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# Influence in Strength Properties of Concrete by Replacing Cement and Fine Aggregate.

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**ABSTRACT—**

Experiment such as specific gravity test of stone dust and sand by pycnometer method, moisture content of sand and stone dust by oven drying method, normal consistency of cement, and initial setting time of cement, were performed to determine the physical property of concrete. On fresh concrete slump test was performed to check workability of concrete and after then compressive strength was checked. Thus stone dust is appropriate substitute of fine aggregates in concrete mix for construction. Glass is an amorphous material with high silica content making it potentially pozzolanic when particle size is less than 75 micron. The main problem in using crushed glass as aggregate in Portland cement concrete are expansion and cracking caused by the glass aggregate due to alkali silica reaction. Due to its silica content ground glass is considered a pozzolanic material and as such an exhibit properties similar to other pozzolanic material. Finely powdered waste glasses are used as a partial replacement off cement in concrete.

***Keywords— specific gravity, construction, compressive strength, high silica content, aggregate,***

## I. Introduction

Coconut shell is an abundantly available agricultural waste from local coconut industries, so its disposal is a serious problem for local environment. So, these wastes can be used as replacement material in the construction industry. This will reduce cost of construction materials and solve the problem of disposal of wastes. The impact resistance, moisture retaining and water absorbing capacity of coconut shells are more compared to conventional aggregate. Densities of coconut shells are comparable to other conventional lightweight concrete, so lightweight concrete can be prepared by using coconut shell as coarse aggregate. These alternative lightweight materials are adopted for non-load bearing walls and non- structural floors in building. Fly ash in one of the residues generated in the combustion of coal,

Fly ash is generally captured form the chimneys of coal-fired power plants and is one of two types of ash that jointly are known as coal ash; the other, bottom ash, is removed from the bottom of coal furnace. Depending upon the source and makeup of the coal being burned, the components of sly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide and calcium oxide. Fly ash is classified as Class F Class C types. The replacement of Portland cement with fly ash is considered to reduce the greenhouse gas footprint of concrete as the production of one ton of Portland cement produces approximately one ton of carbon dioxide as compared to zero carbon dioxide produced using existing fly ash. It has been used successfully to replace Portland cement without adversely affecting the strength and durability of concrete. Several laboratory and field investigations involving concrete containing fly ash had reported to exhibit excellent mechanical and durability properties. However, the pozzolanic reaction of fly ash being a slow process, its contribution towards the strength development occurs only at later ages. Due to spherical shape of lay ash particles, it can also increase workability of cement while reducing water demand of the concrete.

Silica fume is a byproduct in the reduction of high-purity quartz with coke in electric arc furnaces in the production of silicon and ferrosilicon alloys. Silica fume consists of fine particles. Because of its extreme fineness and high silica content, silica fume is a very effective pozzolanic material particle. Silica fume is added to Portland cement concrete to improve its properties, in particular its compressive strength, bond strength and abrasion resistance. These improvements stems from both the mechanical improvements resulting from addition of a very fine powder to the cement paste mix as well as from the pozzolanic reactions between the silica fume and free calcium hydroxide in the paste. Addition of silica fume also reduces the permeability of concrete to chloride ions, which protects the reinforcing steel of concrete from corrosion, especially in chloride-rich environments such as coastal regions. When silica fume is incorporated, the rate of cement hydration increases at the early hours.

## II. LITERATURE REVIEW

Kumar and Sribastava(2015) have studied that the stone dust is such an alternative material which can be effectively being used in construction as partial replacement of natural sand. In this study investigation, an experimental programme was carried out to study the suitability and potential use of stone dust as partial replacement of fine aggregate in concrete. To accomplish this specimen were cast for different replacement level at an interval of %

to determine workability and compressive strength of concrete at different level of fine aggregate with stone dust. Results shows that optimum replacement with stone dust is 60% based on compressive strength.

Niang et al. (2015) have studied that Concrete produced by using glass powder as a binder shows very low permeability to chloride ions. And extensive research project on the use of glass powder as cementitious material is underway at the university of Sherbrook, Quebec, Canada. The northestern Canadian province of Quebec has a policy on waste management to promote the recovery and management of materials from the municipal, industrial, commercial and institutional sectors. Therefore new alternatives for using recycled glass are needed. Glass powder contains approximately 70% silicon dioxide. Thus the replacement of 20% of cement with the incorporation of glass powder into the formulation of concrete provides economic and environmental benefits. Moreover, it has been shown that concrete with 20% glass powder has a very low permeability to chloride ions, which makes it a suitable solution for reinfor4ced concrete elements subject to corroding condition, such as deicing products or a salty atmosphere. The results from a study on the structural behaviour of reinforced concrete column incorporating glass powder. The concrete column made with glass powder show satisfactory structural behaviour. The results showed that for a water-binder ratio of 0.4 the replacement of 20% of cement by glass powder delayed cracking o the concrete cover and slightly improved the load-carrying capacity. For water-binder ration0.55 the results for columns with glass powder tested at 91 days were still slightly lower than those without glass powder. However, the difference was smaller than for columns with the same water-binder ration that were tested at 28 days. Overall, the results showed that structural behaviour of reinforced concrete columns made using concrete with glass powder is similar to column made with normal concrete with 20% glass powder for the construction of sustainable building structures.

Kumar and Singh (2015) have investigate the possibility of using crushed stone dust as fine aggregate partially or fully with different grades of concrete composites. The suitability of crushed stone dust waste as a fine aggregate for concrete has been assessed by comparing its basic properties with that of conventional concrete. Two basic mixes were chosen for natural sand to achieve M25 and M30 grade concrete. The equivalent mixes were obtained by replacing natural sand by stone dust partially and fully. The test results indicates the crushed stone dust can be used effectively to replace natural sand in concrete. In the experimental study of strength characteristics of concrete using crushed stone dust as fine aggregate it is found that there is increase in compressive strength, flexure strength and tensile strength.

Afshinnia and Rangaraju(2016) have studied that the impact of using ground glass powder as either a cement replacement material or as a aggregate replacement material on the fresh and Mechanical properties of Portland cement concrete were investigated. Results from this investigation showed that the workability of concrete was significantly affected depending on whether the glass powder was used as cement or aggregate replacement material, however air content and density of concrete were affected only when glass powder was used as cement replacement material. In terms of mechanical properties in absence of glass powder in concrete, the compressive and splitting tensile strength values of the concrete specimens containg crushed glass aggregate were significantly lower than that of the concrete containing Natural mineral aggregate. When glass powder was used as a cement replacement material in concrete, the compressive strength of concrete decreases regardless of the aggregate type. However, when glass powder was used as an aggregate replacement material, the compressive strength of concrete depended on the type containing crushed glass aggregate increased while the compressive strength of concrete containing natural mineral aggregate decreased.

Kumar and Rao(2016) have examines that the possibility of using glass powder as a partial replacement of cement for new concrete. The global cement industry contributes about 7% of green house gas emission into the earth's atmosphere. Waste glass is one materials when ground to a very fine powder shows pozzolanic properties which can be used as a partial replacement for cement in concrete. Attempts have been made to find out the strength of concrete containing waste glass powder as a partial replacement of cement for concrete. For this the finely powdered waste glasses are used as a partial replacement of cement in concrete and compared it with conventional concrete glass powder was partially replaced cement by 5%, 10%, 15%, 20%, 25%, 30%, 35% and 40% and tested for compressive, split tensile and flexure strength at 7 days, 28 days of age and were compared with those of conventional that glass powder can be used as cement replacement material up to 20% and beyond 20% the strength decreases.

Singh and Agrawal (2016) have studied that the waste generation from granite stone industry is in the form of non-biodegradable fine powder the utilization of this waste in concrete will help in sustainable and greener development.

Siad et al. (2016) have carried out an investigation into the effect of incorporating glass powder as a cement replacement on mortar resistance against sulfuric acid attack. The study examined compressive strength, ultrasonic pulse velocity and electrical resistivity changes of mortars based on 15, 30 and 45 % glass powder replacement rates and 12 weeks immersion in fresh water and 5 % acid solutions. The effects of binary binders based on glass powder and limestone powder, glass powder and slag and glass powder and fly ash were also investigated. Experimental results showed improved sulfuric acid resistance with increased glass powder content and binary binder results confirmed the beneficial effect of incorporating limestone powder with glass powder. Mortars with 45 % glass powder and binary binder based on 20 % glass powder and 20 % limestone showed a loss that was significantly lower in terms of Physical and Mechanical characteristics. Microstructural analysis showed that Si/Al-rich residue, which was surface generated from pozzolanic reaction of glass powder, has the potential to inhibit further corrosion by acting as a barrier to acid ions. Therefore incorporating glass powder up to 45 % replacement of cement can enhance mortar resistance to aggressive sulfuric acid attack.

Ahmed and Tagnit-Hamou(2016) have studied that the mixed coloured glass cannot be recycled and is normally disposed of in landfills, causing obvious environmental problems. So if this glass after grinding to same fineness as cement allow its use as supplementary cementitious materials wspecially it has pozzolanic behaviour. The study reported on herein demonstrates the in situ performance of concrete containing glass powder used as a partial replacement of cement at various construction sites including interior and exterior slabs and structural wall elements. In addition to the environmental benefits the concrete made with 20% glass powder replacement showed increases in 91-days compressive strength (7%). 28-days tensile strength (35%)

and 28-days flexure strength (4%) compared to reference mixtures without glass powder. A significant increase in resistance to chloride-ion penetration can be obtained when using glass powder concrete.

Ghannam et al. (2016) Iron Powder (IP) and Granite Powder (GP) are industrial byproducts that are produced in powder form from the granite milling and polishing industries, respectively. Due to their airborne nature and ease of inhalation, these by products are largely left unused and pose a risk to human health. To determine whether granite powder and iron powder could replace some of the sand in concrete, an experimental examination has been conducted. The preparation and testing of twenty cubes and ten beams of concrete with GP and twenty cubes and ten beams of concrete with IP. GP and IP were substituted for sand at weight rates of 5%, 10%, 15%,and 20%, respectively. In comparison to other ratios, it was found that replacing 10% of the concrete's weight in sand with granite powder had the greatest impact on the material's compressive and flexural strengths. According to the test results, concrete with a 10% GP ratio had a 30% improvement in compressive strength over concrete with a normal GP ratio. The flexure also showed comparable outcomes. Additionally, it was found that adding iron powder to concrete instead of sand up to 20% by weight increased the concrete's compressive and flexural strengths.

Ashish (2018) Global warming is caused by greenhouse gas emissions, which are a result of the cement manufacturing process. Sustainable development may result from substituting industrial by-products such foundry sand, marble powder, rubber tyre debris, waste plastic and coal ash for cement and sand. Marble powder is one of the wastes that have not yet been researched for use in concrete's sand and cement amalgam. The disposal of marble waste generated by the construction sector results in significant financial loss and environmental impact.The study's goal is to determine whether discarded marble powder may partially replace sand and cement amalgam.The seven different concrete mixtures were created by partially substituting marble powder (up to 15%) for sand, and the mechanical strength, ultrasonic velocity (UPV), carbonation, and microstructure analysis of the cement and amalgam were all assessed. Marble powder serves as a filler in addition to having no role in the hydration process. 20% marble powder replaced 10% sand and 10% cement amalgam at the optimal level.

## III. EXPERIMENT AND METHODOLOGY

The artificial cement is obtained by burning at a very high temperature a mixture of calcareous and argillaceous materials. The mixture of ingredients should be intimate and they should be in correct proportion. The calcined product is known as the clinker. A small quantity of gypsum is added to the clinker and it is then pulverized into very fine powder, which is known as the cement. The ordinary cement contains two basic ingredients, namely, argillaceous and calcareous. In argillaceous materials, the clay predominates and in calcareous materials, the calcium carbonate predominates. The ordinary cement is also called Portland cement because it had resemblance in its colour after setting, to variety of sandstone which is found in abundance in Portland in England.

**Table 1 Sieve Analysis for coarse aggregate of 20 mm size.**

| Sieve size | Weight retained (gm) | Cumulative weight retained (gm) | Cumulative % weight retained | % passing |
|---|---|---|---|---|
| 40 mm | - | - | - | 100 |
| 20 mm | 484 | 484 | 9.68 | 90.32 |
| 10 mm | 4165 | 4649 | 92.98 | 7.02 |
| 4.75 mm | 345 | 4994 | 100 | - |
| 2.36 mm | 0 | 4994 | 100 | - |
| 1.18 mm | 0 | 4994 | 100 | - |
| 600 micron | 0 | 4994 | 100 | - |
| 300 micron | 0 | 4994 | 100 | - |
| 150 micron | 0 | 4994 | 100 | - |
| Total = 5 Kg | Fineness modulus = 702.66/100 = 7.026 | | | |

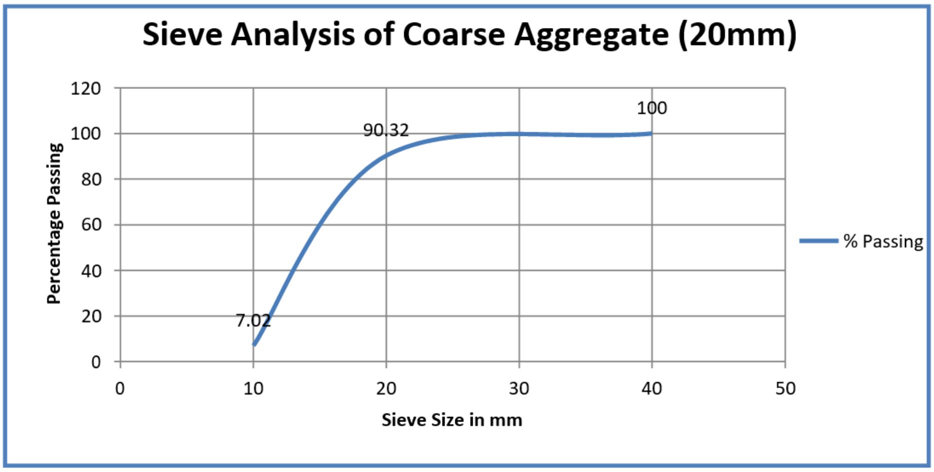


**Figure 1 Sieve Analysis of Coarse Aggregate (20 mm)**

## IV. Conclusions

- The flexure strength of the concrete by replacing 40% sand by stone dusts and 20% cement by the glass powder the strengths are increase by 37, 35, 44 and 43% at 7, 14, 28 and 56 days respectively in M-25 concrete and 19, 18, 42 and 44% at 7, 14, 28 and 56 days respectively in M-30 concrete. As compared to the conventional concrete. Thus, flexure strength is also increase by including the glass powder. It also reduces the consumption of the cement.
- The split tensile strength of the concrete by replacing sand 40% by stone dust the strengths increases 9, 17, 14 and 16% at 7, 14, 28 and 56 days respectively in M-25 concrete and 15, 2, 9 and 10% at 7, 14, 28 and 56 days respectively in M-30 concrete. Hence, stone dust increases the tensile strength of the concrete, which is also saving in fine aggregate.
- The split tensile strength of the concrete by replacing 40% sand by stone dust and 20% cement by glass powder the tensile strength is increase 24, 24, 14 and 13% at 7, 14, 28 and 56 days respectively in M-25 concrete and 5, 6, 8 and 8% at 7, 14, 28 and 56 days respectively in M-30 concrete. Hence by adding the glass powder with stone dust is also increase the tensile strength of the concrete. Hence saving in cost is two ways cost of sand and cement.

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