

Concrete with Smart Material (Manufactured Crushed Sand)-A Review

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ABSTRACT: A review is presented in this paper about the application of crushed sand as a smart material in concrete. After a brief outline of the theoretical as well practical studies few measures are reviewed to replace natural sand with manufactured crushed sand. This helps in reducing the likely damage to the ecological balance due excessive sand lifting from river beds, affecting the ground water level. Crushed sand as replaced materials to natural sand has become beneficial and is common in the world. Different researchers have carried out research to study the effect of use of crushed sand on properties of concrete. Hence, in this paper a review of various operational parameters viz. workability, durability and compressive strength is highlighted.

Keywords- crushed sand, durability, natural sand, compressive strength, workability

I. INTRODUCTION

Concrete is the most widely used man-made construction material in the world & is second only to water as the most utilized substance on the planet. It is obtained by mixing cementitious material, water & aggregates in required proportions. The mixture when placed in form & allowed to cure hardens into a rock-like mass known as concrete. The main components of concrete are; cement coarse aggregate, fine aggregate, water and admixtures. Sand is the one of main constituents of concrete making about 35 % of volume of concrete used in construction industry. Natural sand is mainly excavated from river beds and always contains high percentages of inorganic materials, chlorides, sulphates, silt and clay that adversely affecting the strength & durability of concrete & reinforcing steel there by reducing the life of structure. Digging sand, from river bed, in access quantity is hazardous to environment. The deep pits dug in the river bed, affects the ground water level. Erosion of nearby land is also due to excessive sand lifting. In order to fulfill the requirement of fine aggregates, some alternative material must be found. Crushed sand as replaced materials to natural sand has become beneficial and is common in the world. Crushed sand is manufactured by crushing larger stones of quarry to particular size of sand. Its chemical & physical properties such as color, size & shape, surface texture up particles depend upon types of stone & its source. Use of crushed sand has become a good substitute for natural sand and it has become essential keeping in view of technical, commercial & environmental requirements. Proper quality control while using crushed sand or manufactured sand can result in better results. Different researchers have carried out research to study the effect of use of crushed sand on properties of concrete.

II. AIM AND OBJECTIVE

This paper presents a detailed review about crushed sand as recycled materials that can be effectively used in concrete as a sand replacement. Waste management options with cost effectiveness and research published on the effect of waste materials on the fresh and hardened properties of concrete.

III. DISCUSSION

Common river sand is expensive due to excessive cost of transportation from natural sources. Also large-scale depletion of these sources creates environmental problems. As environmental transportation and other constraints make the availability and use of river sand less attractive, a substitute or replacement product for concrete industry needs to be found. River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas.

Use of Crushed sand in construction is nothing new in western world. It is being used there since few decades. Usage of Crushed Sand in Construction is more a norm there than exception in western countries. ASTM (C -33 - 93) and BS (882 (1992)) has well defined codes With respect to crushed sand usage in construction. IS has slightly amended its code (IS- 383) for usage of crushed sand in construction.

There is a little available published data on the use of crushed sand as a Substitute to natural sand. Ahmed et al in 1989 have studied the performance of concrete with limestone crushed sand as a substitute to the natural sand. The results indicated that the concrete with crushed sand improved the physical properties of concrete [1]. Sangamnerkar in 1999 reported that the dust content upto 10% as a partial replacement of fine aggregates improved the strength properties of concrete [2].

B Balagol & SA Kulkarni [3] investigated the hardened properties of concrete with use of crushed basalt stone fine aggregate as a substitute to natural sand. The researchers concluded that there was significant increase in compressive strength with crushed sand. The compressive strength was increased by 19.44 % to 40.38 % at 7 days age and increased by 8.33% to 25.9% at 28 days age as grade of increased mixes was increased. The flexural strength of concrete with crushed sand was marginally increased about 1 to 5% as compared to natural sand.

Sahu Kumar and Sachan [4] investigated the suitability of crushed stone dust waste as fine aggregate for concrete. Test results indicated that crushed stone dust waste can be used effectively to replace natural sand in concrete. Concrete made with this replacement can attain the same compressive strength, comparable tensile strength, modulus of rupture and lower degree of shrinkage as the control concrete.

Hadassa Baum and Amnon Katz [5] studied the percentage of fines in crushed sand and its effects on the concrete mixes. They pointed out that the addition of fine filler (mesh 0.075mm) has a positive potential on the properties of the concrete. But, at the same time, the fraction of less than 5 microns of the fine filler used for plastering may have a bad effect on the concrete. They also studied the effect of the composition of water reducing agent on mixes containing crushed sand that exhibited the lowest properties. They found that most of concrete properties improve as a result of using advanced and modern admixtures. They also noted that Compressive strength improved, chlorides permeability and the shrinkage reduced.

Dan Ravina [6] investigated the use of crushed sand as fine aggregates along with Fly. He mentioned that the particle shape of crushed sand is more angular with a rougher surface texture, and usually flakier and more~ elongated than of natural sand. Moreover the crushed sand, unless suitably treated, contains much more fines (particles smaller than 75 mm). As a result the workability of the fresh concrete is impaired with the corresponding need for higher water requirement which in turn makes for lower concrete strength and higher drying shrinkage. By contrast, the fly' ash particle has a round shape and a smooth surface. He says that a combination of fly ash and crushed sand yield a far superior concrete mix than crushed sand alone' and obviates the disadvantage of partial or total replacement of natural sand with crushed sand.

Kim J.K and Park C.K [7] experimentally investigated that the fracture characteristics of crushed limestone sand concrete through a wedge splitting test, and compared the results with those of crushed granite sand concrete and river sand concrete. They also investigated strength of crushed limestone sand concrete. They observed that the fracture energy of concrete was little influenced by the type of fine aggregate. In addition, the fracture energy of crushed sand concrete was slightly higher than that of river sand concrete. They say that it seemed to be due to very fine sand (VFS) included in crushed sand, which tends to improve the cohesion between cement paste and aggregate. Also, the fracture energy was not proportionally increased with an increase of concrete strength. The characteristic strength of crushed limestone sand concrete was almost the same as that of river sand concrete or crushed granite sand concrete. The characteristic strength greatly decreased as the strength of concrete increased

Hameed and Sekar [9], 2009 studied effect of crushed stone dust as fine sand and found the flexural strength increases than the concrete with natural sand but the values decreases as percentage of crusher dust increases. It has been reported by Reddy and Reddy [8], 2007 from their experimental study on use of rock flow and insulator ceramic scrap in concrete that the rock flow when used as fine aggregate increases the modulus of rapture thus the flexural strength. From the study of green concrete posses containing quarry dust and marble sludge powder it has been reported that the split tensile strength of green concrete was 14.62% higher at 7days and 8.66 %higher at 28 days. But split tensile strength was found to be lesser by 10.41% at 3 days than

controlled concrete. The overall workability value of quarry rock dust concrete in terms of slump as well as compaction factor was less in comparison to conventional concrete (Ilangovana et al.[10], 2008 as reported by (Hameed and Sekar [9], 2009 the slump value increases (Workability increases), if concrete is mixed with quarry dust as well as marble sludge due to presence of marble sludge powder.

IV. CONCLUSION

A review of different experimental studies performed by various researchers have been carried out to examine various operational parameters viz. workability, durability and compressive strength of concrete with crushed sand as replacement to the natural sand. The data assembled during the course of investigation lead to the following conclusions;

- The concrete with crushed sand performed better than concrete with natural sand as the grade of concrete mix increased.
- The flexural strength of concrete with crushed sand was marginally increased on the strength of concrete with natural sand.
- The workability of concrete manufactured with crushed sand was lesser than that manufactured with natural sand.
- The round shape and smooth surface texture of natural sand reduces the inter particle friction in the fine aggregate component so that the workability is higher in natural sand. Manufactured sand particles are angular in shape and their rough surface texture improves the internal friction in the mix. Because of that the workability is reduced.
- Manufactured sand is free from chemical impurities such as sulphates and chlorides which improves the properties of concrete like strength and durability.
- Manufactured sand contains no organic impurities; hence it gives increased strength of Concrete with same cement content. And does not harm the environment in any way. No wastage since Sand is already sieved in the required size (below 4.75 mm).
- Manufactured sand is economical as compared to natural river sand.

V.FUTURE SCOPE

The concrete with crushed sand was found to be stronger, workable, durable, economical and eco-friendly. Thus crushed sand may be used as a substitute to natural sand.

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