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Influence in Strength Properties of Concrete Using Stone Dust and Glass Powder as Partial Replacement of Sand and Cement

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ABSTRACT—

The main objective of the present research is to investigate the use of Glass Powder and Stone dust as partial replacement of cement and sand for the production of concrete. In this research analyze the strength of concrete made with using these waste materials one is Glass Powder and other is Stone dust. The Glass Powder is used as 20% replace by weight of cement and Stone Dust as the partial replacement of Fine Aggregate from 0%, 10%, 20%, 30% and 40%. The grade of the concrete here is M-25 and M-30 grade. Slump Test has carried out for the fresh concrete whereas Compressive Strength, Flexure Strength and Split Tensile Tests were carried for the Hardened concrete i.e. mechanical behavior of concrete. All tests are done at 7- day, 14 - day, 28 -day, and 56 days with 0 to 40% replacement of sand at an interval of 10%. Again above tests are carried out with 20% replacement of cement by glass powder. It is observed that the glass powder improve the strength and stone dust can be used as sand.

Keywords— concrete, Fine Aggregate, Compressive Strength, Flexure Strength, Split Tensile,

I. Introduction

Concrete is the most widely used construction material in the world it is a mixture of cement, sand, coarse aggregate and water. Cement is binding material in the cement concrete and its role is to provide strength to concrete. Cement fills up voids existing in the fine aggregate and makes the concrete impermeable. Provides strength to concrete on setting and hardening and binds the aggregate into a solid mass by virtue of its setting and hardening properties when mixed with water .Fine aggregate consist of small angular or rounded grains of silica. It is commonly used as the fine aggregate in cement concrete. It fills the voids existing in the coarse aggregate it reduces shrinkage cracking of concrete. It helps in hardening of cement by allowing the water through its voids. To form hard mass of silicates as it is believed that some chemical reaction take place between silica of sand and constituents of cement, Coarse aggregate makes solid and hard mass of concrete with cement and sand .it increase the crushing strength of concrete. its reduces the cost of concrete, since occupies major volume. Scarcity of cement and aggregate 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 carried out. Use of stone dust in concrete not only improves the quality of concrete but also conserve the natural river sand for future generations. They investigate an experimental program was carried out to study the workability and compressive strength of concrete made using stone dust as partial replacement of fine aggregate in range of 10%-100%. M-25 grade of concrete was designed using Portland pozzolana cement for referral concrete. Workability and compressive strength were determined at different replacement level of fine aggregate viz. a viz. referral concrete and optimum replacement level was determined based on compressive strength. Results showed that by replacing 0% of fine aggregate with stone dust concrete of maximum compressive strength can be made as compared to all other replacement levels.

OBJECTIVE

- To check the workability of the concrete by adding glass powder and stone dust
- To find out the compressive strength of concrete by adding glass powder and stone dust
- To determine the optimum percentage of glass powder and stone dust in concrete by replacing 10%, 20%, 30%, 40% of cement and fine aggregate.

II. LITERATURE REVIEW

Mahzuz et al. (2011) Have studied that stone dust produced from stone crushing zones appears as a problem for effective disposal. Sand is common fine aggregate used in construction work as fine aggregate. In this study the main concern is to find an alternative of sand. Substitution of normal sand by

stone powder will serve both solid waste minimization and waste recovery. The study focuses to determine the relative performance of concrete by using powder sand. From laboratory experiments, it was revealed that concrete made of stone powder and stone chip gained about 15% higher strength than that of the concrete made of normal sand and brick chip. Concrete of stone powder and brick chip gained about 10% higher strength than that of the concrete normal sand and stone chip concrete. The highest compressive strength of mortar found from stone powder, which is 33.02MPa, shows that better mortar can be prepared by the stone powder. The compressive strength of concrete from stone powder shows 14.76% higher value than that of the concrete made of normal sand. On the other hand, concrete from brick chip and stone powder produce higher compressive value from that of brick chip and normal sand concrete.

kumar et al. (2013) Have studied that finely powdered waste glasses are used as a partial replacement of cement in concrete and compared it with conventional concrete. This work examines that the possibility of using glass powder as a partial replacement as 10%, 20%, 30% and 40%. And tested for its compressive, tensile and flexure strength up to 60 days of age and were compared with those of conventional concrete: form the results obtained, it is found that glass powder can be used as cement replacement material upto particle size less than 75 micron to prevent alkali silica reaction.

Abdallah and Fan(2014) have investigates that the characteristics of concrete containing fine crushed glass during its process, the best ratio of fine crushed glass which leads to higher strength of concrete in order to produce concrete blocks, and the effects of waste glass replacement on expansion caused by Alkali-Silica reaction. The slump unit weight, compressive strength splitting tensile strength, flexure strength modulus of elasticity, ultrasonic pulse velocity, dry density, water absorption and Alkali-Silica reaction were analyzed in terms of waste glass content (0%, 5%, 15% and 20%) under different curing age of 7, 14, and 28 days. It was found that the slump of concrete containing waste glass as fine aggregate replacement decreased with increased in the waste glass but without loss of workability. The compressive, splitting tensile and flexure strength of concrete with 20% waste glass content increased by 5.28%, 18.38% and 8.92% respectively at 28 days. The coxes with waste glass replacement showed a denser internal concrete structure or more consistent structure under ultrasonic pulse velocity assessment. There was a clear decreased in the water absorption with an increase of waste glass aggregate ratio, and a clear reduction in the expansion of the waste glass concrete, showing an alkali-silica reaction in concrete which occurred between the active silica of waste glass and silica of cement paste.

Ali et al. (2014) have find the use of marble dust in concrete production as cement replacement or as sand replacement (cement addition) gradually enhances both of the Mechanical and Physical properties of concrete especially with lower w/c ratio. Marble dust showed a filler effect in concrete and had no noticeable role in the hydration process. Yet concrete made with marble dust as sand replacement achieved better performance compared to concrete made with marble dust as cement replacement.

Han et al. (2015) have studied the by-products of bottom ash and stone dust can be converted to lightweight concrete aggregate; both stone dust and bottom ash have a chemical composition ideal for use as expansive lightweight aggregates. This study also determined that and oven-dried density of 1.46g/cm3 with and absorption ratio of 8.5 % can produce light weight aggregates ideal for use as light weight concrete for structural uses.

Singh et al. (2015) have studied that stone dust is a waste material obtained from crusher plants. It has potential to be used as partial replacement of natural river sand in concrete. Use of stone dust in concrete not only improves the quality of concrete but also conserve the natural river sand for future generations. They investigate an experimental programe was carried out to study the workability and compressive strength of concrete made using stone dust as partial replacement of fine aggregate in range of 10%- 100%. M25 grade of concrete was designed using Portland pozzolana cement for referral concrete. Workability and compressive strength were determined at different replacement level of fine aggregate viz. a viz. referral concrete and optimum replacement level was determined based on compressive strength. Results showed that by replacing 0% of fine aggregate with stone dust concrete of maximum compressive strength can be made as compared to all other replacement levels.

Mirzahosseini andRiding (2015) have studied that the finely ground glass hs the potential for pozzolanic reactivity and can serve as a supplementary cementitious material uniform composition, amouphous nature, and high silica content made ground glass ideal for studying the effects of glass type and particle size on glassy material reactivity at different temperature. This study focuses on how the combination of glass types and particles sizes affects the microstructure and performance properties of cementitious system containing glass cullet as a supplementary cementitious materials. They found that the reaction rate pozzolanicity and hydration degree qualification of four sets of combined glass types and sizes were investigated using isothermal calorimetry chemical shrinkage, thermogravimetric analysis and analysis of scanning electron microscope images, moreover compressive strength and water sorptivity were performed on mortar samples to correlate reactivity of cementitious materials containing glass to the performance of cementitious mixtures. Results showed that combined glass can increases reaction rate and exhibit pozzolanic properties, especially when particles of clear and green glass below 25 micron were used at a curing temperature of 50 degree Celsius. The simultaneous effect of sizes and types of glass cullet

(surface area) on reaction rate of glass powder also can be accounted for through a linear addition reflecting that the surface area would significantly affect glass cullet reactivity. However performance properties a cementitious systems containing combined glass types and size behaved differently as they followed the weaker portion of the two particles.

III. EXPERIMENT AND METHODOLOGY

Cement in general can be defined as a material which possesses very good adhesive and cohesive properties which make it possible to bond with other materials to form a compact mass. That is to cement is a material which possesses cementitious properties. The cement used by engineers solidifies when mixed with water.

The natural cement is obtained by burning and crushing the stones containing clay, carbonate of lime and some amount of carbonate of magnesia. The clay content in such stones is about 20 to 40 percent. The natural cement is brown in colour and its best variety is known as the Roman Cement. The natural cement resembles very closely eminent hydraulic lime. It sets very quickly after addition of closely eminent hydraulic lime. It sets very quickly after addition of water. It is not as strong as artificial cement and hence it has limited use in practice

Table 1. Analysis of Fine aggregate

Sieve Size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative Percentage weight retained	Percentage Passing	Standard % weight Passing for zone II (IS: 383-1970)
4.75 mm	-	-	-	100	90 – 100
2.36 mm	55	55	5.5	94.5	75 – 100
1.18 mm	228	283	28.3	71.7	55 – 90
600 micron	348	631	63.1	36.9	35 – 59
300 micron	285	916	91.6	8.4	8 – 30
150 micron	75	991	99.1	0.9	0 – 10
Pan	5	996	100	0	0
Total = 1 Kg	Fineness Modulus = 287.6/100 = 2.87				

From the above sieve analysis, the sand is confirming to zone II and Fineness modulus is 2.87. The Specific gravity of fine aggregate is 2.43.

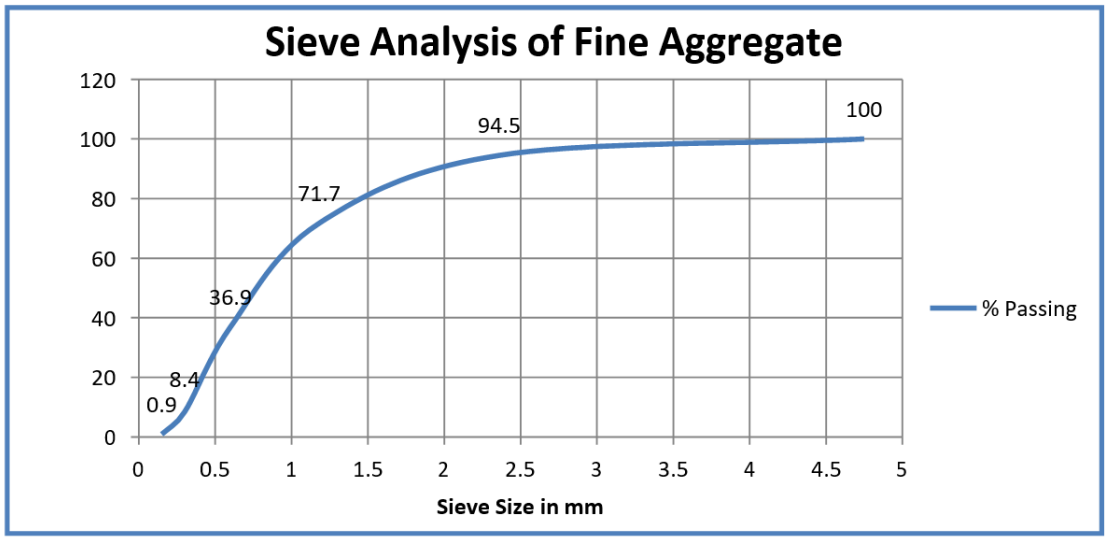

Figure 1 Sieve Analysis of Fine Aggregate

IV. Conclusions

- The compressive strength by replacing 40% sand by stone dust the strength increases by 10, 5, 13 and 14% at 7, 14, 28 and 56 days respectively in M-25 concrete and 9, 8, 12 and 10% at 7, 14, 28 and 56 days respectively in M-30 concrete. As compared to the conventional concrete. Thus stone dust increases the compressive strength of the concrete.
- The compressive strength of the concrete by replacing the 40% sand by stone dust and 20% cement by the glass powder the strength increases by 28, 15, 18 and 24% at 7, 14, 28 and 56 days respectively in M-25 concrete and 30, 15, 12 and 8% at 7, 14, 28 and 56 days respectively in M-30 concrete. As compared to the conventional concrete. Thus glass powder can also be used up to 20%.
- The flexure strength of the concrete by replacing the 40% sand by stone dust increase 18, 28, 29 and 30% at 7, 14, 28 and 56 days respectively in M-25 concrete but in M-30 concrete it increases 12, 19 and 23% at 7, 28 and 56 days respectively and reduced by 1.2% at 14 days. As compared to the conventional concrete. Thus stone dusts also increase the flexure strength at the later ages of the concrete.

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