A Report on Green Concrete And Its Scope: An Eco Friendly Concrete

Kamisetti Sathish[1], Modi Musalaiah[2], Syed Sanavulla[3], Modela Venkata Sai Durga Prasad[4]
[1, 3, 4] Dept of Civil
[2]Asst.Prof, Dept of Civil
[1, 2, 3, 4] MVR College of Engineering and Technology, Paritala, AP.

Abstract- *The main ingredient in concrete is cement and it consist lime stone. During manufacture of cement, its ingredients are heated to about 1000 degree Celsius. During this process the carbon dioxide is driven off. Approximately 1kg of cement releases about 900grams of carbon dioxide into the atmosphere. Therefore, green concrete came into existence to reduce the emission of carbon dioxide. Green concrete is made with waste material as a partial or complete replacement for cement or fine or coarse aggregate. Waste materials used are recycled demolition waste aggregate, recycled concrete aggregate, blast furnace slag, manufactured sand, glass aggregate and fly ash. Some of the forms of green concrete are high-volume fly ash concrete, ultra-high performance concrete, geo polymer concrete and lightweight concrete. Better workability, reduction in shrinkage and creep, less heat of hydration, use of local and recycled materials, good thermal and fire resistant are the advantages of green concrete. High cost of reinforcement, less life of buildings constructed with green concrete and less split tension are the limitations of green concrete. Green concrete requires less energy for its production. It produces less carbon dioxide. Green concrete is used in construction of bridges, buildings, dams and roads. Environmental, technical and economic benefits of green concrete increased the demand of green concrete. This paper reviews the researches done by the scientists globally in the domain of green concrete in particular during the current decade. In this paper the detailed review carried on Green Concrete, the materials involved, the process of preparation of Green Concrete, advantages and disadvantages, limitations and applications of Green concrete were discussed.*

Keywords- Concrete, Coarse Aggregate, Cement, Fine Aggregate and Green Concrete

I. INTRODUCTION

Concrete:

Concrete is a composite material which is made up of filler and a binder. Typical concrete is a mixture of fine aggregate (sand), coarse aggregate (rock), cement, and water. Aggregates are chemically inert, solid bodies held together by the cement. Aggregates come in various shapes, sizes, and materials ranging from fine particles of sand to large, coarse rocks. Because cement is the most expensive ingredient in making concrete, it is desirable to minimize the amount of cement used. 70 to 80% of the volume of concrete is aggregate in order to keep the cost of the concrete low. The selection of an aggregate is determined, in part, by the desired characteristics of the concrete. Cement is a binder, a substance used for construction that sets, hardens and adheres to other materials, binding them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together. Cement is used with fine aggregate to produce mortar for masonry, or with sand and gravel aggregates to produce concrete. Water is a transparent and nearly colorless chemical substance that is one of the main constituent of Concrete which available abundantly on Earth's streams, lakes and oceans and the fluids of most living organisms.

Green Concrete:

Green concrete is defined as a concrete which uses waste material as at least one of its components, or its production process does not lead to environmental destruction, or it has high performance and life cycle sustainability. Green concrete can be defined as the concrete with material as a partial or complete replacement for cement or fine or coarse aggregates. The substitution material can be of waste or residual product in the manufacturing process.

GREEN concrete has nothing to do with color. It 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. 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". It is a concept of thinking environment into concrete considering every aspect from raw materials manufacture over mix design to structural design, construction, and service life. The other name for green concrete is resource saving structures with reduced environmental impact for e.g. Energy saving, CO_2 emissions, waste water. "Green concrete" is a revolutionary topic in the history of concrete industry. This was first invented in Denmark in the year 1998 by Dr. WG. Concrete wastes like slag, power plant wastes, recycled concrete, mining and quarrying wastes, waste glass, incinerator residue, red mud, burnt clay, sawdust, combustor ash and foundry sand. Green Concrete is a term given to a concrete that has had extra steps taken in the mix design and placement to insure a sustainable structure and a long life cycle with a low maintenance surface. e.g. Energy saving, CO_2 emissions, waste water. The goal of the Centre for Green Concrete is to reduce the environmental impact of concrete. To enable this, new technology is developed. The technology considers all phases of a concrete construction's life cycle, i.e. structural design, specification, manufacturing and maintenance, and it includes all aspects of performance, Mechanical properties (strength, shrinkage, creep, static behaviour etc.), Fire resistance (spalling, heat transfer etc.), Workmanship (workability, strength development, curing etc.), Durability (corrosion protection, frost, new deterioration mechanisms etc., Thermodynamic properties (input to the other properties)

II. MATERIALS FOR GREEN CONCRETE

It is composed of renewable material, rather than natural resources. Depending upon the project goals, green material may involve an evaluation of one or more of the following criteria. Locally available. Reusable or recyclable. Re-fumished, salvaged

Materials for Green Concrete		
Coarse Aggregate Replacement	**Fine Aggregate Replacement**	**Cement Replacement**
Plastic Waste Demolition Waste Recycled Glass Aggregates	Manufactured Sand Recycled Glass Aggregates Blast Furnace Slag (Bfs) Fly Ash	GGBS Fly Ash Silica Fume Recycled Glass

Demolition waste:

It is waste debris from destruction of buildings, roads, bridges, or other structures. Debris varies in composition, but the major components, by weight, in the US include concrete, wood products, asphalt shingles, brick and clay tile, steel, and drywall. There is the potential to recycle many elements of demolition waste.

Fresh Local Aggregates:

Many places there are stone quarry available. Though these may not be of high quality stone like granite, basalt, Dolomite etc. but they may be of little lower quality. These can be used in making concrete with the help of appropriate mix design - may be for lower characteristic strength.

Recycled Concrete Material (RCM):

Recycled Concrete Material (RCM), also known as crushed concrete is similar to demolition waste. It is a reclaimed Concrete material. Primary sources of RCM are demolition of existing concrete pavement, building slabs &

foundations, bridge structures, curb and gutter and from commercial/private facilities. This material is crushed by mechanical means into manageable fragments. The resulting material is in the form of Coarse Aggregate. Comprised of highly angular conglomerates of crushed quality aggregate and hardened cement, RCM is rougher and more absorbent than its virgin constituents. Crushed concrete's physical characteristics make it a viable substitute for coarse aggregate However, its physical and chemical properties must be determined before use. The properties of recycled aggregates will vary from place to place and from time to time. Such Aggregate can be used in concrete mix or in Highways concrete construction similar to demolition waste aggregate concrete.

Blast Furnace Slag (BFS):

In India more than 10 million tones of Blast Furnace Slag is produced every year and it is increasing with the increase in steel production. Blast furnace slag is a waste product from the manufacture of pig iron and obtained through rapid cooling by water or quenching molten slag. Iron ore, as well as scrap iron, is reduced to a molten state by burning coke fuel with fluxing agents of limestone and/or dolomite. Blast furnace slag is a non-metallic co- product produced in the process of steel production. BFS forms when slugging agents (e.g., iron ore, coke ash, and limestone) are added to the iron ore to remove impurities. In the process of reducing iron ore to iron, a molten slag forms as a non-metallic liquid (consisting primarily of silicates and alumino silicates of calcium and other bases) that floats on top of the molten iron. The molten slag is then separated from the liquid metal and cooled. Different forms of slag product are obtained depending on the method used to cool the molten slag and subsequent processing: BFS consists primarily of silicates, aluminates, silicates, and calcium-alumina-silicates. Air-Cooled Blast Furnace Slag (ACBFS), one of various slag products, is available when the liquid slag is allowed to cool under atmospheric conditions. Crushed Air-Cooled Blast Furnace Slag may be broken down as typical aggregate with the help of processing equipment to meet gradation specifications. Thus, blast furnace slag can be available as an aggregate as construction materials and acceptable as coarse or fine aggregate for use in green Concrete.

Manufactured Sand for Concrete:

Sand is generally obtained from river bed. However, sand can also be manufactured / produced after crushing stone from
rocks. This process is similar to getting crushed coarse aggregate. Infect after crushing rock stone for coarse aggregate and sieving it on set of sieves between 40 - 6 mm size, the remaining portion passing through 6 mm is called stone dust. This can also be said to be a bi-product of manufacturing coarse aggregate. Such product / stone dust is generally in cubical form and depe nd on the type of rock beingcrushed and can be called manufactured sand. Cubical sand manufactured from crushed rock is the most desirable fine material for concrete production. It is generally accepted that particle shape depends on the rock type, breakage energy and the type of crusher used. It is also generally accepted that the crushers most successful at producing non-flaky aggregates are autogenously (rock on rock) and vertical-shaft impact. If it is produced simultaneously, it saves energy and cost, providing further economies in the overall production cost. Here, fracture in rock generally takes place along the rock's natural grain, producing the characteristic cubical shape and surface texture

Recycled Glass Aggregate

Glass is formed by super cooling a molten mixture of sand (silicon dioxide), soda ash (sodium carbonate), and/or limestone to form a rigid physical state. Glass aggregate is a waste product of recycled mixed glass from manufacturing and post consumer waste. Glass aggregate, also known as glass cullet, is 100 percent crushed material that is generally angular, flat and elongated in shape. This fragmented material comes in variety of colors or colorless. The size varies depending on the chemical composition and method of production / crushing. When glass is properly crushed, this material exhibits fineness modulus & coefficientof permeability similar to sand. It has very low wate r absorption. High angularity of thismaterial, compared to rounded sand, enhances the stability of concrete mixes. Such material can be easily used in concrete construction as fine aggregate and give a better cohesive mix which will save on the consumption of cement.

Cementitious materials - Fly Ash:

Fly ash is a by-product produced during the operation of coal-fired power plants. The finely divided particles from the exhaust gases are collected in electrostatic precipitators. These particles are called Fly ash. Gray to black represents increasing percentages of carbon, while tan color is indicative of lime and/or calcium content. Fly ash particles are very smooth and quite spherical in shape. These particles range from 1 to 150 m in diameter. A typical shape of fly ash particles is seen in figure 8.1. Based on its composition, fly ash is classified into two groups: ASTM Class C or high calcium fly ash and ASTM Class F or low calcium fly ash are the two categories of fly ash.

III. PROPERTIES AND PROCESS OF GREEN CONCRETE:

Workability, which is basically the ease with which concrete can be compacted fully without segregating or bleeding. Segregation, which is basically separation of coarse particles from the green concrete. Bleeding, which is the appearance of water along with cement particles on the surface of freshly laid concrete. Harshness, which is the resistance offered by the concrete to its surface finish.

Green concrete is produced by making use of waste materials as part of the components and by making use of production processes which is not harmful to the environment. The criteria for making green concrete is to develop the product by using materials which are sourced from sustainable or products which are deemed "green" instead of non-sustainable elements. Making use of waste or recycled resources are considered as sustainable as they can contribute to lowering the cost of raw materials as well as reducing the amount of waste piling up at landfills every year. Eco-efficient and low cost concrete can be produced by blending various ratios of fine aggregate and cement with used foundry sand and pozzocrete,p60. As a partial replacement of cement in concrete by pozzocrete,p60 which is a processed quality assured fly ash introduces many benefits from economy, technical and environment point of view. Metal casting process generate several kinds of waste, used foundry sand is the main waste. Used foundry sand is major problem for Indian Small and medium scale Foundry. Since used foundry sand make intensive use of sand as primary direct material, the regeneration of this sand can be considered as main factor in environmental performance to achieve sustainable development. The objectives of **Green Concrete Mix Design were described below,** Optimizes void space between aggregates by optimizing particle proportions and packing of materials. This makes more effective use of the cement binder. Aggregates replace excess cement paste to give improved stability, less shrinkage and increase in strength & durability. Less cement also generates less heat of hydration. The slump of the concrete and its flow are a function of the shape & the quantity of the predominant size of the aggregate in the mix. Use of more fine aggregate gives higher slump & flow. So the optimum proportions of coarse & fine aggregate must be critically found to have the best and dense concrete in both fresh & hardened stage of concrete.

IV. KEY ROLE OF GREEN CONCRETE

Advantages:

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. Green concrete having better workability then conventional concrete. Reduction of the concrete industry's CO_2 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. Flexural strength of green concrete is almost equal to that of conventional concrete.

Disadvantages:

Structures constructed with green concrete have comparatively less. Compressive strength and other characteristics are less compared to conventional concrete water absorption is high. Its compressive strength is less than conventional concrete. The effect of creep and shrinkage is more than conventional concrete. Its flexural strength is less than conventional concrete. Water absorption is more than conventional concrete.

Limitations:

By using stainless steel, cost of reinforcement increases. Structures constructed with green concrete have comparatively less life than structures with conventional concrete. Split tension of green concrete is less than that of conventional concrete.

Applications:

It is used in the construction of bridges. It is widely used in the building Construction. It is used in the construction of Column. It can be used in the road Construction.

Future Scope in India:

"Green concrete" is a revolutionary topic in the history of concrete industry. As green concrete is made with concrete waste it does take more time to come in India because of industries having problem to dispose waste and it also reduces environmental impact with reduction in CO_2 emission. Use of green concrete can help us reduce a lot of wastage of several products.

V. CONCLUSION

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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