ISSN 2393-8471

International Journal of Recent Research in Civil and Mechanical Engineering (IJRRCME)
Vol. 3, Issue 1, pp: (10-16), Month: April 2016 – September 2016, Available at: www.paperpublications.org

Effect of Nanosilica and Sugarcane Bagasse Ash on Strength of Concrete- A Review

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Abstract: **Nowadays the use of cement in construction work is extremely increased. Also new big problem arrived i.e. the shortage of natural resources like stones, aggregate, sand, water, etc. Huge production of cement produces foul gases causes' air pollution and increases temperature of earth. Generally the one tone production of OPC releases approximately one ton of carbon dioxide (CO_2) to the atmosphere. Sugar cane bagasse ash (SCBA) is one of the wastes produced from the sugar industry causes serious environmental problem. From past research it is found that, for conservation of natural resources and utilization of waste product the Nano- silica (NS) and Sugar cane bagasse ash (SCBA) as a supplementary material for cement to improve their strength and performance. Nano Silica has been partially replaced in ratio 2%, 4% and 6% by weight of cement in concrete[13]. Bagassse Ash has been partially replaced in the ratio 0%, 5%, 15% and 25% by weight of cement in concrete[20]. This paper includes review on the strength of concrete by using Nano Silica and Sugar Cane Baggase Ash and its different properties.**

Keywords: **Nano-Silica, Sugar Cane Baggase Ash, Compressive Strengt, Flexural Strength, High Strength Concrete, Properties of Nano-Silica and Sugar Cane Baggase Ash.**

I. INTRODUCTION

A. Baggase ash:

Sugarcane is one of the major crops grown in over 110 countries and its total production is over 1500 million tons. In India only sugarcane production is over 300 million tons/year that cause about 10 million tons of sugarcane baggase ash[20]. Sugar Cane Baggase Ash is a fibrous waste product of the sugar refining industry, along with ethanol vapor. This waste product is already causing serious environmental pollution, which calls for urgent way of handling the waste[20,21]. The rapid increase in the use of SCBA in concrete recognizing to its possitive result on physical properties of fresh concrete and harden concrete. From past research it was observed that it is possible to use sugar cane baggase ash as cement replacement material to improve quality and reduce the cost of construction materials such as mortar, concrete pavers, concrete roof tiles and soil cement interlocking block[16].

Fig. 1. Baggase Ash

B. Nano Silica:

Nano silica is produced from olivine and also is produce as a byproduct of manufacture of silicon metals and ferro- silicon alloys. There are different methods to produce NS products. One production method is based on a sol-gel process (organic or water route) at room temperature. An alternative production method is based on vaporization on silica between 1500 to 2000^{o}C by reducing quartz (SiO_2) in an electric arc furnace. Also NS can produce by precipitation method. The addition of nano silica in self-compacting concrete (SCC) mixes causes the decrease of swelling amount & increasing compressive strength. Due to nano silica swelling amount from SCC reduced by 31% as concrete age is increased [1]. Nano silica react with CH (calcium hydroxide) to produce new forms of CSH(calcium silicate hydrate) which leads to concrete having improved compressive strength and durability [13, 16]. But the major disadvantage of Nano silica is the tendency to form agglomeration during wetting &mixing. The XRD (X-ray Diffraction) analysis shows the addition of 2% of nano silica reduces the calcium hydroxide about 58% [6]. The nano silica increases the density, reduces porosity, improve the bond between cement matrixes and aggregate [7].

Fig. 2. Nano Silica

II. PROPERTIES

A. Sugar Cane Baggase Ash:

TABLE I: CHEMICAL COMPOSITION

Sr No	*Composition*	*Mass %*
1	Sio_2	78.34
2	Al_2	8.55
3	Fe_2O	3.61
4	Cao	2.15
5	Na_2O	0.12
6	K_2O	3.46
7	Mno	0.13
8	Tio_2	0.50
9	Bao	<0.16
10	P_2O_5	1.07

B. Nano Silica:

TABLE II : PHYSICAL PROPRTIES

Sr. No.	*Particulars*	*Properties*
1	Colour	White
2	Solid Content (Sio_2 – Content)	50 Wt %
3	Density	1.4 G/Cm^3
4	P^H	9.5
5	Viscosity	<15cps
6	Specific Surface Area	650 ^{2}/Gm

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TABLE III. CHEMICAL COMPOSITION

Sr. No.	***Constituent***	***Wt***
1	Sio_2 %	99.4
2	Na_2O %	0.45
3	Al_2O_3 %	0.075
4	Sulphate %	<0.1
5	Fe (Ppm)	25
6	Ca(Ppm)	10
7	Zn, Pb , Cu (Ppm)	<0.1

TABLE IV: THE STRENGTH OF SUGAR CANE BAGASSE ASH WITH DIFFERENT PROPORTION IS SHOWN BELOW AS PER RESEARCHES' DONE.

Sr. No.	***Author***	***Methodology***	***SCBA %***	***Compressive Strength(Mpa) 28 Days***	***Flexural Strength (Mpa) 28 Days***
1	R. Srinivasan Et Al.,	Experimentlal Work	0	21.47	3.46
			5	29.50	3.74
			10	24.0	3.56
			15	19.32	3.38
			20	18.85	3.18
			25	17.73	3.02
2	Prashant Modani Et Al.,	Experimental Work	SCBA %	Compressive Strength (Mpa)28 Days	Split Tensile Strength (Mpa) 28 Days
			0	22.38	4.31
			10	23.85	3.99
			20	21.9	3.87
			30	19.17	3.35
			40	14.7	3.12
3	K. Ganesan Et Al.,	Experimental Work	SCBA %	Compressive Strength(Mpa)90Days	Sorptivity X 10-6 (M/S1/2)
			0	38.45	9.76
			5	44.21	6.85
			10	44.60	3.45
			15	43.56	3.05

TABLE V. THE STRENGTH OF NS WITH DIFFERENT PROPORTION IS SHOWN BELOW AS PER RESEARCHES DONE.

Sr.No.	***Author***	***Methodology***	***Ns %***	***Compressive Strength(Mpa) 28 Days***	***Flexural Strength (Mpa) 28 Days***
1	M.Iyappan Et Al.,	Experimental Work	0	51.14	5.30
			2	58.29	5.78
			4	66.70	6.12
			6	64.80	5.98
2	Sameh Yehia Et Al.,	Experimental Work	NS %	Compressive Strength(Kg/Cm^2) 28 Days	Flexural Strength (Kg/Cm^2) 28 Days
			0	240.6	36.38
			1	305.0	43.31
			3	318.5	49.50
			5	341.2	52.88
			7	374.7	58.31
			10	336.1	53.44

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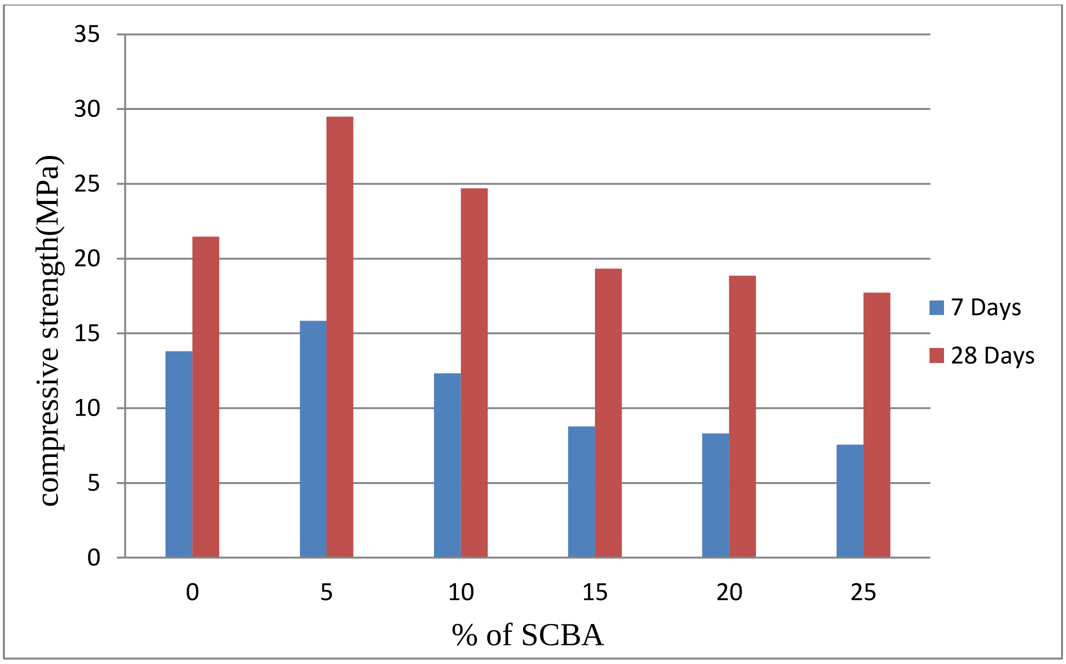
3	A.Siva Sai Et Al.,	Experimental Work M60 Grade Concrete	NS %	Compressive Strength(Mpa) 28 Days	Split Tensile Strength(Mpa) 28 Days
			0	63.64	5.75
			2	68.78	5.85
			4	47.78	3.51
4	A.Siva Sai Et Al.,	Experimental Work M70 Grade Concrete	NS %	Compressive Strength(Mpa)28 Days	Flexural Strength (Mpa) 28 Days
			0	83.64	6.32
			2	87.81	6.13
			4	66.84	3.20
5	Hongxia Yang Et Al,	Experimental Work	NS %	Dry Shrinkage Rate (X 10^{-6})	
				7 Days	28 Days
			0	38.84	100.05
			0.50	97.01	175.56
			0.75	128.93	227.18
			1.0	160.15	263.09

III. RESULTS AND DISCUSSION

A. Sugar Cane Bagasse Ash:

1. Compressive Strength:

The compressive strength of concrete varies with change in % of Sugar cane bagasse ash. Srinivasvan et.al.,[20] showed that increase in compressive strength observed up to 10% addition of SCBA. While addition of 15% of SCBA decreases the compressive strength of concrete. More effective result found at 10% addition of SCBA as partial replacement of cement.



According to research done by Modani et al.,[1] addition of 0%, 10%,20%,30% and 40% of SCBA as partial replacement of cement. The increases compressive strength of concrete up to 10% SCBA.

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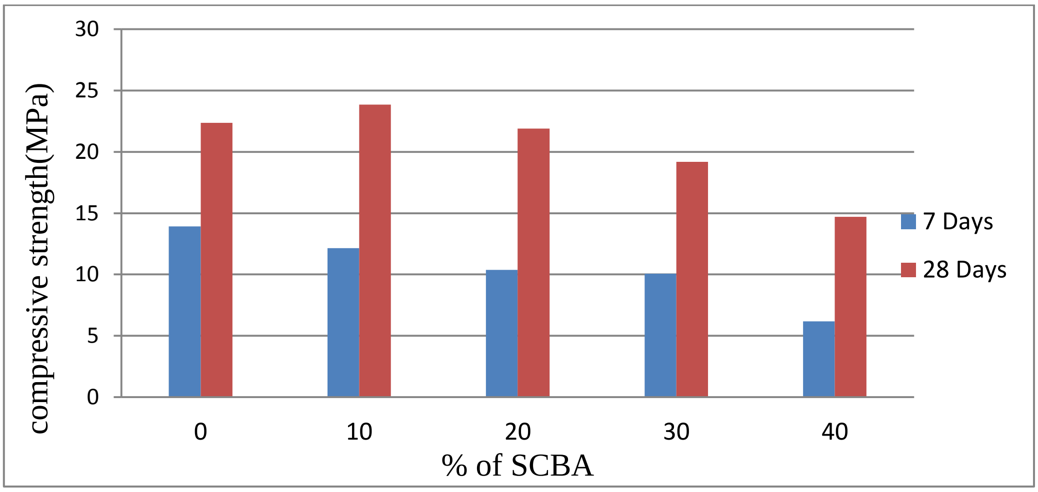
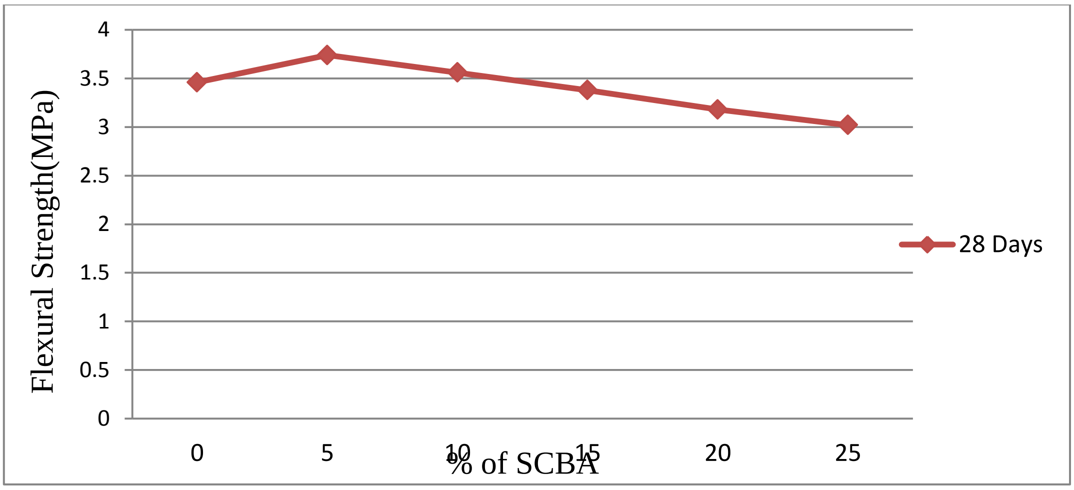


2. Flexural Strength:

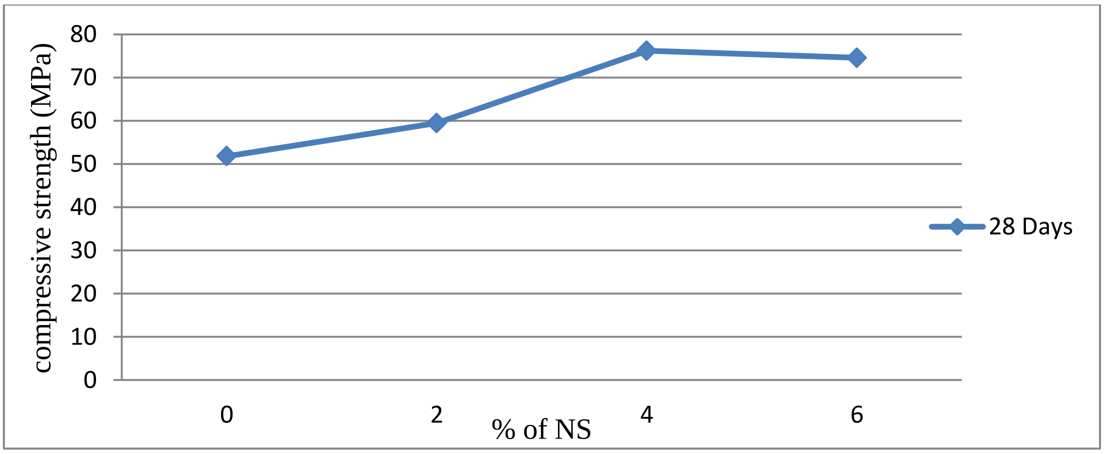
Srinivasan et al.,[20] shows that maximum flexural strength obtained at 5% addition of SCBA. More than 5% addition of SCBA reduces the flexural strength. Following graph shows increment in flexural strength.



B. Nano-Silica:

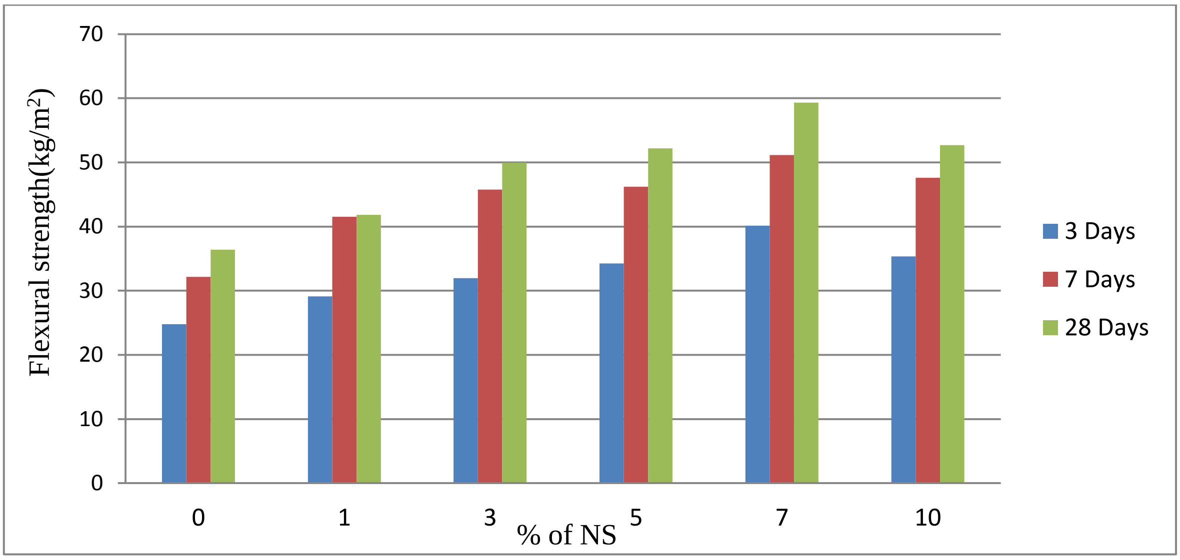
1. compressive strength:

M. Iyappan et al.,[13] has investigated that use of Nano silica in concrete improve the quality of concreting and SCC with 4% of Nano silica produce comparatively better results in both strength as well as durability.



2. Flexural Strength:

Sameh et al.,[21] shows that improvement of flexural strength for Nano silica cement mortar, which replaced by cement content equal 7% gives optimum percentage in improvement.



IV. CONCLUSION

Based on above review, the tremendous use of conventional material such as cement, aggregate and sand, future extinction may occur. Use of these conventional material has adverse effect on environment as nature is the origin of these materials. Sugar Cane Bagasse Ash and Nano Silica is waste material, cost effective. Use of 2% and 4% Nano Silica in self compacting cement, it increase in compressive strength, flexural strength, split tensile strength about 11.93%, 10.51%, 13.09% and 18%, 16.01%, 23% respectively[13]. Utilization of Nano Silica and Micro Silica in Self Compacting Concrete reduces the swelling amount by 31% and 48% as concrete age is increased[1]. It is promote that the cement could be advantageously replaced by Sugar Cane Bagasse Ash upto maximum limit of 10%[20]. The chloride resistance is the greatest when the replacement of Ground Baggase Ash increased up to 50% by weight of binder[19]. It can be use as a supplementary material for concrete to reduce environmental effect and improve their strength and performance.

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