Review Paper on Partial Replacement of Concrete Ingredients

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Abstract

Today construction cost is very high with using routine material like cement, fine aggregate and coarse aggregate. This study includes use of different waste material as a partial replacement of cement or fine aggregate or coarse aggregate. Industries in India produce lots of waste which may be useful in partial replacement of all the raw materials due to their different properties. So hereby we studied as many useful research papers in this field and trying to improve with locally available waste material so it can be proved economical as well. Research in this field and positive results are crucial so as to continue all developments with least damage to surrounding environment and obtaining all infrastructures for services and convenience which are desired to get.

Keywords: Partial Replacement of Concrete Ingredients, Industrial Waste, Eco-Friendly, Construction Material, Review Paper

I. INTRODUCTION

Cement could be a binder, a substance that sets and hardens and might bind alternative materials along. The word "cement" traces to the Romans, UN agency used the term “opus caementicium” to describe masonry resembling fashionable concrete that was made up of rock with calcined lime as binder. The volcanic ash and small-grained brick additives that were additional to the calcined lime to get a hydraulic binder were later brought up as cimentum, cäment, and cement.

Non-hydraulic cement won’t set in wet conditions or underwater, rather it sets because it dries and reacts with CO₂ within the air. It may be attacked by some aggressive chemicals when setting.

Hydraulic cement is created by replacement a number of the cement during a combine with activated metal silicates, pozzolanas, like ash. The chemical action leads to hydrates that aren’t terribly soluble then square measure quite sturdy in water and safe from chemical attack. This permits setting in wet condition or underwater and additional protects the hardened material from chemical attack (e.g., Portland cement). The action for Portland cement found by ancient Romans used volcanic ash (activated metal silicates). Presently cheaper than ash from power stations, recovered as a pollution management live, or different waste or by merchandise square measure used as pozzolanas with plain cement to provide Portland cement. Pozzolanas will represent up to four-hundredth of cement.[1]

The most necessary uses of cement square measure as an element within the production of mortar in masonry, and of concrete, a mix of cement associated a mixture to create a robust artifact.

Cement may be a fine grayish powder that, once mixed with water, forms a thick paste. Once this paste is mixed with sand and gravel and allowed to dry it's known as concrete.

Portland cement is factory-made by heating sedimentary rock or chalk with clay during a rotary oven to a extreme temperature (about 1450°C) to provide onerous nODULES of clinker that are unite with slightly mineral during a ball mill. The firing method consumes vital quantities of fuel, sometimes coal or crude oil coke.

The makers have taken steps to minimize the impacts by:

1. Reducing primary material wants by increasing the employment of by-products from alternative industries, beside mud suppression measures and landscaping once production.

2. Use of waste product as various fuels (oil, solvents, and tires) beside larger emissions management and investment in additional economical plant (heat exchangers, pre-heaters, insulation). Reducing cement clinker by exchange throughout the grinding method with building materials from by-products of alternative industries.

3. Use of grinding aids to cut back clinker edge time and improved instrumentality potency.
II. LITERATURE REVIEW

Abdullah Anwar et al.\(^1\) teammates stated that marble dust powder is now days intensely focused research topic in which many problem related to environmental well as civil engineering are associated. They stated that Marble dust powder is settled by alleviation then drop away, which end up in environmental contamination, additionally to forming dust in summer and threatening each agriculture and public goodness. They replaced (OPC & PPC) cement consequently within the reach of 1/3, 5%, 10%, 15%, 20%, & twenty fifth by weight of M-20 grade concrete & concrete mixtures were developed, tested and compared in terms of compressive strength to the conventional concrete. The aim of their investigation was to analyze the behavior of concrete while replacing the Marble Dust Powder with Different proportions in concrete.

Osman Simsek et al.\(^3\) mates investigated that the sulphate resistance of cement mortars when subjected to different exposure conditions. They added that cement mortars were prepared using ground waste brick (GWB) as a Pozzolanic partial replacement for cement at replacement levels of 0%, 2.5%, 5%, 7.5%, 10%, 12.5 and 15% & mortar specimens were stored under three different conditions: continuous curing in lime-saturated tab water (TW), continuous exposure to 5% sodium sulphate solution (SS), and continuous exposure to 5% ammonium nitrate solution (AN), at a temperature of 20 ± 3 °C, for 7, 28, 90, and 180 days. They also stated that prisms with dimensions of 25x25x285 mm, to determine the expansions of the mortar samples; and another set of prisms with dimensions of 40x40x160 mm, were prepared to calculate the compressive strength of the samples & it was determined that the GWB replacement ratios between 2.5% and 10% decreased the 180 days expansion values. They concluded that the highest compressive strength values were found for the mortars with 10% replacement ratio in the TW, SS, and AN conditions for 180 days & the microstructure of the mortars were investigated using scanning electron microscopy (SEM) and the Energy dispersive X-ray (EDX).

Amitkumar D. Raval et al.\(^4\) investigated that the ceramic industry inevitably generates wastes, irrespective of the improvements introduced in manufacturing processes & about 15%-30% production goes as waste. They stated that these wastes pose a problem in present-day society, requiring a suitable form of management in order to achieve sustainable development. In their research study, they replaced (OPC) cement by ceramic waste powder accordingly in the range of 0%, 10%, 20%, 30% 40%, & 50% by weight for M-25 grade concrete & the wastes employed came from ceramic industry which had been deemed unfit for sale due to a variety of reasons, including dimensional or mechanical defects, or defects in the firing process. They concluded that the use ceramic masonry rubble as active addition endows cement with positive characteristics as major mechanical strength and the economic advantages & reuse of this kind of waste has advantages economic and environmental, reduction in the number of natural spaces employed as refuse dumps.

Ankit Nileshchandra Patel et al.\(^5\) researched that stone waste is one of the most active research areas that encompass a number of disciplines including civil engineering and construction materials. They stated that the stone dust is settled by sedimentation and then dumped away which results in environmental pollution, in addition to forming dust in summer and threatening both agriculture and public health & therefore, utilization of the stone dust in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the environment. They stated that, it is most essential to develop eco-friendly concrete from stone waste & in their research study, the (PPC) cement has been replaced by stone waste accordingly in the range of 0%, 10%, 20%, 30% 40%, & 50% by weight for M-25 grade concrete & concrete mixtures were produced, tested and compared in terms of workability and strength to the conventional concrete. These tests were carried out to evaluate the mechanical properties for 7, 14 and 28 days & as a result, the compressive strength increased up to 20% replacing of stone waste. This research work is concerned with the experimental investigation on strength of concrete and optimum percentage of the partial replacement by replacing (PPC) cement via 0%, 10%, 20%, 30%, 40% and 50% of stone waste. The aim of their investigation was to check the behavior of concrete while replacing of waste with different proportions of stone waste in concrete by using tests like compression strength.

Candra Aditya et al.\(^6\) researched on alternative materials primarily from waste have been additional material at area manufacture of building materials, especially concrete roof tile. Their research would expand utilization of marble waste in East Java region of Indonesia in the manufacture of concrete roof tiles by combining the use of sand and waste marble powder as a substitute for river sand and portland cement. Their research would create a material innovation product of environmentally friendly with relatively low prices without compromising quality. The purpose of their research was to find the composition of the mixed-use waste marble tile that produces the most optimal strength & experimental method used in this study to test the basic material and test physical and mechanical properties of concrete roof tiles (bending loads, water absorption and resistance to water seepage) in accordance with ISO 0096:2007 with eight variations in material composition. They stated that the concrete tile with marble waste produces a lighter weight 3% compared to water seepage) in accordance with ISO 0096:2007 with eight variations in material composition. They stated that the highest compressive strength values were found for the mortars with 10% replacement ratio in the TW, SS, and AN conditions for 180 days & the microstructure of the mortars were investigated using scanning electron microscopy (SEM) and the Energy dispersive X-ray (EDX).

Mohammad Alizadeh Kharaazia et al.\(^7\) stated that industrial waste materials which have pozzolanic and / or cementitious property, can possibly be used in concrete mixtures or in controlled low strength material (CLSM) mixes & these materials as a cementitious or pozzolan not only reserve the environment but can replace Portland cement or reduce it. They studied that in production of one tonne of Portland cement about one tonne of carbon dioxide is released into the environment & their aim was to reduce the amount of the Portland cement used in construction materials as much as technically possible. They concluded that...
some of the industrial waste materials or by-product materials which are produced in a vast amount per year can be reused as a pozzolan and cement additives in construction material mixtures.

Mohammad Alizadeh Kharaazia et al. [9] studied that the abrasion resistance of concrete proportioned to have four levels of fine aggregate replacement (10%, 20%, 30%, and 40%) with Class F fly ash. They designed a control mixture with ordinary Portland cement to have 28 days compressive strength of 26 MPa & specimens were subjected to abrasion testing in accordance with Indian Standard Specifications (IS: 1237). They performed tests also for fresh concrete properties and compressive strength as well as tests on compressive strength and abrasion were performed up to 365 days by them.

C Meyer et al. [9] studied that the reuse of waste glass poses a major problem in large municipal areas of the United States. They stated that the post-consumer glass is often mixed-color and commingled with plastics and metals, contaminated with other materials like ceramics and organic matter and partially broken & this reduces its value and complicates the ability to achieve the cullet specifications of bottle manufacturers or other markets such as the construction industry. They studied that most of these markets make little use of the inherent chemical and physical properties of glass; therefore its market value is very low. They investigated that specific products such as paving stones, concrete masonry blocks, terrazzo tiles, and precast concrete panels are close to commercial production. In their research, they concluded the various steps that need to be taken by recyclers like to collect the glass, separate it from the other materials, clean it and crush it to obtain the appropriate grading to meet the specifications for specific applications.

Sudhir S. Kapgate et al. [10] studied that the concrete plays the key role and a large quantum of concrete is being utilized in every construction practices. They also studied that natural river sand is one of the key ingredients of concrete, is becoming expensive due to excessive cost of transportation from sources & also large scale depletion of sources creates environmental problems & to overcome these problems there is a need of cost effective alternative and innovative materials. They studied deeply & stated that Quarry dust is as waste obtained during quarrying process & it has very recently gained good attention to be used as an effective filler material instead of fine aggregate & also, the use of quarry dust as the fine aggregate decreases the cost of concrete production in terms of the partial replacement for natural river sand. They formed the design mix of M25grade concrete with replacement of 0%, 20%, 25%, 30%, and 35% of quarry dust organized as M1, M2, M3, M4 and M5 respectively have been considered for laboratory analysis viz. slump test, compaction factor test, compressive strength, split tensile strength and flexural strength of hardened concrete. They investigated the hardened properties of concrete using quarry dust.

Siddhesha H et al. [11] studied that increased construction activity and continuous dependence on conventional materials of concrete making are leading to scarcity of the construction material and increased construction cost. In this study, he has made an attempt to find the suitability of ceramic fine aggregate as a possible substitute for conventional fine aggregate in concrete. He carried out experiments to determine the compressive, split tensile and flexural strength of ceramic fine aggregate and comparison is made with conventional concrete. He concluded that, the properties of ceramic fine aggregate are well within the range of values of concrete making aggregates.

III. CONCLUSION

Today we live in the world full of development and enthusiastic for still more comfort and facilities. This leads to innovations and revolutions in each and every field, but on contrary it has negative impact on environment as resources get depleted and pollution to different natural sources are occurred. So after studying all these research paper we concluded that if we can reduce or reuse some material in field of concrete production which is at its top now-a-days then it largely impact environment and leads to pollution free and soothing surrounding. Thus as concluded from above literature review we can research further more in direction of partially replacing cement, sand and aggregate up to most optimum level we can by reusing or introducing waste material as its option. From studying all these research paper it is clear that positive and favorable results are obtained if further research work and study is carried out in this field. And by using locally available wastes like glass waste, marble dust powder, ceramic waste, quarry dust, GGBS, Fly ash, etc. as partial substitution at place of concrete ingredients, it may prove more economical than traditional concrete and question of damping of such waste produced by different industries is also get solved. Ultimate goal is to produce economical and eco-friendly concrete with all desired properties and strength which one obtains by regular concrete ingredients.

IV. ACKNOWLEDGEMENT

This is the place to admit that while there appears only author on the cover, this work just as any other, is a product of the interaction with and support during our thesis work, among them, first I express my gratitude to my guides Dr. V.M.Patel & Prof. Ankit Patel for their affection throughout guidance, advice and encouragement. Thanks to all my family members for their affection, care and encouragement. Special thanks to my college for giving me the invaluable knowledge. Above all I am thankful to almighty God for everything and all researchers whose research papers in this field have been referred for our study.

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