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CONTEXT OVERVIEW ON UTILIZATION OF WASTE MARBLE POWDER AND GGBFS IN CONCRETE

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Abstract: Because of the rising demand for concrete, it is critical to expand cement output. As a result, greenhouse gas emissions, which are to blame for global warming, are growing. Instead of cement, industrial byproducts such as fly ash, GGBFS, silica fume, metakaoline, marble powder, and so on can contribute to long-term growth. This will result in the utilization of waste resources and, as a result, a reduction in the cost of making concrete. The bulk of environmental issues are caused by garbage accumulation in the environment. The large-scale discharge of materials into the environment, such as Ground Granulated Blast Furnace Slag (GGBFS) and Waste Marble Powder (WMP), emphasizes the need of reusing these products.

Key Words **- GGBS, Marble Waste Powder, Environment Problems and Concrete**

I. INTRODUCTION

The Indian construction industry uses around 400 Million Tonnes (Mt) of concrete per year, with a projected growth to 1000 Mt in less than a decade. Cement consumption is expected to expand in parallel with concrete demand in the coming years. Annual cement output is 366 (Mt) from 77 major and 365 minor manufacturers, with annual output predicted to expand to 421 Mt by 2017. An increase of up to 550–600 Mt is predicted through 2025. The long-term expansion of cement and concrete manufacture will be determined by natural resource depletion and environmental concerns. The use of cement in the construction industry raises CO2 emissions, which can be lowered by utilising alternative materials instead of cement[1].As a result, researchers must investigate other materials that might be utilised as a partial replacement for cement in concrete. Previous research indicates that materials such as GGBFS and WMP have the potential to be used as a partial replacement for cement in concrete.

GGBFS is made by quenching molten iron slag in water or steam at around 1500 degrees Celsius, yielding a glassy, granular product that is subsequently dried and pulverised into a fine powder. It is used to improve the workability, strength, and durability of concrete. The ore is transformed into iron, and the unusual components combine to produce slag, which floats on top of the iron. Ground-granulated blast furnace slag is highly cementitious and has a high concentration of calcium silicate hydrate, a strength-enhancement component that increases the strength, durability, and look of the concrete.

GGBFS is widely used in Europe, and it is gaining popularity in the United States and Asia (particulary in Japan, India and Singapore). Because GGBFS is a by-product and waste, appropriately utilizing it contributes to a greener environment while also ensuring the strength of the concrete is not impaired. As a result, the researchers recommend for the introduction of GGBFS into concrete in order to improve the strength, durability, and sustainability of concrete manufacture.

Aside from GGBFS, marble garbage is another waste material produced during the cutting and shaping of marble. It is likely to cause environmental problems due to its high calcium oxide content. India is the world's second largest producer of marble, after only China, Turkey, Brazil, Iran, and Italy. [2] Significant efforts in the scientific community have been concentrated over the last decade on developing sustainable methods for reducing non-biodegradable trash by proposing novel waste management. Recycling trash, on the other hand, without adequately established scientific study and development, might result in environmental concerns that are worse than the garbage itself. Marble dust is a waste product created during the marble harvesting process. A huge volume of powder is created during the cutting procedure. As a result, around 25% of the initial marble mass is lost inside the type of dust.

In India, around 6 million tonnes of garbage are created by marble industries as a result of cutting, polishing, processing, and grinding. Every year, several Indian states create a significant amount of garbage in the environment. Leaving trash goods in the environment may cause environmental problems.

GGBFS and marble dust might be used as mineral admixtures in concrete as a partial replacement for cement, which could enhance certain concrete properties. The ability to make concrete from recycled waste material provides a new dimension to construction while also helping to ensure environmental sustainability. Green concrete achieves its eco-friendliness by incorporating recycled, low-cost, and ecologically beneficial ingredients into the mix, such as discarded marble powder, GGBFS, and so on.

II. Literature Review

Sivakumar S. et al. (2013) investigated the mechanical properties of concrete using Marble Dust (MD) and Ground Granulated Blast Furnace Slag (GGBS) as partial substitutes for cement and fine aggregate. Based on a prior evaluation of the literature,10%, 20%, and 30% of MD and 40% of GGBS were chosen for the study. The purpose of the experiment was to evaluate the mechanical properties of M20 grade concrete using GGBS and MD. When concrete specimens admixed with GGBS and MD were examined for compressive strength and split tensile strength after 7, 28, and 56 days, only minor improvements in strength were seen when compared to standard concrete. The maximum strength was attained at GGBS replacement levels of 40% and MD replacement levels of 30%.

O. M. Ofuyatan et al. (2019) investigated the use of marble dust powder in concrete, in which marble dust at various percentages (0, 15%, 25%, and 35% of the total) was substituted by sharp sand added in M15 grade and the water cement ratio 0.50 was kept constant in the concrete mixes. To examine the quality, performance, and reliability of the concrete, its compressive and split tensile strength were measured after 7, 21, 28, and 56 curing days. According to the laboratory data, substituting marble dust powder with cement increased the strength of concrete by up to 25% in terms of compressive load resistance and tensile strength.

A. Talah et al. (2015) studied the mechanical properties and durability of high performance concretes using marble powder as a partial alternative for Portland cement (PC). The results with experimental on concrete with a fineness modulus of 11500 cm2/g and a marble powder content of 15% in a chloride environment revealed that it contributes positively to the perfection of its mechanical properties, durability with respect to chloride ion migration, and oxygen permeability. Based on assessment findings, it was determined that marble powder is suitable for the creation of high performance concretes (HPC), with properties far superior to the reference concrete (RC).

Vinayak Awasare et al. (2014) investigated the strength properties of M20 grade concrete with GGBS substitution of 30 percent, 40 percent, and 50 percent and compared it to conventional concrete. This investigation was also expanded to determine the optimal proportion of replenishment by utilising both crushed and natural sand. The simple cement concrete was made with OPC cement and crushed sand of M20 grade. The greatest compressive strength attained was 29.78 MPa at 30% GGBS replacement, while those reached at 20%, 40%, and 50% concrete replacement were 27.11MPa, 26.37MPa, and 22.22MPa, respectively.

Bahador Sabet Divsholi et al. (2014) studied the effect of carbonation on GGBS blended cement by testing over 200 samples with different water-cementitious materials ratios (0.4, 0.5, and 0.6) and GGBS replacement percentages. His carbonation test was conducted over a four-year period to investigate the natural carbonation rate of GGBS-blended concrete. He measured the carbonation depth using a Phenolphthalein indicator on a newly cut concrete surface. The rate of carbonation rose for samples with 30 and 50% GGBS replacement; however, a longer duration of water curing for GGBS blended cement concrete lowered the carbonation rate and alleviated worry about grew carbonation rate. According to the author, the only drawback reported for the GGBSblended cement concrete is the increased rate of carbonationdue to consumption of calcium hydroxide

Corinaldesi, Moriconi, and Naik (2010) studied the rheological properties of composite binders by replacing cement with marble slurry at 10% and 20%, with and without superplasticizing agent, and with two w/c ratios of 0.4 and 0.5. The use of marble powder is said to enhance the yield stress of cement pastes, i.e. the cohesiveness necessary for self-compacting concrete. Marble powder also improved segregation resistance. The thixotropy values of cement pastes containing marble powder were low, indicating that the cement pastes flowed better through narrow areas when set in motion. When 10% cement was substituted in the mortar construction, the compressive strength of the mixes was lowered by 10% when compared to standard mortars.

Aliabdo, AbdElmoaty, and Auda (2014) used calcite marble with a fineness of 3996 cm2/g to replace OPC in percentages of 5%, 7.5 %, 10%, and 15%. When the fresh and hardened properties were examined, it was observed that the amount of water required by pastes to achieve the appropriate consistency was the same. The starting and end setting times were the same for all versions. The composite cement pastes also expanded within limits. The highest compressive strength was obtained for pastes with 10% replacement, with a reported performance improvement of 12%.

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