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STUDY ON SUSTAINABLE CONSTRUCTION WITH GREEN CONCRETE

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ABSTRACT :

A variety of material is available to make choice regarding construction material in construction industry. Only because of interest in serviceable or durable construction, architects and engineers are more concerned to select material which is more durable or viable. Green concrete which possesses more sustainable construction is identified due to utilization of industrial waste for decreasing natural resources consumption, energy consumption and environmental pollution. Substituting materials in conventional concrete is only factor that makes green concrete further environmentally-safe. Fly ash, crushed concrete, quarry rocks and sludge powder of marble are few materials that are used in making green concrete, a sustainable construction.

Keywords:- Geo-polymer concrete, green concrete, recycled materials, sustainable construction , construction industry.

1. INTRODUCTION:-

Green concrete is having no relation to color. Its only concept to think about environment in every perspective of raw materials production to construction, design of mix over structural design and structural durability. Generally green concrete is regarded to be economical or inexpensive because of consuming recycled material through which the charges to dispose off the waste is avoided, less energy is consumed and durability is more. In normal construction method or technique over aim is confined to short time economic consideration whereas in sustainable construction our focus will be practicing best techniques that stress on long time effectiveness, economical or inexpensive and durability. On each step of life process of construction, green concrete enhances ease and characteristic of life and at the same time it decreases unfavourable environmental thrust and raises economic sustainability of structure. Any framework constructed and designed in sustainable manner will help in reduction of resource usage in complete life process of construction procedure where green concrete plays significant role in attaining sustainable construction. Due to extremely more advantages, green concrete has gained popularity in world in construction industry and it is one of coming out technology in sustainable construction. Green concrete is a future tool and wonder for present. Green concrete is “future tool” because it will be used when natural resources become extinct or on verge of extinction.

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2. WHAT SUSTAINABLE CONSTRUCTION REALLY MEAN ?

Sustainable construction means the construction that focuses on lessening impact to environment and at the same time improving its economically efficiency.

3. Sustainable construction with green concrete : A challenge to construction industry -

In any formwork like commercial and public building, the turnover of construction industry have considerable disadvantage of maintaining sustainable economy and significant load on environment. Moreover, we know that a sustainable construction cannot be done without making change in concrete technology since green concrete is vital technology which is used in construction industry.

In this paper our concern is to discuss how sustainable construction can be achieved with green concrete. Ordinary concrete has gained a huge popularity due to its familiar advantages and is used widely by construction industry. Though this fame of concrete is arrived at by huge thrust to environment and also making construction unsustainable.

All around universe, near about 5 billion cubic yard concrete is produced. To produce such amount, large volume of natural resources is required for cement and aggregate.

The main component of concrete is cement and when it is used in cement it causes urban heat island gap outcome. To produce one ton of cement, one ton Co_2 is the major pollutant that causes green house effect due to which global warming occurs.

As we know ordinary concrete generally manufactured with inferior quality that causes corrosion in reinforced concrete, sulphate attack and alkali-aggregate reaction etc. Also solid waste is produced due to destruction and disposal of pavements, concrete structures etc. which create problem of disposal.

Finally, water demand of concrete industry is very high that more than one trillion gallon water is used every year globally in which curing and wash water are not included so it is problem in areas where fresh water is not accessible.

The points mentioned above give an idea that concrete industry has now become victim of its very own achievement and consequently is facing enormous challenge but not that much as it seems. Since concrete is an eco-friendly material that demonstrated with its life-cycle study. The prime challenge is to lessen impact caused by Portland cement on environment. Means, we may use concrete as much as we want but with little Portland cement.

4. APPLIANCES AND APPROACH :

A no. of approaches are there through which sustainable construction is achieved with green concrete.

- More depending on recycled substance with using recycled material, use of virgin material can be reduced.
- By using supplementary materials, cement can be partially replaced like slag and fly-ash since large amount of Co_2 is generated in producing Portland cement and extremely large energy is consumed.
- Enhancement of mechanical properties : With properly using recycled material, mechanical properties can be improved.

- Reusing wash water : Most of construction industries are practicing recycled wash water and needed by law in few countries.
- These above mentioned points show methods of achieving sustainable construction with using green concrete. Methods will be taken under consideration in coming points.

4.1 Use of Geo-polymer concrete :

A quiet new introduction in concrete is application of range of geo-polymers. These substances can be mixed with substances like fly-ash, ground granulated slag and natural pozzolana's for producing concrete with no requirement of using Portland cement. These substances are considered durable and strong. Geo-polymers are having high resistivity against acid attack. Moreover, it shows zero alkali aggregate expansion in region of reactive aggregate which is significant properly. Though an important application of few geo-polymer concrete is highly superior fire resistance compound to conventional Portland cement concrete. Only approx. 7% carbon dioxide is generated in producing traditional OPC with geo-ploymer concrete and hence giving power to material to earn carbon credits.

4.2 Partial substitution of cement :

For decreasing use of Portland cement, cement is partially substituted with various cementitious substances like blast furnace slag, fly-ash, wood ash, limestone powder and metakaolin. The concrete which was famous as "high-strength concrete' in 1970's now mentioned as "high-performance concrete". Reason being it is much more than strong. Using cementitious substances result in enhancement of concrete properties including low heat of hydration that reduces chances of cracking and contraction least insulation of concrete clone to lessen temperature differentials in surface and core at early period. Also chemical attack is resisted including salt water and sulphate. Further, resistance increased or eliminated alkali-aggregate reaction. Also resistance to chloride that causes corrosion is increased which is necessary for structure near or in marine environment.

4.2.1 Blast furnace slag :

Blast furnace slag is an outstanding cementitious substance. It is acquired by quenching molten iron slag (which is by product of steel & iron) from blast furnace in steam or water for producing a granular, glassy product which then dried and converted into fine powder. Here cement is replaced between 75% an 80%. As fly-ash, blast furnace slag has ability of improving durability and mechanical properties of concrete & less heat of hydration is generated. Using blast furnace slag in concrete is accelerated in current years and expected to last longer. Only around 25 million ton blast furnace slag per year is produced around world. Though, not available usually as fly-ash. Normally, the comparison between blast furnace slag and Portland cement summed up as follows :-

- Setting time of concrete that containing slag is slight longer than Portland cement especially for high dosage and for moderate and at low temperature.
- Concrete with pozzolana cement or higher dosage of blast furnace slag will result in lesser heat of hydration.
- Concrete with IS cement (Pozzolana Cement) will gain strength slowly and tends to possess low strength is early time and higher or equal strength in later period.

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- Raising dosage of slag is related with lower permeability of concrete.
- If dosage of blast furnace is more than 35% by mass of cementitious substance, indicates increase is resistance against sulphate attack and also suppress alkali-aggregate expansion.

4.2.2 Fly-ash :

A no. of advantages are there of using fly-ash. Only theoretically it is possible to substitute 100% Portland cement with fly-ash but substitution level over 80% needs a chemical activator. Though, some properties like strength can be improved with fly-ash. Because of production of less heat of hydration, it is used for mass concrete operations. Fly-ash is available commonly where coal is burnt. Another benefit is that it is still inexpensive compared to Portland cement. Also disposal of by-product of coal burning which is fly-ash would be costly if not used better way with utilization of its cementitious characteristic, we securing its best value.

4.2.3 Rice husk Ash (RHA) :

Pulverization of rice produces a by- product which is known as Husk. It encloses paddy grain. During pulverization of paddy, near about 78% weight is rice, cracked rice and bran. Remaining 22% weight is obtained as husk. This husk utilized as feel for generating steam in rice mills for parboiling operation. In this husk, 75% matter is volatile and rest 25% will convert into ash with process of firing known as RHA. In this RHA, amorphous silica present is 85% to 90%. It is not available commercially, if as blast furnace slag and fly after it will become commercially possible then this may be most important cementitious substance is concrete for partially replacing Portland cement to decrease emission of Co_2. As rice is fundamental food for million people and covers 1% surface of earth. Near about 600 million tone rice paddy is produced every year. 20% is husk on an average, producing 120 million tone annually.

4.2.4 Silica fume (SF) :

It is an amorphous polymorph of Sio_2, Silica and also popular as micro silica. It is by product of silicon and ferrosilicon alloy generation and consisting of particle diameter 150 mm on average with spherical shape. It is extremely fine powder. Due to condensation of Sio_2 gas, finely divided glazed powder is obtained. Silica fume mainly composed of Sio_2. Its particles are nearly 100 times tinier than Portland cement. It is used about 7 to 12% of mass of cementitious substance. It's a mineral admixture that used in concrete. Since its more surface area, fine particle and high content of Sio_2, it is very reactive to be used in concrete. It is estimated to produce around 2 million tone. It is used in specialized works as structures that exposed to aggressive chemicals. It enhances durability by reducing permeability. Initially, small particles reduces the space in void of cement matrix known as packing. Silica fume enhances compressive strength or durability. With proportions, it acquires high early and high ultimate compressive strength. Concrete with using silica fume can produce compressive strength more than 103.42 MPa.

4.3 Application of Recycled material :

4.3.1 Foundry sand :

Foundry sand is generally recognized as metal casting sand that contains high quality silica with identical physical properties. It's a by-product of metal casting industry that may be non-ferrous or ferrous in which sand used as molding substance due to its uncommon engineering characteristic. In modern day practice, sand is recycled and used again with number of production cycle. For annual production about 100 million tone sand is used. Out of which, 4 to 7 million is rejected and recycled in industries to other products. Rigid chemical

and physical property gives a low quality sand that results in casting error. A study by Wendorf and Naik done to analyse behavior of by- product of foundry in masonry and concrete in which coarse aggregate is replaced with foundry slag that air-cooled (50 & 100%) and paving stone by foundry sand (up to 40%). Test result proposed that that compressive strength decreased with use of air-cooled foundry slag. ASTM specifications are fulfilled by hand masonry blocks in terms of absorption, strength and bulk density.

4.3.2 Cupolas slag :

Slag is obtained by metallurgical process as by-product. The well-known slag are steel and blast furnace slag. Their use and treatment is familiar and used very extensively. Cupolas slag used as coarse aggregate in the concrete. Its density is 1280kg/m^3 which lies between normal weight aggregate i.e. 1600 g/m^3 and light weight aggregate i.e. 1120 kg/m^3.

4.3.3 Concrete Debris :

Concrete debris appears as major successor and is reused as aggregate in concrete. On one side, large quantity of material is required for aggregate. But on other side, construction debris is largest cement of solid waste in which concrete is present in largest portion. Use of such type debris will help in producing new concrete, reducing land filling capacity, minimizing virgin material use and consuming natural resources.

4.3.4 Wood Ash :

The powder that left as residue after wood combustion likewise burning of wood at fireplace in a home or in an industrial plant is known as wood ash. Traditionally gardeners uses it as a source of potash in domestic gardens. Now wood ash is used as a recycling material for green concreting. Supplementary fuels like oil, gas, coal and petroleum is required to burn wood waste. Wood ash is made of both organic and inorganic compounds. The chemical and physical characteristics of wood ash is regulated by wood species and method of combustion that involves temperature of combustion, boiler efficiency and fuel that used as supplementary fuel. A study related to wood ash was conducted by Krans and Naik that stated its extreme potential to act as pozzolanic mineral admixture and as catalyst for cementitious material. Wood ash can replace cementitious material and it is used in concrete upto 35%. Compressive strength of approx. 36 MPa is achieved with wood ash in test which is sufficient for a lot of structural application.

CONCLUSION :

We should not ignore our aim of achieving sustainable construction. A no. of ways are there for attaining sustainable construction and one way is with green concrete. For achieving sustainable construction, the prime step in construction industry is green concrete technology as we discussed above. Through green concrete, natural resources can be saved for future generations and use and sustain it for longer time. As time passes, virgin material start depleting so cost of material also increased that adds cost to construction but if waste material is used, virgin material become sustained material and cost of construction will reduce. Using waste material, environmental problems could be reduced and natural material is saved for future generation also. Our paper deals with strategic and tools for ensuring that green concrete could replace Portland cement. Green concrete usage ensures the sustainable development and acquiring popularity since its origin.

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