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EXPERIMENTALINVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT BY SUGARCANE BAGASSE ASH

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ABSTRACT

We are aware that a lot of damages done to environment in the manufacture of cement. It involves lot of carbon emission associated with other chemicals. The researches has shown that every one ton of cement manufacture releases half ton of carbon dioxide, so there is an immediate need to control the usage of cement. On the hand materials wastes such as Sugar Cane Bagasse Ash is difficult to dispose which in return is environmental Hazard. The Bagasse ash imparts high early strength to mortar and also reduce the permeability of mortar. The Silica present in the Bagasse ash reacts with components of cement during hydration and imparts additional properties such as chloride resistance, corrosion resistance etc. Therefore the use of Bagasse ash in concrete not only reduces the environmental pollution but also enhances the properties of mortar and also reduces the cost. It makes the mortar more durable. This project mainly deals with the replacement of cement with Bagasse ash in fixed proportions and analyzing the effect of HCl on SCBA blended mortar. The mortar mix designed by varying the proportions of Bagasse ash for 10%, 20%, 30%, the cubes are been casted and cured in normal water and 5% HCl solution for ages of 7, 14, 28 days. The test result indicate that the strength of mortar increase in adding 5% Sugarcane Bagasse Ash (SCBA) replacemen wuth cement.

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CHAPTER1

INTRODUCTION

GENERAL

An essential component of mortar includes, fine aggregate, river sand being most commonly used. Due to the extensive use of mortar, the demand of cementisquitehighindevelopedcountriesowingtoinfrastructuralgrowth.The growth of construction industry is affected by the insufficient quantity of ordinary cement used for making mortar. In Tamil Nadu, government has imposed restrictions on used large amount of cement due to unsafe impacts threatening many parts of the state. This project reports on the result of an investigation of utilization of SCBA. The use of this waste material in cement is cost effective as well as an environment-friendly to dispose of waste. In thiscase studies are needed to study the performance of mortar using Sugarcane Bagasse as a cement replacement material.

Increase in the waste quantity for disposal possess acute shortage of dumping sites, sharp increase in the transportation and dumping costs affecting the environment and preventing sustainable development. The problemof waste disposal is becoming serious in the present work. The aim is to develop a new building material from granite scraps (an industrial waste) as replacement materials in mortar. By doing so, the objective of reduction of cost of construction can be met and it will help overcome the problem of region. Substitution of alternative materials can result in changes in the performance characteristics that may acceptable for high performance mortar.

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Cement **SugarcaneBagasse** **SugarcaneBagasseAsh**

Fig1.1ProcessofmakingSugarcaneBagasseAsh MATERIALS REQUIRED

FOR CASTING

1) Cement:

The most common cement used is an Ordinary Portland Cement (OPC). The Ordinary Portland Cement manufactured by SHANKAR CEMENT was used for the experiment. Portland cement is most common type of cement in general use around the world because it is a basic ingredient of concrete, mortar and most non–specially grout. It is manufactured in the form of different grades. OPC is manufactured by burning siliceous materialslikelimestoneat1400˚Candthereaftergrindingitwithgypsum.

Properties	**Obtained Values**	**Requirementsasper IS:8031-1988**
InitialSetting time	30mins	Notlessthan30min
Finalsettingtime	600mins	Notmorethan 600mins
Fineness Consistency	32%	25%to35%
Specificgravity	3.14	3.12-3.19

Table1.1:PropertiesofCement

2) SugarcaneBagasseAsh(SCBA):

SugarcaneBagasseAsh(SCBA)isusedasanadditiveincementhaving sieved with 90 micron size.

BasictestswereconductedonSCBAsuchassieve,specificgravity.

3) Fineaggregate:

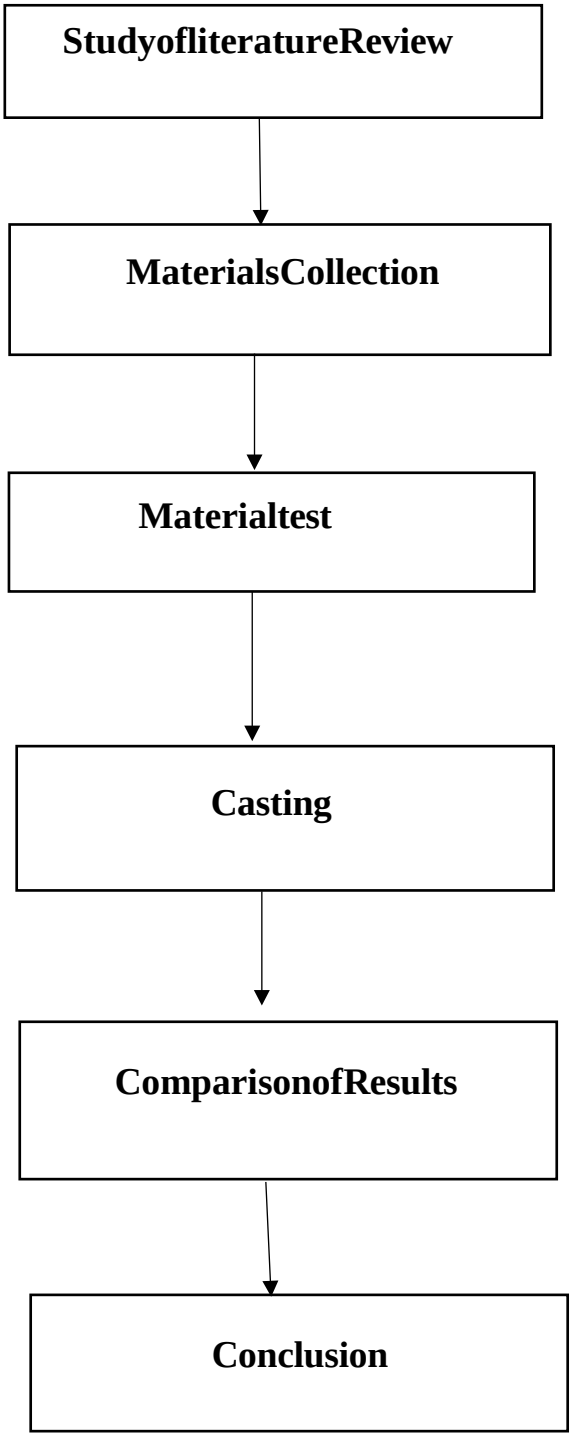
Sand is the naturally occurring granular material composed of finely dividedrockandmaterialparticles.ThecompositionoftheSandishighly variable,depending on thelocal rocksources andconditions,butthe most common constituent of the and in land continental settings and non- tropical coastal settings is silica usually in the form of quartz. Locally available natural Sand with 2.36mm size was used as fine aggregate in thisproject.Thesandissievedtoremoveallpebblesandimpuritiesinthe soil.

4) Water:

Ordinary portable water of good quality was used for casting of specimens. It should free from alkalis, organic matter and any other dissolved salts.

CHAPTER – 2

METHODOLOGY



CHAPTER – 3

LITERATUREREVIEW

1. IJCSE-InternationalJournalofCivil&StructuralEngineering Research Piyushkumar, Anil Pratapsingh (2015):

They studied on "Effect of use of Bagasse Ash on Strength of Concrete", with increasingdemand and consumptionofcement,researchersandscientistareinsearch of developing alternate binders that are eco friendly and contributes towards waste management. In these papers SCBA has been chemically and physicallycharacterized and partially replaced in the ratio of 0%, 5%, 10%, 15% & 20% by weight of cement in concrete. The properties for fresh concrete are tested like slump cone test and for hardened concrete compressive strength at the age of 7& 28 daysbyusing grade M30. The test results indicate that the strength of concrete increase up to 10% SCBA replaced with cement.

2. IJSLE-InternationalforServiceLearningInEngineeringR Shrinivasan and K. Sathiya (2010):

They studied on "Experimental Study on Bagasse Ash in Concrete". The utilizationof industrial and agricultural waste produced by industrial processes has been the focus of waste reduction research for economic, environmental, and technicalreasons. Sugar-cane bagasse is a fibrous waste-product of the sugar refining industry, along with ethanol vapour. This waste product (Sugar-cane Bagasse ash) is already causing serious environmental pollution, which calls for urgent ways of handling the waste. Bagasse ash mainly contains aluminium ion and silica. In this paper, Bagasse ash has been chemically and physically characterized, and partially replaced in the ratio of 0%, 5%, 15% and 25% by weight of cement in concrete. Fresh concrete tests like compaction factor test and slump cone test were undertaken was well ashardened concrete tests like compressive strength, split tensile strength, flexural strength and modulus of elasticity at the age of seven and 28 days was obtained. The test result indicate that the strength of concrete increase up to 15% SCBAreplacement with cement.

3. SiriratJanjaturaphanandSupapornWansom(2010):

Theystudiedon,"ThePazzolonicActivitiesofIndustrialSugarCaneBagasseAsh".

Theyfind out the chemical composition ofthe Sugarcane Bagasse Ash and compared them with the other pazzolonic material that is, rice husk ash and concluded that the SCBA is suitable for the partial replacement of cement.

4. D.Mukharjee(2011):

He has Study made on "Utilization of SCBA". They described the various uses of SCBA in agriculture, construction, use of bagasse as fertilizers; in horticulture etc. their chemical and other fertilizing properties etc. also gave various options for utilizingbagasseashinvarious fields.Ashes obtained aftercontrolburningof SCBat 600oC/5hour were reasonably reactive given by the fact that little crystallization of minerals occurred. Morphological, XRD and TGA/DTA study of the blended pastes confirmed the hydration reaction of SCBA within the cement gel. Compressive and flexural strength tests confirmed the actual behavior of SCBA blended mortars and it suggested that up to 15% substitution of OPC with SCBA can be made with better strength results than that with pure cement.

5. KMeeravali,KVGDBalaji,T.SanthoshKumar(2014):

They studied on, "Partial Replacement of Cement in Concrete with Sugar Cane Bagasse Ash-Behaviour in Hcl Solution". In this paper concrete cubes are castedwith different percentages of Sugarcane Bagasse ash replaced with cement by weight (i.e. 0%, 5%, 10%, 15%, 20%, and 25%), and this cubes are exposed to 5% HCL environment. Compressive strength of cubes for 7days, 28 days and 60 days are observed. Having gone through above literatures, it has been found that several researchers studied the effect of SCBA with their thermal and mechanical properties on concrete. Higher grade of concrete was considered as a base sample for above all research.Soanattempthasbeenmadetofindoutthe%ofSCBAtobeaddedtoM20 grade concrete in order to increase its strength and make it competition with higher grade concrete with maintaining the economy of work.

6. Sagar W.Dhengare, Dr.S.P.Raut, N.V.Bandwal, Anand Khangan(2015);

They Studied on, "Investigation into utilization of Sugarcane Bagasse Ash as Supplementary Cementations Material in Concrete". This paper presents the use of sugarcane bagasse ash (SCBA) as a pazzolanic material for producing high-strength concrete.Theutilizationofindustrialandagriculturalwasteproducedbyindustrial

processes has been the focus on waste reduction. Ordinary Portland cement (OPC) is partially replaced with finely sugarcane bagasse ash. The concrete mixtures, in part, are replaced with 0%, 10%, 15%, 20%, 25% and 30% of SCBA respectively. In addition, the compressive strength, the flexural strength, the split tensile tests were determined. The bagasse ash was sieved through No. 600 sieve. The mix design used for making the concrete specimens was based on previous research work from literature. The water –cement ratios varied from 0.44 to 0.63. The tests were performed at 7, 28, 56 and 90 days of age in order to evaluate the effects of the addition SCBA on the concrete. The test result indicate that the strength of Concrete increaseupto15%SCBAreplacementwithcement.

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CHAPTER – 4

EXPERIMENTALINVESTIGATION

4.1 MATERIALTESTINPROCEDURE

Thebasicmaterialtestwascarriedoutforcementandfineaggregate.

CEMENT

ConsistencyTest

Theamountofwaterisneededtoprepareaplasticmix.

- Take400gof cement
- Mixitwith28%ofwater
- Nowputthemixinthemouldofthe aggregate
- Fixtheplungerofsize10mmdiameterand50mm length.
- Nowletoffthepinandnotethereading
- Continuetheprocedureuntilwegetthereaddingbetween5-7cm
- SothatistheconsistencypercentageoftheCement.

4.2.2Specificgravitytest

- Weighthespecificgravitybottledry(W1).
- Fillthebottlewithdistilledwaterandweighthebottle (W2).
- Dry the specific gravity bottle and fill it with kerosene and weigh (W3).
- Pour some of the kerosene out and introduce a weighted quantity of cement (say about 60 grams) into the bottle.
- Roll thebottlegentlyin theinclined position until no furtherair bubble rise to the surface. Fill the bottle to the top withkerosene and weigh it (W4).

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SPECIFICGRAVITYOFCEMENT

$$\text{Specificgravity} = \frac{\text{weightofsolidmaterialexcluding pores}}{\text{Weight of equal volume of gas free distilled water}}$$

Specific gravity = 3.14

4.2.3.Finenesstest

- Take100gof Cement.
- PuttheentiresieveinthesieveshakerandputtheCementon the top of the sieve.
- Nowrotatethesieveshakerforabout 15minutes.
- Nowremoverthesievefromthe sieveshakerandweighthe amount of Cement retained on the IS Sieve.

Fine Aggregate

Finenessmodulustest

- Take1kgof Sand.
- ArrangethesievesizefromIS4.75mmsieveto IS150microns in descending order.
- PuttheentiresievesinthesieveshakerandputtheSandonthe top of the sieve.
- Nowrotatethesieveshakerforabout 15minutes.
- Nowremoverallthesievesfromthesieveshakerandweighthe amount of sand retained on each of the IS Sieve.

Specificgravitytest

- Weightheemptypycnometerdry(W1).
- FillthepycnometerwithSand(W2).
- Fillthepycnometerwithsandandintroducethewaterintoit and weigh (W3).

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- Drythepycnometerandfillitwithdistilledwaterandweigh (W4).

SPECIFICGRAVITYOFFINEAGGREGATE

Specificgravity= weightofsolidmaterialexcludingpores

Weightofanequalvolumeofgasfreedistilled water

Specific gravity = $\frac{(W2-W1)}{(W2-W1)-(W3-W4)}$

Specificgravityofcement= 2.6

SIEVEANALYSISOFFINEAGGREGATE

ISsievesize (mm)	**Weight Retained(g)**	**Cumulative Weight (g)**	**Cumulative %ofweight retained**	**Cumulative %of passing**
10	0	0	0	100
4.75	7	7	1.4	98
2.36	10	17	3.4	96
1.18	41	58	11.6	88
600micron	66	124	24.8	75
300micron	243	367	73.4	26
150micron	243	489	97.8	2
<150micron	-	500	-	-

Finenessmodulusoffineaggregate=2.12

Table4.2.Sieveanalysisoffine aggregate

S.No	Property	Results	Permissible Limits
1	Specificgravity	2.6	2.5– 3
2	Finenessmodulus	2.12	Notlessthan1.4(conforming to IS 1542–1992)

Table4.3Propertiesoffineaggregate

PREPARATION OF TEST SPECIMENS:

- Theingredientsforthevariousmixesareweighedand prepared.
- Precautionsweretakentoensureuniformmixingofingredients.
- The specimens were casted in steel moulds and compacted by a damping rod. The specimens of 70.5×70.5×70.5 mmsize of cubes were casted for the determination of compressive strength at different ages.
- Curing of the specimen was started as soon as the top surface of the concrete in the mould got dried and was stiff.

Specimen	Size	No ofspecimen				Test
Cube	70.5×70.5×70.5mm	**0%**	**10%**	**20%**	**30%**	Compressive strength
		9	**9**	**9**	**9**	

Table4.4PreparationofTestSpecimen

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CHAPTER – 5

RESULTANDDISCUSSION

COMPRESSIVESTRENGTHTEST

Average Compression strength for 7, 14, 28 days obtained by takingaverage of 3 specimens for each day are compiled below.

While casting Sugarcane Bagasse Ash 0%, 10%, 20%, 30% of all specimen was produced in a laboratory. The proportions followed by the cement, sand, SBAand water,after24hours themoulds were removed andthespecimen were kept for curing in a moist atmosphere for 28 days and thendriedproperlybefore testing. Compression test is the most common test conducted on mortar, partly because it is an easy to perform, and partly because most of the desirable characteristic properties of mortar are quantitatively related to its compressive strength.

Compressivestrengthat 7days

Percentage	**Sample -1 Compressive strength (N/mm^2)**	**Sample–2 Compressive strength (N/mm^2)**	**Sample-3 Compressive strength (N/mm^2)**	**Average compressive strength (N/mm^2)**
0%	10.44	11.6	12.8	11.61
10%	9.76	10.3	11.2	10.42
20%	8.72	9.2	10.5	9.47
30%	7.84	8.3	9.2	8.44

Table5.1CompressiveStrengthat7days

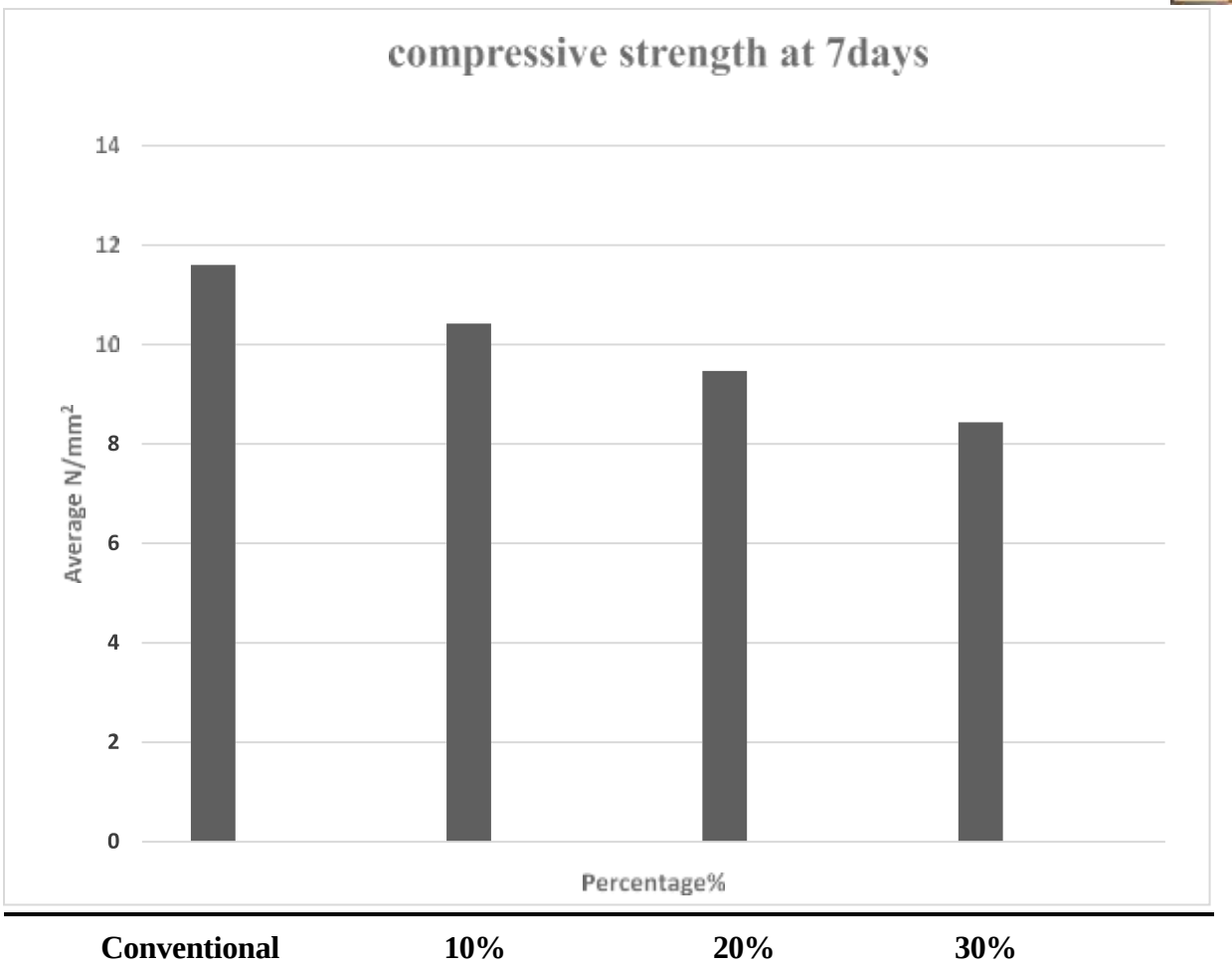

Chart5.1compressivestrengthat7days

Discussion:

From the 7 days compressive strength test results, the conventional mortar has attained of 11.61N/mm^2 and the SBA with 10% of SBA mix has attained strength of 10.42 N/mm^2. When compared to otherdosages which is nearly of the target mean strength.

Compressivestrengthat14days

Percentage (%)	Sample-1 Compressive strength (N/mm^2)	Sample-2 Compressive strength (N/mm^2)	Sample-3 Compressive strength (N/mm^2)	Average compressive strength (N/mm^2)
0%	12.6	13.2	14.5	13.2
10%	10.7	11.3	12.5	11.5
20%	9.25	10.5	11.8	10.51
30%	8.48	9.82	10.62	9.64

Table5.2Compressivestrengthat14days

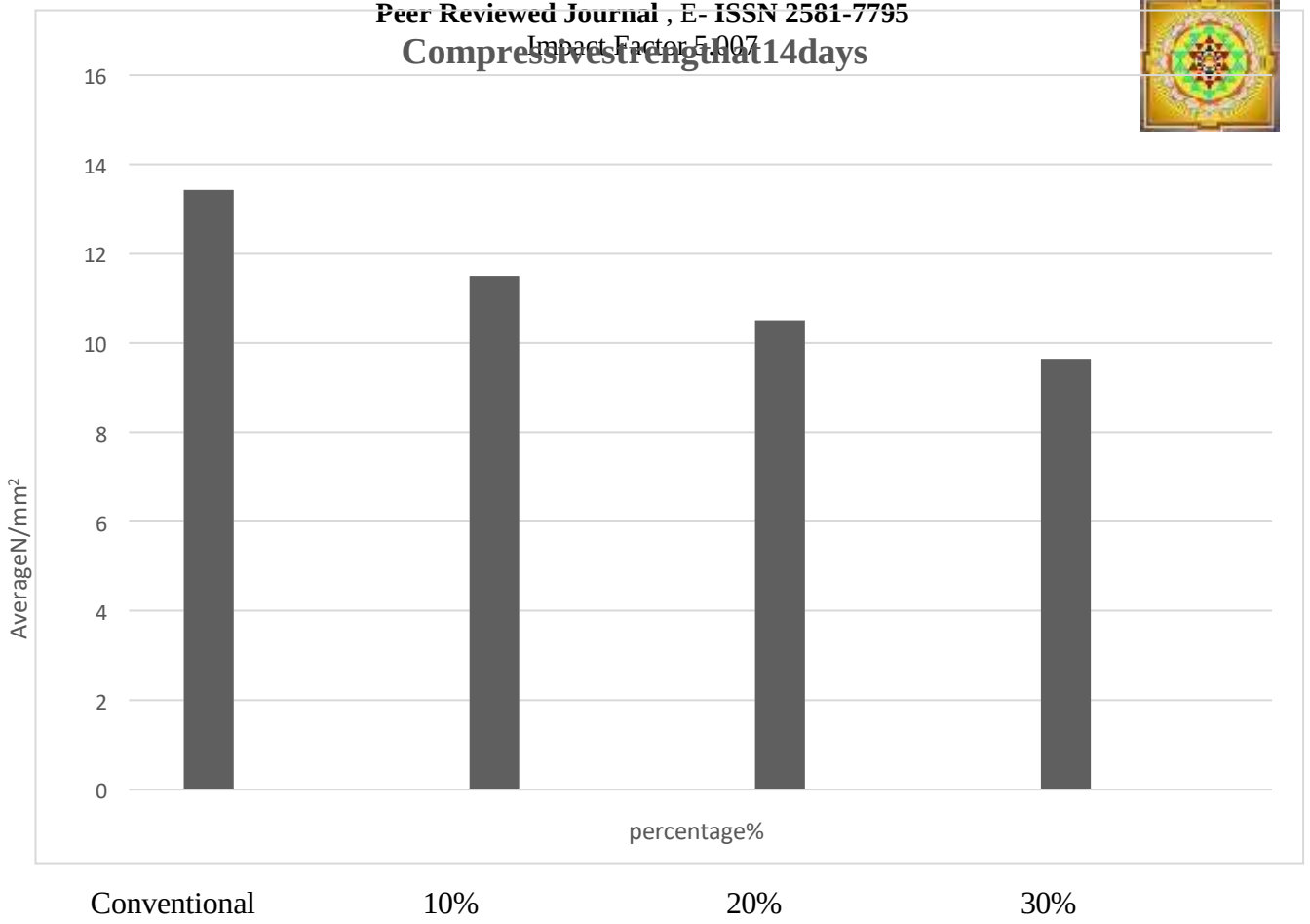

Chart5.2compressivestrengthat14days

Discussion:

From the 14 days compressive strength test results, the conventional mortar has attained of13.2N/mm^2 and theSBAwith10%of SBAmix has attainedstrength of 11.5N/mm^2. When compared to the dosage which is nearly of the target means strength.

CompressiveStrengthat28days

Percentage (%)	Sample-1 Compressive strength (N/mm^2)	Sample-2 Compressive Strength (N/mm^2)	Sample-3 Compressive strength (N/mm^2)	Average Compressive strength (N/mm^2)
0%	14.0	13.42	12.72	13.38
10%	12.5	13.2	13.9	13.43
20%	10.43	11.3	12.01	11.24
30%	9.62	10.72	11.2	10.51

Table5.3CompressiveStrengthat28days

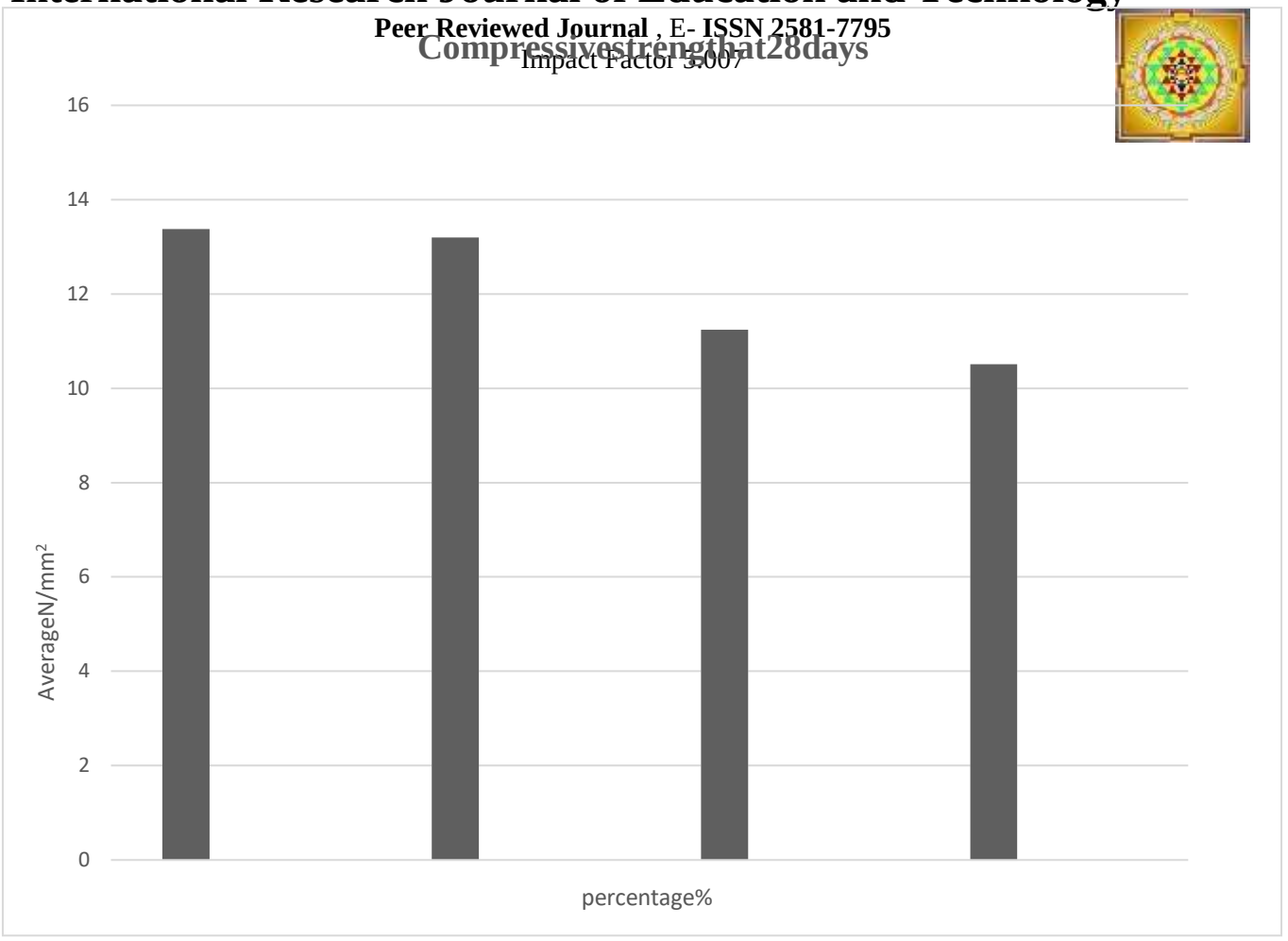

Chart5.3Compressivestrengthat28days

Discussion:

From the 28 days compressive Strength test results, the conventional mortar has attained of 13.38N/mm^{2}and the Sugarcane Bagasse with 10% of powder form ash mix has attained strength **13.43** N/mm^2.When compared to other dosages which is nearly of the target mean strength.

Fig5.1 SugarcaneBagasseAsh

Fig5.2SievedAsh

Fig:5.3Mortarmix

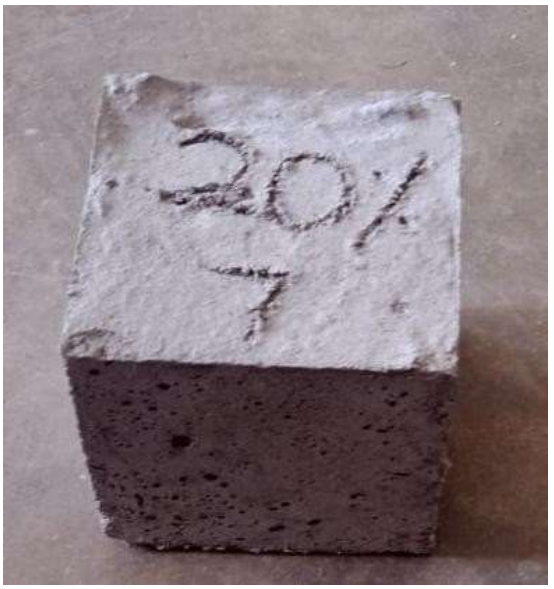

Fig5.4PreparedCubes

Fig5.5TestingofCubes

Fig5.6TestingandRecordingofvalues

CHAPTER-6

CONCLUSION

Fromthisprojectworkwecametothefollowingconclusion:

- It was concluded that the compressive strength of 10% replacement of SCBA gives high strength when compared to other proportions.
- Compressive test done after heat transfer in cubes also gave good results for SCBA cube which implies that they have good heat resistance capacity and also increases its overall strength.
- Water absorbing property of SCBA in corporate cube is less than normal mortar so that it can be used in exposed surfaces.
- SCBA can be used where the weight of structure has to be reduced as its weight is less than normal mortar.

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