies increase the cost of construction. Refer Table 2 for the Physical properties of quarry rock dust.

VI.RECYCLED CONCRETE AND MASONRY AS AGGREGATES

Coarse recycled concrete and masonry (RCM) is 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. Manufactured sand can be used to replace a major proportion of natural sand with no significant loss of performance in cement based products.

VII.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.

VIII.WASTE PLASTIC AS CONCRETE COMPOSITE

Plastic is a material that is being developed for various applications like product packaging, bottling, plastic Bucket, plastic glass, bottles, mugs, plastic furniture's, plastic utensils, plastic auto parts etc. This cheap flexible and strong material is unfortunately non-biodegradable MSW whose disposal is becoming menace. Plastics can be separated 262 Kislaybharti, Amankumar&BumbumkumarArticles can be sent to editor@impactjournals.us into two types. The first type is thermoplastic, which can be melted for recycling in the plastic industry. These plastics are polyethylene, polypropylene, polyamide, polyoxymethylene, polytetrafluorethylene and polyethylenerephthalate (PET). The second type is thermosetting plastic. This plastic cannot be melted by heating because the chains are bonded firmly with meshed crosslink's. These plastic types are known as phenolic, melamine, unsaturated polyester, epoxy resin, silicone, and polyurethane. At present, these plastic wastes are disposed by either burning or burying. However, these processes are costly. Rebeiz (1996) [4] investigated the strength properties of un-reinforced and reinforced polymer concrete using an unsaturated polyester resin based on recycle polyethylenerephthalate (PET) plastic waste. The results showed that the resins based on recycled PET can be used to produce a good quality of precast concrete.

IX.SUITABILITY OF GREEN CONCRETE IN STRUCTURES

- Reduce the dead weight of a structure and reduce crane age load; allow handling, lifting flexibility with lighter weight.
- Good thermal and fire resistance, sound insulation than the traditional granite rock.
- Improve damping resistance of building.
- Speed of construction, shorten overall construction period.
- Reduction of the concrete industry's CO2-emission by 30 %.
- Increased concrete industry's use of waste products by 20%.
- No environmental pollution and sustainable development.
- Green concrete requires less maintenance and repairs.
- Green concrete sometimes give better workability than conventional concrete.
- Good thermal resistant and fire resistant.
- Compressive strength behavior of concrete with water cement ratio is more than that of conventional concrete.
- Flexural strength of green concrete is almost equal to that of conventional concrete.

X.SCOPE IN INDIA

Green concrete is a revolutionary topic in the history of concrete industry. As green concrete is made with concrete wastes it does take more time to come in India because of industries having problem to dispose wastes and it also reduces environmental impact with reduction in CO_2 emission. Use of green concrete can help us reduse a lot of wastage of several products. Various non-biodegradable products can also be used and thus avoiding the issues of their disposal.

Chemical properties of Fly-Ash

SI. No.	Test Conducted	Observed Value(%)	Requirement as per IS: 1320-1981
1.	Loss of Ignition	2.32	5.0
2.	silica as SiO_2	42.04	
3.	Iron as Fe_2O_3	4.40	**-**
4.	Alumina as Al_2O_3	33.60	**-**
5.	Calcium as CaO	12.73	**-**
6.	Magnesium as MgO	0.00	5.0
7.	Sulphate as SO_3	0.40	3.0
8.	Chloride	**-**	
9.	Lime Reactivity	4 N/mm^2	4.5

XI.CONCLUSIONS

The review presented in this report clearly indicates an increasing trend and incentives for the greater use of manufactured and recycled aggregates in construction. These are, however limitations to the use such materials. This report 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 CO_2 in environment and environmental impact but it is also economical to produce.

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