INFLUENCE OF BAGASSE ASH AND NANO-SILICA ON STRENGTH PROPERTIES OF CONCRETE

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Abstract-***The purpose of the experimental study is to find the effect of Nano-Silica (NS) and Bagasse Ash (BA) on strength properties of concrete. The industrial by product like Bagasse Ash and Nano-Silica are utilized as a partial additional of cement. Now the current experimental study the cement is partially adding the 10% and 20% of Bagasse ash and Nano-silica 1%, 2% and 3% by mass. The impact of shared utilization of Bagasse ash and Nano-silica on compressive strength, split tensile strength and flexural strength of M25 grade of concrete is studied. The investigate test after effects of concrete prepared utilization the different extents of bagasse ash and Nano-silica are compared there upon of controlled concrete. The difference of different test results of concrete arranged with several proportions of Bagasse ash and Nano-silica shows the similar trend. Based on the test results, it may be determined that concrete prepared with 10% Bagasse ash and 2% Nano-silica mixture preserves better properties compared to the controlled concrete. The SEM analysis is carried out to know the bond characteristics in the concrete specimen.***

Keywords: *Cement, sand, Bagasse Ash, Nano-Silica, SEM, M25.*

1. INTRODUCTION

Concrete is the foremost necessary materials among the building materials in all kinds of civil engineering works. Since the variation of concrete as a building material, heap of researches and studies has been created to develop the superiority, strength and durability of it. Similar time efforts also are made to economize concrete construction compared to alternative materials.

Concrete are often thought-about because the most generally employed in the construction area. The current days construction follow together with the strength equivalent significance is gives the durability of concrete. The Indian Standard Code of practice for plain and reinforced concrete embraces the lowest cement content to delight the toughness and strength. Be that as it may, the cement manufacture expends more quantity of energy and discharges carbonic acid gas ends up in environmental effluence. Thus one amongst the answers for those challenges is to scale back the utilization of cement and Pozzolanic ingredients for the readiness of concrete. Earlier amendments indicates that the utilization of Bagasse ash, Matakaoline, GGBFS, fly ash and micro-silica as partial addition of cement, diminishes the cement utilization and conjointly will developments the toughness and strength of concrete. To boost the presentation of concrete more, nano-ingredients area unit currently existence is presented as additional ingredients.

2.OBJECTIVE OF STUDY

The purpose of this analysis work is to search out the influence of the combined application of bagasse ash and nano silica on various strength properties of concrete. To acknowledge the behaviour of concrete the cement is replaced by bagasse ash and nano silica in the proportion of 0, 10, 20% and 1, 2, 3% respectively. To accomplish this, M25 grade of concrete is used for the experimental work. To determine the compressive strength, split tensile strength of concrete and flexural strength of concrete with the addition of various proportions of Bagasse ash and Nano-silica and the determined results are compared with conventional concrete.

3. EXPERIMENTAL PROGRAMME

3.1 CEMENT

In the present investigation of 43Grade confirming to IS:8112-1989 specifications was utilized. The cement should be fresh and without lumps. The test was carried out as per Indian standard specification as shown in Table

SL No.	Properties	Test results	Limitations as per IS: 8112-1989
1	Specific gravity	3.12	2.5-3.15
2	Normal consistency (in %)	32%	28-35
3	Setting time (in Minutes) a)Initial setting time b)final setting time	45min 370min	Not less than 30mins Not more than 600mins
4	Fineness of cement	3%	10%

1.

Table1: Physical Properties of Cement

3.2 Fine Aggregate

Locally available river sand confirming to IS: 383-1970 specifications were utilized as the fine aggregate in the concrete preparation. The fine aggregate is passing through 4.75mm sieve size is utilized as shown in Table 2.

Table 2: Physical Properties of Fine Aggregates

Physical properties	Fine aggregates
Specific gravity	2.61
Water absorption	1.61%
Fineness modulus	2.62
Bulk density(kg/m^3)	1768

3.3 COARSE AGGREGATE

Coarse aggregate utilized in the study of 20mm down size locally accessible crushed stone acquired from quarries. Confirming to IS: 383-1970 specifications were used as shown in Table 3.

Table3: Physical Properties of Coarse Aggregate

Physical properties	Coarse aggregates
Specific gravity	2.67
Water absorption	0.3%
Bulk density(kg/m^3)	1505.37

3.4 BAGASSE ASH

The sugarcane bagasse ash remains consists around 50% of cellulose, 25% of hemicelluloses and 25% lignin. The residue when combustion offerings a chemical composition leads the silicon dioxide (SiO_2). Disregarding presence a fabric of onerous degradation which offerings constrained nutrients, the ash is utilized on the ranches as chemicals in the sugarcane harvests as shown in Table 4.

Table 4:Physical Properties of Bagasse Ash

Physical properties	Test results
Specific gravity	1.9
Fineness of bagasse ash	1%

3.5 NANO-SILICA

The Nano-silica utilized in this analysis is powder type. It's probably higher than the opposite pozzolanic materials owing to high content of amorphous silica (>99%) and therefore the reduced size of its spherical particles of order 10-19*nm*. During this investigational study the cement is substituted by 1%, 2% and 3% of nano silica by mass as shown in Table 5.

Table 5: Physical Properties of Nano-Silica

SL No.	Physical properties	Test result
1	Diameter of particles(nm)	19nm
2	PH	9.3-9.6
3	Specific gravity	1.08
4	Texture	Milky white powder
5	Purity percentage (in %)	99.9%
6	Specific surface(m^2/gm)	160m^2/gm

3.6 WATER

Water used for casting and curing of concrete test specimens is free from impurities that once gift will adversely influence the strength of concrete. The water utilized for each of compound and concrete curing is should to free from contaminations, harmful amounts of like acids, alkalis, oils, salts, organic matter or different substances which will be injurious to concrete.

3.7 Test Specimens

Concretetest specimens consist of 150mm×150mm× 150mm cubes, cylinders of 150mmdiameter × 300mm height and beam of 500mm×100mm×100 mm respectively. Concrete cubes and cylinders were tested different curing periods (7 and 28 days) to get compressive strength, split tensile strength. Concrete beam were also tested at the age of 28 days to obtain the flexural strength. The rate of loading is as per the Indian Standard Code specification.

4.RESULTS AND DISSCUSSION

Compression test develops a rather more complex system of stresses. Due to compression load, the cube or cylinder undergoes lateral expansion owing to the poison's ratio effect. The method adopted for finding out ultimate direct tensile strength it is almost impossible to apply truly axial load. There is always some eccentricity present. The stress changed due to eccentricity of loading. These may introduce major error on the stress developed regardless of specimen size and shapes. Concrete is relatively strong in compression and weak in tension. However tensile stresses are likely to develop in concrete due to drying shrinkage, rusting of steel reinforcement, temperature gradients and many other reasons. Therefore, the knowledge of the tensile strength of concrete is of importance all these information as coated in table 6.

Table 6: Strength criteria forcompressive Strength, Split Tensile Strength and Flexural Strength of concrete prepared with Bagasse ash (BA) and Nano-silica (NS).

S. No.	**Concrete**	**Compressive Strength (MPa)**		**Split Tensile strength (MPa)**		**Flexural Strength (MPa)**
		7 days	**28 Days**	**7 Days**	**28 Days**	**28 Days**
1	BA0%	20.44	32.44	1.70	2.41	9.93
2	BA10%	21.77	33.32	2.12	3.11	-
3	BA20%	16.44	25.77	0.85	1.42	-
4	BA0%+NS1%	21.44	32.88	1.83	2.55	-
5	BA0%+NS2%	23.70	36.44	2.54	3.25	-
6	BA0%+NS3%	24.88	37.77	2.70	3.54	-
7	BA10%+NS1%	23.55	33.77	2.26	3.40	-
8	BA10%+NS2%	25.77	35.56	2.69	3.96	11.97
9	BA10%+NS3%	19.55	30.66	1.83	2.84	-
10	BA20%+NS1%	17.33	26.22	1.13	1.70	-
11	BA20%+NS2%	18.22	28.44	1.27	2.12	-
12	BA20%+NS3%	14.66	23.56	0.99	1.27	-

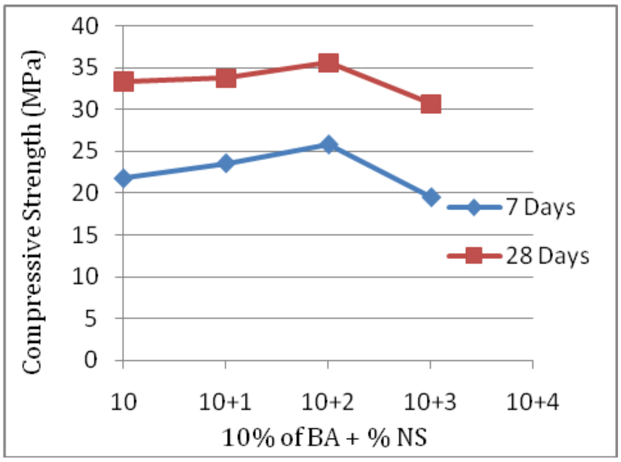

Fig. 1: BA10% + % NS V/s Compressive Strength 7 Days and 28 Days

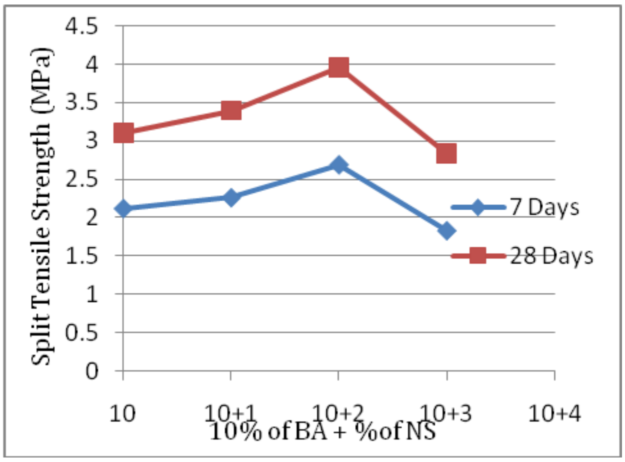

Fig. 2: BA10% +%of NS V/s Split Tensile Strength for 7 Days and 28 Days

4.1 Compressive Strength

From the fig1 it is noticed that, for the combination of 10% bagasse ash and 1% Nano-silica of the compressive strength is found to be 23.55MPa and 33.77MPa at age of 7 and 28 days correspondingly. Also the combination of 10% bagasse ash and 2% nano-silica the compressive strength is 25.77MPa and 35.56MPa at the period of 7 and 28days respectively. By keeping the bagasse ash content (10%BA) and increasing the nano-silica in the mix from 2 to 3% it is found that the compressive strength is decreasing i.e., 19.55MPa and 30.66MPa after age 7 and 28 days of curing. From the graph is detected that the percentage increase of strength for 10%BA and percentage variation of nano-silica from 1 to 2% is 1.32 to 6.69% respectively when compared to 10% bagasse ash content mix. Beyond the increasing of percentage of nano-silica i.e. from 2 to 3% NS the percentage decrease in compressive strength is 8.01% when compared to 10% bagasse ash content mix. From all these it is observed that for 10% bagasse ash and 2% nano-silica in the concrete mix is found to be more effective.

4.2 Split Tensile Strength

From the fig2, it is noticed that, for the combination of 10% bagasse ash and 1% Nano-silica of the spilt tensile strength is found to be 2.26MPa and 3.40MPa at age of 7 and 28 days correspondingly. Also for the combination of 10% bagasse ash and 2% nano-silica the spilt tensile strength is 2.69MPa and 3.96MPa at the age of 7 and 28 days correspondingly. By keeping the bagasse ash content (10%BA) and increasing the nano-silica in the mix from 2 to 3% it is found that the spilt tensile strength is decreasing i.e. 1.84MPa and 2.83MPa after age 7 and 28days of curing. From the graph is observed that the percentage increase ofstrength for 10%BA and percentage variation of nano-silica from 1 to 2% is 9.32 to 27.33% respectively when compared to 10% bagasse ash content mix. Beyond the increasing of percentage of nano-silica i.e., from 2 to 3% NS the percentage decrease in spilt tensile strength is 9.00% when compared to 10% bagasse ash content mix. From all these it is observed that for 10% bagasse ash and 2% nano-silica in the concrete mix is found to be more effective.

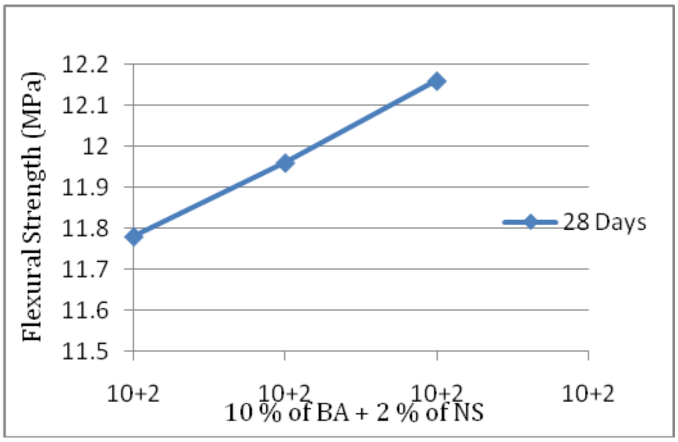

Fig. 3: 10% of BA + 2 % NS V/s Flexural strength

Fig.3, indicates that the combination of 10% BA + 2 % NS gives 11.97MPa of flexural strength at the age of 28days. So it is better substitute for concrete mix and it is more effective.

4.3 SCANNING ELECTRON MICROSCOPE (SEM) ANALYSIS

Figures: 4, 5 and 6 represents the SEM images of 10%BA, 10%BA+ 2 %NS and 0 %BA + 3% NS concrete specimens correspondingly. In our study specimen samples of 10% bagasse ash replacement of cement were exposed for SEM after 28 days of curing. Figure 4:is micrograph of 10%BA mix. It clearly shows that the mix possesses lower voids, porosity and packing structure in compared with other mixes. But the strength of the mix is low compared to other mixes this is due to the bagasse ash absorbs more of water. Fig.5: is micrograph of 10%BA +2% NS. It conjointly clearly shows that the mix possesses lower porosity, voids and more packing structure as compared with 10% BA mix and 0% BA+ 3% NS (Fig 6). It shows the growth of correct and clear C-S-H paste in many phases. The vital purpose to be noted in the micrograph is that the C-S-H gel i.e. the black mass and white mass parts are spread all over aggregates (both coarse and fine) thus acting as binders of the paste respectively. But from Fig 6, we can see that the strength is low, this may be due to there are so many voids , pores and the packing structure of the mix is not clear as compared to other mixes.

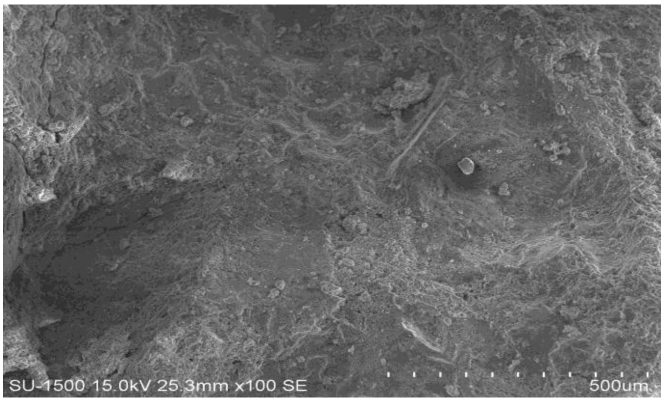

Fig 4: Micrpgraph of 10% BA

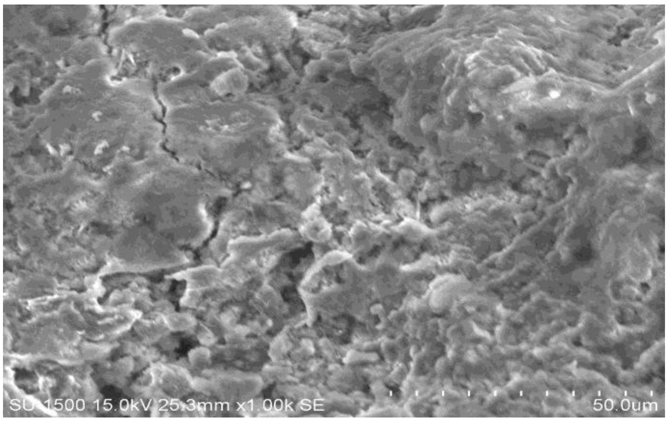

Fig 5: Micrpgraph of 10%BA+2%NS

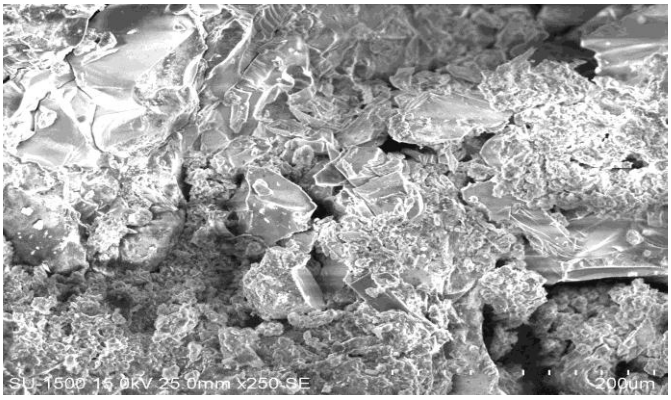

Fig 6: Micrpgraph of 0%BA+ 3%N

5 CONCLUSIONS:

- From the experimental results it is obtained that 10% of bagasse ash is create to be well replacement for cement.
- Compressive strength results it is obtained that 10% of bagasse ash substitute with cement can produce higher compressive strength compared to conventional concrete.
- Split tensile strength of cylinders it is obtained that 10% of bagasse ash substitute with cement will produce improved tensile strength as compared to conventional concrete.
- From the experimental work the addition of 0% of bagasse ash and percentage of variation of nano-silica (i.e. 1%, 2% and 3%) which gives the increasing orders of compressive strength and split tensile strength respectively.
- Also 10% of bagasse ash and add 2% of nano silica can be a good substitute for concrete.
- Cube compressive strength and split tensile tests it is found that 10% of bagasse ash and add 2% of nano silica replacement with cement will yield better compressive and tensile strengths respectively when compared to conventional concrete.
- We are able to conclude that addition of up to 10% of bagasse ash and 10% of bagasse ash plus 2% of nano silica as additional for cement to create structural concrete which might be utilized for practical structural utilization.
- The flexural strength it is found that 10% of Bagasse ash plus

2% of Nano-silica replacement with cement will yield higher flexural strength.

- The Scanning Electronic Microscopic (SEM) analysis is performed 10%BA, 10% BA +2% NS and 0% BA +3%NS obtained lower porosity and less voids.

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