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Partial Replacement of Cement By Sugarcane Bagasse Ash and Rice Husk and Stone Dust

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ABSTRACT:

Earth is the only habitat to millions of people and several organisms. Due to rapid growing technology we are running out of the space for living area which has been occupied by the solid waste obtained from the maximum utilization of industries increased in large scale. The worlds objective is to reduce or minimize the solid waste.My objective is to make the solid waste and the byproducts obtained from industries Eco-friendly by converting those materials into recyclable substances. Enormous research had been conducted in this field of replacing cement by using silica flume, fly ash and ceramic waste. I want to make substantial contributions to this field by using sugar cane baggies rice husk ash and stone dust with limited proportions to increase the strength of ordinary Portland cement. Scientific methodology is used to obtain the desired results which is economical and eco- friendly considerably reducing the optimum utilization of natural resources and remain as the best substitute to dispose the industrial solid waste.

Key Words: ***OPC: Ordinary Portland cement, CTM:compressive testing machine, SCBA: sugarcane bagasse ash,RHA: rice husk ash, SD: stone dust, FCK: characteristics compressive strength, Sp.g: specific gravity, SD: standard deviation, W/C: water cement ratio, b: breadth of specimen, d: diameter of specimen, h: height of specimen, %: percentage (or) mass.***

1.Introduction: In Civil engineering, theoretical knowledge is an application for practical knowledge which is quite different in any field. In civil engineering aspects now-a-days the construction of buildings, industries, residential complexes etc.... are more essential. These are included with high expensive of cost, to built-up. For that, the no of techniques are implemented to reduce the cost of construction in all aspects. Economically, it is very useful for construction purpose.Replacement of a material with another material is one type of technique which is mostly using in now-a-days to reduce the cost.

Replacing of cement (or) coarse aggregates (or) fine aggregates with other materials which is made to be an economical.

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1.2 Need Of The Present Project:

Cement is the most costly material and energy intensive component of concrete. The unit cost of concrete can be reduced by partial replacement of cement with SCBARHA & SD. Concrete making with conventional material is becoming costlier day by day. More over concrete suffers little resistance to cracking. These problems may overcome by inclusion of these admixtures into concrete.

1.3 Materials Used:

1.3.1 Cement: The most common cement used is ordinary Portland cement. Out of the total production, ordinary Portland cement accounts for about 80-90percent. Many tests were conducted to cement (53 grade) some of them are consistency tests, setting tests, soundness tests, etc.

1.3.2 Fine Aggregate: Locally available free of debris and nearby river bed sand from rivers is used as fine aggregate. The sand particles should also pack to give minimum void ratio, high voids content leads to requirements of more mixing water. In the present study the sand conforms to zone II as per the Indian standards.

1.3.3 Coarse Aggregate: The crushed aggregates used were 20mm nominal maximum size and are tested as per Indian standards and results are with-in the permissible limit.

1.3.4 Water: Water available in the college campus conforming to the requirements of water for concreting and curing as per IS:456-2000.

1.4 Test Conduct On Cement:

1.4.1 Specific Gravity Test: According to IS2720-part-3. Specific gravity is the ratio of the density of a substance compared to the density (mass of the same unit volume) of a reference substance. Apparent specific gravity is the ratio of the weight of a volume of the substance to weight of an equal volume of the reference substance. The reference substance is nearly always water for liquid or air for gases.

1.4.2 Fineness Test: According to IS 4031-1968. Fineness is defined as the surface area of the cement particles per unit weight, means more number of particles per unit weight.

1.4.3 Standard Consistency Test: According to IS 4031(part-4) 1998. The standard consistency of a cement paste is defined as the mould. Consistency which will permit the plunger to a point 5 to 7mm from the bottom of the vicate mould.

1.4.5 Compressive Strength of cement: According to IS 8112-1989. Compressive strength of cement is determined from mortar cubes of size 7.07*7.07*7.07c.m and cement to sand ratio 1:1.5:3.

Physical properties of cement(OPC 43 GRADE)(IS 8112-1989):

S.NO	PROPERTY	VALUES
1	Fineness of cement by sieving	2.5%
2	Specific gravity	3.12%
3	Normal consistency	31%
4	Setting time i)Initial setting time ii)Final setting time	 65min 300min
5	Compressive strength i)7 days ii)14days iii)28days	 25.3N/mm2 36.6N/mm2 52.26N/mm2

TABEL-1

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2.Introduction of Admixtures: The admixtures are the materials which are added as a ingredient of concrete or mortar other than water, aggregates or cement to provide the extra cementing properties to the mix.The admixtu res which are used to replace by cement in mix are as follows.

1. Sugar Cane Bagasse Ash (S C B A)
2. Rice Husk Ash (R H A)
3. Quarry dust (or) Stone dust

These admixtures which shows the difference in both physical and chemical condition of the concrete, so many experiments are done by comprising these properties as a result which shows the physical properties are greater than the chemical properties when adding these admixtures. the physical properties are depending on the size, shape and texture of particles similarly chemical properties depends up on the capability of aluminous compounds, react chemically in the presence of water like calcium hydroxide etc., The main objective of adding these admixtures is to increase the high compressive strength, high workability, performance and durability of concrete.Due to adding these admixtures the properties like heat of hydration, accelerate (or) retard setting time, workability, water reduction, dispersion and air–entrainment, impermeability and durability factors are modified commonly.

2.1 Introduction of sugar Cane Bagasse Ash (S C B A):

Sugar cane bagasse ash is the fibrous solid waste-product from the sugar refining industries. Which contains ethanol vapour. The production of SCBA from industries are increased day by day which leads to threat for environment because which contains aluminum ion and silica which pollute the environment so we have to carefully handled these waste by replacing with cement as a byproduct in concrete. In this SBCA was characterized by mean of chemical, physical and partially replaced in the composition of 0%, 2%, 4%, 6%,8%, and 10% by amount of cement in concrete.

Compaction factor test and slum cone test were conducted on fresh concrete, compressive strength, split tensile strength test are conducted on hardened concrete at the age of 7 and 28 days. The strength of concrete increased as percentage by adding SCBA as admixture.

fig(a): Sugarcane bagasse ash

2.2Introduction of Rice Husk Ash (R H A):

On worldwide the production of rice husk in the form of residue is 21% of the 650 million tons rice. The chemical properties which are changes from one sample to another due to various types of crops like paddy, crop rotation, climate, geographical and topographical condition the residue from the crop which causes the environmental problems in order to reduce this problem,

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the RHA is used as a admixture of concrete in the partial replacement of cement. RHA is pozzolanic material which contains rice in silicon dioxide and it is very reactive with lime due to its non-crystalline silica content RHA contains nearly 85-90% of silica when compared to other RHA is very good replaceable substance to OPC

fig(b): Rice husk ash

2.3Introduction of Stone Dust (Or) Quarry Dust :

Stone dust a waste from the stone crushing unit accounts 25% of the final product from stone crushing unit. This stone which is released directly into environment can cause environmental pollution. To reduce the impact of the stone dust on environment and human, this waste can be used to produce new products or can be used as admixtures in concrete so that the natural resources are used efficiently and hence environmental waste can be reduced here stone dust is used for partial replacement of cement in concrete are 0%, 2%,4%,6%,8%&10%. Advancement in utilization of wastes in concrete as admixture reduces pollutants in environment and maximize usage of natural resources. During the production of cement CO2 is produced which cause global warming. By reducing cement consumption environmental can be protected. An attempt was made to partially replacing the cement with waste material stone dust with an aim not to lose the strength far from original concrete mix. The physical and mechanical properties of material used in concrete were investigated. For each replacement casting was done for 7&28 days for compressive strength and split tensile strength.

fig(c): Stone dust powder

3.Properties Of Materials:

3.1 General:

The materials used in the experimental work namely cement, bagasse ash, Rice husk ash, Stone dust, fine aggregate and coarse aggregate have been in laboratory for use in mix designs. The details are present below.

3.2 Cement[Is:2386-1963]:

Ordinary port-land cement of 53 grade was used in this project.The general standard values of different tests on

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cement described below.

S.NO	PARTICULAR	OPC 53 GRADE
1	Normal consistency	32%
2	Specific gravity	3.15
3	Setting time a) Initial Setting time b) Final Setting time	 45min 583min
4	Soundness test of cement	3mm
5	Fineness of cement	2.33

Table 2

3.3 Fine Aggregate(As Per IS: 383)

Aggregate smaller than 4.75mm and up to 0.075mm are considered as fine aggregate.

3.3.1 Specific Gravity

The specific gravity of the fine aggregate is in ranges between 2.6 to2.9

3.4 Coarse Aggregate(As per IS: 383)

Aggregate greater than 4.75mm are considered as coarse aggregates. Generally, the size of coarse aggregate used is 20mmand 10mm.

3.5 Properties Of Admixtures:

3.5.1 Properties Of Sugarcane Bagasse Ash In our project sugarcane bagasse ash was collected from KCP sugar industries VUYYURU. The below mentioned SCBA composition was obtained with the help of Industry.

SL.NO	COMPONENTS	MASS%
1	SIO2	55.78
2	Fe2O3	0.72
3	Al2O3	1.79
4	CaO	1.68
5	MgO	2.02

Table 3

Sugarcane bagasse ash was sieved by IS: 300-micron sieve before mixing in concrete

Mix Design:

M-20 Concrete Mix Design:

4.1 Is Method:

This Indian standard was adopted by the Indian standards institutions on 30th July after the draft finalized by the cement & concrete sectional committee had been approved by the civil engineering division council.The following basic data are required to be specified for design of a concrete mix:

A.Characteristic compressive strength below which only specified proportion of test results are allowed to follow of concrete at days fc_k

B. Degree of workability desired.

C.Limitations on the water cement ratio and the minimum cement content to ensure adequate durability.

D.Type and maximum size of aggregates to be used.

E.Standard deviations of compressive strength of concrete.

5.Requirements: The required materials for the processing of projects are…

OPC 53 grade

Sugarcane bagasse ash

Rice husk ash

Stone dust (or) quarry dust

Coarse aggregates (20mm)

Fine aggregates (sieved by 2mm)

5.1 Instruments

The required instruments for the processing of project are….

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Compressive testing machine (Fig a)

Concrete mixture

CONCRETE MIXTURE(Fig b)

The concrete mixer which is used to mix the concrete perfectly compared to hand mixing mainly this concrete mixture used in small scale construction which is very portable had many uses compared to hand mixing.

Types of concrete mixing

1.Hand mixing

2.Machine mixing

Vibratory machine (Fig c)

Weighing machine (Fig d)

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Slump cone (Fig e)

6.Methodology:

The detailed explanation of project is as follows …

A partial replacement of cement with admixtures is done by mix proportions of mixed design procedure which is M20 grade. Before going to adding the admixtures into the cement a normal proportion is to be done.

For normal mix:

The 0% of replacement of cement is considered, the mixing of all the materials are undertaken from M20 mix design. The quantity of required materials are given in pg.no.15. Through those proportions with water –cement ratio, the mixing of all aggregates is taken. The step by step process is explained below. The step by step process is same as for 2%,4%,6%,8% and 10% of all admixtures.

The detailed explanation of step by step process are follows…

Sieving

Batching

Mixing

Grease coating

Slump cone test

Casting

Curing

6.1 Sieving

The materials which are to be sieved. The sieving is done for all the materials to get fineness for the mixing. The all admixtures are sieved by 300microns to replace it in a cement material.

The sieved materials are added in to the cement material with the belonging proportions into the cement materials. The sieved materials are shown in Fig 1

6.2 Batching

After sieving the material, the weight is to be consider for the mixing proportions from the mixed design procedure.Here we consider the mixing proportions are 2%,4%,6%,8% and 10% for the admixtures. The batching as shown in figure(h)

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6.3 Mixing

According to proportions the admixtures are to be mixed in to the cement through a known weight and also coarse & fine aggregates are mixed as per design procedure.The mixing includes the water cement ratio. This is shown in fig(i).

In my project i used to mix the materials like fine aggregates, coarse aggregates, cement and water by using hand mixing, because it is very flexible for small amount of concrete. By gradually adding water to the contents mix the concrete mixture.

6.4 Grease Coating

The specimens are to be coated with grease oil for the easy way of to release the moulds from the specimen.

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Before the casting the coating is essential for the cubes and cylinders. The coating is as shown in figure(j).

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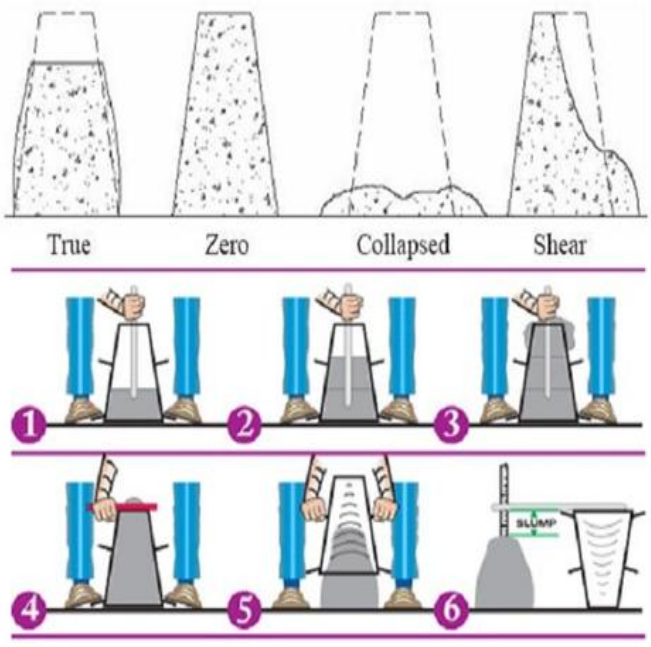
6.5 Slump Cone Test

The slump cone test is mainly conducted to determine the workability of fresh concrete. This test is suitable for both field and laboratory, which gives us the exact values of workability when compared with other tests. Mainly the workability of concrete which depends on the water cement ratio of concrete. The nominal sizes of the slump is 30cm height and having 10cm top diameter and 20cm bottom diameter. By providing two handles on either side of the slump for its vertical rise. The slump cone test is as shown in Fig (m)

Types of slump

There are mainly three types of slump. They are

1. True slump (up to 125mm)
2. Shear slump (up to 150mm)
3. Collapse slump (150-250mm)
4. Zero slump



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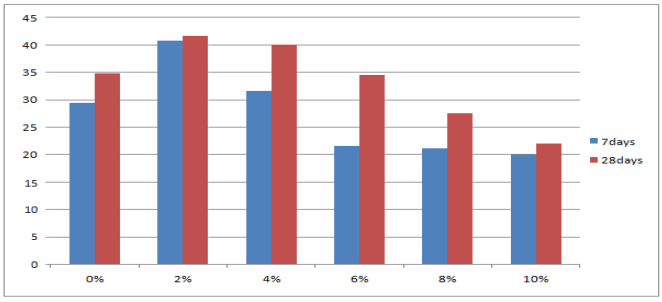
Testing of Cubes in compressive testing machine for Compressive Strength



6.8.2 Spilt Tensile Strength

The Split tensile strength of concrete have been evaluated by testing the cylindrical specimens of size 15 cm diameter and 30 cm length. The testing procedure is shown in fig.(r)& fig(s).The split tensile tests are done by placing a cylindrical specimen horizontally between the loading surface a compression testing machine and the load is applied until failure of cylinder, along the vertical. The split tensile test values determined for different specimens from tests are presented in table-8. The result obtained from the experimental work for 7 & 28 days are shown in the charts as given below.

Before test: After test:

7.Results:

CUBES:

The values obtained by testing of cube in a compression testing machine to know the compression strength of the specimens for 7 & 28 days are…

Testing values for 7 days...

Normal Mix	29.44N/mm^2
Mixture of 2%	40.84N/mm^2
Mixture of 4%	31.64N/mm^2
Mixture of 6%	21.5N/mm^2
Mixture of 8%	21.2N/mm^2
Mixture of 10%	20.0N/mm^2

Testing Values of 28 Days

Normal Mix	34.8N/mm^2
Mixture of 2%	41.6N/mm^2
Mixture of 4%	40.0N/mm^2
Mixture of 6%	34.5N/mm^2
Mixture of 8%	37.5N/mm^2
Mixture of 10%	22.0N/mm^2

Cylinders

The values obtained by testing of cylinder in a compression testing machine to know the split tensile strength of the specimens for 7 & 28 days are…

Testing Values For 7 Days...

Normal Mix	2.10N/mm^2
Mixture of 2%	2.70N/mm^2
Mixture of 4%	2.68N/mm^2
Mixture of 6%	2.60N/mm^2
Mixture of 8%	1.81N/mm^2
Mixture of 10%	1.47N/mm^2

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Testing Values of 28 Days

Normal Mix	2.87N/mm^2
Mixture of 2%	3.12N/mm^2
Mixture of 4%	3.03N/mm^2
Mixture of 6%	2.75N/mm^2
Mixture of 8%	2.27N/mm^2
Mixture of 10%	2.20N/mm^2

The Compressive strength and Split Tensile strength of cubes & cylinders are increases at 6% which includes 2% of each admixture, when compared to normal mix &other mix proportion.

Conclusions:

It has been observed that by the incorporation of SCBA, RHA & SD as a partial replacement to cement in plain concrete, increases workability when compared to workability with reference to concrete made without admixtures.The mix proportion of 6% replacement of cement with SCBA (2%), RHA (2%) & SD (2%) showed good properties like Compressive and Tensile strength.It has been observed that cement replacement using SCBA, RHA & SD can go up to 8% safely through strength values are less compared to 2% replacement of cement and is most economically feasible.

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