International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 11 Issue 7 ǁ July 2023 ǁ PP. 344-352

Experimental Study on Sugarcane Bagasse Ash and Lime as Partial Replacement of Cement in Concrete

SONIYA.V, M.E, *Structural Engineering (Student) Arulmigu Meenakshi Amman College of Engineering,*
Vadamavandal -604 410,Thiruvannamalai Dt.

Ms.R.HARIPRABA, M.E., (Ph.D) *Assistant Professor Arulmigu Meenakshi Amman College of Engineering, Vadamavandal -604 410,Thiruvannamalai Dt.*

Dr.P.RAGUNATHAPANDIAN, M.E., Ph.D, *Professor and Head of the Department*
Arulmigu Meenakshi Amman College of Engineering,
Vadamavandal -604 410,Thiruvannamalai Dt.

ABSTRACT
A Comparative study on concrete by partial replacement of cement by sugarcane bagasse ash and lime in different percentages and expecting to achieve more strength and conventional concrete mix of M25.Fresh concrete tests as well as hardened concrete tests were undertaken. Lime concrete, produced by this mix, makes a good base for load bearing walls, columns, or laying under floors because it has a degree of flexibility that regular concrete does not. It also has a certain waterproof property to it that prevents subsoil dampness in floors and walls. Specimens of shapes namely cubes, cylinders and prisms or beams are casted in order to test the compressive strength, split tensile strength and flexural strength of concrete at an interval of 7 days, 14 days and 28 days of curing. It is obtained that the percentage of replacement of cement with 0% ,20% and 40% of sugarcane bagasse ash and lime gives the better results when compared with other percentages.

KEY WORDS *-Bagasse ash, Lime, compression strength, Flexural Strength, Pozzolanic material.*

Date of Submission: 14-07-2023 Date of acceptance: 30-07-2023

I .INTRODUCTION

Ordinary Portland cement is recognized as major construction material throughout the world. Researchers all over the world today are focusing on ways of utilizing either industrial or agricultural waste, as a source of raw material. This waste, utilization would not only be economical, but also result in foreign exchange earnings and environmental pollution control. Currently, there has been an attempt to utilize the large amount of bagasse ash, the residue from an sugar industry and the bagasse-biomass fuel in electric generation industry. When this waste is burned under controlled conditions, it also gives ash having amorphous silica, which has pozzolanic properties.

Many additives such as cement,lime, asphalt emulsions, bituminous materials, and natural and industrial byproducts have been tested to improve the mechanical properties and to enhance the durability of the compacted blocks. In view of the above mentioned, several research activities have been directed towards partial or total substitution of Portland cement by pozzolanic binders, e.g. lime, fly ash, and natural pozzolans among others.

The purpose of this paper is to investigate the replacement of cementwith lime in the production of normal weight concrete with the express objective ofreducing the waste material. In environmental terms, lime does not generate as much CO2 in its production as does the production of Portland cement. Lime has been used as the basis for the pozzalonic material in concrete for thousands of years. Portland cement's development in the late eighteenth century and its adoption as the primary pozzalonic material in concrete resulted in the displacement of lime as the primary cementitious material. Lime has a number of properties that are of interest in the development of long term durability of materials, particularly the slow carbonation rate and resulting self-healing properties. This paper deals with the physical strength properties of concrete when the Portland cement is replaced with hydrated lime of varying proportion

II.LITERATURE REVIEW

1. Divyadevi Sundaravadivel et al.,(2018)

Studied in this article, the explanation and the major description of Sugarcane Bagasse ash (SCBA) have reviewed. This paper investigates the various process involved in the SCBA. This paper provides a historical point of view on the explanation and use of SCBA as a mineral admixture. This paper focuses on the mechanical and durability properties of SCBA in concrete and mortar.

2. A.S. Vijay Vikram et al.,(2017)

This project paper at reviewing how to the utilization of solid waste, which is generated from manufacturing of sugar factories and also replacing the coarse aggregate by using the sintered earth blocks, these materials is the generated in huge quantities in India. It's highly rich in silica content that can play the major role of an effective pozzolan materials leading to enhanced the cementitious materials is suitable for binding materials in building construction for various mixes of concrete. Sugarcane bagasse ash is a waste of product materials are used for feasible and cost effective solutions in waste management. For various literature reviews on the dif erent replacement percentage of cement along with the dif erent percentage of coarse aggregate for various mixes showed the better strength enhancement without af ecting the durability. Nowadays waste materials are utilized in the preparation of conventional concrete for suitable for mass construction. In the present work, this type of waste materials considered is the third largest material consumed by human begins after food and water. Cement manufacturing industry is one of the CO2 is emitting sources besides deforestation and burning of fossil fuels. To summarize, sugarcane bagasse ash not only has improved performance in most of the cases but also has reduced the cost of the material, leading to the conclusion that its suitable for mass concrete is a genuine and extremely useful solution for waste management as well as cost economy.

3. P. Kasinatha Pandian et al.,(2017)

Valorisation of solid wastes in the manufacture of soil based building materials is one of the several technically feasible and cost-effective solutions for waste management. Sugarcane bagasse ash is one such solid waste generated in huge quantities in India, a leading sugar producer. This paper aims at reviewing the valorisation of sugarcane bagasse ash in the manufacture of stabilized as well as sintered earth blocks. Sugarcane bagasse ash is a silica rich material that can play the role of an effective pozzolan leading to enhanced pozzolanic reactions resulting in better performing building materials. The reviewed literature reveals that it has been utilized in the manufacture of blocks as well as tiles in the form of an auxiliary additive as well as a primary stabilizer. However, its utilization in stabilized blocks has been more common compared to sintered blocks due to higher energy consumption in the latter. To summarize, sugarcane bagasse ash not only has improved performance in most of the cases but also has reduced the cost of the material, leading to the conclusion that its valorisation in manufacture of blocks and tiles is a genuine and highly productive solution for waste management as well as cost economy.

4. Mr. G. Siva Kumar et al., (2013)

Studied on "Preparation of Biocement using Sugarcane bagasse ash and its Hydration behaviour". In this study they had used as partial Replacement in ordinary Portland Cement (OPC) by 10% weight. Compressive strength of the sample was carried out and reported that the cementious material in sugar cane bagasse ash is responsible for early hydration. The pozzolanic activity of bagasse ash results in formation of more amount of C-S-H 21 gel which results in enhances the strength, and hence bagasse ash is a potential replacement material for cement.

5. Mr. H.S. Otuoze et al.,

Had investigated on "Characterization of Sugar Cane Bagasse ash and ordinary Portland Cement blends in Concrete" , The SCBA is obtained by burning Sugar cane Bagasse at between 600-700 degrees Celsius, since the sum of Sio2, Al2o3 and Fe2o3 is 74.44%, For strength test , mix ratio of 1:2:4 was used and OPC was partially replaced with 0% ,5%, 10%, 15%, 20%, 25%, 30%, 35%, 40% by weight in concrete. Compressive strength values of hardend concrete were obtained at the ages of 7,14,21,28 days. Based on the test conducted, it can be concluded that SCBA is a good pozzolana for concrete cementation and partial blends of it with OPC could give good strength development and other engineering properties in concrete. An optimum of 10% SCBA blends with OPC could be used for reinforced concrete with dense aggregate.

Higher blends of 15% and up to 35% of SCBA with OPC are acceptable for plane or mass concrete. The value fell short of meeting requirements for reinforced 22 concrete with dense aggregate because of excessive fines

from increasing SCBA and reducing Strength of bonding.

6. Mr. Lavanya M.R et al.,

Had studied on "A Experimental Study on the Compressive Strength of Concrete by Partial replacement of Cement with Sugar cane bagasse ash". The Feasibility of using sugar cane bagasse ash , a finely grounded waste product from the sugarcane industry, as partial replacement for cement in conventional concrete is examined. The test were conducted as per Bureau of Indian Standard (BIS) codes to evaluate the stability of SCBA for partial replacement up to 30% of cement with varying water cement (W/C) ratio. They showed that addition of SCBA results in improvement of strength in all cases and according o the results obtained, it can be concluded that Bagasse ash can increase the overall strength of concrete when used up to a 15% cement replacement level with W/C ratio of 0.35, bagasse ash is a valuable pozzolanicmaterial and it can potentially be used as a partial replacement for cement.

II. MATERIALS USED.

1. CEMENT

Ordinary Portland cement (53 Grade) was used for casting all the specimens. To produce fibre reinforced high performance concrete, the utilization of high strength cements is necessary. Different types of cement have different water requirements to produce pastes of standard consistence. Different types of cement also will produce concrete having a different rates of strength development. The choice of brand and type of cement is the most important to produce a good quality of concrete.
Properties of cement physical properties of the cement in the present experimental work are given below.

1.1 Physical Properties of Cement

S.NO	PROPERTY	VALUES
1.	Fineness of cement	225m^2/kg
2.	Specific gravity	3.1
3.	Normal consistency	33%
4.	Setting Time i) Initial setting time ii) Final setting time	 85 mins 240 mins
5.	Compressive strength i) 3days ii) 7days iii) 28days	 28.68 N/mm^2 40.34 N/mm^2 54.62 N/mm^2

2. FINE AGGREGATE: -

Sand conforming to Zone-II (White Sand) was used as the fine aggregate, as per I.S 383-1970. The sand was air dried and free from any foreign material, earlier than mixing. The sand which was locally available andpassing through 4.75mm IS sieve is used. The specific gravity of fine aggregatewas 2.60.

Locally available river sand conforming to Grading zone-II of IS: 383 –1970.Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm Sieve will be used for casting all the specimens.

Fine aggregate is defined as material that will pass from No.4 sieve and will, for the most part, be retained on a No. 200 sieve, for increased workability andfor economy as reflected by use of less cement, the fine aggregate should havea rounded shape.

The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a working agent. Properties of Fine Aggregate Physical properties of the fine aggregate used in the present work are given below.

1.1 Physical Properties of Fine Aggregate

S.NO	PROPERTY	VALUES
1.	Specific gravity	2.60
2.	Bulk Density (gm/cc)	1.542

3.	Fineness modulus	2.74
4.	Zone	II

3. WATER: -

Water to be used in the concrete work should have following properties: It should be free from injurious amount of oil, acids, alkalis or other organic or inorganic impurities. It should be free from iron, vegetable matter orother any type of substances, which are likely to have adverse effect on concrete or reinforcement. It should be quite satisfactory for drinking purpose which is used in mixing of concrete.

.

4. COARSE AGGREGATE : -

Aggregates generally occupy 70 to 80 percent of the volume of concrete and can therefore be expected to have an important influence on itsproperties. We have used coarse aggregate maximum size of 20 mm. They are granular materials, derived for the most part from natural rock (crushed stone or natural gravels) and sands, although synthetic materials such as slag and expanded clay or shale are used to some extent, mostly in lightweight concretes. In addition to their use as economical filler, aggregates generally provide concrete with better dimensional stability and wear resistance. Aggregate classifications are made principally for the purpose of easier identification of particular aggregate lots, or to become familiar with the different types of aggregates. There are numerous ways of classifying aggregates.

1.1 Physical Properties of Coarse Aggregate

S.NO	PROPERTY	VALUES
1.	Specific Gravity (G) (20mm)	2.74
2.	Bulk Density (gm/cc)	1.610
3.	Fineness Modulus	7.17
4.	Aggregate Impact Value (%)	25.21
5.	Aggregate Crushing Value (%)	25.22

5. SUGARCANE BAGASSE ASH

Sugarcane bagasse is a by-product from sugar industries which isburnt to generate power required for different activities in the factory. The burning of sugarcane bagasse leaves sugarcane bagasse ash as a waste, which has a confrontation property that would potentially be used as a cement replacement material. It has been known that the worldwide total production ofsugarcane is over 1500 million tons. sugarcane bagasse while the sugar recovered is about 10%, and the sugarcane bagasse leaves approximately eight% sugarcane bagasse ash (this figure rely on the great and kind of the boiler, contemporary boiler release decrease amount of sugarcane bagasse ash)as a waste, this disposal of sugarcane bagasse ash can be of significant situation. Sugarcane sugarcane bagasse ash has recently been tested in world for its use as a cement replacement material. The sugarcane bagasse ash found to improve some properties of the paste, mortar and concrete including compressive strength and water tightness in certain replacement percentages and fineness. The higher silica content in the sugarcane bagasse ash was suggested to be the main cause for these improvements. Although the silicate content may vary from ash to ash depending on the burning conditions and other properties of the raw materials including the soil on which the sugarcaneis grown, it has been reported that the silicate undergoes a confrontation reaction with the hydration products of the cement and results in a reduction ofthe free lime in the concrete.

Figure 1: Making of sugarcane bagasse ash

5 .1 Physical Properties of SCBA

S.NO	PROPERTY	VALUES
1.	Density	575 kg/m^3
2.	Specific Gravity	2.2
3.	Mean Particle Size	0.1 – 0.2 µm
4.	Min Specific Surface Area	2500 m2/kg
5.	Particle Shape	Spherical

6. LIME

Lime concrete, produced by this mix, makes a good basefor load bearing walls, columns, or laying under floors because it has a degreeof flexibility that regular concrete does not. It also has a certain waterproof property to it that prevents subsoil dampness in floors and walls.
Additionally lime concrete can be made easily and cheaply while still providing a durable. material that resists weathering and wear and tear. Utilization of industrial and agricultural waste products in the construction industry has been the focus of research for economical and environmental reasons.
In this paper, Lime sludge,a paper and pulp industry waste product, has been chemically, physically and thermally characterized, in order to evaluate the possibility of its use as construction materials. X- ray Fluorescence and X-ray diffractometry studies for the determination of composition and presence of crystalline material and Thermo Gravimetric Analysis to identify the phase transition of lime sludge, aswell as physical and mechanical properties and its pozzolanic activity have been conducted.
It is concluded that the acceptance of this waste product by theconstruction industry could be decided depending on the application, keeping in view of the limitations on the mechanical strength.

The advantages of lime are

- Lime increases the workability and plasticity of the mortar mix.
- Lime has a good water retention capacity and does not evaporate quickly. Also, dry bricks are not able to suck water from the lime mortar.
- It helps to reduce the risk of water ingress.
- Lime mortar also has a greater ability to transmit water vapour than cement-onlymixes.

Figure : 2 Lime

IV- MIX DESIGN

The mix design for M25 grade concrete were calculated according to IS10262-2019codal provisions.

1. MIX PROPOTIONS

Quantity of cement	=419kg/m^3
Quantity of Coarse Aggregate	= 1175kg/m^3
Quantity of Fine Aggregate	= 510 kg/m^3
Quantity of Water	= 208 kg/m^3
W/C	= 0.4
Mix ratio	= 1:1:2

2. CONVENTIONAL MIX DESIGN

Grade designation M25

Exposure condition Severe

Type of cement OPC 53

Workability 40-150MM

Maximum nominal size of coarseaggregate 20mm Degree of supervision Good

V- RESULT AND ANALYSIS

Figure 3: Compression Test

In this experimental program, the compressive strength of concrete containing sugar cane bagasse ash (SCBA) and Lime were investigated.
When M20 concrete with Sugarcane bagasse ash & Lime by replacing cement by 2%, 4%, 6%, 8% is compared with rain forced cement concrete, it is found that the compressive strength decreases to 18%at the end of 7 days.

Table : Result obtained after adding SugarcaneBagasse Ash & Lime

% of {Sugarcane Bagasse Ash + Lime Powder}	Modified Concrete Strenght M25 (N/ mm2)	Normal Concrete Strengh M25 (N/mm2)	CuringDays
0 %	17.45	18	7
2 %	14.12	18	7
4 %	14.35	18	7
6 %	14.67	18	7
8 %	15.39	18	7

COMPRESSION STRENGTH RESULTS OF SBA CONCRETE

% of SBA	**7 days (MPa)**	**28 days (MPa)**	**56 days (MPa)**	**90 days (MPa)**
B00%	19.84	31.08	28.89	37.32
B05%	21.09	30.88	37.62	41.45
B10%	23.82	35.04	48.44	45.12
B15%	18.20	23.84	32.71	33.98
B20%	16.22	22.35	28.26	31.36

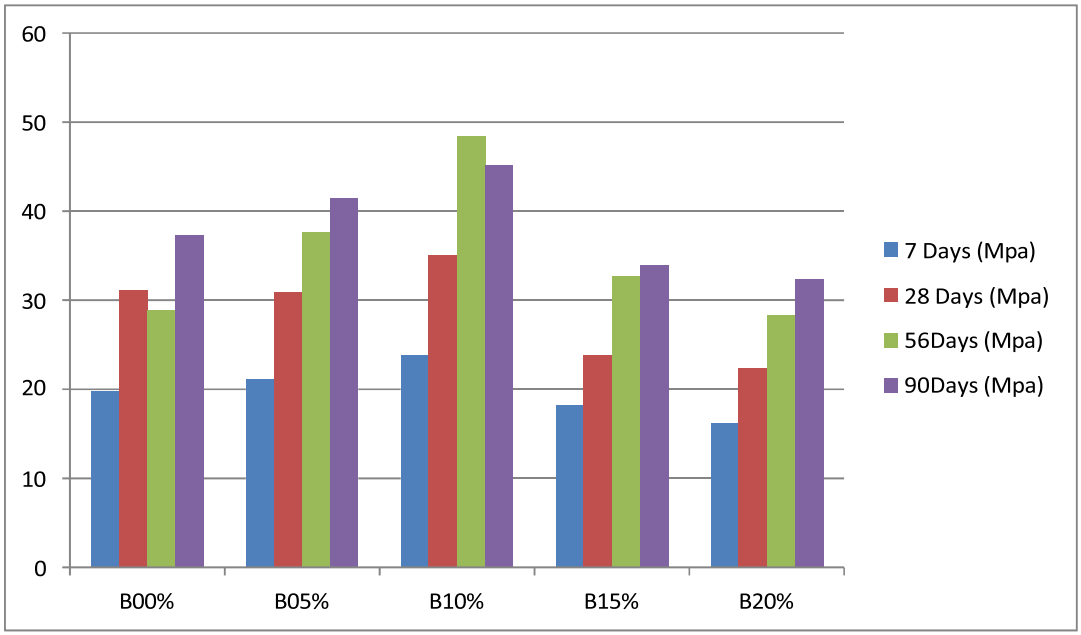

Figure 4:Compressive Strength of M_{25} Grade Concrete at Different Ages FLEXURAL STRENGTH RESULTS OF SCBA CONCRETE

% of SBA	7 days (MPa)	28 days (MPa)	56 days (MPa)	90 days (MPa)
B00%	7.05	9.32	10.21	10.84
B05%	8.15	10.13	10.66	11.06
B10%	9.23	10.51	11.28	11.82
B15%	6.34	8.86	9.32	10.06
B20%	5.83	7.75	8.65	9.16

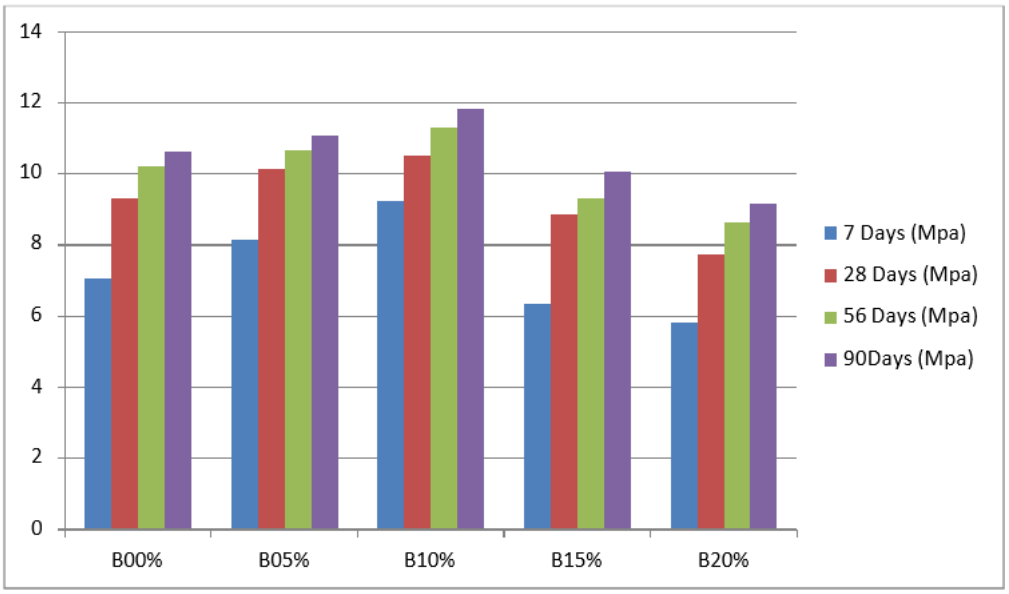

Figure 5: Flexural Strength of M_{25} Grade Concrete at Different Ages

VI- CONCLUSION

This investigation was conducted to evaluate the performance of concrete containing different percentages 0%, 20% and 40% of Sugarcane Bagasse Ash and Lime as partial replacement of cement. The compressive strength tests are conducted on the materials of concrete and the reports were given for different percentages. From the test results taken for 7th day, 14th day and 28th day of Compressive strength of concrete for various percentages (0%, 20% and 40%) of Sugarcane Bagasse Ash and Lime the maximum strength attains at the replacement of 5% Lime and 15% Sugarcane Bagasse Ash and it was found to be appropriate, economical and gives the best result for the futureuse.

REFERENCES

[1]. Amrita Kumari, Prof. Sheo Kumar, "Experimental Study on Partial Replacement of Cement by Sugaracne Bagasse Ash" Vol. 4, Issue: 07, July 2015, IJERT ISSN(Online): 2319-8753,ISSN(Print) : 2347-6710

[2]. Beulah M. Asst Professor, Prahallada M. C. Professor, "Effect of replacement of cement by metakalion on the properties of high performance concrete subjected to hydrochloric acid attack", IJERA ISSN: 2248-9622 vol.2, Issue 6, NOV-DEC 2012, pp.033-038.

[3]. BIS – IS 10262: 2009, "Indian Standard, recommended guidelines for concretemix designs", Bureau of Indian Standard, New Delhi.

[4]. Kanchana lata Sing and S.M Ali Jawaid,(August 2013) , "Utilization of sugarcane bagasse ash(SCBA) as pozzolanic material in concrete"

[5]. M.Vijaya Sekhar Reddy, I.V.Ramana Reddy, "Studies on durability characteristics of high performance concrete" International journal ofadvanced scientific and technical research, issue 2 volume 6, December 2012 ISS 2249- 9954.

[6]. Pratheba, Deepeka, Kanimozhi, Malathi, Nandhini, "An experimental study onbagasseash as partial replacement for cement in concrete"Volume:05, Issue:03| March 2018, IJRET e-ISSN: 2395-0056 p- ISSN: 2395-0072

[7]. U.R.Kawade et al., "Effect of use of cane trash ash on strength of concrete", International journal of innovative research in science, Engineering and technology.(July 2013)