

STUDY ON THE CERAMIC WASTE UTILIZATION IN THE CONCRETE

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Introduction:

In the modernization of infrastructure around the globe, a huge quantity of raw materials are utilized, and researchers around the world have reported that Construction and Demolition (C & D) waste constitutes around 20 to 30% of total solid waste generated. C & D waste is comprised of several materials which depend on the materials used during construction. In India, the total C & D waste generated is estimated at around 150 million tonnes but recycles just one percent of its total waste generated as per the new report released by Centre for Science and Environment (CSE) in the year 2020. About 70 to 80 % of C & D waste is concrete, masonry, and other materials (like steel, flooring materials, wood, aluminium, and glass) from the civil industry.

In India, ceramic materials production is more than 100 million metric tons annually and it is estimated that around 15 to 30% of these produced materials are being dumped in landfills which indirectly results in soil, air, and groundwater pollution also resulting in serious environmental hazards (Amitkumar et al., 2013). Considering the above issue, to use these waste materials with simple processing will lead to sustainable development in the civil construction industry.

On the other hand, it is observed from the past three decades in the construction field that "River Sand" was predominantly used as raw material for the construction and the production of concrete, which is the most consumed material next to water in the civil construction industry. Extraction of river sand is completely prohibited as per local guidelines, and non-availability of river sand at the site is a feasible cost. To overcome the problems of river sand usage in the industry, it has been replaced by "M-Sand" as raw material for construction. However, the mines and geology department is unable to supply the required quantity of source materials to produce M-Sand because of major issues like unavailability of source materials in quarries, underground water pollution, and the workers are more prone to lung-related diseases.

along with its fatal scenarios were also observed and many workers lost their lives during the un-scientifically used blasting process. Hence most of the quarries were closed due to the unavailability of raw materials so most of the construction activities were stopped. Considering the above scenarios and problems in the present situation in the construction industry, Construction and Demolition (Ceramic) waste can be used in the production of concrete. This waste can be utilized in place of river sand. In this present study, a detailed experimental investigation will be carried out on the utilization of ceramic waste from the construction industry in the production of concrete.

Objectives

- To determine the process of processing C & D waste particularly Ceramic waste to desired size and required properties.
- To study the properties of processed materials in the concrete and compare them with the normal concrete.

Methodology:

In the present study the processing of raw materials and experimental investigation is divided into number of tasks as follows.

Task-1: Collection and processing of raw materials: Collection of construction and demolition waste particularly ceramic materials are identified and separated from the whole. Separated ceramic materials will be processed and brought to the required size and gradation by means of appropriate methods like crushing, hammering, and sieving.

Task-2: Basic characterization of processed material: The processed materials will be characterized as per the Indian standards and compared with the M-sand. Engineering properties like specific gravity, water absorption, and bulk density, as per IS 2386 (1963) and particle size distribution as per IS 383 (2016).

Task-3: Production and testing of concrete: The processed and well-characterized material from construction and demolition waste will be used in the production of concrete using mix guidelines as per IS 10262 (2019). Detailed investigation of the concrete properties such as fresh and hardened properties will be observed.

Task-4: Comparison of the concretes: Observed results from task 3 will be compared with normal concrete which is produced with M-Sand.

Task-5: Reporting: After the complete investigation of the above said concretes, a detailed report on the study will be reported as per the guidelines.

Results and conclusion:

Based on the proposed experimental methodology the fresh properties of concrete produced with M-Sand and Ceramic waste (fully replaced) for two different grade of concrete (M30 and M40) is tested for slump and flow table values. The observed results of different concretes are presented in the Figure 1. It is noted the workability of produced concrete with ceramic waste is having higher values when compared with normal concrete.

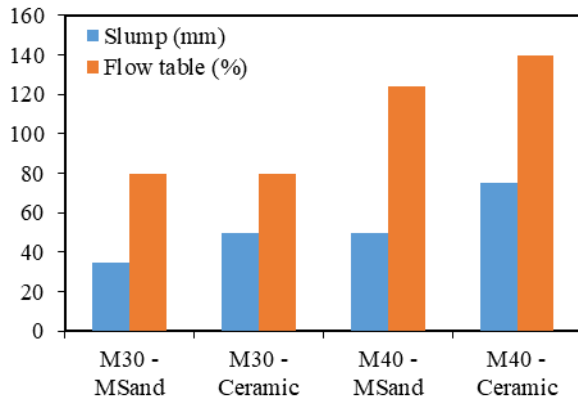


Figure 1: Fresh properties of concretes

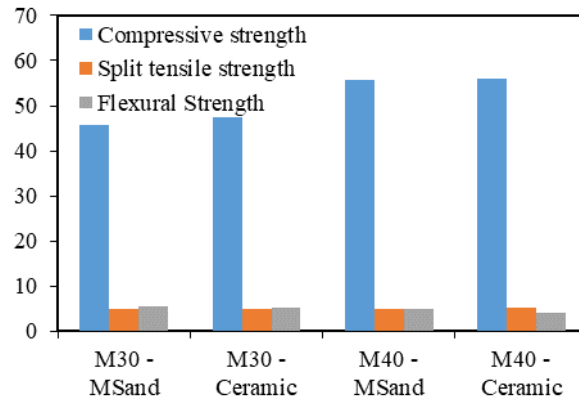


Figure 2: Strengths of hardened concrete

Concretes (M-Sand and Ceramic waste) were tested for hardened state properties i.e., compression strength test, split tensile strength test and flexural strength test. The observed results are presented in the Figure 2. It is noted the strength properties of produced concrete is with ceramic waste is almost similar to that of conventional concrete. The detailed strength results will be presented in the report.

In the present study, at the end of all experimental test results for various properties of concrete and comparing them with conventional ones, we can conclude that processed ceramic waste can be used as fine aggregates in place of natural river sand or M-Sand.

Scope for future work:

From the present study, the construction industry can have ceramic waste in the C & D waste which can be used as an alternate material with simple processing. As the produced ceramic waste aggregates is having low specific gravity which will have light weight concrete to certain extent. However, water absorption of these aggregates is higher than the natural aggregates, there is need to know the properties of reinforcement concrete and its effect on long term durability. Using this recycled ceramic waste material as a raw material for the concrete leads to avoiding the exploitation of natural resources like rocks, rivers, and forests. Utilization of C & D waste will be increased drastically, which will grow towards sustainable development and also reduces the disposable issues in the landfills.