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Effect of Marble Powder on Concrete: A Review

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Abstract **–** Effective waste management is one of the most challenging problems facing today's globe as a result of recent increases in industrialization and urbanization. Several studies have been conducted to assess marble powder's usefulness as a potential coarse and fine aggregates substitute in concrete. An orderly and modern review of marble powder's application in concrete is provided in this paper. According to reviewed study, marble powder in concrete has the same physical and mechanical properties as regular concrete. This demonstrated the viability of using marble waste as an effective substitute for coarse and fine aggregate in structural concrete and showed that the compressive strength, flexure strength, bond strength, etc. of the concrete using marble powder achieved the requisite standards.

Keywords – Marble Powder, Physical Properties, Mechanical Properties, Durability, Review.

I. Introduction

Modern construction methods have grown to include the use of earthenware materials like tiles, clean fixtures, and other waste materials. Research is also being done to increase the durability and strength of concrete. Concerns about resource depletion and environmental degradation have led to the development of materials made from renewable resources. Eco-friendly materials are currently the focus of intensive research in order to lessen the environmental effects of the building industry and protect natural resources. Concrete trash from demolition projects is disposed of in landfills, which causes similar issues with capacity and the environment. Thus, it is vital to find suitable replacements for concrete.

Right now, marble is a popular material for finishing. Nevertheless, waste in the form of powder is created when cutting marble. The marble industries are now under pressure to find a workable strategy to dispose of the increasing volumes of trash that are created every day. These materials will have a negative impact on the environment if they are not properly disposed of.

In order to create a solid foundation for future research, several experts have made significant efforts to examine the mechanical and physical properties of marble powder and analysis of marble powder concrete is organized in a way that will be useful for both current and future research

II. Marble Powder Use In Concrete

A. *Compressive Strength*

Table 1. The compressive strengths of several marble dust concrete mixtures

Mix	Compressive Strength			
	7days	21days	28days	56days
0% marble	13.4	19.3	22.8	27.5
15% marble	14.5	22.05	24	30.7
25% marble	17.5	23.71	26.4	32.8
35% marble	14.3	21.6	25.84	29.2

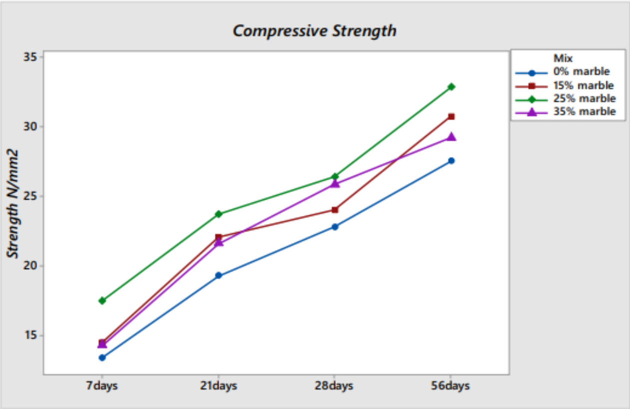

Figure 1. Demonstrating the compressive strength of each series replacement after curing for a certain number of days with marble dust

According to the results, the compressive strength of M15 grade waste marble dust at the corresponding curing days rose by up to 25% when marble dust powder was added. Concrete's compressive strength (35 percent marble dust) was diminished when the proportion was raised further

B. *Split Tensile Strength*

Table 2. Split tensile strengths of several marble dust concrete mixtures

Mix	Split Tensile Strength			
	7days	21days	28days	56days
0% marble	2.22	2.56	3.07	3.54
15% marble	2.34	2.8	3.2	3.68
25% marble	2.45	3.14	3.56	3.82
35% marble	2.27	3.05	3.42	3.71

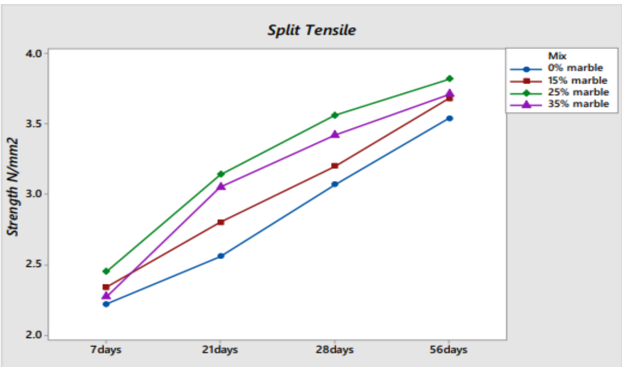

Figure 2. Demonstrating the split tensile strength of each series replacement after curing for a certain number of days with marble dust

The split tensile strength of M15 grade concrete was observed to rise with an increase in the percentage of marble dust powder up to 35% at both 7 and 28 days. For M15 grade concrete at 7 and 28 days, the split tensile strength increased by 15.55% and 17.95%, respectively. Yet, there is a connection between the proportion of replacement and tensile strength. The marble dust's ability to fill spaces in the concrete mix and its cohesive qualities are what give the material its boost in strength.

C. *Recycling of Marble Waste*

Prioritizing recycling applications will benefit the marble sector, the environment, and the economy. Recent studies have found that WMP (waste marble powder) is frequently utilized in concrete in place of aggregate. Hence, the goal is to lessen the detrimental consequences of marble waste on the environment. The effects of marble waste on the tensile strength of concrete were also studied. On the basis of an analysis of prior studies, recycling solutions for waste marble were thoroughly investigated. The findings showed that using discarded marble at various rates in concrete was adequate to replace the coarse/fine aggregate, cement, and additive content, producing concrete with improved strength. Moreover, functional equations were constructed in the current work to estimate the compressive strength and splitting tensile strength of waste-containment concrete. (Gulden Cagin Ulubeylia,2015)).

D. *Efficiency of Waste Marble Powder In Controlling Alkali–Silica Reaction Of Concrete*

The use of recycled garbage in building materials is becoming increasingly popular. It offers security but also more. Natural resources are used in construction, but they also improve the qualities of already-existing materials, bringing about both financial gains and ecologically beneficial architecture. Finding out the waste efficiency was the study's key goal. Concrete's alkali-silica reactivity can be managed using marble powder (WMP). The marble business provided WMP for this reason. Reaction aggregates were utilised to start ASR phenomenon. The study's mortar bar samples were made with WMP at 10%, 20%, and 30% cement replacement content, and 40% replacement surfaces (by cement weight) were tested using the ASTM C1260 normative test procedure. To research the impact, tests on compressive strength and heat analysis were performed. After replacing 10% of the cement with WMP, compressive strength and thermal analysis findings demonstrate enhanced strength. Also, after substituting 10% and 40% of the cement with WMP, respectively, it was found that the Mortar bar expansion was reduced by 28% and 50%. ASR, including mortar bars WMP, did not exhibit any symptoms of cracking in scanning electron microscopic pictures. Nevertheless, the control specimens showed signs of ASR-caused cracking. Moreover, energy dispersion X-ray spectroscopy (EDS) demonstrated that following cement replacement, the amount of alkali reduces. WMP causes ASR growth to be under control. Based on the outcomes, WMP may thus be employed efficiently. Limit ASR growth for long-lasting, sustainable, and cost-effective construction. (SaleemKazmi, 2017).

E. Sustainable Use Of Marble Slurry In Concrete

A significant factor in both greenhouse gas emissions and reductions is the Portland cement production process. Resources in nature. Concrete is more durable and supports sustainable growth when cement is partially replaced by industrial wastes like fly ash, silica fume, slag, stone refuse, etc. The impact of marble slurry on the resilience of concrete has not been researched, despite previous investigations into different wastes. The impact of marble slurry on the resilience of concrete has not been researched, despite previous investigations into different wastes. At marble processing factories, slurry is produced in vast amounts during the cutting, grinding, and polishing processes. Both the environment and people are negatively impacted. The current study has assessed the viability of employing marble slurry. making concrete in place of Portland cement to some extent. Six concrete mixtures were created, each of which contained up to 25% marble slurry in place of Portland cement. These mixtures were tested for permeability, porosity, morphology, resistance to chloride migration, carbonation, and corrosion. 10% marble slurry shown to be the most effective surface substitute for Portland cement. (J. Csetenyib, 2015).

F. Influence Of Marble Wastes On Soil Improvement

Several marble-cutting techniques are used in marble-manufacturing businesses to produce waste marble dust. Uncontrolled spilling of these waste products, however, might cause environmental harm to sensitive natural areas. In this study, we looked at the usage of marble waste as a fine aggregate in concrete manufacturing as well as a method of improving clay soil. Our research focused on identifying the soil's physical, mechanical, and physicochemical characteristics (MD). A few improvements were seen in further test results. Soil is where soil action happens. As a filler material, marble mud waste may also be employed. (Nazile Ural, 2014).

G. Environmental Benefits Of Using Rice Husk Ash And Marble Dust In Concrete

Large-scale cement manufacturing occurs in emerging nations like India, which results in the manufacture of cement. Fillers containing rice husk ash can be used to replace significant volumes of carbon dioxide cement (RHA). Using such fillers improves strength and economy. The goal is to substitute RHA for cement in amounts ranging from 0% to 20%. Moreover, it is advised to substitute marble waste powder (MWP) for fine aggregate in concrete at levels ranging from 0% to 30%. The micro filling effect of MWP results in greater strength and significant economic advantages. To enhance the mechanical and permeability properties, steel fibres were added to cement at a rate of 1.5% by weight. According to the testing findings, the highest aggregate was produced with 15%RHA, 30% MWP, and 1.5% hooked steel fibre's. Highest gains in compressive, tensile, and flexural strength of 44.4%, 60%, and 46.13% were achieved for the best possible combination. Moreover, the inclusion of RHA, MWP, and steel fibres reduced porosity and water absorption. An economic feasibility assessment revealed a justifiable cost rise when RHA, MWP, and steel fibres were included. Good mechanical and permeability improvement with favourable environmental effects. Regression analysis was used to gather experimental findings and offer new equations for calculating compressive, splitting tensile, and flexural strength. The suggested equation showed strong correlation coefficients and looked to be in good accord with the experimental data. Also, utilizing recipe midway and endpoint analyses, the environmental evaluation of the addition of MWP to concrete was assessed. a lot of people. an a new life's work is a specialized in determining whether to go on to the next of.... Environmental contamination is effectively reduced, creating a clean and sustainable environment. (Vermab, 2020).

H. *Marble Powder Use In Mortar And Concrete*

Given that the water-cement ratio was appropriate, marble powder's substantial fineness proved to be quite successful in providing very strong cohesiveness of mortar and concrete, even in the presence of a super plasticizing additive. not as The use of marble powder does not appear to be associated with a significant propensity of energy loss during concrete placing, as is the case for other exceedingly fine mineral admixtures, based on the low thixotropic values obtained (such as silica fume). After 28 days of curing, a 10% marble powder substitution for sand produced a mix with maximal compressive strength at the same workable level as the reference mix in terms of mechanical performance. Additionally, marble powder has another advantageous impact. (R.Naikb, 2009).

İ. *Influence Of Marble Powder/Granules In Concrete Mix*

It is greatly decreased when marble powder is transformed in part to cement by weight. Comparing the mortar mix to the control sample at each treatment age, the compressive strength values rose with an increase in the amount of marble powder. Concrete gains more flexural strength due to marble powder. These compositions contain an increasing percentage of marble debris. This demonstrates the fact that the flexural strength of concrete improves along with the void marble mix. (Rai, 2013).

J. *Properties Of Hardened Concrete Produced By Waste Marble Powder*

All of the study's findings indicate that employing marble powder as a binder or fine/coarse aggregate in conventional concrete has a favourable impact on the hardened concrete's qualities. Contrarily, the mechanical characteristics of concrete were deteriorated in self-compacting concrete when the proportions of waste marble were increased in the mix. It was therefore determined that the qualities of hardened concrete were enhanced by replacing waste marble with cement or aggregate in ordinary concrete. The qualities of hardened concrete were not improved by the use of marble powder in self-compacting concrete. (CaginUlubeyliaRecepArtirb, 2015).

K. *Partial Replacement Of Cement By Waste Marble Powder*

WMP is not a pozzolanic substance in this case. Its high lime level and crystalline CaO content restrict its effectiveness as a setting medium. MP lowers flexural strength at all replacement surfaces: mostly as a result of the cement bond not developing enough. The WMP's concrete quality has been well-confirmed by the Schmidt hammer test. Compressive strength appears to be determined by the amount of sags. According to UPV data, the total power falls as the degree of WMP change rises. Conclusion: Marble powder can serve as a partial alternative for cement, and placement of concrete at a rate of 10–20% produces the greatest outcomes. (Khitab,2020).

L. *Mechanical Performance And Corrosion Resistance Of Reinforced Concrete With Marble Waste*

During time, marble that has been added enhances the compressive and flexural strengths by 5%. The compressive and flexural strengths are seen to decline as the marble content rises. The use of this less dense ingredient in comparison to cement is restricted to regulated rates, unless lighter concrete is desired. The Mg2 and CO3 2-ions released by marble are thought to be the cause of the creation of carboaluminates, which in turn cause additional porosity reduction and higher strengths. The inclusion of marble in place of cement results in a higher potential for noble corrosion than control concrete, according to the anodic polarization curves. When compared to control concrete, the corrosion current density values for the concrete containing marble are around eight times lower. According to the electrochemical impedance characteristics, the control concrete has a higher capacity than marble-filled concrete, which illustrates how vulnerable regular concrete is to corrosion in chlorinated media. The usage of marble will significantly reduce the amount of cement used, advance the cause of sustainable development, and reduce CO2 emissions. All findings indicate that adding marble as an additional cementitious material can enhance the performance of concrete without reducing its strength. (LundSkovhusc, 2018).

III. CONSLUSIONS AND RECOMMENDATIONS

The literature that is currently accessible was studied to determine whether waste marble powder is a possible replacement to coarse and fine aggregates in concrete. The findings of these experiments suggest that marble powder could work well in place of coarse and fine aggregates in concrete. In light of the literature reviews, the following judgements are made:

With a 25% marble powder level, the addition of leftover marble powder boosted the concrete's compressive strength by 11%. For both cubes and cylinders, a replacement rate of 25% for sand with marble waste is ideal. Since that Waste Marble Powder is inexpensively accessible, this research suggested a straightforward and practical technique to reduce the expenses associated with the manufacture of concrete. The use of waste marble powder in the creation of green concrete would be a potential technique to enhance the performance of concrete, according to observations made from the test results and analyses of WMP concrete. Because of the large increase in toughness, WMP concrete can withstand greater amounts of stress, which increases the load-bearing capacity of concrete structures produced with WMP concrete. Given what is currently known about WMP concrete, further study is required in a number of areas before waste marble powder may be efficiently employed in the production of concrete. It is important to extensively analyses the flexure and shear behavior of concrete members made with marble powder particles. The deflection characteristics of WMP concrete beams and slabs can also be researched. Studying the effectiveness of reinforced pre-stressed concrete members manufactured from leftover marble powder under static and fatigue stresses is also conceivable. Examining the long-term mechanical and durability properties of WMP concrete will require more study.

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