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Evaluation of Crusherdust as Replacement of Filler in Concrete

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ABSTRACT: - In any construction activity the most commonly used fine aggregate is sand derived from river banks. River sand has been the most popular choice for the fine aggregate component of concrete in the past, but overuse of the material has led to environmental concerns, the depleting of river sand deposits and an increase in the price of the material. To investigate the possibility of using crushed stone dust as fine aggregate partially with different grades of concrete composites. The suitability of crushed dust as fine aggregate for concrete has been assessed by comparing its basic properties with that of controlled concrete. One mix was selected for natural sand to achieve M30 grade concrete. The equivalent mix was obtained by replacing natural sand by crusher dust partially. The test result indicates that crushed stone dust waste can be used effectively used to replace natural sand in concrete.

Keywords: - Crusher dust, Compressive strength, Fine Aggregate

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I. INTRODUCTION

As the world is experiencing rapid growth the need for the development of new infrastructure is also increasing day by day. To reach the required demands of the urbanization more civil engineering structures like buildings, bridges etc., are to be constructed with the available materials is a problem facing by the civil engineering community. To meet the demands with the available materials studies are being done to utilize the waste materials like Crusher dust, fly ash, pond ash etc.., as a construction material and to assess its performance, tests like compressive strength test on concrete, compaction, strength have been performed to suit as a fill material in place of sand. Parameters like Compressive strength, workability, slump, compacting factor etc., were determined. Fine aggregate are basically sands taken from the land or the marine environment. Among these ingredients river sand is commonly used as fine aggregate in concrete which is becoming scarce and hence expensive due to excessive cost of transportation from natural sources. The large scale depletion of these sources creates serious environmental problems. So Governments are restricting the collection of river sand from river bed. In this study an attempt was made to In such a situation the crusher dust can be an economical alternative to river sand. Crusher dust is a byproduct generated from quarrying activities involved in the production of crushed coarse aggregate. It is possible to use Crusher dust as fine aggregate in concrete which will reduce not only the demand for natural river sand but also the environmental burden.

Several studies were performed on the crusher dust by various researchers like Satyanarayana.P.V.V (2016) Compared the results of crusher dust with Red soil loss of shear strength in terms of cohesion and friction various moisture contents. Pofale.A.D (2013), Hanumanthu.K (2016), Lakhan nagpal (2013), Radhikesh.P (2010) as a replacement to natural sand in concrete. Vijayakumar.A (2015) studied about the changes in pH values with replacement of crusher dust to concrete. Praveen Kumar. et.al (2006) studied crusher dust as a sub-base material by conducting CBR tests. In the present investigation geotechnical characterizations like compaction, strength, seepage, gradation and comparison of compressive strength of conventional concrete and crusher dust replaced concrete have been performed.

II. MATERIALS USED

1.1 CEMENT

Cement acts as a binding material in the concrete due to its adhesive and cohesive properties in he presence of water. The important component of cement that is responsible for strength is C3S and C2S.

1.2 AGGREGATE

They give body to the aggregate and consists around 75 to 80% of the concrete volume. Coarse Aggregate attains strength to concrete were as fine aggregate which consists of spherical shape and smooth

surface enhances the workability of the concrete. It reduces drying shrinkage and other dimensional changes due to moisture.

1.3 QUARRY DUST

Quarry dust is a waste material obtained from stone quarries while crushing stones, stone crusher dust, which is available abundantly from crusher units at a low cost in many areas, provides a viable alternative for river sand in concrete. Earlier investigation indicates that stone crusher dust has a good potential as fine aggregate in concrete construction. Crusher dust not only reduces the cost of construction but also helps to reduce the impact on environment by consuming the material generally considered as a waste product with few applications. Crusher dust has potential as fine aggregate in concrete structure with a reduction in cost of concrete by about 20 percent compared to conventional concrete.

III. DETAILS OF EXPERIMENTAL WORK

1.4 PREPERATION OF TEST SPECIMEN

It is not possible to predict the strength and other concrete properties solely based on the properties and proportions of the mix components. Therefore, mixes are designed on an empirical basis, often with the help of trial mixes. The objective of the mix design is to assure that the product has specified properties in both the fresh and hardened state**.** The experimental work was carried out on concrete cubes which were casted by considering a concrete mix of M_{30} (1: 1.26: 2.45). The specimens were cast in steel moulds of size 150mm x 150mm. A weighing balance is used for weighing the cement and aggregates to the required quantities and placed in concrete mixer for mixing in dry condition. Mixing was done until the entire mix achieves a uniform colour before adding water. Water is added as per the water cement ratio (0.40) by using measuring jar. This is done to know the possibilities of inclusion of quarry dust in optimum proportion in the ordinary construction activities using cement concrete.

1.5 COMPRESSIVE TEST ON CUBES

The compressive strength of concrete will be evaluated by testing cubes of size15cm×15cm×15cm. The cubical specimen is kept between the loading surfaces of the Compressive testing machine of capacity 3000KN, such a way that the smooth surface receives the load directly and the load is applied until failure of the cube occurs along the sides of the cube. The compressive strength is determined by the ratio of failure load to the cross sectional area of the specimen.

TABLE1: Details of mix proportions in kg/m^3

Constituents	**Controlled Concrete**	**25% CRUSHER DUST**	**50% CRUSHER DUST**
W/C Ratio	0.4	0.4	0.4
Crusher dust	0	151.5	303.3
Cement Content	480	480	480
Fine Aggregate	606.3	454.3	303
Coarse Aggregate	1177.94	1177.95	1177.95
Water Content	191.6	191.6	191.6

TABLE2: Geotechnical properties of crusher dust

Property	**values**
Grain size distribution	
Gravel (%)	6.9
Sand (%)	90.2
Fines (%)	2.9
Specific gravity	2.62
Consistency	
Liquid Limit (%)	NP
Plastic Limit (%)	NP
IS Classification	SP
Permeability	1.67×10^{-2}
Compaction Characteristics	
Optimum moisture content,%	11.19
Maximum dry density, g/cm^3	2.19
Shear parameters	
Angle of internal friction (Ø)	36.65^0
Cohesion,kPa	0

TABLE3: Test Results on the Properties of Fresh Concrete

SI.NO	CONCRETE MIX	SLUMP (mm)	COMPACTING FACTOR	FLOW (%)
1	M_{30}CONTROL MIX	75	0.98	18
2	M_{30} 75:25	70	0.96	18
3	M_{50} 50:50	65	0.94	18

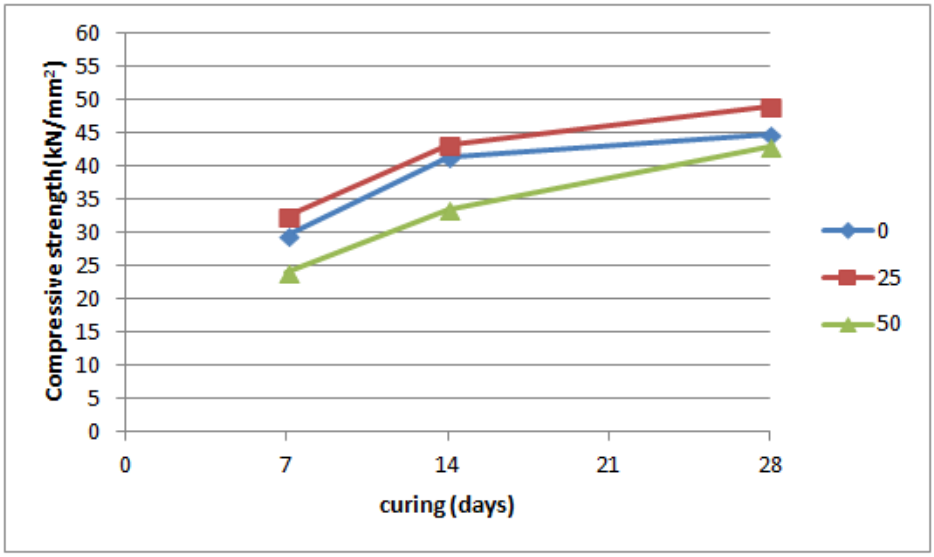

Fig1: Variation of Compressive Strength of Concrete with Curing Period

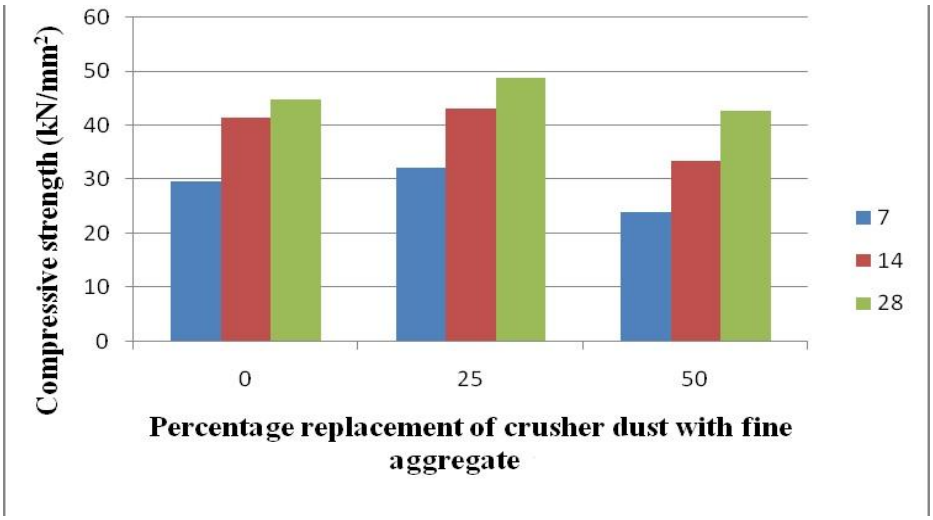

Fig2: Compressive Strength of Different Concrete Mixes at Different Ages

IV. TEST RESULTS AND DISCUSSIONS

1. At 7 days curing period the compressive strength of concrete with 25% crusher dust is more than the controlled concrete by 9.01%.
2. At 14 days curing period the compressive strength of concrete with 25% crusher dust is higher by 4.23% than that of controlled concrete.
3. At 28 days curing period the compressive strength of concrete with 25% crusher dust is higher by 10.48% than that of controlled concrete.
4. The compressive strength of concrete with 50% crusher dust is less than the controlled concrete by 29.12% for 14 days curing period.
5. The compressive strength of concrete with 50% crusher dust is less than the controlled concrete by 23.31% for 7 days curing period.
6. At 28 days curing period the compressive strength of concrete with 50% crusher dust is lesser by 4.58% than that of controlled concrete.

From the charts, it is observed that the compressive strength of concrete is increased with a 25 % replacement of quarry dust with fine aggregate. But with a replacement of 50% of crusher dust with fine aggregate the compressive strength of the concrete has reduced. Hence it is advisable to use the quarry dust in cement concrete by partial replacement up to 50 %.

V. CONCLUSION

Crusher dust is a byproduct generated from quarrying activities involved in the production of crushed coarse aggregate. It is possible to use Crusher dust as fine aggregate in concrete which will reduce not only the demand for natural river sand but also the environmental burden. Crusher dust imbibes sufficient strength to concrete when it is added up to 50% total weight of sand. The workability of concrete mix will reduces with an increase in the crusher dust quantity and turns the concrete in to a harsh mix.

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