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An Experimental Study on Concrete by Partial Replacement of Cement with Bagasse Ash and Fine Aggregate by Quarry Dust

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Abstract - *Concrete plays the key role and a large quantum of concrete is being utilized in every construction practices. 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. Quarry dust is a 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. Design mix of M20 grade concrete with replacement of 5%, 10%, 15%, and 20% 0f quarry dust.*

Key Words: Quarry dust, Bagasse ash, Compressive strength, split tensile strength.

1. INTRODUCTION

Research concerning the use of by-products to augment the properties of concrete has been going on for many years. In the recent decades, the efforts have been made to use industry by-products such as fly ash, silica fume, ground granulated blast furnace slag (GGBS), glass cullet, etc., in civil constructions. The potential applications of industry by-products in concrete are as partial aggregate replacement or as partial cement replacement, depending on their chemical composition and grain size. The use of these materials in concrete comes from the environmental constraints in the safe disposal of these products.

Big attention is being focused on the environment and safeguarding of natural resources and recycling of wastes materials. Actually many industries are producing a significant number of products which incorporate scrap (residues). In the last 20 years, a lot of works concerning the use of several kinds of urban wastes in building materials industrials process have been published. Many researchers have been extended to study new kinds of wastes to investigate deeply particular aspects. The addition of wastes, apart from the environmental benefits, also produces good effects on the properties of final products.

Jayminkumar A. Patel & Dr. D. B. Raijiwala concluded that optimum amount of sugar cane Bagasse ash that can be replaced with cement is 6% by weight without any admixture. 1. T. S. Abdulkadir, D. O. Oyejobi, A. A. Lawal examines the suitability of SCBA as a partial replacement for cement in concrete productions and concluded that, SCBA is a low weight material and 10% replacement of SCBA has the highest PAI. Also, 10% and 20% replacement of SCBA with compressive strengths of 22.3N/mm2 and 20.1N/mm2 are recommended for reinforced concrete.

The major significance of this project work is to ascertain the replacement of cement by sugarcane ash and also adding lathe scrap fibers as fiber reinforcement for concrete making. The effect of SCBA in concrete by partial replacement of cement in the ratios of 0%, 10%, 15% and 20% by weight. The main ingredients consist of Portland cement, SCBA, crushed sand, coarse aggregate and water. After mixing, concrete specimens were casted and subsequently all test specimens were cured in water at 7, 14 and 28 days.

2. Materials

i. Cement

Portland cement is the most common type of cement in general use around the world, used as basic ingredient of concrete, mortar, stucco, and most non specialty grout. It is a fine powder produced by heating materials in a kiln to form called clinker, grinding the clinker, and adding small amounts of other materials. Several types of Portland cement are available with the most common being called ordinary Portland cement (OPC) which is grey in color, but a white Portland cement is also available.

ii. Bagasse ash

With the utilization of natural resources such as water, sunlight, etc. agricultural products are produced. At the same time, certain waste products are also produced. The only difference between these products and their wastages is the way of using them. With little or no investment, most of the agricultural wastes can be used creatively for various purposes in the field of construction. This situation has led to the extensive research on concrete resulting in mineral admixture to be partly used as cement replacement to increase workability in most structural application If some of raw material having similar composition can be replaced by weight of cement in concrete then cost could be reduced without affecting its quality For this reason sugarcane Bagasse ash (SCBA) is one of the main byproduct can be used as mineral admixture due to its high content in silica (SiO2). Currently, there has been an attempt to utilize the large

amount of sugarcane ash, the residue from an in-line sugar industry and the Bagasse-biomass fuel in electric generation industry. When this waste is burned under controlled conditions, it also gives ash having amorphous silica, which has Pozzolanic properties. A few studies have been carried out on the ashes obtained directly from the industries to study Pozzolanic activity and their suitability as binders, partially replacing cement. Therefore it is possible to use sugarcane Bagasse ash (SCBA) as cement replacement material to improve quality and reduce the cost of construction materials such as mortar, concrete pavers, concrete roof tiles and soil cement interlocking block.

iii. Quarry dust

Concrete is an assemblage of cement, aggregate and water. In the production of concrete, granite/basalt stone and river sand are used as course and fine aggregate, respectively although these materials are usually available, at some places it is economical to substitute these materials by locally available once. At the same time increasing quantity of crushed stone dust is available from crushers as waste. The disposal of this is a serious environmental problem. If it is possible to use this crushed stone dust in making concrete by partial replacement of natural river sand, then this will not only save the cost of construction but at the same time it will solve the problem of disposal of this dust. On the other hand, the advantages of utilization of by-products or aggregates obtained as waste materials are pronounced in the aspects of reduction in environmental load & waste management cost, reduction of production cost as well as improving the quality of concrete. Quarry dust has been used for different activities in the construction industry such as road construction and manufacture of building materials such as light weight aggregates, bricks, and tiles. The use of quarry dust in concrete is desirable because of its benefits such as useful disposal of by-products, reduction of river sand consumption as well as increasing the strength parameters and increasing the workability of concrete.

2.1 Methodology

Tests on materials

i. Cement

Table: 1 Physical properties of Cement

Elements	Content
Specific Gravity	3.15
Fineness Modulus	9.25%
Standard Consistency	29%
Initial Setting time	30min

Table: 2 Chemical properties of Cement

Oxides	Percentages
Cao	62.85
SiO_2	20.98
Al_2O_3	5.42
Fe_2O_3	3.92
MgO	1.76
SO_3	2.36
Na_2O	0.28
K_2O	0.53
Loss of Ignition	1.90

Table: 3 Physical properties of fine aggregates

Sl No	Particulars	Obtained Values
1	Specific gravity	2.60
2	Fineness modulus	2.55
3	Water absorption	1.3%

Table: 4 Physical properties of Quarry dust

Sl No	Particulars	Obtained values
1	Specific gravity	1.85
2	Sieve analysis	2.76%

Table: 5 Physical properties of coarse aggregate

Sl No	Particulars	Obtained values
1	Specific gravity	2.58
2	Sieve analysis	2.26
3	Water absorption	0.80%

Table: 6 Chemical Properties of Bagasse ash

Sl.no	Component	Mass%
1	SiO_2	55.76
2	Fe_2O_3	0.72
3	Al_2O_3	1.79
4	Cao	1.68
5	Mgo	2.02

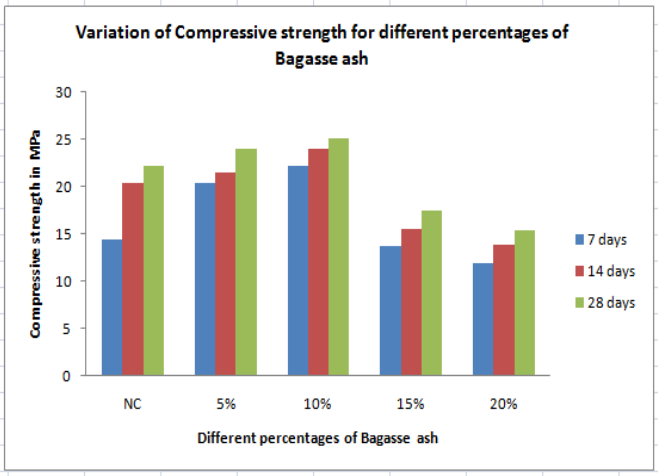
Table: 7 Physical properties of Bagasse ash

Sl No	Particulars	Obtained values
1	Specific gravity	1.63
2	Sieve analysis	1.42

2.2 Results and Discussions

Table: 8 Variation of Compressive strength (MPa) values at 7, 14 and 28 days for M20 grade concrete

ID	7 days	14 days	28 days
NC	14.44	20.44	22.23
5%	20.4	21.48	24
10%	22.16	23.96	25.18
15%	13.73	15.55	17.48
20%	11.85	13.78	15.4



The above graph indicates that the compressive strength of 7days,14 days, 28days with 0%, 5%, 10%, 15% and 20% percentage of baggase ash replaced in cement and quarry dust replaced with fine aggregate in the concrete mixes. The normal concrete give a compressive strength compared to different days of curing. Strength of concrete increases with increase in percentage of replacement of Bagasse ash up to 10% and thereafter deceases with remaining percentages of Bagasse ash.

3. CONCLUSIONS

1. At the replacement of Ordinary Portland Cement by Bagasse and fine aggregate by quarry dust from 5% to 10% results in a better compressive strength.

2. The compressive strength results of the concrete have revealed that the concrete with 5% cement replacement by Bagasse ash and full replacement of fine aggregate by quarry dust have shown a compressive strength improvement at 28 days over the control concrete with the 100% Ordinary Portland Cement.

3. Partial replacement of cement by Bagasse ash and full replacement of fine aggregate by quarry dust increases workability of fresh concrete; therefore use of super plasticizers is not substantial.

4. The workability of concrete containing Bagasse ash decreases slightly as the Bagasse ash content increases which is due to the higher water demand of Bagasse ash.

5. Fully replacement of quarry dust can slightly decrease the compressive strength compare to sand.

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