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Strength Assessment of Bamboo Trunk Ash (BTA) and Grinded Snail Shell (GSS) As Additives in Self-Compacting Concrete (SCC)

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***Abstract* - This research examined how bamboo truck ash (BTA)/grinded snail shell (GSS) can be use as partial replacement of cement in self-compacting concrete. One hundred and Twenty (120) specimens were produce, the water-powder (cement+GSS+BTA) ratios were 15%BTA/0%GSS, 10%BTA/5%GSS, 5%BTA/10%GSS, 0%BTA/15%GSS, and SP430 from 0%, 1%, 2% and 3% while other mix components were kept constant. Laboratory investigation results showed that sample at 7 days, 1 % COMPLAST SP430 and 2% bamboo trunk ash/grinded snail shell, the maximum average compressive strength was 8.81N/mm2 also at 28 days 1%, 2 % bamboo trunk/grinded snail shell, maximum average compressive strength was 19.85N/mm2. Self-compacting concrete criteria on the fresh concrete mix ratio show that at 2% and 3% SP430 complast (as super plasticizer) addition with 15/0, 10/5 and satisfied self-compacting concrete criteria. Compressive strength of concrete was obtained within the range of 15N/mm2 to 18.74N/mm2.The strength was examined using standard deviation and they were within the acceptable limits. The significance of this work lies in its attempt to provide information on the performance of self-compacting concrete and its major advantages in saving time, labor and environmentally friendly as noise from vibrator is completely eliminated.**

Keywords: self-compacting concrete, compressive strength, bamboo trunk ash, grinded snail shell and plasticizer.

I. INTRODUCTION

Cement concrete, due to its satisfying performance in strength requirement and its ability to be molded into variety of shapes and sizes has been the most widely used building material. Construction works globally is increasing at alarming rate with substantial consumption of cement in large proportion hence the need for full or partial replacement of cement. In the building construction industry, self-compacting concrete (SCC), also referred to as "self-consolidating concrete" and "High-performance concrete" has recently been one of the most important developments (Kameswara, 2012). It is a form of concrete that can pass through and fill gaps of reinforcement and corners of moulds without the uses of vibration and compacting equipment during the pouring process. It's results in durable concrete structures and saves and consolidation noise. It can also be use in precast concrete or in-situ concrete. Okamura and Oluchi were the pioneer researchers on SCC, which was later referred to as Japanese Method. Self-compacting concrete (SCC) was first developed to increase concrete usage by engineers in Japan in the early 1980s with the introduction of conventional super-plasticizers to create highly fluid concrete, while also using viscosity-modifying admixtures (VMA), which increased plastic viscosity thus preventing segregation up to a level of fluidity that would normally cause segregation. Kou, and Poon, (2009). SCC has been defined Khayat, et al.,(1999) as a highly flowable, yet stable concrete that can spread readily into place and fill the formwork without any consolidation and without undergoing any significant segregation.

Rheological properties of conventional and self-compacting concrete are quite different and water-cement ratio has significant effect on the strength properties of self-compacting concrete as revealed by Olafusi *et al.,* (2015) in their evaluation of fresh and hardened properties of self-compacting concrete.

An understanding of the necessary optimization of properties of materials required for self-compacting concrete is needed prior to designing a mix for SCC as opined by John N, *et al.,* Kou and Poon (2009) discovered in their research on the role of chemical admixture in achieving good rheological properties that, the dosage of the super plasticizer and viscosity modifying admixture (VMA) is an important influencer of rheological properties of SCC.

Researchers have utilized and experimented the influence of agro-wastes such as corn cob ash on the strength of self-compacting concrete. Olofintuyi and Oluborode (2015) in their research on influence of corn cob ash on self-compacting concrete discovered that, the mix proportion that could give proper and maximum compressive strength at different curing

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days most especially 28 days was established in their research to be 2%SP43030%CCA at a compressive strength of 20.37N/mm².

Bamboo leaf ash (BSA) has been investigated by a lot of researchers, Olofintuyi *et al.*,(2015) found out bamboo possesses the required amount of pozzolanicity that makes it suitable for use in conventional concrete. Their investigation showed that, that higher percentage of BLA between 10% and 15% could be used to produce workable lightweight and mass concrete works.

In view of the above, this research studies the immediate and remote influence of other parts of bamboo such as bamboo trunk and other locally generated wastes such as snail shells in self-compacting concrete.

II. MATERIALS AND METHODS

The materials used for this research were Bamboo Trunk Ash (BTA), Grinded Snail Shells (GSS) Portland cement conforming to ASTM type 1, Sand (Fine aggregate), Granite (Coarse aggregate), Complast SP430 (Plasticizer) and clean and deleterious-free water. The bamboo trunk were dried and later burnt in a furnace at temperature of 700oC for 3 hours to obtain the ash, which was later subjected to sieve analysis to determine the particle size distribution and the amount passing 75µm sieve for the concrete mix, while the snail shells were subjected to grinding to obtain powdery form. The sieved additives were used to replace cement up to a maximum level of 15% in a ratio of 15/0, 5/10, 10/5 and 0/15 for BTA/GSS as mass ratio. The concrete were produced using a mix ratio of 1:2:4, to achieve a composite mix. The concrete produced were subjected to self-compacting evaluation such as filling ability, passing ability and segregation potentials.

The mix ratio used was 1:2:4 at different nominal replacement of OPC with CCA and water cement ratio of 0.5 by weight. The replacement levels of 0% to 15% by weight of Portland cement was partially replaced by BTA/GSS to determine the workability of the concrete a self-compacting concrete, where Complast SP-430 was also used at a percentage of 0% -3% as super plasticizer. Compressive strength was determined on the hardened concrete after a curing period of 7days to 28days.

III. RESULTS AND DISCUSSION

a) Compressive strength results

Compressive strength results of the mix were determined for 7 days and 28days as presented in tables 3.1 and 3.2 respectively. Figures 3.1 and 3.2 revealed the compressive strengths against the percentage of plasticizer replacement at 7 and 28 days curing ages respectively. Figure 3.1 showed that at 0%BTA/0%GSS, there was initial gain of strength at 1% addition of super plasticizer, the strength obtained at 3% addition of super plasticizer was maximum at 8.58N/mm2 and 8.49N/mm2 for both 0%BTA/0%GSS and 15%BTA/0%GSS respectively.

TABLE 3.1
7days Compressive Strength Results

SP430 / VOLUME OF BTA/GSS	0 %	1 %	2 %	3 %
(0%BTA/0%GSS) **N/mm²**	8.81	9.33	8.52	8.58
(15%BTA/0%GSS) **N/mm²**	8.44	8.64	8.47	8.49
(10%BTA/5%GSS) **N/mm²**	8.40	8.40	8.37	8.33
(5%BTA/10%GSS) **N/mm²**	8.46	8.42	8.33	6.82
(0%BTA/15%GSS) **N/mm²**	8.67	8.74	8.04	5.50

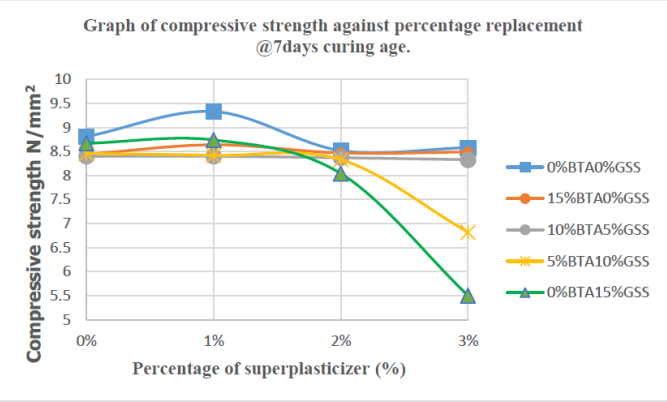

Figure 3.1: Graph of compressive strength against percentage replacement @7days curing age

TABLE 3.2
28days Compressive Strength Results

SP430 / VOLUME OF BTA/GSS	0 %	1 %	2 %	3 %
(0%BTA/0%GSS) **N/mm²**	19.41	19.70	19.85	19.70
(15%BTA/0%GSS) **N/mm²**	17.78	18.09	18.74	17.70
(10%BTA/5%GSS) **N/mm²**	17.48	17.56	17.18	16.74
(5%BTA/10%GSS) **N/mm²**	17.70	17.75	16.45	14.37
(0%BTA/15%GSS) **N/mm²**	18.00	18.22	14.37	10.96

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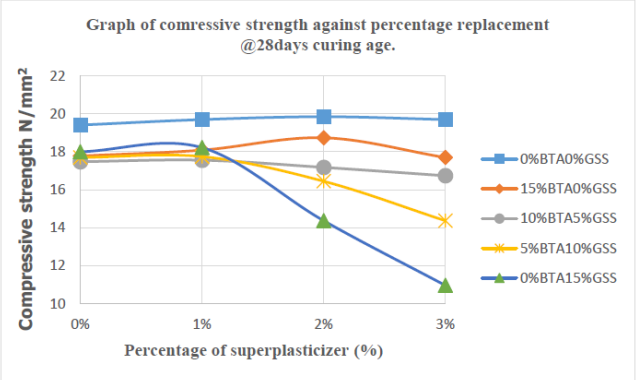

Figure 3.2: Graph of compressive strength against percentage replacement @28days curing age

Figure 3.2 showed that optimum compressive strength 18.74N/mm2 was attained at 2% addition of super plasticizer for 15%BTA/0%GSS. The result indicated that curing days has influence on the attainment of compressive strength and the addition of plasticizer plays a major role.

b) Self-compacting test results

According to EFNARC, recommendations on the types of test to measure workability self-compacting concrete quantitatively were established in Annex B of their publications. The results obtained experimentally were compared with the EFNARC standard.

The results show that GSS/BTA possesses suitable properties aided by super plasticizer combination in the mix at 2% addition. A large percentage of the mix fell within the EFNARC recommended range of results.

TABLE 3.3
Self-Compacting Concrete Evaluation Results

SCC EVALUATION TEST	PERCENTAGE OF COMPLAST SP430																				EFNARC STANDARD
	0%					1%					2%					3%					
	BTA/GSS FRACTIONAL WEIGHT																				
	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	
Segregation potentials (mm)	200	230	240	300	500	620	600	630	620	600	730	650	730	680	760	720	820	670	620	740	650-800
Fillingability (secs)	22	25	28	26	6.0	8.0	10	11	10	6.0	8.0	8.0	5.0	12.	6.0	8.0	6.0	5.0	5.0	7.0	6-12
Passingability (mm)	3.0	3.0	3.5	4.0	5.0	6.0	5.0	7.0	20	25	8	23	25	26	28	20	22	25	24	28	0-30

IV. CONCLUSION

This research has demonstrated the overall impact of the combination of GSS/BTA in a self-compacting concrete mix. The workable mix that yielded optimum compressive strength and provided acceptable SCC results was achieved at a mix of 15%BTA/0%GSS and 2% addition of Complast SP 430 super plasticizer. This result can therefore be applied in areas where non-structural load bearing concrete is needed and other light weight concreting.

V. RECOMMENDATION

More research should be explored in the usage of this mix in harsh environmental conditions. Applicability of other agro-wastes in construction should be exploited to further utilize our waste into wealth.

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