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EXPERIMENTAL STUDY OF SUGARCANE BAGASSE ASH BLEND & ITS APPLICATION IN M-30 GRADE OF CONCRETE FOR MODERATE EXPOSURE CONDITIONS

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Abstract - *Conventional concrete is responsible for amount of carbon-dioxide emission to some extent. So to reduce the emission, various types of concrete are developed using waste products from industries and agricultural use like blast furnace slag, rice husk, fly ash which requires low amount of energy and also cause least harm to the environment. Bagasse Ash generated in Sugar industries after burning bagasse it creates disposal problems, when bagasse ash is disposed in open environment it causes various health problems which has led to urgent ways to handle bagasse ash. As Bagasse ash possess pozzolanic property as that of cement it was partially replaced with cement for 10%,20%,30%, and 40% for M30 grade of concrete and also examined for concrete properties like workability, compressive strength, split tensile and Flexural strength. After obtaining results for above tests 10% replacement proved optimum replacement.*

Key Words: Fly Ash, SBA, Carbon Dioxide, Split Tensile, Sugar Factory.

1. INTRODUCTION

Development of world is mainly based on the infrastructure of various nations in large scale. Increase in infrastructure leads to use of various material during construction which also have disadvantage in some extent.

Ordinary Portland cement (OPC) is recognized as one of main construction material used worldwide. In today's world, global warming is increasing due to rate of carbon-dioxide (CO_2) emission through various materials, in which cement is also one component which emits 5-8% CO_2. When cement and water are considered individually they do not contain individual strength nor they can act as binder, but when they are mix together for a purpose at that time calcium oxide (CaO) and silica oxide (SiO_2) react with water to form Calcium Silica Hydroxide gel (C-S-H) which brings strength to the mixture. As it is exothermic reaction, heat is generated which is known as heat of hydration. When this reaction exists the emission of carbon-dioxide takes place which contributes in GHG phenomenon.

When the studies was carried out it was identified that partial replacement of cement can be done using various pozzolanic materials. Pozzolanic material contains high amount of silica, addition of these materials helps silica (SiO_2) to react with free lime released during heat of hydration which reduces carbon-dioxide emission. Industrial waste such as fly ash, blast furnace slag, silica fume contains pozzolanic properties, in addition agricultural wastes also contains high amount of pozzolanic properties in rice husk ash, wheat straw ash and sugarcane bagasse ash.

Sugarcane is a major crop grown in about 115 countries which has production 1600 million tonnes yearly. India produces 300 million tonnes of sugarcane per year. A thousand tonne sugar cane produce 26% of bagasse and 0.62% of bagasse ash. This ash is produced by controlled burning of sugarcane bagasse above 120^{o}C and below 800^{o}C. After burning bagasse it gives amorphous silica which has pozzolanic properties.

Bagasse ash contains around 68.82% of silica which helps to reduce carbon emission after reacting with cement and it also contains sugar in some amount which is responsible for increase in strength. Therefore it is possible to use Sugarcane Bagasse Ash (SBA) as partial cement replacement material to improve quality, strength and reduce cost of construction.

1.1 MATERIALS & METHODS:

CEMENT: Cementitious material used was OPC 53 grade, Is the main ingredient used in for bonding of concrete. The usage of other cement is possible but depends on local availability. Supplementary cementitious material is replaced with bagasse ash at about 10% 20% 30% 40% with cement. The test conducted on cement are initial setting time, final setting time, soundness, specific gravity test.

FINE AGGREGATE: Fine aggregates used were available on site and are tested, the results are as per Indian standards BIS: 383: 1970. Specific gravity of fine aggregate is 2.94. These are used in replacement to river sand. Use of fine aggregate improves the compressive strength of concrete. The aggregates to cement ratio usually varies between 4:1 to

5:1. Use of fine aggregates provides better bonding or interlocking of both fine and coarse aggregates.

COARSE AGGREGATE: 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 specific gravity of coarse aggregate is 3.09. Aggregates should be kept moist or wet when high temperature is expected, If wet aggregates are used absorption and moisture must be considered. Improper amount of free water can lead to excess drying or improper compaction. Adversely too much of water will make the paste or mortar too thin and improper bond between aggregates and allowing paste/mortar seepage. The paste/mortar will result in lower permeability rates of system.

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

Sugarcane Bagasse Ash:

Sugarcane bagasse ash which is obtained after burning of sugarcane it is a waste product which can be useful as partially replacing cement due various chemical property. Bagasse ash was collected from Ajinkyatara Sahakari Sakhar Karkhana Ltd; Satara in Maharashtra state of India. Bagasse ash contains 40-50% moisture at the time of collection from factory. Bagasse is by product which burnt to generate power required for different activities in factory.

Use of sugarcane bagasse ash as a replacement material to cement improves the quality and reduce the cost of construction. Sugarcane Bagasse Ash (SBA) is used as mineral admixture as it has high silica content, thereby helps in increasing the strength of concrete. Reduces the setting time of concrete as it has some properties of admixture due to presence of sugar content in SBA. The chemical properties of Sugarcane bagasse ash are as follows:

Table No.:- 1.1 Chemical properties of sugarcane bagasse ash

CHEMICAL COMPOUND	ABBREVIATION	% CONTENT
Silica	SiO_2	68.42
Aluminium Oxide	Al_2O_3	5.812
Ferric Oxide	Fe_2O_3	0.218
Calcium Oxide	CaO	2.56
Phosphorous Oxide	P_2O_5	1.28
Magnesium Oxide	MgO	0.572
Sulphide Oxide	SO_3	4.33
Loss on Ignition	LOI	15.90

Source:- As per data supplied by Sugar Factory

2. EXPERIMENTAL DETAILS

In this experiment number of cubes, beams and cylinders were 45, 30 and 30 respectively. The size of the moulds of cubes, beams and cylinder were 150x150x150 mm, 150x150x700 mm and 150x300 mm respectively. The mix design was made using IS 10262-2009 for M30 grade concrete in which mix proportion was 1:1.91:2.42 for 1m^3 concrete. Water cement ratio used was 0.38. SCBA was partially replaced in concrete by 0%, 10%, 20%, 30% & 40% by the weight of cement. Compaction of concrete specimen was done using hand compaction and vibrator. The specimens were removed after 24 Hrs. from the time of casting and kept in curing tank for 7, 28, 90 days for cubes & 28, 90 days for beams and cylinders.

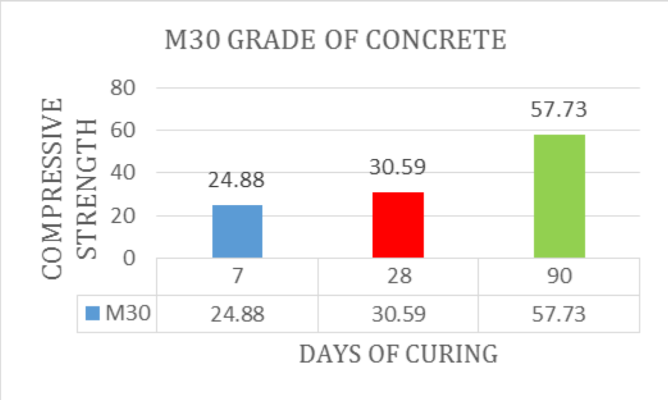
Compression test for cubes were conducted on Compression Testing Machine (CTM) of capacity 2000kN. Flexural and splint tensile test were conducted on Universal Testing Machine (UTM) of capacity 600KN.

Fig No.:-2.1 Showing final finishing of casted cubes

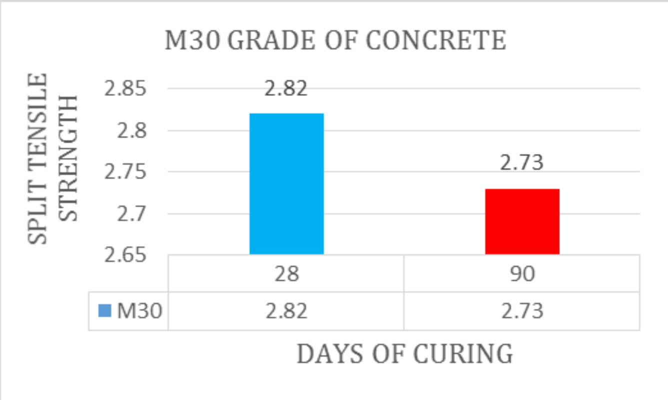
3. RESULTS & DISCUSSION

After casting and testing M30 grade of concrete specimens for compressive, split, flexure strength was carried out. Results for compressive are shown in graph compressive strength for 20% has highest strength which has 29.40% strength to ordinary. In split tensile test, strength of 10% replacement was 2.75 more than ordinary concrete. For flexure strength 20% replacement has highest strength with 7.60% increase in strength as compared to ordinary concrete.

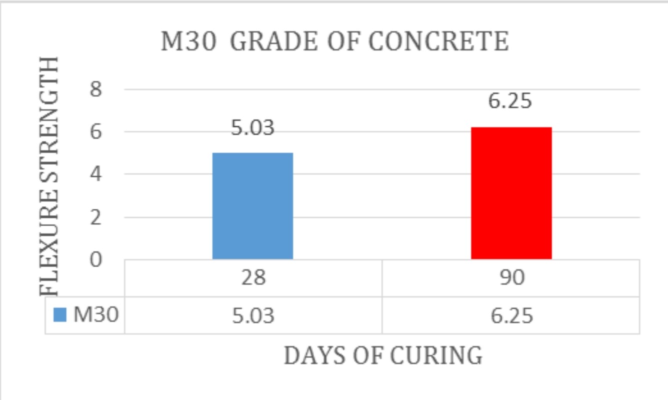
The results of ordinary and replacement of bagasse ash are as follows:



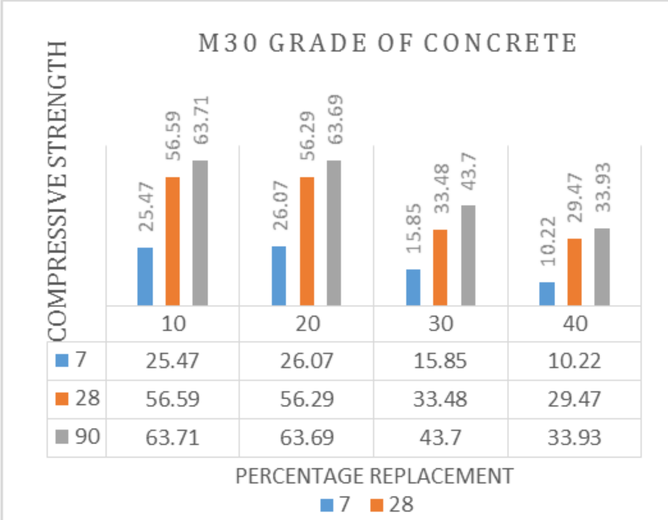
Graph No. 3.1:- Showing results for M30 grade of ordinary concrete for compressive strength



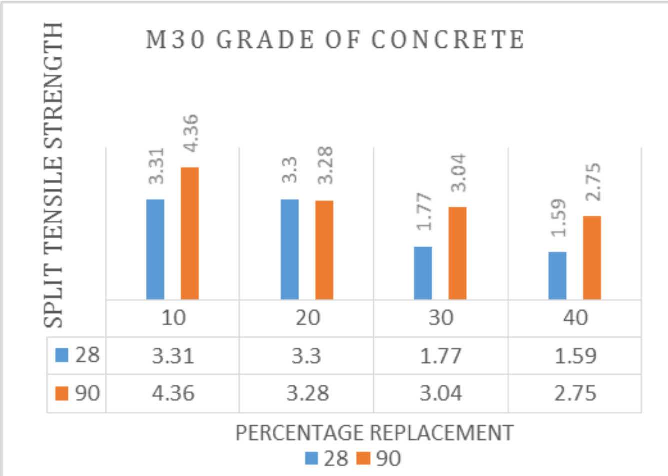
Graph No.3.2:- Showing results for M30 grade of ordinary concrete for split tensile strength



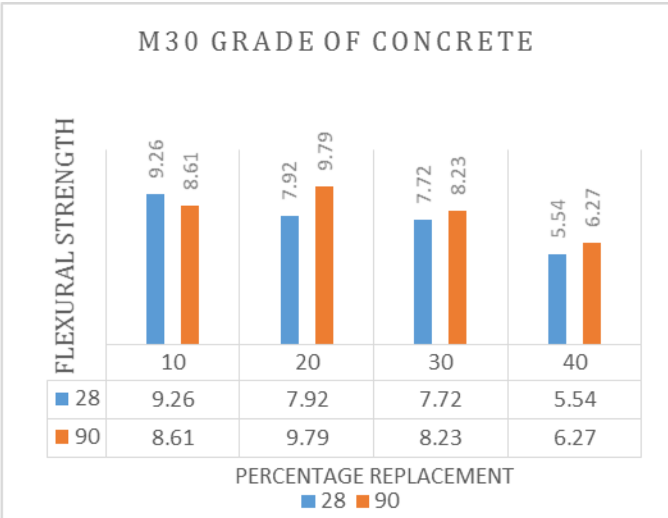
Graph No. 3.3:- Showing results for M30 grade of ordinary concrete for flexural strength



Graph No. 3.4:- Showing results for M30 grade of concrete for various % replacement for compressive strength



Graph No. 3.5:- Showing results for M30 of concrete for various % replacement for split tensile strength



Graph No. 3.6:- Showing results for M30 grade of concrete of various % replacement For flexural strength

4. CONCLUSION

The results shows that Sugarcane Bagasse was added in M30 grade concrete in 10%, 20%, 30%, 40% replacement from this experimentation we have obtained various results of compressive strength, split tensile strength and flexure strength was increased at 10% for M30 grade concrete as compared to ordinary concrete. SBA partially in concrete increase the workability of concrete as compared to ordinary concrete. The compressive strength of concrete is achieved at 7th day as compared to ordinary one. The results for compression concluded that SBA can be used partially in concrete at 10% replacement.

It was seen that due to use of artificial sand in concrete the strength achieved was less due to the brittle property of artificial sand for split tensile. Use of SBA in concrete also reduces overall co_2 emission from concrete which is satisfactory. As the workability of concrete is increased therefore use of super plasticizer is not essential. Concrete mix can be made effective using the sugar industrial waste as it provides to be cheaper or economical for the cost of construction. It reduces of about 10% cost for 1m^3 concrete production. Utilization of sugarcane bagasse ash in concrete also overcomes the problem of the disposal of the waste produced by the sugar industries. Due to the light weight property of the bagasse ash the density of the concrete mix is reduced.

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