



Comparative Analysis of Conventional Concrete with Concrete using Marble Dust Powder and Glass Powder by the Partial Replacement of Cement - A Literature Review

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ABSTRACT—

Concrete is mainly formed from the mixture of water, aggregate, and cement. Usually there are additives and reinforcements included to achieve the desired physical properties of the finished material. For solving the disposal of large amount of recycled material, reuse of such materials in concrete industry is considered as the most feasible application. The reuse of material can reduce the normal usage of ingredients in concrete and thereby reduce the cost of construction. This study is focused on the use of marble dust powder and glass powder as a partial replacement of cement in concrete. The aim of this paper was to review the previous investigation done on the characteristics of concrete with the addition of such materials and comparing it with the control mixes, thereby determining the advantages and disadvantages of doing so.

Keywords: Conventional Concrete, Marble Dust Powder, Glass Powder, Compressive Strength, Flexural Strength, Tensile Strength, Workability, Durability.

1. Introduction

Concrete is the most widely used construction material. Use of marble dust and waste glass powder in construction industry not only solve the problem of disposal of waste marble dust and glass powder but it also gives an alternative for cement in concrete. Having properties like high strength, durability, high reactivity efficiency, good cohesiveness of mortar and concrete, it is used as high-performance concrete.

Marble is a metamorphic rock resulting from the transformation of pure lime stone. Turkey has the 40% of total marble reserve in the world. 7,000,000 tons of marble have been produced in Turkey annually and 75% of these productions have been processed in nearly 5000 processing plants. It can be seen that the waste materials of these kinds of plants reach millions of tons. Stocking of these waste materials is impossible. These types of solid waste materials should be inactivated properly without polluting the environment. The most well suited inactivating method nowadays is found to be recycling. Recycling provides us with some advantages such as protecting the natural resources, contributing to economy, energy saving, decreasing the waste materials and investing in the future.

Glass is an amorphous (non-crystalline), its not a solid but a super cooled liquid. Glass can be made with excellent homogeneity in a variety of forms and sizes from small fibres to meter-sizes pieces. Primarily glass is made up of sand, soda ash, limestone and other additives. Constituents of Glass:

Silica (SiO₂) - 72.5%

Alumina (Al₂O₃) - 1.06%

Lime (CaO+3) - 0.8%

Iron Oxide (Fe₂O₃) - 0.36%

Magnesia (MgO) - 4.18%

2. OBJECTIVES OF THE STUDY

The main objective of this research is to review the properties of conventional concrete and concrete with the addition of such materials in terms of its workability, durability and strength. The use of various materials like marble dust powder, glass powder, rice husk, phosphor-gypsum, fly ash, GGBS, quarry dust, broken bricks etc in concrete helps in minimizing the resources consumption used to develop the conventional concrete and provide benefits

like improved strength and workability of concrete with useful disposal of by-products. This type of concrete will also used to control the energy consumption and will able to minimize the hazards caused to the environment.

3. Literature Review –

There were various studies been conducted on the use of such recyclable materials in concrete which gives adequate strength and its durability. The studies also suggests about the difficulties arise for the use of such by-products in the proportion of concrete. Few of the data from previous studies have been discussed here along with the methodology adopted and conclusions. Many research investigations have been carried out regarding the use of such by-products to minimize the amount of energy consumed and also to reduce the damage to the surrounding environment.

Nitesh Bhatt¹, Aditya Joshi², Chinmaya Patil³, Bruhan Sampangi Rama⁴, Priya V⁵, STUDY ON PARTIAL REPLACEMENT OF CEMENT WITH THE COMBINATION OF GLASS POWDER AND MARBLE DUST, *IJARIE-ISSN(O)-2395-4396 Vol-7 Issue-4 2021*- In this study, a small proportion of post-consumer glass has been recycled with high performances and unique aesthetic properties which make it suitable for wide spread uses. As marble dust is a waste product during the sawing and polishing of parent marble block and about 20-25% of the processed marble is turned into dust form. The production of cheaper concrete using waste marble dust and glass powder can solve to some extent the ecological and environmental problems. From the experimental work carried out following results were achieved. Slump of fresh concrete tended to increase at 30% replacement (10% marble dust powder, 20% glass powder) and the obtained slump value was 81mm. Strength loss in compressive strength starts increasing after 30% replacement of cement by waste marble dust and glass powder for all the ratios. Loss in compressive strength is more in 45% replacement, so the results show that compressive strength is optimum at 30%. Strength loss in flexural strength starts increasing after 30% replacement of cement by waste marble dust and glass powder. It is more for 45% replacement. Similarly, strength loss in split tensile is more at 45% replacement of cement with waste marble dust and glass powder. For the mix proportion where admixture is added the strength is more at 30% replacement as compared to 15% and 45%.

Mr. Balachandiran. M. E., EXPERIMENTAL INVESTIGATION OF PARTIAL REPLACEMENT OF CEMENT WITH MARBLE POWDER AND FINE AGGREGATE WITH GLASS POWDER *International Journal of Scientific & Engineering Research Volume 11, Issue 3, March-2020 ISSN 2229-5518* - In this paper, the behaviour of concrete using marble powder and glass powder are determining. The mix design is done for M25 grade concrete as per Indian Standard. The different percentage of powder (i.e.) marble powder and glass powder at the range of 10% to 20% by weight of cement were used. The concrete specimen with different percentages will cast, cure and test for 7, 14 and 28 days. Here the compressive, tensile and flexural strength of the control specimen is determined. And the strength of the admixture concrete will be determined at the next phase and also the comparison of the control specimen and the admixture concrete. So as per the literature review the strength of the admixture concrete is increased by the adding of admixture.

Diksha Sharma¹, Er. Jainender Sharma²- Study on Partial Replacement of Cement with Waste Marble Dust and Waste Glass Powder, *IJESC, June 2019, ISSN 2321 3361, Vol. 9, Issue No. 6* - In their research, they use glass and marble powder as a partial replacement for cement. From the previous researches they come to know that optimum percentage of glass powder is 20% and for marble powder it is 10%, after increase in percentage of these powders the strength of concrete starts decreasing. Due to presence of high silica and high lime content in glass powder and marble powder respectively, it is used for high performance concrete, as they increase the strength and reactivity efficiency of concrete making it highly durable. In this research, we use M30 grade concrete in which we partially replaces cement with marble and glass powder for different percentages at 15%, 30% and 45% and determine the compressive, split tensile and flexural strength of concrete and compare the results. Results show that there is slight improvement in strength of mix at low replacement level.

Abhijeet Bhawsar, Mayur Singi, Ajay Bidare *International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 07 | July-2018*, “EXPERIMENTAL STUDY ON CONCRETE AS PARTIAL REPLACEMENT OF CEMENT BY GLASS POWDER”. This paper deals with the use of Glass Powder in the present days as a substitute for cement is to increase the strength of cement concrete. The Glass Powder was replaced by 0%, 5%, 10%, 15%, 20% & 25% for 7, 14 & 28 days for Cubes for Compressive strength and Cylinder are casting for Split Tensile Strength and other properties like compacting factor and slump were also determined for three mixes of concrete. The use of cement and production of cement creates much more environmental issues & costlier. To avoid such circumstances, the content of cement is reduced in concrete and replaced by Glass Powder which reduces cost & increases strength & durability of concrete. The subsequent modification of the micro structure of cement composites improves the mechanical properties, durability and increases the service-life properties.

Ms.Ruchi Chandrakar, Mr. Avinash Singh *International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 05 | May -2017* “Cement Replacement in concrete with Marble Dust Powder”. This paper deals with the study total 42 cubes were casted. Marble products are mixed in concrete mix M-20 in different percentage (5%, 10%, 15%, 20%, 25%, and 30%) by weight. The cement was replaced by marble powder. After curing (7 and 28 days), cubes were tested. The replacement of cement with 10% of marble powder gives the maximum compressive strength at both 7 days and 28 days curing period. It was found that marble dust available at every processing plant in huge quantity and its cost is very less compared to cement. So with the replacement of cement by marble dust a cost effective concrete can be achieved.

Jashandeep Singh, Er. R S Bansal *International Journal of Technical Research and Applications e-ISSN: 2320-8163, Volume 3, Issue 2* “PARTIAL REPLACEMENT OF CEMENT WITH WASTE MARBLE POWDER WITH M25 GRADE”. This paper deals with study the behaviour of concrete, having partial replacement of cement with waste marble powder M25 grade for which the marble powder is replaced by an experimental study was carried out and the effect on compressive strength and split tensile strength characteristics (0%, 4%, 8%, 12%, 16%, and 20%) was studied. The result of this present investigation indicates that the replacement of 12% of cement with waste marble powder attains maximum compressive and tensile strength. The optimum percentage for replacement of marble powder with cement and it is almost 12% cement for both cubes and cylinders and it also minimize the costs for construction with usage of marble powder which is freely or cheaply available more importantly.

Mukul Dutt Pandey, Abhay Kumar Jha International Journal for Scientific Research & Development| Vol. 4, Issue 05, 2016 “Effect of Glass Powder in High Strength Concrete”. This paper deals with when this hydration process goes on it liberate some poisonous gases, these poisonous gases will affect the environment and harm the ozone layer, to reduce this effect on the environment some scientist and researchers concluded that cement which is major ingredient of concrete is partially replaced by waste material like Glass Powder. Basically Glass Powder is a by-product of Glass factories. Glass Powder is present on a satisfactory scale in India and also it shows a great pozzolanic properties, due to this Fly ash we can use as a partial replacement of cement. For this project High strength M60 concrete is designed by IS 10262 and M60 concrete cubes are casted and all mix is prepared, after mixing concrete cube is casted then these cubes are tested for compressive strength and flexural strength.

Sonu Pal, Amit Singh, TarkeshwarPramanik, Santosh Kumar, International Journal for Innovative Research in Science & Technology Volume 3 Issue 03 “Effects of Partial Replacement of Cement with Marble Dust Powder on Properties of Concrete”. This paper deals with the utilization of waste of Marble dust powder in concrete and enhancement of strength of concrete more economically. The Marble dust powder was added in M20 grade of concrete at (0%, 5%, 10%, 15%, 20%, 25% & 30%) with partial replacement by weight of cement. Water/Cement ratio (0.50) was kept constant, in all the concrete mixes. The concrete samples (cube & cylinder) were tested for compressive strength and split tensile strength after 7 & 28 days of proper curing. The results of the laboratory work showed that replacement of cement with Marble dust powder increases up to 10% for both compressive strength and split tensile strength of concrete.

Malay. M Patel, Ankit. J.Patel, Jay H Patel, Kushagra T Rawal, International Journal for Innovative Research in Science & Technology Volume 1 Issue 7, “REVIEW PAPER ON PARTIAL REPLACEMENT OF CONCRETE INGREDIENTS” This paper deals with 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.

M. Kumaran, M. Nidhi, Bini P.R, International Journal of Advance Research, Ideas and Innovations in Technology, (Volume 4, Issue 3), “Replacement of fine aggregate with plastic in concrete” - The work aims to study the possibility of disposing waste plastic as fine aggregate in concrete. In this study waste plastic mix concrete is also reinforced with polypropylene fibre to get the advantages of fibre reinforced concrete. For this, an experimental study was carried out with three different grades of concrete (M20, M25 & M30) to evaluate mechanical and durability properties of waste plastic mix concrete with and without the addition of fibre. Sand is substituted with plastic waste at a dosage of 15% by volume which is the optimum percentage without considerable reduction in strength. Results show that adding polypropylene fibre we can improve the quality of waste plastic mix concrete. The compressive strength of WPC was lowered by the addition of plastic, the reduction being in the range 4 to 7 %. But this loss was compensated to a certain extent by the addition of polypropylene fibres to WPC whereby the loss percent reduced to around 3 %. The flexural strength of WPC was lowered by the addition of plastic, the reduction being in the range 10 to 18 %. But this loss was compensated to a certain extent by the addition of polypropylene fibres to WPC. There will be an increase in flexural strength around 25 % when compared to Normal concrete. These results suggest that plastic waste mix concrete may be a useful cementitious composite with better durability characteristics than normal concrete.

3. Conclusion –

It was important to note that the quantity of by-product or waste replacement played a vital role to the properties of concrete. From all the previous studies, following points have been concluded:

- There is significant potential in waste materials to produce such type of concrete.
- To use marble dust as a replacement of cement in concrete.
- To use glass powder as a replacement of cement up to certain limit in concrete.
- To conduct experimental analysis for the strength of different grades of concrete.
- To compare the economic feasibility of conventional concrete and such type of concrete made with such recyclable materials.
- To check the suitability of such materials in higher grade of concrete.
- To conduct durability tests on high-performance concrete.

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