Volume 5, Issue 2, April 2018 ISSN: 2348-8565 (Online)
International Journal of Modern Engineering and Research Technology
Website: http://www.ijmert.org Email: editor.ijmert@gmail.com

# Application of Different Agricultural Waste in Concrete as a Partial Replacement of Cement

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## ABSTRACT

*In this thesis the study of compressive strength of concrete has been studied incorporating Sugarcane Bagasse Ash and Rice husk ash as partial replacement of cement (Ordinary Portland cement 43 grade) with varying percentage of Sugarcane Bagasse ash and Rice husk ash; appear that the ratio are designed for target strength and result in increased compressive strength.*

*The thesis was conducted with M20 grade concrete .the compressive strength test was performed on 90 number of concrete cube of size 150 mm × 150 mm × 150 mm. The study is done with Sugarcane Bagasse Ash 0%,10%, 20%, and 30% Rice husk ash 0%,10%,20% and 30% For each replacement percent of cement total 09 number of cube were tested 03 numbers of cube for 07 days, 03 number of cube for 14 days and 03 numbers of cube for 28 days .*

*The test of compressive strength of concrete has been done and result are show in graph between the compressive strength and percentage of Sugarcane Bagasse Ash and Rice husk ash.*

*This research has show that the Sugarcane Bagasse Ash and Rice husk ash.have potential to produce high performance of concrete and it will also improve the properties fresh and hardened concrete.*

***Keywords:—****Rice husk ash(RHA), Sugarcane Bagasse Ash (SBA), cement replacement, concrete, Compressive strength, Workability.*

## I. INTRODUCTION

There has been alarming rate of increase in the price of building materials in the recent past. This has necessitated government, private and individuals to go in research for locally sourced materials to supplement (replace-fully or partially) the conventional materials. The increasing demand for cement and concrete is met by the partial replacement of cement. The whole concept of this idea is to ensure that an average working class citizen of India will be able to own a house. Concrete is a composite material which consists eccentrically of a binding medium. Concrete is no longer made of aggregate Portland cement and water only. Often but not always it has to incorporate at least one of the additional ingredients such as admixture or cementations material to enhance its strength and durability. Within which are embedded particles or fragments of relative inert filler in Portland cement concrete. The binder is a mixture of Portland cement. The filler may be any of a wide variety of natural or artificial. Fine and coarse aggregate; and in some instances an admixture. Concrete is

presently one of the most popular materials used in building construction and other civil engineering works. When reinforced with steel, it has a higher capacity for carrying loads. Concrete being a heterogeneous material. The quality of the constituents and the proportions in which they are mixed, determine its strength and other properties.

## II. LITERATURE REVIEW

### *2.1 Research Background*

The following details of all the research work done on paper waste used in concrete mix all around the world, with thorough study of these research papers I was able to carry on my research work more conveniently and effortlessly.

**Shukeri Ritzawaty binti Mohamad and Ghani A.Naser Abdul, (2008) [1].** "Concrete Mix With Waste Paper" Compressive strength, Concrete mix, This research is aim to evaluate the addition of paper waste to concrete mix, to study the effect of paper waste on the strength of concrete, and to develop mixture proportions for concrete containing paper waste, In general, each group of concrete mixes containing paper waste, compressive strength, tensile strength, and flexural strength of concrete decreased with the increase of the amount of paper waste. Concrete mix with 5% paper waste showed higher tensile strength and flexural strength than control mix. Good relationship was observed in compressive, tensile, and flexural strength of concrete mixes containing paper waste

**Ahmad Sajad, Malik M. Iqbal, Wani Muzaffar Bashir, Ahmad Rafiq, (2013) [2].** **"**Study of Concrete Involving Use of Waste Paper Sludge Ash as Partial Replacement of Cement", Compressive strength, Durability, split tensile strength, Waste Paper Sludge Ash Concrete, Workability. This work examines the possibility of using waste paper sludge ash as partial replacement of cement for new concrete. 5% replacement of cement by waste paper sludge ash showed 10% increase in compressive strength at 7 days and 15% increase in compressive strength at 28 days. With increase in waste paper sludge ash content, percentage water absorption increases. Splitting tensile strength decreases with increase in waste paper sludge ash content and is more than reference concrete at 5% replacement.

**Balwaik Sumit A, Raut S P, (2013) [3].** **"**Utilization of Waste Paper Pulp by Partial Replacement of Cement in Concrete", Compressive Strength; Flexural Strength; Paper Pulp Concrete; Split Tensile Strength. The use of paper-mill pulp in concrete formulations was investigated as an alternative to landfill disposal. The cement has been replaced by waste paper sludge accordingly in the range of 5% to 20% by weight for M-20 and M-30 mix. Generally, the compressive, splitting tensile and flexural strength increased up to 10% addition of waste paper pulp and further increased in waste paper pulp reduces the strengths gradually. Use of waste paper pulp in concrete can save the pulp and paper industry disposal costs and produce a 'greener' concrete for construction. The most suitable mix proportion is the 5 to 10 % replacement of waste paper pulp to cement.

**Pitroda Prof. Jayeshkumar, Zala Dr. L.B., Umrigar Dr.F.S., (2013) [4].** **"**Innovative use of paper industry waste (hypo sludge) in design mix concrete", Compressive Strength, Split Strength, hypo sludge (supplementary cementitious material), hypo sludge Concrete. The cement has been replaced by waste paper sludge accordingly in the range of 0% (without Hypo sludge), 10%, 20%, 30% & 40% by weight for M-25 and M-40 mix. Concrete mixtures were produced, tested and compared in terms of strength with the conventional concrete. Compressive strength reduces when cement replaced hypo sludge. As hypo sludge percentage increases compressive strength and

split strength decreases. Compressive strength reduces when cement replaced hypo sludge. As hypo sludge Percentage increases compressive strength and split strength decreases.

**Monte M.C., Fuente E., Blanco A. and Negro C., (2009)[ 5].** "Waste management from Pulp and Paper Production in the European Union", Paper industry wastes, pulp and paper sludge, solid waste generation, waste recovery, waste minimization. The European paper industry generates about 11 million tonnes of waste, 70% of which originates from recycled paper production. The waste is very diverse in composition and consists of rejects, different types of sludges and, in case of on-site incineration, ashes. The production of pulp and paper from virgin pulp generates less waste and the waste has the same properties as deinking waste, although with less inorganic content. Within the European Union several already issued and other, foreseen directives have great influence on the waste management strategy of paper producing companies. Through legislation, the landfill option is restricted, although it has not phased out on-site landfills.

***Aim:***

The aim of this experimental investigation is to study the variation in strength characteristics of concrete structural elements, for the proportion of M20 grade. In each mixes containing different percentages of Rice husk ash (RHA) and sugarcane bagasse Ash (SBA) is replaced by means of cement starting from 0% as normal concrete, i.e. controlled concrete 10%, 20%, and 30%, .The number of specimens casted for each case is as follows.

1. Workability of concrete test like slump cone test and compaction factor test.
2. Mechanical properties like Compressive strength,
3. Experimental View

**Table 1: Casting and Curing of M20 Grade of Concrete with 0% Fly Ash**

| Particular | Mix Design | Code | No. of Specimen | Curing period In days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M1 | 9 no's | 7, 14, 28 | 150x150x 150mm |

**Table 2: Casting and curing of M20 grade of concrete with 10% cement replaced by Rice husk ash.**

| Particular | Mix Design | Code | No. of Specimen | Curing period In days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M2 | 9 no's | 7, 14, 28 | 150x150x 150mm |

**Table 3: Casting and curing of M20 grade of concrete with 20% cement replaced by Rice husk ash.**

| Particular | Mix Design | Code | No. of Specimen | Curing period In days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M3 | 9 no's | 7, 14, 28 | 150x150x 150mm |

**Table 4: Casting and curing of M20 grade of concrete with 30% cement replaced by Rice husk ash.**

| Particular | Mix Design | Code | No. of Specimen | Curing period In days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M4 | 9 no's | 7, 14, 28 | 150x150x 150mm |

**Table 5: Casting and curing of M20 grade of concrete with 10% cement replaced by sugarcane ash.**

| Particular | Mix Design | Code | No. of Specimen | Curing period in days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M5 | 9 no's | 7, 14, 28 | 150x150x 150mm |

**Table 6: Casting and curing of M20 grade of concrete with 20% cement replaced by sugarcane ash..**

| Particular | Mix Design | Code | No. of Specimen | Curing period In days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M6 | 9 no's | 7, 14, 28 | 150x150x 150mm |

**Table 7: Casting and curing of M20 grade of concrete with 30% cement replaced by sugarcane ash.**

| Particular | Mix Design | Code | No. of Specimen | Curing period In days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M7 | 9 no's | 7, 14, 28 | 150x150x 150mm |

**Table 8: Casting and curing of M20 grade of concrete with 10% cement replaced by 5% sugarcane ash and 5% Rice husk ash.**

| Particular | Mix Design | Code | No. of Specimen | Curing period in days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M8 | 9 no's | 7, 14, 28 | 150x150x 150mm |

**Table 9: Casting and curing of M20 grade of concrete with 20% cement replaced by 10% sugarcane ash and 10% Rice husk ash.**

| Particular | Mix Design | Code | No. of Specimen | Curing period in days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M1 | 9 no's | 7, 14, 28 | 150x150x 150mm |

**Table 10: Casting and curing of M20 grade of concrete with 30% cement replaced by 15% sugarcane as .and 15% Rice husk ash.**

| Particular | Mix Design | Code | No. of Specimen | Curing period In days | Cube size |
|---|---|---|---|---|---|
| Cube | M20 | M10 | 9 no's | 7, 14, 28 | 150x150x 150mm |

## III. Results and Discussion of Compressive Strength:

Compressive strength of concrete mixes made with and without rice husk ash and sugarcane bagasse ash with different percentage were determined at 7, 14, and 28 days of curing. The test results are given in table and shown in figure. The maximum compressive strength was obtained for a mix having a 10% rice husk ash of 10% sugarcane bagasse ash by weight and increase in strength over plain concrete .

**Table 11. Compressive Strength of Grade M20 as M1, M2, M3, M4, M5, M6**

| Mix | M-1 | M-2 | M-3 | M-4 | M-5 | M-6 |
|---|---|---|---|---|---|---|
| Rice husk ash (RHA) (%) | 0 | 10 | 20 | 30 | 00 | 00 |
| Sugar-cane Bagasse Ash (SBA) (%) | 0 | 0 | 0 | 0 | 10 | 20 |
| **Test age (days)** | **3-3 SAMPLES COMPRESSIVE STRENGTH (N/mm²)** | | | | | |
| 7 | 12.0<br>12.5<br>12.0<br>**Av=12 .1** | 12.6<br>12.5<br>12.6<br>**Av=12 .56** | 13.3<br>13.2<br>13.4<br>**Av=13 .3** | 13.7<br>13.8<br>13.9<br>**Av=13 .8** | 15.3<br>15.5<br>15.1<br>**Av=15 .3** | 14.8<br>14.0<br>14.4<br>**Av=14 .4** |
| 14 | 15.0<br>15.0<br>15.6<br>**Av=15 .2** | 16.7<br>16.8<br>16.9<br>**Av=16 .8** | 17.7<br>17.8<br>17.9<br>**Av=17 .8** | 18.4<br>18.3<br>18.5<br>**Av=18 .4** | 19.0<br>21.8<br>20.4<br>**Av=20 .4** | 19.2<br>20.5<br>18.5<br>**Av=19 .2** |
| 28 | 19.5<br>19.0<br>19.5<br>**Av=19 .3** | 20.0<br>21.0<br>22.0<br>**Av=21** | 22.2<br>22.3<br>22.4<br>**Av=22 .3** | 22<br>23<br>21<br>**Av=23** | 26.5<br>24.5<br>25.5<br>**Av=25 .5** | 25.0<br>23.0<br>24.0<br>**Av=24** |

**Table No. 12: Compressive strength of grade M20 as m7, M8, M9, M10.**

| Mix | M-7 | M-8 | M-9 | M-10 |
|---|---|---|---|---|
| Rice husk ash (RHA) (%) | 00 | 5 | 10 | 15 |
| Sugarcane Bagasse Ash (SBA) (%) | 30 | 5 | 10 | 15 |
| Test age (days) | 3-3 Samples Compressive Strength (N/mm²) | | | |
| 7 | 14.0<br>13.1<br>15.2<br>Av=14.1 | 17.9<br>18.0<br>17.8<br>Av=17.9 | 14.9<br>16.5<br>16.3<br>Av=15.9 | 14.5<br>14.4<br>15.2<br>Av=14.7 |
| 14 | 19.6<br>18.0<br>18.8<br>Av=18.8 | 22.8<br>22.9<br>22.7<br>Av=22.8 | 22.2<br>21.0<br>20.4<br>Av=21.2 | 19.5<br>20.7<br>18.6<br>Av=19.6 |
| 28 | 24.5<br>22.5<br>23.5<br>Av=23.5 | 27.0<br>26.5<br>26.0<br>Av=26.5 | 27.0<br>28.0<br>27.5<br>Av=27.5 | 24.5<br>23.5<br>25.5<br>Av=24.5 |

The 7 day compressive strength of rice husk ash and sugarcane bagasse ash concrete was found to be high as 17.9 Mpa. Which is more than ordinary concrete. Similarly 28 day compressive strength was found to be about 27.5 Mpa which is more than that of ordinary concrete.

The effect of replacement of cement with three percentages of Rice husk ash and sugarcane bagasse ash on the compressive strength of concrete is shown figure. It is clear that the replacement of cement with 30 % of Rice husk ash and sugarcane bagasse ash reduced the compressive strength of concrete. And for a particular percentage of Rice husk ash and sugarcane bagasse ash there was a decrease in compressive strength of concrete, as the percentage of rice husk ash and sugarcane bagasse ash from 10% to 20%. However, this reduction in strength with addition of Rice husk ash and sugarcane bagasse ash continued to decrease with an increase in the percentage of Rice husk ash and sugarcane bagasse ash content. Generally, presence of Rice husk ash and sugarcane bagasse ash induces porosity and reduces compressive strength depending upon Rice husk ash and sugarcane bagasse ash content.

## IV. CONCLUSION

The result of study shows that there are good prospects of using Rice husk Ash (RHA), Sugarcane Bagasse Ash (SBA) as a pozzolana combination with ordinary Portland cement (OPC) in the Concrete cube. M-20 grade concrete cube is casted and its compressive strength and workability is determined. The combination of 10%, 20% and 30% cement replacement Mix is prepared by using agricultural waste.

Workability of the concrete increased with the increased percentage of Sugarcane Bagasse Ash in concrete and decreased with increased percentage of Rice husk. It has been observed that Sugarcane Bagasse gives very good workability when they replace cement in concrete.

Compressive Strength of concrete increased with increasing percentage mix give good compressive strength. When Rice Husk Ash replace cement in concrete it has been observed that its 10% and 20% mix gives good compressive strength.

Concrete is a versatile building material which is largely used in construction. When cement is replaced by these waste material upto 30%. By using these waste material INR 94.5/- can be saved on per bag of cement i.e. 30% of the cost.

From the study conducted, it was clearly shown that Rice husk ash (RHA), Sugarcane Bagasse Ash (SBA), are pozzolanic material and can contribute to the sustainability to the construction material.

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