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Review on Potential Use of Waste Granite and Glass Powder in Concrete

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ABTRACT

This essay provides a review of In the modern world, solid waste management is a major concern. Large amounts of solid waste are produced annually by various industrial processes. Only a very small portion of this trash is recycled, and the rest is dumped in open spaces. Numerous environmental problems are brought on by this untreated solid waste in the neighbourhood. Utilizing such industrial waste in the production of concrete could find a solution to the solid waste management issue. Additionally, it will be advantageous in easing the pressure on landfills caused by solid waste, protecting river beds from the extensive mining of natural sand, and addressing environmental problems related to the manufacture of cement. Examining substitute materials for traditional ones in concrete while keeping these advantages in mind Thus, the goal of this study is to replace sand and cement, respectively, in concrete with industrial waste, specifically granite powder and glass powder. Waste glass powder (GP) was obtained in a laboratory from used glass bottles, jars, containers, and windows. Waste granite powder (GrP) was gathered from processing facilities of the granite industry. The right amount of fly ash (FS) and marble powder (MP) was added to glass granite concrete in order to produce concrete in an efficient and environmentally friendly manner.

2. LITERATURE SURVEY

The use of SCMs in the building sector has come under scrutiny due to the high demand for cement and sand and the scarcity of available supplies. Near Jaipur, there are several locations and businesses that produce garbage in the form of glass bottles, windows, glassware, containers, jars, granite, marble, fly ash, Kota stone, etc. These trash are produced by various processing businesses and dumped in the landfill. Due to the nonbiodegradable nature of the garbage, this disposal site (as depicted in Figure 2.1) causes significant problems for the neighbourhood. Numerous research studies have attempted to lessen the load of such wastes by employing it in concrete in response to the issues of scarce natural river sand for the manufacturing industry and the production of CO2 due to the burning of fuel and cement raw material.

Natural river sand was replaced with (GCW) by Zafar et al. In this investigation, granite cutting waste was incorporated into five distinct mixes. In five-point intervals, the percentage of waste granite was used as 0%, 5%, 10%, 15%, and 20%, respectively. The following mechanical and durability criteria were evaluated: acid attack, flexural strength, compressive strength, and water absorption density.Jain et.al investigated the use of GCW as alternative of fine aggregate in concrete. The % of GCW was used as 0%, 20%, 40%, 60%, 80%, and 100% as FA. Parameters of control and blended mix measured in respect of slump, mechanical properties, water absorption, water permeability

Li et al. looked examined the mechanical performance and durability of mortar that contained 5%, 10%, and 15% by weight of cement of granite dust. Total of four combinations, with w/b ratios of 0.40, 0.45, 0.50, and 0.55, were employed. Analysis was done on the qualities of the concrete, including workability, carbonation, water absorption, drying shrinkage, and compressive strength.

In place of natural sand, Singh et al. used granite cutting waste (GCW) in concrete. For assessments of CM and blended mix, experimental work was done with different w/b ratios, namely 0.40, 0.35, and 0.30. The percentages at which GCW replaced river sand were 0%, 10%, 25%, 40%, 55%, and 70%, respectively.

Under unfavourable exposure circumstances, Narde et al. evaluated granite cutting waste (GCW) as river sand. This study looked into the effects of carbonation, chloride ion penetration (CIP), acid assault, and sulphate attack under various conditions and temperatures. Throughout the trial, the water to cement ratio was maintained between 0.30 and 0.40. 10%, 25%, 40%, 55%, and 70% of GCW were used in concrete, correspondingly.

Glass powder (GP) was used as an alternative to cement in Hongjian and Kiang's investigation of the mechanical and durability properties of concrete. GP was utilised in significant quantities—up to 60% in blended mixes—in this investigation. The results analysis led to the recommendations shown below. The waste GP formed a compound of by reacting with Ca(OH)2, according to XRD and TGA measurements (CSH gel). Due to the decrease in vacancies and connection between spaces, the GP added concrete exhibited resilience against water infiltration and salt ingress.

Waste glass powder (GP), an alternative to cement, was employed by Aliabdo et al. The trash GP was collected from glass jars, bottles, windows, and containers. In this investigation, GP was applied in increments of 5% as 0%, 5%, 10%, 15%, 20%, and 25% by weight of cement, respectively. Microstructural analysis was used to determine the pozzolanic activity of GP. The findings led to this conclusion. The effects of the GP's pozzolanic characteristics on the setting and expansion times of cement were examined. The mechanical strength of mortar increased by 9.0% when 10% GP was used in place of cement.

Yu et al. studied the use of waste glass and steel slag as cement and coarse aggregate substitutes. Density, MoE, compressive, slump, and flexural strength were examined for performance. A configuration of concrete columns with dimensions of 800 mm in length and 250 mm in diameter was created in order to undertake a fire test.

Lavanya and Karuppasamy looked at using waste glass as a sand substitute in place of cement. The desired grades for employment were M20, M30, and M40. For the experimental examination, flexural, splitting tensile, and compressive strength were taken into consideration. All of the results from the various qualities were analysed in relation to the control concrete. The results led to the conclusions listed below.

With an increase in glass and granite fines in the concrete, the flexural, tensile, and compressive strength all increased. It was determined that GP and GrP may be utilised as a traditional substitute for cement and river sand.

Fine sand (FS) and coloured glass waste were combined to create concrete by Xie et al (MCWG). They employed MCWG as a fine aggregate and FS as a component of the cement (FA). This experimental study mainly focused on mixes comprising FS and MCWG and the alkali-silica reaction (ASR). The Wang et al. study's method involved making concrete with fine sand (FS), stone powder (SP), and LCD glass in place of river sand. The sieve number 4 was used to filter used LCD glass. The LCD glass percentages used were 0%, 10%, 20%, and 30%. Cement, FS, and slag powder were mixed in a set 7:2:1 ratio. The series was created using three distinct w/b ratios, namely 0.28, 0.32, and 0.36, in order to assess the mechanical and durability properties of control and blended concrete. At low water to binder ratios, the value of ultrasonic pulse velocity (UPV) rose with age.

Ingham and Almesfer smashed leftover glass bottles from the region of New Zealand were used to make concrete. They claim that 30% of glass bottles are waste materials and are widely available. Around 20% of total waste glass was employed as a partial replacement for CA and FA. According to the findings, using glass as CA and FA had no negative effects on the materials' compressive, flexural, air-content, or alkali-silica reaction characteristics (ASR).

Waste glass fume (GF) was exploited by Harbec et al. as a pozzolanic substance. In this investigation, GF was favoured in cement weights of 0, 5, 10, 20, and 40%. The mechanical and durability characteristics of the control and blended mixes were evaluated. On various concrete mix compositions, other properties tests such as the RCPT, sulphate attack, and ASR of glass were performed. Results showed that the filler effect and GF's pozzolanic reactivity contributed to the early development of mechanical strength. After 91 days, the strength of the concrete with GF additions was equal to that of the concrete with SF additions. Due to slower pozzolanic activity in the beginning, the durability characteristics of GF-added concrete were worse than those of SF-added concrete.

Kanapathypillay and Vasudevan Gunalaan Seri Ganis examined the test results at 7, 14, and 28 days of curing of specimens containing waste glass powder as a partial replacement for cement, and his findings demonstrated that the 20% glass powder mix amount shows a positive value of compressive strength at 28 days compared to other ratios, which are 10% and 15% are not achievable even though have slight increments from 14 days results.

After researching the effectiveness of concrete as a partial substitute for cement, Khatib J.M. et al came to the conclusion that the greatest compressive strength occurs at around 10% glass powder and that, after that point, it begins to decline and is lower than that of the control.

When concrete is not subjected to sulphate attack or when concrete is subjected to sulphate attack, peak compressive strength is achieved at 20% replacement of cement by waste glass powder.

Bajad M.N. et al. studied the strength properties of concrete containing glass when subjected to sulphate attack and demonstrated that the increase continues up to 25% replacement after which it decreases.

In their study, "Elevated Temperatures on the Strength Properties of LCD Glass Powder Cement Mortars," Her-Yung and Hou-Tsung-Chin found that replacing 10% of the cement with glass powder increased the mortars' compressive strength, especially when the added glass had a powder fineness of less than 4500 cm2/g. This quantity of glass powder substitute might hypothetically be used to replace cement in actual practises.

The goal of Pereira de et alstudy .'s was to evaluate the pozzolanic activity of green, amber, and flint coloured waste glass with a range of particle sizes (75-150 m, 45-75 m, and 4 m) employed as a filler or binder in mortar and concrete. He came to the conclusion that 30% of the 45 to 75 mm range of ground waste glasses might be used to substitute cement in mortar or concrete.

3. Conclusion

The use of industrial waste in concrete offers the possibility of the addressing the seemingly mind-boggling problem of eco- friendly disposal. Over the past few years, use of glass waste in concrete has been a hot topic of research. However, the research on examining the potential of glass waste in concrete has been limited in terms of in depth discussion about the effect of granite on durability and microstructural aspects besides strength properties. The present study aims at assessing the aforementioned attributes of glass substituted concrete comprehensively. In the present study, an industrial waste product glass powder (GP) obtained from waste glass bottles was used as partial replacement of cement. The experimental work was conducted in first part mechanical and durability parameters were analyzed by using different ratio of GP.

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