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Experimental Study Comparing the Manufacture of Concrete using Waste Glass Dust to Partially Replace Cement.

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A B S T R A C T

Glass powder (GP) used as a pozzolan component in concrete works is of interest, according to the authors' previous work. The powder is made from pieces of colored glass, including soda-lime glass. To evaluate the performance of GP in field concrete works, a study was conducted using mixed concrete with 40 MPa strength at different percentages (0, 10%, 20% and 30%) of GP as cement. replacement with a new one. Ten aggregates, some of which still contain large particles of sand cullet aggregate, will be used to make ten samples. Cylinders and prisms are also cast from the same batch for the evaluation of compressive strength and splitting tensile strength. Today's construction industry is expanding every day, leading to demand for composite materials, including cement, fine and coarse mixes. Cement is important in concrete making. The global cement industry accounts for about 7% of the greenhouse gases released into the earth's atmosphere. To solve the environmental problem associated with cement production, there is a need to provide an alternative to concrete. In addition to cement, coarse aggregate accounts for 40% to 50% of the weight of concrete during its construction. Therefore, the price of the stone increased. Use other products to reduce costs. Recycling plastic and glass to be healthy and sustainable has many benefits.

Keywords: Glass Powder, Glass Debris, Amorphous Material, Non-Biodegradable, River Sand, Crushed Glass

1. Introduction

The paper is presented here with its title, if desired, in a box with the same font size as the other article. The article continues here, separated only by headings, subheadings, images and patterns. Bold and 9.5 points, including dots. Additional notes for authors are below.

1.1 General

It is widely accepted that the greatest environmental and economic risk of our time is global warming. According to Mahlia (2002) and Zhang et al., greenhouse gas (GHG) emissions associated with human activities are responsible for global warming and will have serious consequences if not controlled and managed. (2012). Greenhouse gas emissions have reached alarming levels and are expected to increase due to rapid economic growth and increase in the public and private sectors. According to the U.S. Department of Energy, carbon dioxide emissions in 2015 could be 50 percent higher than in 1997.If current emissions continue, this combination will lead to a 5.8oC increase in global temperature (GMT) in the 21st century.

1.2 Type of waste generated from cement industries

Solid waste

The waste stone waste separated from the raw material during cement production, clinker production and preparation of raw steel constitutes the majority of the waste. Furnace dust and fly ash from power plants are also considered waste. Both tree leaves and open ground where dust accumulates are harmful to the environment. Oil waste and scrap metal are two types of waste generated during the cleaning process. Much of this waste ends up in open-air landfills, where it can cause many respiratory illnesses.One of the most important side effects of cement production is particulate matter (PM) emissions. PM emissions are associated with the movement of materials, packaging activities and the storage, use and storage of fuels.

Waste water

Waste water from lime mines and cement factories must be taken to treatment plants. Coke, coal and other wastes to the public can clog nearby streams and storm drains. If there is too much sulfate in the soil, the dust contains dangerous metals such as zinc, lead and chromium, there is too much TDS in the groundwater and rainwater can reach the tank.

Waste fule

Coal and lignite are the most used fuels in the cement industry. The main problem with the high sulfur content in the oil is sulfur release in the furnace ring. Cement kilns can burn fuel with a high calorific value due to their very alkaline environment and high temperatures (2000°C). Hazardous metals and their compounds, hydrogen fluoride (HF), hydrogen chloride (HCl), polychlorinated dibenzodioxins (PCDDs), and volatile organic compounds (VOCs) can be released if not controlled. The use of fossil fuels and oil includes lead, cadmium, mercury, etc. caused an increase in the number of heavy metals such asWaste oil releases more greenhouse gases into the atmosphere than any other type of waste.

Noice pollution

It has an impact on the cement business. Noises are particularly frequent in places where machinery is being used, such as compressor rooms, kilns, cement conveyors, and stone crushing and milling facilities. So noise is a safety issue in the cement business. Prolonged loud noise exposure might cause hearing loss.

2. Methodology

Powdered glass has been produced on a small scale for years and is still used in some industries. Currently, glass powder is produced from industrial waste and raw materials, both of which are used only for certain areas. It is best to use local equipment, as the shipping cost increases. The easy availability of disposable glassware makes consumer disposable glassware essential for the production of glass powder. However, the use of glass waste after its use as a food product has many disadvantages, the most notable of which is its tendency to become contaminated with a variety of food and chemicals and to mix with garbage, including labels and other materials, as well as other ceramics. , plastic .changes after Glass is known to act as a pozzolanic material when powdered, which means it exhibits cementitious properties when wet, but is undesirable as a component in large glass concrete as it occurs between the well-known Alkali-Silicate Reaction (ASR). silica in glass and alkali in other rocks and weak rocks. Based on previous studies of the use of glass fritters in construction, there are differences in current test results. These conflicts affect new stones and glass powdered stones. Fresh settling as glass powder passed through a 300 µm filter and added to the mix.

2.1 Material

The authors' previous work (Tan and Du 2013; Tan and Du 2014) described the crushing process of recycled glass, Du and Tan (2014a, 2014b). Waste bottles (made of soda-juice glass) were collected by local consumers in Singapore. Use a stone to grind the fine sand thoroughly. Figure 3 describes how soil GP and cement dimensions change during inspection.1. The average particle size of cement and GP is the same and is around 10um. The specific gravity of cement is 3.15 while the specific gravity of GP is 2.53. The comparison between GP and OPC is shown in Figure 3..

2.1.1 Cement,Water,aggregate

Cement, aggregate and water are just a few of the inexpensive materials used to make concrete. Throughout the project, Class 43 Normal Portland cement according to IS 8112 was used. The maximum size of the clean sand used in this experiment is 4.75 mm, it belongs to the fine aggregate and belongs to the gradation zone II. The coarse aggregate uses machine-crushed horn blue granite.The first container (16 mm) and the second container (25 mm) pass through 12.5 mm and 20 mm of the stored material, respectively. The properties of coarse aggregates are determined according to IS: 2386 - 1963 guidelines.

2.2 Test on material checking

Cement

1. Fineness test

The test is done by sieving a cement sample through a standard IS sieve. Determine the weight of cement particles larger than 90 microns and calculate the percentage of retained particles. This is called cement quality. Apparatus 90µm IS Screen Gravimetric Scale, Capacity 10 mg/100 g Nylon or Pure Brush IS Code IS4031 (Part 69, 1) Determination of cement quality in accordance with IS 4031 (Chapter 69, 1) 1). Conclusion According to IS recommendations , the standard value for cement fineness should be less than 10%

2. Standard consistency Test

The consistency of the mortar is defined as the percentage of water added to the 300 g cement weight that will allow a 50 mm long and 10 mm diameter Vicat piston to enter the mold to a depth of 33-35 mm. from the top of the mortar. Apparatus Vicat Apparatus IS CODE Consistency Test of Cement IS Cement IS code –IS:5513 IS:4031 (Part 4)-1988 Results Cement5 paste2 consistency often varies.

3. Initial and Final Setting Time of Cement Test

The initial setting time gives the rate at which the cement starts to lose its plasticity, and the final setting time gives the time it takes for the cement to lose its plasticity completely and gain a strength to resist blocking. Initial time of cement: The time from the addition of water to the cement until the cement mortar begins to lose its plasticity. Final setting time of cement: It is the time elapsed from the moment when water is added to the cement paste until the cement paste loses all its plasticity and reaches a hardness that can withstand certain pressures. Initial and final setting time of the cement test. According to IS Code , IS: 4031 (Part 5) - 1988. Tools Balances, Vicat tools, chronometers, measuring instruments or mixing trowels, glass dishes, enamel bowls result According to standard , the onset time of OPC cement should be less than 30 minutes. For OPC cement, it should not exceed 600 minutes.

4. Soundness Test of Cement

After the cement has set and hardened, the volume becomes unstable and the concrete elements break, which affects the quality of the structure and even causes a serious accident called not good in a fixed place. Strength Test Apparatus (Le-Chatelier) Apparatus Le-Chatelier Molds, Cement, Glass Plates, Mixing Plates, Trowels, White IS Code IS Cement Strength Test Code IS: 4031-Part 3-488 quality cements have the same or OPC, fast, low temperature, PPC and high alumina cement type L1 - L2 not more than 10 mm.

5. Heat of Hydration Test

The stone was transformed into a hydrothermal reaction during the treatment and heat is produced by chemical reactions. The temperature rise in the rock can be up to 50oC. Therefore, non-heat resistant cement is used to reduce this heat. The test is based on the principle of increasing heat using a calorimeter. Apparatus calorimeter, insulated wooden box, thermometer plus stand, thermos with stopper, glass funnel, mixing paddle and mirror are necessary equipment for testing.IS code IS 4031-1968 is recommended for testing water temperature on cement. Conclusion Low-temperature cement should not produce 65 calories per gram of cement every 7 days and 75 calories per gram of cement every 28 days.

6. Specific Gravity Test on Cement

It can also be defined as the ratio of the density of cement to the density of the same volume of water. Specific Gravity Test Apparatus Apparatus Le Chaterlier Bottle, Weighing Scale, Kerosene (anhydrous). Results The specific gravity of the cement is 1440kg/m3, around this value, the specific gravity of the cement is calculated in accordance with the standard and construction.

7. Tensile Strength Test

The tensile strength of cement is the maximum value that the cured cement can withstand without cracking when tensile is applied. Measuring the tensile strength of cement is necessary because the concrete structure is subjected to tensile stress due to the application of various loads. Tensile strength is much less than compressive strength. Testing Machine Apparatus Testing Machine, Pressure Bar, Stone Mold, Trowel Is code IS: 456 2000 provides the formula for calculating the tensile strength of concrete. Results The tensile strength of cement is between 3-5 MPa.ve 300-700psi

3. Result and Discussion

3.1 General

The aim of this study is to evaluate the compressive strength of concrete 7, 14 and 21 days after the addition of partial glass powder instead of cement. They can provide the best and cheapest solutions for concrete construction. Information is gathered through empirical research and presented, where appropriate, with graphics and photographs.

3.2 Chemical Composition of Glass Powder And Cement

Using XRF technology, it is possible to determine the chemical composition (purity and color) of glass powder samples. In Table 7, the results are compared with other pozzolanic materials. Results obtained for glass samples are compared with the ASTM C618 minimum requirement for pozzolan samples with 70% ($SiO_2 + Al_2O_3 + Fe_2O_3$). The model also specifies the maximum limit for SO_3, electrical potential loss (LoI) and moisture content of 4%, 10%, and 3%, respectively. As shown in Table 7, the SO_3 content of the glass sample was determined to be well below the allowable level, and the LoI and moisture content were negative.Therefore, glass powder samples should exhibit pozzolanic behavior in cementitious systems.

3.3 Mortar Test

3.3.1 Flow test

Mortar samples were prepared for flow tests in accordance with EN 196-1 (EN, 2005) with a constant water/binder ratio (0.5). As shown in Figure 3, the mortar flow slightly increased after a small amount of cement was replaced with glass powder. The fact that glass dust increases the amount of water in the waste may be in the cleaning of glass products.According to Rashed (2014), previous studies have shown that adding glass can improve performance. Streams with mixed products are expected to show comparable patterns, as the results differ only slightly with respect to the difference in gear shifting. However, the difference between mixed and unmixed flow must be vertical.

3.3.2 Compressive Strength Test With Age Test

The compressive strength of mortars of different ages providing recycled glass is added. At 7, 14 and 56 days, lower mean compressive strength was noted compared to mortar (0% glass change). At 90 days, the average compressive strength of all other cement-modified mortars was higher than that of the control mortar, except for the 25% glass addition. These findings support previous research by Nassar and Soroushian (2011). According to Rashed's (2014) analysis, there is a complete contradiction; Some studies say that the density increases, while others show that the density decreases.For this study, the 10% cement substitution level resulted in the highest mortar compressive strength at 90 days. The compressive strength of the mortar has been tested without additives.

Test Result

Compressive strength results of M35 quality concrete after 7, 14 and 21 days of curing were tested in the laboratory.

4. Conclusion

4.1 General

In a laboratory test, the Compressive Strength of M35 grade concrete is measured after 7, 14, and 21 days of curing. At this age, the outcomes are satisfactory. Strength has decreased in comparison to 0% replacement of GP if we are replacing some of the cement with an increasing percentage of GP. Since glass powder is a byproduct of glass and lacks the cementitious material's strength, it can only replace up to 30% of the cement's constituent particles. To reduce water and increase strength, we also added mid-PCE additive at 2% to cementitious. We also employed micro silica and GGBS to increase strength. Ground Granulated Blast Furnace Slag, or GGBS, is a type of glass slag cement. the GGBS.

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