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COMPARISON OF SUGARCANE BAGASSE ASH, FLY ASH AND RICE HUSK ASH ON M25 GRADE OF CONCRETE

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Abstract - In this research study, the comparison of strength properties of concrete have been assessed by partially replacing cement with Sugarcane Bagasse ash, Fly ash and Rise husk ash. These ingredients are environmental pollutants, and their utilization in concrete not only save the material but can also solve the problem of their disposal and environmental pollution. Using these alternate waste materials as admixtures in concrete; cubes, cylinders and beams were cast and tested for compressive, split tensile and flexural strengths. Initial trials were conducted by partially replacing cement with Sugarcane bagasse ash starting from 2% to 12% with the gradual increase of 2% for each trial and observed maximum strength gain at 10% replacement of cement. Keeping this 10% of SCBA as constant, cement was partially replaced with variable content of FA and RHA. The proportion of FA and RHA in cement replacement was 5% to 15% and 2% to 4 %, with gradual increase of 5% and 1%. About 25% increase in the compressive, split tensile and flexural strength was found when the cement content is decreased to 78% and remaining 22% is replaced with 10 % SCBA, 10% FA and 2 % RHA.

Keywords- OPC Cement, Compressive Strength, Flexural Strength, Split Tensile Strength, Sugarcane Bagasse Ash (SCBA), Fly Ash (FA), and Rice Husk Ash (RHA).

1. INTRODUCTION

The increasing scarcity of raw material these days has lead to the exploration of replacement of ingredients of concrete with newer materials. Large quantities of waste materials and by-products are generated from manufacturing processes, service industries and municipal solid wastes, etc. Also disposing of industrial waste these days is a major challenge as they pose serious environmental threats to all the countries across the world.

In civil engineering projects, now-a-days, the construction of buildings, industries, residential complexes etc. are more essential and building these entail high cost. For this, no. of techniques have been tried to reduce the cost of construction in all aspects. Economically, it is very useful to replace conventional material with waste material to reduce the construction cost. Replacing of cement, coarse aggregates or fine aggregates with other material makes construction economical.

In this study, attempt has been made to use industrial waste as well as agricultural waste such as SCBA, FA and RHA as a replacement of cement. Pozzolanic material contains high amount of silica and addition of these material helps silica (SiO_2) to react with free lime released during heat of hydration. Industrial waste such as sugarcane bagasse ash, fly ash, and rice husk ash contains pozzolanic properties. These waste materials used as replacement of cement leads to improved quality, strength, reduction in the cost of construction besides reducing its impact on environment.

In the manufacture process of cement high amount of carbon dioxide is released. Therefore, there is need to reduce the emission of carbon dioxide throughout the world to control green house effect. This can be achieved by partially replacing cement with these industrial wastes.

Sugarcane bagasse ash used for this project has been obtained from A.B. Sugar limited (Dasua), Distt-Hoshiarpur, Punjab. After burning bagasse it gives amorphous silica which has pozzolanic properties. Fly ash used for this project has been obtained from NABHA Power Limited, Distt-Patiala, (Rajpura) Punjab and Rice Husk Ash used has been obtained from Guru Metachem Pvt. Ltd. Gujarat. Physical properties of these waste materials are given in the following table 1 to 3:

Table-1.1 Test Results of SCBA

S. No	Parameters	SCBA
1	Sp.Gravity	2.2
2	% passing 75micron, sieve	3.6
3	Moisture content at 250+, - , 27 Deg C	1.8

Table-1.2 Test Results of FA

S. No	Parameters	FA
1	Sp. Gravity	2.3
2	% passing 45micron sieve	3.9
3	Fineness, m^2/kg	461

Table-1.3 Test Results of RHA

S. No	Parameters	RHA
1	Sp. Gravity	2.0
2	% passing 45micron sieve	2.5
3	Fineness in cm^2/gm	18700
4	Moisture content % by mass	1.37

2. MATERIALS AND METHODOLOGY

- In this project cement used was Ordinary Portland cement of ultratech make conforming to IS 8112: 1989.
- Fine aggregate corresponding to zone-III and procured locally was used for this research study.
- Coarse aggregates used were 20mm and 10mm and was mixed in the proportion of 2.5:1 to make it well graded as per the requirements of mix design as per BIS: 10262.

2.1 Mix Design

Concrete of grade M25 was designed as per BIS: 10262-2009 and design proportion achieved has been highlighted under table-2.1.

Table-2.1 Test Results of Concrete

Material	Cement	Fine aggregate	Coarse aggregate
Mix proportion	1	1.74	3.36
Specific gravity	3.15	2.63	2.77

2.2 Workability

Workability describes the state of fresh concrete. Workability was checked just before placing of the concrete by measuring its slump value. The size of the slump cone used was 20-cm diameter base, 10 cm diameter top and 30 cm height as per IS:456-2000.

2.3 Casting

Three sets of cube of size 15X15X15 cm, three sets of Beam of size 10X10X50 cm and three sets of cylinder of size 10 cm diameter and 20 cm height were cast using proportion of 1 : 1.74 : 3.36, M25 grade of concrete as per IS:456-2000.

2.4 Curing

Curing was done by using potable tap water. The compressive cubes, flexural beams and split tensile cylinders were cured for testing at different ages of 7 and 28 days as per IS: 456-2000.

3. RESULTS

3.1 Compressive Strength

The results of compressive strength obtained at different ages for M25 grade of concrete, with different combinations of cement, SCBA, FA and RHA with cement have been presented in Table 3.1.

Table-3.1 Test Results of Compressive Strength

Compressive strength values				
S. No.	**Cement (%)**	**SCBA+FA+RHA (%)**	**7 Days N/mm^2**	**28 Days N/mm^2**
Mix1	83	10-5-2	22.8	34.3
Mix2	82	10-5-3	24.2	35.2
Mix3	81	10-5-4	23.7	34.9

Mix4	78	10-10-2	26.4	39.6
Mix5	77	10-10-3	25.5	33.4
Mix6	76	10-10-4	23.7	32.9
Mix7	73	10-15-2	20.2	28.9
Mix8	72	10-15-3	18.2	27.2
Mix9	71	10-15-4	17.5	25.4

The above table show experimental results of different percentage combination of SCBA+FA+RHA in terms of compressive strength for M25 grade of concrete were tested at 7 and 28 days. It was observed that the compressive strength of concrete initially increased by adding SCBA+FA+RHA in percentage of 10-5-2 to 10-10-2 and then showed a considerable decline with compressive ratio of 10-10-3 to 10-15-4. Thereby leading us to conclude that maximum strength would be achieved with the addition of SCBA+FA+RHA in the ratio of 10-10-2.

3.2 Split Tensile Strength

The results of split tensile strength obtained at different ages for combinations of cement, SCBA, FA and RHA with cement have been presented in Table 3.2.

Table-3.2 Test Results of Split Tensile Strength

Split Tensile Strength Values				
S. No	**Cement (%)**	**SCBA+FA+RHA (%)**	**7Days N/mm^2**	**28Days N/mm^2**
Mix1	83	10-5-2	1.6	2.9
Mix2	82	10-5-3	1.7	3.1
Mix3	81	10-5-4	1.9	3.3
Mix4	78	10-10-2	2.1	3.8
Mix5	77	10-10-3	1.4	2.7
Mix6	76	10-10-4	1.4	2.5
Mix7	73	10-15-2	1.2	2.2
Mix8	72	10-15-3	1.1	2.1
Mix9	71	10-15-4	1.1	1.9

The above table show experimental results of different combination for split tensile strength of M25 grade of concrete tested at variable ages, It has been observed that split tensile strength to given optimum results with the combination of 10-10-2.

3.3 Flexural Strength

Table-3.3 Test results of Flexural Strength

Flexural strength values				
S. No	**Cement (%)**	**SCBA+FA+RHA (%)**	**7Days N/mm^2**	**28Days N/mm^2**
Mix1	83	10-5-2	3.1	5.9
Mix2	82	10-5-3	3.4	6.5
Mix3	81	10-5-4	3.3	6.6
Mix4	78	10-10-2	3.5	6.9
Mix5	77	10-10-3	2.9	5.6
Mix6	76	10-10-4	2.6	5.4
Mix7	73	10-15-2	2.6	5.3
Mix8	72	10-15-3	2.4	5.2
Mix9	71	10-15-4	2.2	5.1

The flexural strength results obtained at different ages for combinations of cement, SCBA, FA and RHA have been presented in Table 3.3.

4. DISCUSSION OF RESULTS AND CONCLUSION

- It was observed that the optimum dosage of SCBA was 10% in the given materials for M25 grade of concrete.
- After analyzing results for Compressive, Split tensile and flexural strength of 7 and 28 days, it can be concluded that optimum combination of 22% with breakup of 10-10-2 (SCBA+FA+RHA) proved to be more viable and feasible for the present grade of concrete.

- The experimental results of different percentage combination of SCBA+FA+RHA for compressive strength of M25 grade of concrete initially increased by adding SCBA+FA+RHA in the combination 10-5-2 to 10-10-2 and then showed descending trend.
- The experimental results of different percentage combination of SCBA+FA+RHA for split tensile and flexural strength of M25 grade of concrete initially increased by adding SCBA+FA+RHA in the combination 10-5-2 to 10-10-2 and then decreases probably due to higher dosage of non reactive finer particles.
- As mentioned previously the overall experimental methodology implemented in research work trend towards eco-friendly and techno-economical aspects. Although the cost of concrete using the combination of SCBA+FA+RHA may increase, but the whole exercise of utilizing the SCBA+FA+RHA, in the concrete would save depletion of environment to a greater extent and thus this methodology can further achieve the dividends as all the materials used are eco-friendly.

5. RECOMMENDATIONS

- The depleting trends of the natural source of cement can be reduced to a greater extend by making it sustainable in the judicious use of future generation.
- The optimum compressive, flexural and split tensile strength of the concrete can be achieved with the addition of 22%. Combination of SCBA+FA+RHA for achieving M25 grade of concrete and using Ordinary Portland cement.
- Trials using the same combination of SCBA+FA+RHA can be tried for achieving concrete of higher grades with appropriate modification as per field conditions.

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