

IMPROVING THE STRENGTH OF CUBE USING MOSAIC TILES AS COARSE AGGREGATE

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ABSTRACT

Since last few years, construction has taken boom and due to this the concrete jungles had replaced the greeneries. This process continues due to increase in population also housing is the basic need of humans. But for these housing and other major constructions large amount of concrete is required and so as the requirement of coarse as well as fine aggregate arises. This leads to depletion of natural resources as quarrying sand and aggregates have adverse effect on environment. Also due to modernization people are using cladding material highly for lavish decoration of houses. Which includes excessive use of tiles, marbles and granites in new houses? Due to these reasons the reuse of constructional wastes like mosaic tiles, granite powder, marble chips came into the picture to reduce the solid waste and to reduce the scarcity of natural aggregates for making concrete. The ceramic tile waste is not only occurring from the demolition of structures but also from the manufacturing unit. Studies show that about 20-25% of material prepared in the various tile manufacturing plants are transforming into waste. This waste material should have to be reused in order to deal with the limited resource of natural aggregate and to reduce the construction wastes. This article is about finding the optimum percentage of replacement of coarse as well as fine aggregate and to perform various tests regarding strength of concrete. Availability of raw material is very less due to higher use of concrete. Normal practice of concrete is batching of all raw materials, mixing (all raw materials), transporting, compaction at site, finishing and curing is followed by industry. In developed country like India use of concrete is higher quantity and availability of raw material is very less. Total replacement of concrete is not possible due to no material plays the role of concrete in terms of strength, durability, and workability. We have to partial replace all the material to achieve desired properties of concrete in terms of workability, strength and durability. This paper includes survey of different waste material used in the concrete from this survey we can understand the effect of different waste materials on the properties of concrete. Use of hazardous waste in concrete will lead to green environment. The objective of this investigation is to Ceramic waste have a potential to be utilized as a partial replacement of construction materials. Ceramic materials have been used for a long time for multiple uses like making goods such as tableware (crocery, cutlery etc.), sanitary ware and high voltage electric insulators. Ceramics are normally used as a building material too. Ceramic floor, tiles and various clay building brick are example of it. This paper presented a review of the use of ceramic materials in construction industry as partial replacement of conventional materials and cement focus on concrete making.

1. INTRODUCTION

Concrete is the world's second most utilized substance after water and it shapes the built environment. It is also recoverable as recycled aggregate. An estimated 33 billion tonnes of concrete are manufactured globally each year. This means that over 1.7 billion truckloads each year, or about 6.4 million truckloads a day, or over 3.8 tonnes per person in the world each year. Twice as much concrete is used in construction around the world than the total of all other building materials, including wood, steel, plastic and aluminum [1]. Environmental Society generates over 60 million tonnes of waste annually with less than 10% waste management capacity. The need to manage these wastes has become one of the most pressing issues of our time, requiring specific actions aimed at preventing waste generation such as promotion of resource recovery systems (reuse, recycling and waste-to-energy systems) as a means of exploiting the resources contained within waste, which would otherwise be lost, thus reducing environmental impact. According to [2], million tonnes of these waste materials are abundantly available and discarded every year in the world. Recycling of such wastes as a sustainable construction material appears to be a viable solution not only for pollution problems control, but also as an economical option in the design of green buildings. In Nigeria today, the increasing concern for environmental protection, energy conservation with minimal impact on the economy has been motivating researchers to look for other alternatives for coarse aggregates in concrete industry [3]. In view, different industrial waste materials such as fly ash, blast furnace slag, quarry dust, tile waste, brick, broken glass waste, waste aggregate from demolition of structures, ceramic insulator waste, etc. have been investigated as likely viable substitute

material to the conventional materials in concrete. Mujedu, et al [4] investigated the suitability of broken tiles as coarse aggregates in concrete production, and observed that the compressive strength and density are maximum for concrete cubes with 100% crushed granite and minimum when broken tiles content is 100%. It was reported in [4] that replacement of crushed granite with 39% to 57% broken tiles content showed satisfactory result. Kumar, et al [5] investigated the effect of waste ceramic tiles as partial replacement of coarse and fine aggregate in concrete and concluded that the compressive strength increased for all mixes and the maximum compressive strength was obtained for the mix having 10% of crushed tiles and 20% of tiles powder. They opined that the optimum percentage of coarse aggregate that can be replaced by crushed tiles is 10%. Takakoi, et al [6] studied the properties of concretes produced with waste ceramic tile aggregate and observed that the optimal replacement of ceramic tile aggregate for sand falls within 25% to 50% and 10% to 20% replacement levels was the best range for coarse aggregate. Further observation showed an increase in compressive strength and a decrease in unit weight due to the adverse effect of water absorption. Binici used crushed ceramic waste and pumice stone as partial substitute for fine aggregates in the production of mortar and concrete. The results showed that the resultant product had good compressive strength and abrasion resistance, as well as strong resistance to chlorides attack. This provides greater protection for the reinforcement when used in reinforced concrete. Another noteworthy study was that of [7] in which the possibility of incorporating ceramic waste from electrical porcelain into concrete structures was investigated. The study demonstrated the viability of reuse, although the damaging effect of certain by-products which generated an alkali-aggregate reaction made it necessary to use sulphate resisting cement. Also, [9] studied the viability of incorporating coarse aggregate from concrete waste and ceramic block waste in the production of new concrete and concluded that as regards durability, structural concrete can be made using recycled aggregates, but that the 4-32 mm fraction of natural aggregates cannot be totally substituted. Various researchers have worked on partial replacement of coarse aggregate with ceramic waste, but little or no work has been reported on total replacement of aggregate with ceramic waste. This work aims at investigating the effect of replacing coarse aggregate with ceramic waste in production of concrete. The parameters to be investigated are the physical properties, workability, compressive strength and tensile strength.

2. MATERIAL AND METHOD

2.1 Component material

To carry out the investigation, the following materials were used: cement, fine aggregates, coarse aggregates, ceramic waste and water. Cement used was Ordinary Portland Cement (Grade 32.5R) produced in accordance with the standards [10, 11]. The water used for the experiment was portable tap water, free from any sulphate, ferric, alkaline, oils, vegetation or salt that could affect the properties of concrete in the fresh or hardened state [12]. River sand obtained from Ogun river basin located at Ibafo in Ogun State, Nigeria was used as fine aggregate. The sand was dried and sieved through sieve with the aperture size of 3.35mm but retained on sieves of 63 μ m and treated in accordance with the standard methods [13]. It was confirmed to be salt-free and free from deleterious substances. The coarse aggregate used in this study was crushed granite of igneous origin. The size of the aggregate varied between 12.5mm to 19mm. The Ceramic Waste used was obtained from on-going construction sites within the University of Lagos. The crushing of ceramic wastes was done manually and made into smaller pieces about 5-40mm sizes by hammer blows. The broken small pieces were then fed into vibrator, sieved to get the required 12.5 -19.0mm size. For the purpose of this investigation, a mix ratio of 1:2:4 by weight of cement, sand and coarse aggregate was used, and the water-cement ratio of 0.60 was adopted. The granite in the mix was partially replaced with ceramic waste at an interval of 25% up to 100%. Concrete with 0% CW replacement served as the control.

2.2 Method

The following pertains to some laboratory procedures carried out in this report

2.3 Physical Analysis of Materials

Laboratory tests carried out on the aggregates include particle size distribution, specific gravity, dry and bulk densities, and moisture contents. Water absorption test was performed on both the ceramic waste and granite by keeping the samples immersed in water and removing the excess water on the surface of the samples after 24 hours, and measuring the saturated weight. After that, the samples were kept in the oven by maintaining 100 \pm 5 $^{\circ}$ C for one day. Oven dry weight of the samples was recorded and the water absorption capacity evaluated.

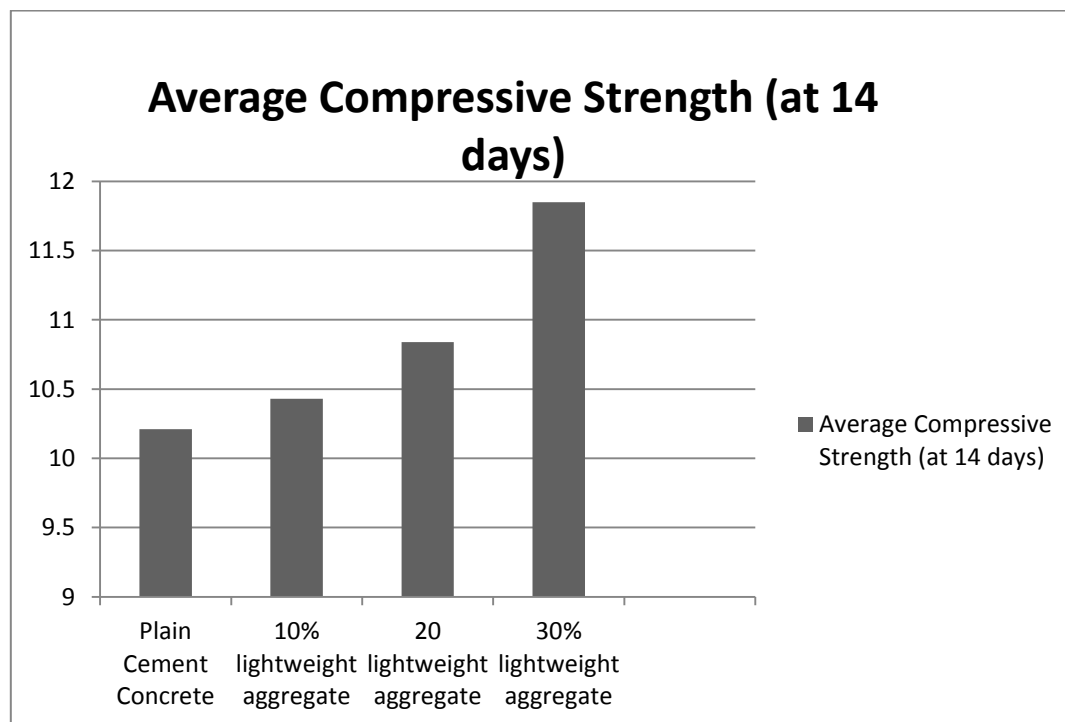
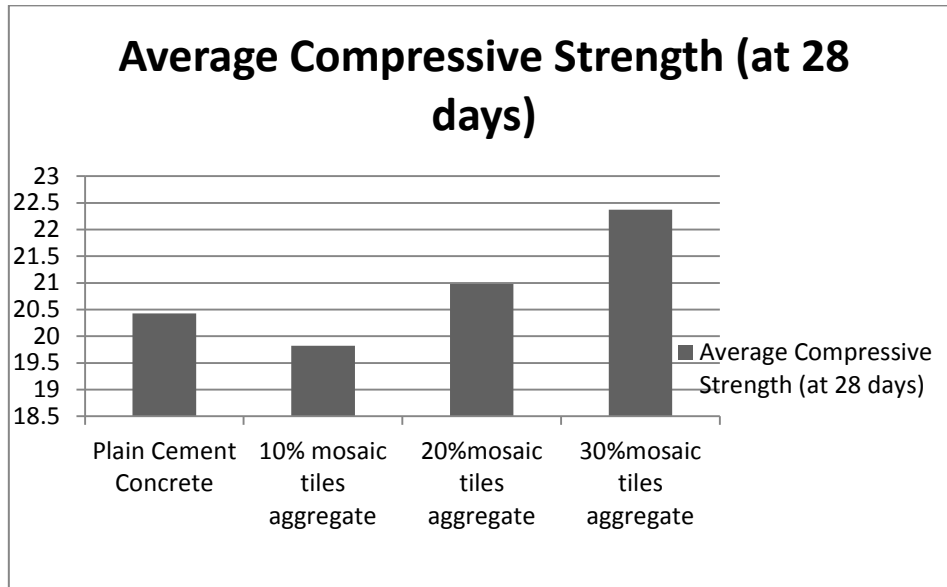
2.4 Workability

The slump test was carried out in accordance with the provisions of [14]. The replacement of coarse aggregate with CW was done at interval of 25% up to 100%. The sample without CW served as the control.

2.5 Compressive strength

Compressive strength test was performed in accordance with [15, 16]. For the tests, 150x150x150 mm cube specimens were used. This test was performed to confirm whether the targeted 28-day compressive strengths for both the normal concrete and concrete having ceramic waste were achieved. The cubes were tested for their compressive strength at 7, 14, 28, 45 and 90-day curing ages. The strength characteristics of each cube were determined on 1500 kN Avery Denison Universal Testing Machine at a loading rate of 120 kN/min. Three specimens for each mix were tested at each curing age and the values of the crushing load were averaged and used to evaluate the mean strength for each batch. A total number of 75 cube specimens were produced and tested.

3. RESULTS AND FINDINGS



4. CONCLUSIONS

In this project we find effect of light weight aggregate concrete over the plain cement concrete, and we prepare the cube for test of plain, light weight aggregate concrete. We use 10%, 20%, 30%, of light weight aggregate by weight of coarse aggregate. The 30% light weight aggregate concrete gives more strength over plain cement concrete.

For 14 days cured concrete has average strength light weight aggregate concrete

1. The plain cement concrete has average strength 10.22 N/mm².

2. Light weight aggregate concrete has average strength for 10% is 10.43 N/mm².

3. Light weight aggregate concrete has average strength for 20% is 10.84 N/mm².

4. Light weight aggregate concrete has average strength for 30% is 11.85 N/mm².

Among all of that plain cement concrete is carry more strength as compare to the light weight aggregate concrete.

For 28 days cured concrete has average strength light weight aggregate concrete

1. The plain cement concrete has average strength 20.43 N/mm².

2. Light weight aggregate concrete has average strength for 10% is 19.82 N/mm².

3. Light weight aggregate concrete has average strength for 20% is 20.97 N/mm².

4. Light weight aggregate concrete has average strength for 30% is 22.37 N/mm².

Among all that of the light weight aggregate concrete is carry more strength than the plain cement concrete. The tensile strength, from the results is clearly in an increment way compared to the plain cement concrete at all the curing ages of 14 days and 28 days. The replacement of aggregates by various proportions has positive effect on the strength of the concrete. So the most likely percentage of light weight aggregate that can be used in concrete as a replacement for coarse are 20% and 30%.

5. REFERENCES

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