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An Experimental Investigation on Utilization of Sugarcane Bagasse Ash and Quarry Dust in Concrete

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ABSTRACT -

In the present era, a number of researchers are using either industrial or agriculture priceless products as a basic source of raw materials for the construction industry. These waste products are economical and helpful in producing a sustainable environment and reducing environmental pollution. Compressive strength tests for seven days and twenty-eight days are done for the concrete before using the quarry dust and sugarcane bagasse ash of various percentages such as five percentages to twenty percentages as partial replacement. It is proposed to study that Cement is partially replaced the material of as five percentages to twenty percentages of Sugarcane Bagasse Ash and Fine Aggregate is partially replaced the material of as five percentages to twenty percentages of Quarry Dust. In this research, total [67] concrete samples (three conventional cubes, forty-eight replacement cubes and sixteen cylinders) were made with water cement ratio of 0.5 by using of M25 grade of concrete. The cube specimens are taken of size 150 mm x 150 mm x 150 mm and cylinder specimen of size 150 mm x 300 mm. Concrete cubes and cylinders are kept moist for seven days and twenty-eightdays. The main purpose of this research study was to observe the compressive strength and split tensile strength of concrete blended with various proportions of sugarcane bagasse ash and quarry dust.

Key words: Sugarcane bagasse ash, Quarry dust, Coarse aggregate, Fine aggregate, Cement, Compressive strength, Split tensile strength.

1. INTRODUCTION

Sugarcane bagasseash is agro waste material that is replaced in concrete as a cementitious material. Concrete is a homogeneous mixture of cement, fine aggregates, coarse aggregates, water and admixtures. Sugarcane is the crucial crop in world which is used in sugar mills for more purposes like sugar, juice. After, the separation of extract from sugarcane than sugarcane bagasse is obtained. Sugarcane bagasse is used for more purposes in sugar industries. Sugarcane bagasse is an unutilized and waste material which is reused in sugar industries as fuel to generate the heat for boilers and electricity. China is the first country, whose gross production of sugarcane is more than 1510 million per tons and India is second another country and its total production of sugarcane is more than 300 million tons per year. Sugarcane bagasse is used to generate the electricity and heat generation for boilers and sugarcane bagasse is burnt for these purposes. After the combustion of sugarcane bagasse ash is formed. This ash is also known as the sugarcane bagasse ash and it is obtained directly from the sugar mills. It is not more reactive because it is scorched under uncontrolled environment and at very high temperatures. After, burning the sugarcane, bagasse ash is produced in large amount of silica, aluminium and calcium oxides. Sugarcane bagasse ash becomes an industrial waste and its causes more environmental problems developed. In last year's, we studied sugarcane bagasse ash is utilized in the study of Pozzolonic action and the quality as binder with partial replacement of cement in concrete and it also used to analyse the workability, slump, compaction factor, compressive strength etc. in concrete. Most commonly ashes are produced by industrial wastes e.g. fly ash; bagasse ash, blast furnace slag and silica fume etc. These wastes are used in concrete as additional cementitious material. Presently, there has been used large amount of Sugarcane bagasse ash in concrete. Consequently, it achievable to use sugarcane bagasse ash as partially replaced with cement to modify the quality & decrease cost of building materials such as soil interlocking blocks, mortar, concrete roof tiles & concrete pavers etc. Sugarcane bagasse ash is a waste material and un-utilized from industries. In first form, we carried out the physical properties, chemical composition of Sugarcane bagasse ash and characterization of bagasse ash and this consist of initial setting time, final setting time and water property of blended cement.

1.1 NEED FOR REPLACEMENT OF CEMENT

Ordinary Portland Cement is recognized as a major construction material throughout the world. Portland cement is the conventional building material that actually is responsible for about 5% - 8% of global CO2 emissions. This environmental problem will most likely be increased due to

exponential demand of Portland cement. Researchers all over the world today are focusing on ways of utilizing either industrial or agricultural waste, as a source of raw materials for industry. This waste, utilization would not only be economical, but may also result in foreign exchange earnings and environmental pollution control. Utilization of such wastes as cement replacement materials may reduce the cost of concrete production and also minimize the negative environmental effects with disposal of these wastes.

1.2 PROPERTIES OF CONCRETE:

A hardened concrete must possess the following properties:

1) Strength: Strength is defined as the resistance of the hardened concrete to rupture under different loadings and is accordingly designated in different i.e., tensile strength, compressive strength, flexural strength, etc. A good quality concrete in hardened must possess the desired crushing strength.

2) Durability: Durability is defined as the period of time up to which concrete in hardened - withstands the weathering effects satisfactorily. This property is mainly affected by water cement ratio. A good quality concrete in hardened state must be durable.

3) Impermeability: The impermeability of hardened concrete may be defined as the property to resist entry & water. This property is 10 achieved by using extra quantity of cement in concrete mix. A concrete in hardened state must be impermeable.

4) Elasticity: Though hardened concrete is a brittle material, it is desired that it possess adequate elasticity.

5) Shrinkage: A hardened concrete should experience least shrinkage. This property is guided by water cement ratio. Shrinkage is less if w/c ratio is less.

1.3 OBJECTIVES:

- To collect the raw materials like sugarcane bagasse ash, quarry dust, cement, fine aggregate and coarse aggregate.
- To conduct the various cement tests like fineness of cement, standard consistency of cement, setting time of cement and specific gravity of cement.
- To conduct the various fine aggregate test like specific gravity, water absorption, sieve analysis.
- To conduct the various coarse aggregate tests like specific gravity, water absorption, flakiness index, elongation index, impact test and abrasion test.
- To conduct the various replacement materials, test for sugarcane bagasse ash and quarry dust like fineness of Sugarcane bagasse ash, specific gravity of Quarry dust.
- To use M25 grade of concrete.
- To use 5%, 10%, 15% & 20% of the fine aggregate with quarry dust in concrete.
- To use 5%, 10%, 15% & 20% of cement with sugarcane bagasse ash in concrete.
- To compare the cost of conventional cement concrete and concrete with partial replacement of cement by sugarcane bagasse ash and fine aggregate by quarry dust.

2. MATERIALS:

2.1 MATERIALS COLLECTION:

CEMENT

Cementitious material used was OPC 53 grade, Is the main ingredient used for bonding of concrete. Cement was collected from Puttaparthi. The usage of other cement is possible but depends on local availability. Supplementary cementitious material is replaced with bagasse ash at about 5%, 10%, 15% and 20% with cement. The test conducted on cement are initial setting time, final setting time, standard consistency, fineness and specific gravity test.

FINE AGGREGATE (FA)

Fine aggregates used were available on site and are tested, the results are as per Indian standards BIS: 383:1970. Use of fine aggregate improves the compressive strength of concrete. Use of fine aggregates provides better bonding or interlocking of both fine and coarse aggregates. The test conducted on fine aggregate are specific gravity, water absorption and sieve analysis.

COARSE AGGREGATE (CA)

The aggregates used were 20mm nominal maximum size and are tested as per Indian standards and the results are within permissible limits (BIS: 10262, BIS: 383). The aggregates used were locally available quarry in the region of beedupalli, puttaparthi. The test conducted on coarse aggregate are specific gravity, water absorption, flakiness index, elongation index, impact test and abrasion test.

SUGARCANE BAGASSE ASH (SCBA)

Sugarcane bagasse which is obtained from raw sugarcane after extraction of juice and dried in open air is known as bagasse waste. Bagasse was

collected from Puttaparthi and Kothacheruvu in sathya sai district. Sugarcane bagasse ash is obtained after burning of sugarcane which can be used as partially replacement of cement due to various chemical properties. The burnt bagasse ash is collected and sieved in 90micron sieve to use as partial Replacement of cement in concrete.

QUARRY DUST (QD)

Quarry dust is byproduct of the crushing process which is a concentrated material to use as aggregates for concreting purpose, especially as fine aggregates. In quarrying activities, the rock has been crushed into various sizes; during the process the dust generated is called quarry dust and it is formed as waste. Quarry dust was collected from locally available quarry in the region of beedupalli, puttaparthi.

WATER

Water required for curing and casting was being available on site and does satisfy as per IS456:2000 pH value of water used was 7.3.

3. RESULT AND DISCUSSION

Table-1: Compressive Strength for 7 days and 28 days of conventional concrete cubes

Mix	Experimental trails	Compressive strength for 7 days(N/mm^2)	Compressive strength for 28 days(N/mm^2)
Mix I	M1	17	25

From Table 4.7: Compressive strength for 7 days of curing is obtained 17 N/mm^2 and compressive strength for 28 days of curing is obtained 25 N/mm^2.

Table-2: Compressive Strength for 7 days of replacement cubes

Mix	Experimental Trails	Bagasse ash (%)	Quarry dust (%)	Compressive strength(7 days)(N/mm^2)
Mix I	M1	5	5	22.6
	M2		10	20
	M3		15	20
	M4		20	23
Mix II	M5	10	5	15.55
	M6		10	15.55
	M7		15	11.11
	M8		20	11.11
Mix III	M9	15	5	10.66
	M10		10	10
	M11		15	10
	M12		20	9.5
Mix IV	M13	20	5	8.88
	M14		10	8
	M15		15	8
	M16		20	7.65

From Table-2: Compressive Strength for 7 days of Replacement Concrete cubes obtained 65% of strength successfully. The results obtained for M1 to M16 are mentioned in the above table. The optimum compressive strength for 7 days of curing cubes value by using 5% of SCBA and 20% of QD are 23 N/mm^2 is obtained respectively. After the optimum value the results are decreased due to high percentage use of SCBA and QD.

Table-3: Compressive Strength for 28 days of replacement cube

From Table-3: Compressive Strength for 28 days of Replacement Concrete cubes obtained 99% of strength successfully. The results obtained for M1 to M16 are mentioned in the above table. The optimum compressive strength for 28 days of curing cubes value by using 5% of SCBA and 20% of QD are 26.77 N/mm^2 is obtained respectively. After the optimum value the results are decreased due to high percentage use of SCBA and QD.

Table-4: Split tensile Strength for 28 days of replacement concrete cubes

Mix	Experimental Trails	Bagasse ash (%)	Quarry dust (%)	Compressive strength(28 days)(N/mm2)
Mix I	M1	5	5	20.44
	M2		10	25.77
	M3		15	24.88
	M4		20	26.77
Mix II	M5	10	5	21.10
	M6		10	20.55
	M7		15	20.40
	M8		20	19.75
Mix III	M9	15	5	19.66
	M10		10	19.50
	M11		15	19.21
	M12		20	19.00
Mix IV	M13	20	5	18.88
	M14		10	18.75
	M15		15	18.50
	M16		20	18.00

From Table 4.10: Split tensile Strength for 5%, 10%, 15%, 20% of SCBA values are mentioned in the above table. From these results, it is observed that the maximum split tensile strength is obtained ate 5% of SCBA and 20% of QD is 3.3 N/mm^2. Later on, the strength decreases while the percentage of SCBA and QD replacement increases.

4. CONCLUSIONS

1) According to the tests performed, it is observed that there is remarkable increment in the properties of concrete on replacement of cement by Sugarcane Bagasse Ash and replacement of fine aggregate by quarry dust.
2) When the sugarcane Bagasse Ash and quarry dust was added to concrete by replacing cement & fine aggregate up to 20% in M25 concrete, it is found that there is considerable increase in workability and increase in compressive strength, when compared with plain cement concrete of M25 grade.
3) It can be concluded that the optimum amount of SCBA &QD replacement for cement & Fine aggregate for M25 Concrete is 5% -20%.
4) When the cost comparison of plain cement concrete of M25 grade and concrete with 5%- 20% replacement of cement and fine aggregate by SCBA & QD, it is found that there is a significant reduction in cost for one cubic meter of concrete

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