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Experimental Study on effects of Sugarcane Liquid on Concrete Properties

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Abstract*—The initial hardening of concrete reaction usually occurs within a few hours. It takes some weeks for concrete to succeed in full hardness and strength. Admixtures take an important role to improve physical and economic benefits with respect to concrete and mortar. Sugar is well-known as a good retarder to delay the concrete hardening. In this research paper [I] Compressive strength test were conducted on concrete cubes in comparison with conventional concrete and sugarcane liquid added concrete on 7 days, 14 days and 28 days, [II] The effect of sugarcane liquid on concrete properties are tested based on strength gain in stages of 7 days, 14 days and 28 days. Two extreme dosages of sugarcane liquid admixture as 0.03% and 0.3% of cement weight is taken for the experiment. The specimens are cast in mortar cubes with desired compressive strength (f'c)=30 MPa. This research meets conclusions as follow: (1) The sugarcane liquid can be used as 'green' concrete admixture, (2) The dosage of sugarcane liquid admixture of 0.03% by weight of cement can perform as 'retarder' which having compressive strength values for 7 and 14 days are 24.56 MPa and 28.12 MPa respectively, (3) The dosage of sugarcane liquid admixture of 0.3% by weight of cement can perform as 'accelerator' which having compressive strength values for 7 and 14 days are 31.07 MPa and 30.92 MPa respectively, (4) It is questioned whether compressive strength values increase or decrease in older ages.*

Keywords—Accelerator, admixture, compressive strength, conventional concrete, retarder, sugarcane liquid

I. INTRODUCTION

Versatility, durability, sustainability, and economy of concrete have made concrete the most widely used construction material in the world. About four tons of concrete are produced per person per annum worldwide. The concrete refers to a mix of aggregates, usually sand, and either gravel or crushed stone held together by a binder of cementitious paste. When aggregatesare mixed with dry cement and water, the mixture forms a fluid slurry that is easily poured and molded into shape. The cement reacts with the water and other ingredients to make a tough matrix that binds the materials together into a durable stone-like material. Often, additives such as pozzolans or superplasticizers are included within the mixture to enhance the physical properties of the wet mix or the finished material. Most concrete is poured with reinforcing materials (such as rebar) embedded to provide tensile strength and yieldingreinforced concrete.

The selection of concrete proportions involves a balance between economy and requirements of workability,density strength, durability,and appearance. Optimal proportions of concrete mix ingredients are vital for establishing a relationship between the simplest particle distribution and therefore the corresponding degree of packing. The maximum strength is attained when the porosity of the granular structure is minimum. The main objective of the mix design was to supply an optimum concrete mixture of required design stipulations supported combinations of optimized aggregate grading and effective estimation of the specified water and cement content. Chemical admixtures are mostly used to accelerate, improve workability, retard, reduce mixing water requirements, increase strength, or alter other properties of the concrete. The general approach of all existing methods of concrete mix design is to identify a starting set of mix proportions following the standard country code guidelines based on the paste to aggregate estimation, and by making adjustments to the proportions after every trial mixes until the desired mix requirement parameters are satisfied.

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Concrete nowadays isn't just mixing of cement, aggregate & water but it also comprises chemical and mineral admixtures. It is becoming a more and more effective construction material as a result of the addition of admixtures and improvements in production techniques. The chemical admixtures, especially are frequently used to enhance the characteristics of both fresh and hardened concrete like to increase or accelerate setting characteristics, entrain air, reduce water content, increase cohesiveness, enhance flow, introduce compacting properties, improve durability and enhance strength parameters. Therefore, the role of chemical admixture in concrete is becoming important annually. It is often emphasized that the new admixtures play a more important role in concrete than new cement. Chemical admixtures are inorganic or organic materials. Ordinary Portland Cement, water, and aggregate are added to the combination immediately before or during mixing. These are added into the mix not normally exceeding 5% by mass of cement or cementitious materials. Admixtures react with hydrating cement by physical, chemical or physic-chemical actions. However, sometimes the value of admixtures is comparable to that of the cement in high-performance concrete due to its high dosage. There also are problems related to it including the assembly of stiffer concrete, variation in an initial slump and slump loss using some sorts of cement, large variations within the flow characteristics using a combination of different admixtures, etc. thereforeusing natural and green admixtures like sugarcane liquid is convenient.

Sugarcane is several species of tall perennial true grasses. It has stout, jointed, fibrous stalks that are rich within the sugar sucrose, which accumulates within the stalk internodes. The plant is 2 to 6 meters (six to twenty feet) tall. All sugarcane species can interbreed and therefore the major commercial cultivars are complex hybrids. Sugarcane belongs to the grass family Poaceae, an economically important spermatophyte family that has maize, wheat, rice, and sorghum, and lots of forage crops. Sugarcane is the world's largest crop by production quantity perspective. Sugarcane juice is that the liquid extracted from pressed sugarcane. It is consumed as a drink in many places.

II. MATERIALS AND METHOD

2.1MATERIALS:

1. Cement: The Ordinary Portland Cement (OPC) of 53-grade is used in this experiment.

2. Coarse Aggregates: Aggregates which are passing through 10 mm IS sieve and retained on 6.3 mm IS sieve and aggregateswhich are passing through 20 mm IS sieve and retained on 16 mm IS sieve are used in this experiment.

3. Coarse sand: Sand which is passing through 4.75 mm IS sieve and retained on 2 mm IS sieve is used in this experiment.

4. Sugarcane liquid: It is obtained from fruit market near the experiment area. It is the liquid extracted from pressed sugarcanewiththe help of fixed rebar, then it is filtered to remove some residual particles from sugarcane fiber.Table 1 shows the chemicalanalysisof sugarcane liquid.

Sr. No.	Parameter	Result	Standard
1.	pH	5.67	>5 2
2.	Specific Gravity	0.968	0.90 – 0.99
3.	Sugar Content (%)	15.1	-
4.	Total Solid (mg/kg)	67.6	< 83
5.	Water Content (%)	20.44	< 25
6.	Sulphur (mg/kg)	0.08	1.0
7.	Lead (mg/kg)	0.04	0.3
8.	Copper (mg/kg)	0.02	0.5
9.	Acidity (mg/koH/g)	0.70	1.5
10.	Arsenic Acid (mg/kg)	<0.01	0.2
11.	Salinity (ppm)	0.56	1
12.	Conductivity (us/cm)	5.06	-
13.	Iron (mg/kg)	2.80	5

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TABLE 1: Chemical analysis of sugarcane liquid

2.2METHOD OF EXPERIMENT:

Concrete cubes of size 150 mm x 150 mm x 150 mm are casted having desired compressive strength (f'c) is 30 MPa. Mix Design is done according to IS 456:2000. (1) 9 cubes of 0.03% added sugarcane liquid admixture by weight of cement, (2) 9 cubes of 0.3% added sugarcane liquid admixture by weight of cement and (3) 9 cubes of conventional concrete are casted. Total 27 numbers of cubes are casted. All specimens are cured for 7, 14, and 28 days, then it is tested for its compressive strength in Compression Testing Machine (CTM) as per IS 516:1959.

2.3 MIX DESIGN:

Table 2 shows the result of each ingredient of mix design

Ingredients		SSD mix (in kg)	Corrected (in kg)	Batch (0.04 m^3) (in kg)
Cement		400	400	16.000
Aggregates	passing through 10 mm IS sieve and retained on 6.3 mm IS sieve	450	443	17.720
	passing through 20 mm IS sieve and retained on 16 mm IS sieve	630	624	24.960
Coarse Sand		810	778	31.120
Water		160	205	8.200
Sugarcane Juice added in % by weight of cement	For, 0.03%	0.120	0.120	0.0048
	For, 0.3%	1.200	1.200	0.0480
	For, Normal	0	0	0

TABLE 2: Result of each ingredient of mix design

III. RESULTS AND DISCUSSION

3.1 Aggregates:

1. Passing through 10 mm IS sieve and retained on 6.3 mm IS sieve:
    1) Specific gravity=2.81
    2) Water absorption=1.63%
    3) Flakiness index=11.28%
    4) Elongation index= 13.08%
    5) Combined index of flakiness and elongation=24.36%
    6) Impact value =7.89%
    7) Bulk density =1.508 kg/litre

2. Passing through 20 mm IS sieve and retained on 16 mm IS sieve:
    1) Specific gravity =2.82
    2) Water absorption =1.21%
    3) Flakiness index=12.37%
    4) Elongation index=12.24%
    5) Combined index of flakiness and elongation=24.61%
    6) Impact value =9.04%

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7) Bulk density =1.519 kg/litre

3. Coarse Sand:
   1) Specific gravity =2.69
   2) Water absorption =3.09%
   3) Bulk density =1.700 kg/litre

3.2 Cement:

1) Fineness =3.38%

3.3. Concrete:

1. Slump Cone Value:
   1) For 0.03% added sugarcane liquid admixture by weight of cement = 50 mm
   2) For 0.3% added sugarcane liquid admixture by weight of cement= 60 mm
   3) For conventional concrete =45 mm

2. Compressive Strength:
   Table 3 shows the result of concrete compressive strength of concrete with sugar cane liquid admixture of 0.03% and 0.3% by weight of cement and conventional concrete.

TABLE 3: Results of Compressive strength (MPa)

% added sugarcane liquid	Compressive strength (f'c) (MPa)		
	7 days	14 days	28 days
0.03%	i. 23.94	i. 27.82	i. 34.21
	ii. 24.12	ii. 29.03	ii. 33.84
	iii. 25.62	iii. 27.51	iii. 32.21
	Avg =24.56	Avg = 28.12	Avg = 33.42
0.30%	i. 30.82	i. 31.05	i. 18.44
	ii. 31.13	ii. 30.88	ii. 18.39
	iii. 31.26	iii. 30.83	iii. 18.88
	Avg = 31.07	Avg = 30.92	Avg = 18.57
Conventional	i. 30.15	i. 26.98	i. 23.03
	ii. 30.03	ii. 27.35	ii. 22.82
	iii. 29.88	iii. 28.02	iii. 20.72
	Avg = 30.02	Avg = 27.45	Avg = 22.19

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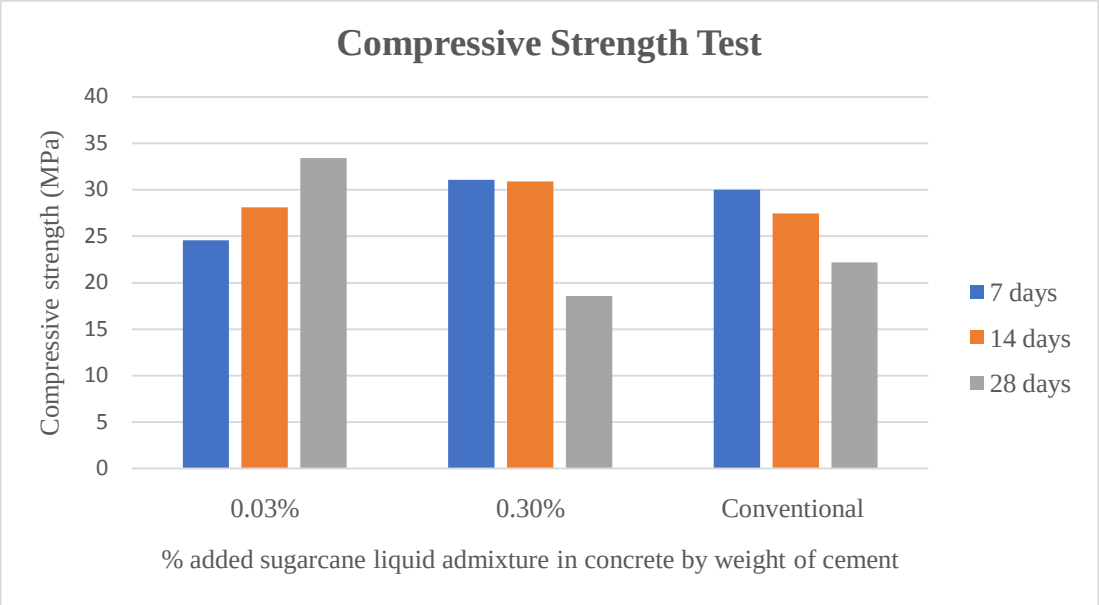

FIGURE 1:Compressive strength (in MPa) of cubes 0.03%, 0.3% added sugarcane liquid admixture by weight of cement and conventional concrete at the age of 7 days, 14 days and 28 days

IV. CONCLUSION

This experiment meets conclusions as follow:

1) The sugarcane liquid can be used as a 'green' concrete admixture.
2) The dosage of sugarcane liquid admixture of 0.03% by weight of cement can perform as 'retarder' which having compressive strength values for 7 and 14 days are 24.56 MPa and 28.12 MPa respectively, on average of 7 days and 14 days compressive strength it reduces about 8.33% in comparison with conventional concrete.
3) The dosage of sugarcane liquid admixture of 0.3% by weight of cement can perform as 'accelerator' which having compressive strength values for 7 and 14 days are 31.07 MPa and 30.92 MPa respectively, on average of 7 days and 14 days compressive strength it increases about 7.29% in comparison with conventional concrete.
4) It is questioned whether compressive strength values increase or decrease in older ages.

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REFERENCES

[1] Amaziah Walter Otunyo And Innocent Koate, "Sugar Cane Juice As A Retarding Admixture In Concrete Production" *Global Journal Of Engineering Research Vol 14, 2015: 17-23 (Received 22 October 2015; Revision Accepted 9 November 2015)*

[2] Abalaka, A. E., "Comparative Effects of Cassava Starch and Simple Sugar in Cement Mortar and Concrete" *Building Department, Federal University of Technology, FUT, Minna, Nigeria. ATBU Journal of Environmental Technology, 4, (1), December 2011*

[3] SalahaldeinAlsadey, "Effects of Super Plasticizing and Retarding Admixtures on Properties of Concrete", *International Conference on Innovations in Engineering and Technology (ICIET'2013) Dec. 25-26, 2013 Bangkok (Thailand)*

[4] A. W. Otunyo,*, S. C. Onwusiri and N. Nwaiwu, "Effect Of Sugar Cane Juice On Slump Values Ffect Of Sugar Cane Juice On Slump Values Ffect Of Sugar Cane Juice On Slump Values Ffect Of Sugar Cane Juice On Slump Values, ,, , Setting Times Setting Times Setting Times Setting Times And AndAndAnd Strength Of Strength Of Strength Of Strength Of Concrete ConcreteConcreteConcrete" *Dept. Of Civil Engineering, Rivers State University Of Science & Technology, Nkpolu, Port Harcourt. Nigeria*

[5] Akogu Elijah Abalaka, "Effects of Sugar on Physical Properties of Ordinary Portland Cement Paste and Concrete", *Building Department, Federal University of Technology Minna, Niger State, Nigeria AU J.T. 14(3): 225-228 (Jan. 2011)*

[6] Antonio Price, Ryan Yeargin,EllieFini and Taher Abu-Lebdeh, "Study of Different Admixtures and their Effects on Concrete" *International Journal for Research in Applied Science & Engineering Technology (IJRASET) IJRASET Volume 5 Issue V, May 2017*

[7] Rr. M.I. RetnoSusilorini, Robert IndarkoGanis, Hartaman Aris Nugraha, Imam Syaefudin4, SunuArdi B, "The Using Of Sugar Cane Liquid As 'Green' Retarder And Accelerator For Concrete Mixture" *Simposium Nasional RAPI VII 2008*

[8] Rr. M. I. RetnoSusilorini, "The use of sugar, sucrose, and sugaracane liquid mix as sugar based admixture for mortar", *lecturer, department of civil engineering, faculty of engineering, Soegijapranata Catholic University, Jl. Pawiyatanluhur IV/1, BandanDhuwur, Senarang 50234, Seminar National VI 2010 TenikSipil FTSP ITS Surabaya PengenbanganInfrastrukturDalamMenunjangPengenbanganEkonomi Nasional*

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[10] Indian Standard 516:1959 "Methods of Tests for Strength of Concrete", Eighteenth Reprint June 2006 (Incorporating Amendment No 1 and Including Amendment No 2), Bureau of Indian Standards manak bhavan. 9 bahadur Shah Zafar Marg new Delhi 110002.

[11] Indian Standard 456:2000 "Plain and Reinforced Concrete-code of practice", (Fourth Revision), Tenth Reprint April 2007 (Including Amendments No. 1 and 2), Bureau of Indian Standards manak bhavan. 9 bahadur Shah Zafar Marg new Delhi 110002.

[12] Mindess, S. and Young, F., (1981), "Concrete", Prentice Hall Inc., Englewood Cliffs, New Jersey.