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REVIEW OF SUBSTITUTE MATERIALS FOR GREEN CONCRETE

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ABSTRACT

Green concrete is made from environmentally friendly waste. It reduces CO2 emissions while causing the least amount of environmental damage. Manufacturing cement accounts for 8 to 10% of total global CO2 emissions. When limestone and clays are crushed and heated to high temperatures, the greenhouse gas is released. Green concrete is defined as concrete that contains at least one component made from waste, or whose manufacturing process does not harm the environment, or which has high performance and life cycle sustainability. It cuts water consumption by up to 20%. The major factors driving the green concrete market are the reduction of carbon footprints by 40-50% during the manufacturing process, the increase in construction activities in developing countries, and the use of less water. Apart from all this it also provides excellent thermal insulation, and high level of fire resistance that enables the structure built with green concrete. Waste materials have significant potential for use in the production of green concrete. The partial replacement of ingredients with waste materials and admixtures results in higher compressive and tensile strength, improved sulphate resistance, decreased permeability, and improved durability.

Keywords: Green Concrete, Recycled Aggregates, Cotton Stalk Nano Particles, Glass Aggregate, Pvc Waste Powder.

I. INTRODUCTION

In the history of the concrete industry, green concrete is a ground breaking concept that was first developed in 1998 in Denmark. About 8-10% of total global CO2 emissions, which are believed to be the main drivers of global climate change, are not caused by vehicle pollution on highways or forest fires, but by cement production in cement plants. This is due to the manufacturing process. Greenhouse gases are released in when cement, limestone and clay raw materials are ground and heated in high temperature (± 1500°C) furnaces. About 1.89 billion tons of cement, the main component of concrete, is produced worldwide every year. When waste items are utilized to partially replace cement, disposal fees are saved, less energy is needed during manufacture, and durability is higher, green concrete is also more affordable to produce. In order to use natural resources more effectively and preserve the environment from waste deposits, waste can be used to create new goods or used as admixtures. Instead of using 100% Portland cement, the green concrete is made using 25% to 100% fly ash. Decrease the amount of CO2 emissions. Increased the usage of fuels obtained from waste in the cement industry, reducing the demand of fossil fuels. Over their useful lives, the structures do not significantly impact the environment. The tensile strength of concrete made with recycled aggregate was increased as a result of replacing 50% of the cement with slag.

II. METHODS OF GREEN CONCRETE

(i) Reduced Carbon-emission Concrete: Low-carbon concrete is a way to reduce and sequester carbon emissions in the concrete manufacturing process.

(ii) Carbon Reduced Manufacturing: Concrete that emits less CO2 and concrete that reuses aggregates from building demolition. Traditional concrete manufacturers are working to reduce the carbon footprint of their production facilities in order to reduce the overall carbon footprint of their products. This includes using biofuels to fuel plants and vans.

(iii) Carbon Sequestration: One approach to this is a technology that captures carbon dioxide from industrial processes (including the burning of limestone in traditional concrete production) and injects the captured carbon dioxide into the water used to construct concrete. This method can increase the strength of concrete by 10-20%, but it is estimated that it can reduce the carbon emissions of concrete by only 5%. Carbon sequestration involves mixing cement powder with sand and filling the empty space with water and bound

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carbon dioxide. This process reacts to form calcium carbonate and silica, which hardens into concrete that is 10-25% stronger and presumed to be more resistant to cracking in freeze and thaw environments.

(iv) Concrete Recycling: Concrete scraps and impregnant concrete can be put to many uses. The concrete is recycled and the impregnant concrete is either returned to new concrete plants or the vestal concrete is cast into blocks and sold in block form. Some companies also recycle old and broken concrete as sub-base material for new construction sites. Alternatively, companies can use recycled materials such as glass and porcelain in decorative concrete and concrete substrates.

(v) Mixed-Materials Concrete: Mixing concrete with non-traditional materials is an innovative way to reduce the amount of concrete needed. This approach uses graphene, fly ash and crushed blast furnace slag in the construction of concrete. Concrete with fly ash or jet slag is also called supplementary cement concrete. The use of graphene was carried out under laboratory conditions, resulting in concrete expected to be more durable. It is expected to have improved protection from water, resistance to cracking, and the ability to capture and store carbon dioxide, a greenhouse gas.

III. COMPREHENSIVE SUMMARY

Roushan Kumar et al (2017) have studied that this concept considers the environment from the perspective of concrete, considering all aspects such as raw material production, mix design, structural design, construction and lifespan. It was first invented in Denmark in 1998. Green concrete has nothing to do with colour. Green concrete is very common and inexpensive to manufacture. Replacing conventional concrete components with waste and products provides an opportunity to produce concrete in an economical and environmentally friendly manner. Partial replacement of components using waste or admixtures improves compressive and tensile strength, improves sulphate resistance, reduces permeability, and improves processability.

M. Manjunatha et al (2022) reports the comparative scenario of conventional concrete and green concrete prepared with GGBS and PWP to study the technic and environmental impact assessment. This investigation mainly focuses on fresh and chemical properties of binders, fresh and hardened properties of concrete and environmental impact assessment of all the mixes as indicated. Similarly, a sudden decrease in environmental loads like water consumption and mineral resource scarcity is noticed because of GGBS and PWP as a substitute for cement. It indicates that, by using industrial by-products, one can save natural resources and overcome the disposal challenges of industrial waste by-products. The use of industrial by-products not only helps in terms of environmental conservation it also benefits in lowering the cost of concrete by eliminating the usage of natural resources. Hence researchers and practitioners can attempt the use of industrial waste by-products in concrete as a sustainable approach, not only towards the strength aspect, but also it lowers the impact on the environment.

Jin-Cheng Liu et al (2023) study aims to (i) develop high-strength concrete with high volume of VA, and (ii) evaluate the CO2 emissions based on the lifecycle assessment (LCA) technique and the associated cost compared to the conventional ones. In addition to the comprehensive mechanical and durability performances of the designed concretes, the sustainability potential index was developed based on the corresponding CO2 emissions and cost. The best VA concrete mixture developed in this study shows comparable compressive strength to the controlled OPC concrete, yet with lower carbon emissions and a much better ability against chloride ingress. Based on the analysis of the sustainability potential index, VA concrete with a water/binder ratio of 0.33 and a VA replacement percentage of 30% is the most “sustainable”. The overall results show that VA can be effectively used as a substitute of OPC by 30–50% in volume to produce durable and sustainable concrete with comparable cost while catering to various strength grade requirements for different applications.

Huaguo Chen et al(2022) shows that with scientific technologies for solving the critical problems in concrete composites with urban waste, making use of different urban wastes endows them with an array of functions, such as enhancement of workability and strength for concrete, yielding opportunities for the design of sustainable concrete materials with desired mechanical properties. We also outline the existing challenges and future perspectives associated with the utilization of urban waste in concrete in order to promote the progressive development of sustainable concrete from research and application aspects. With the future directions under discussion, it is envisioned that incorporating urban waste in concrete can aid in engineering

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sustainable concrete in the construction industry and handling urban waste in a clean manner within the waste-management sector.

IV. MATERIALS FOR GREEN CONCRETE

Fly ash:

Typical fly ash replacement levels for Portland cement range from 15% to 35%. The compressive strength of concrete with these replacement levels of fly ash is about the same as that achieved using plain Portland cement after 90 days when adequate curing is provided, but strength at earlier times may be less.

Recycled Concrete Aggregates:

The use of recycled aggregates from construction and demolition wastes is showing prospective application in construction as alternative to primary (natural) aggregates. It conserves natural resources and reduces the space required for the landfill disposal.

Figure 1: Recycled Concrete Aggregates

Aluminium Can Fibres:

It is a lightweight material capable of exhibiting strength properties with a potential for reusability in concrete. The aluminium fibres used in this work were looped at its ends to enhance its bond strength with the concrete.

Recycled Demolition waste Aggregates:

Recycled concrete aggregate could be produced from (a) recycled precast elements and cubes after testing, and (b) demolished concrete buildings. Whereas in the former case, the aggregate could be relatively clean, with only the cement paste adhering to it, in the latter case the aggregate could be contaminated with salts, bricks and tiles, sand and dust, timber, plastics, cardboard and paper, and metals. It has been shown that contaminated aggregate after separation from other waste, and sieving, can be used as a substitute for natural coarse aggregates in concrete.

Figure 2: Demolition Waste

Glass Aggregates:

Specialty glass aggregates made from recycled glass that is melted down and re-formed give you a different look than plain old crushed glass. Crushed bottles and window glass tend to be flat, with parallel sides, whereas specialty glass aggregates can have fuller, more irregular shapes, like crushed gravel.

Blast Furnace Slag:

Blast furnace slag is a nonmetallic coproduct produced in the process. It consists primarily of silicates, aluminosilicates, and calcium-alumina-silicates. The molten slag, which absorbs much of the sulfur from the charge, comprises about 20 percent by mass of iron production. Blast furnace slag has been used extensively as a successful replacement material for Portland cement in concrete materials to improve durability, produce high strength and high performance concrete, and brings environmental and economic benefits together, such as resource conservation and energy savings.

PVC Waste Powder:

Economical, versatile polyvinyl chloride (PVC, or vinyl) is used in a variety of applications in the building and construction, health care, electronics, automobile and other sectors, in products ranging from piping and siding, blood bags and tubing, to wire and cable insulation, windshield system components and more. Studies have shown that plastic can be used in concrete; this type of material has become a major research subject in recent years. The lightweight building material industry is considered useful in promoting reused materials

Cotton Stalk Nano Particles:

Cotton stalk, a waste material from agriculture serves as a highly useful, low-cost material in the development of green nanoparticles. Chemical treatment of cotton stalk provides highly porous activated carbon for template synthesis of gold nanoparticles. The porous structure of the activated carbon ensures uniform distribution of gold nanoparticles in and out of the nanopores. The nanocomposite displayed a photothermal effect at 55°C when exposed to light for 300 s. The nanomaterials could decrease the cement porosity, generating a denser interfacial transition zone. In addition, nanomaterials reinforced cement can allow the construction of high-strength concrete structures with greater durability, which will decrease the maintenance requirements or early replacement.

Figure 3: Cotton Stalk

Urban Waste:

Urban waste accumulation has changed the landscape of cities through environmental pollution. This detrimental change is pushing the development of advanced and green waste management strategies for reshaping green cities, given that the traditional disposal approaches of incineration and landfilling cause soil and water pollution. The utilization of urban waste in concrete shows immense potential as an alternative, as it brings about environmental, economic, and technological benefits.

V. CONCLUSION

The recent study states that the use of flyash, Recycled Demolition wastes aggregates, Recycled Concrete Aggregates, Urban Wastes, Aluminium can fibers, Cotton Stalk Nano Particles, PVC Waste Powder, Blast Furnace Slag and Glass aggregate can be used as suitable material for making green concrete. The use of industrial by-products not only helps in terms of environmental conservation it also benefits in lowering the cost of concrete by eliminating the usage of natural resources. Hence researchers and practitioners can attempt the use of industrial waste by-products in concrete as a sustainable approach, not only towards the strength aspect, but also it lowers the impact on the environment.

VI. REFERENCES

[1] Huaguo Chen, Cheuk Lun Chow, Denvid Lau, Developing green and sustainable concrete in integrating with different urban wastes, Journal of Cleaner Production, Volume 368, 133057, 2022.

[2] Roushan Kumar, Deepak Kumar, Sahil Hussain, Green concrete, International Conference on Emerging Trends in Engineering Technology Science and Management, pp.270-274, 2017.

[3] Jing Yu, Cong Lu, Christopher K.Y. Leung, Gengying Li, "Mechanical properties of green structural concrete with ultrahigh volume fly ash", Construction and Building Materials 147, pp.510-518, 2017.

[4] Jin-Cheng Liu, Md Uzzal Hossain, S. Thomas Ng, Hailong Ye, High-performance green concrete with high-volume natural pozzolan: Mechanical, carbon emission and cost analysis, Journal of Building

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Engineering, Volume 68, 2023, 106087.

[5] Guohao Fang, Jieting Chen, Biqin Dong, Bing Liu, Microstructure and micromechanical properties of interfacial transition zone in green recycled aggregate concrete, Journal of Building Engineering, Volume 66, 2023, 105860.

[6] Shipeng Zhang, Zaid Ghouleh, Yixin Shao, Green concrete made from MSWI residues derived eco-cement and bottom ash aggregates, Construction and Building Materials, Volume 297, 2021, 123818.

[7] Fahad K. Alqahtani, Technical Assessment of Green lightweight concrete containing manufactured plastic aggregates, Journal of Building Engineering, Volume 50, 2022, 104169.

[8] T. Vijayashankar, T. Girinath, S. Dineshkumar, S. Saravanaganesh, Experimental Study On Geopolymer Concrete Using Heavy Weight Aggregate, International Research Journal of Modernization in Engineering Technology and Science, Volume 04, Issue 06, June-2022, pp 4663-4667.