International Journal of Civil Engineering and Technology (IJCIET)
Volume 9, Issue 10, October 2018, pp. 1041–1047, Article ID: IJCIET_09_10_105
Available online at http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=9&IType=10
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

EVALUATION OF SPLIT TENSILE STRENGTH OF SHREDDED POLYTHENE BAGS IN CONCRETE

Sani, R.O
Department of Civil Engineering, College of Engineering,
Covenant University, Ota Ogun State.

Daniel N. N
Nigerian Building and Road Research Institute (NBRRI), plot 750 Nnewi-Okigwe Expressway, P.M.B 5070, Nnewi, Anambra State,Nigeria Author2

Taiwo E. E
Department of Building University of Lagos, Lagos State, Nigeria

Odetoyan, A.O
Department of Civil Engineering, College of Engineering,
Covenant University, Ota Ogun State

ABSTRACT

The plastic industry has experienced rapid growth in the world today due to increase in population and generation of more plastic products to cater for the ever increasing population rate. Disposal of waste generated from plastic industry has become a major environmental problem today. The construction industry constantly seeks to find better and cost effective additives to concrete in other to improve on concrete properties. This study evaluates the effects of shredded polythene bags (pure water sachets) on the split tensile strength of concrete. 0, 0.1, 0.2, 0.3, 0.4, 0.5, 1.0, 1.5, and 2.0 % of shredded polythene bags waste was used in concrete and the effect of each percent dosage on the slump value and tensile strength of concrete was determined. Slump values where observed to move from very high slump to high slump through medium slump then low slump, till no slump was observed at 2 % shredded polythene bags waste dosage. At 0.2 % SPBW dosage in concrete and cured for 28 days, the concrete mix tensile strength was observed to be higher than that of concrete mix with 0 % SPBW dosage and also cured for 28 days. Implying that by adding 0.2 % of shredded polythene waste bags when mixing concrete, the tensile strength is improved. Therefore by introducing just 0.2 % of SPBW in concrete during construction, it would go a long way in solving plastic waste disposal problems.

Key words: plastic, Disposal, concrete, shredded polythene bags, split tensile strength, Slump.

Cite this Article: Sani, R.O, Daniel N. N, Taiwo E. E and Odetoyan, A.O, Evaluation of Split Tensile Strength of Shredded Polythene Bags in Concrete, *International Journal of Civil Engineering and Technology (IJCIET)* 9(10), 2018, pp. 1041–1047.
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=9&IType=10

1. INTRODUCTION

The plastic industry is one of the industries that have experienced a rapid growth in the world today as a result of an increase in population and the generation of more plastic products to cater for the ever increasing population rate. Environmental waste pollution has been on the high [10] and it's constantly increasing. The disposal of waste generated from plastics has become a major environmental problem today. The chemical bond that makes plastics durable equally makes it to be highly resistant to the natural process of degradation. Research has it that since the 1950s, over one billion tons of plastics have been discarded as waste and may have failed to degrade for hundreds or even thousands of years [2]. Polythene bags, pure water sachets, plastic bottles, packing strips etc are examples of post-consumer plastic wastes which are difficult to separate from household garbage. Most times they litter the environment posing significant environmental hazards such as reduction in soil fertility, reduction in water percolation, health hazards to animals and birds on consumption, pollution of ground water due to leaching of chemicals from waste products etc [3]. The construction is also a thriving industry, consuming billions of tons of concrete per year. Materials used in producing concrete are obtained from the crust of the earth thereby depleting its resources yearly creating ecological strains [8]. The construction industry constantly seeks to find better and cost effective additives to add to concrete in other to increase the strength of concrete therefore any of such additives capable of complementing sand, cement or coarse aggregates is always of great interest. Research has shown that addition of additives to concrete has improved its properties such as its strength, durability and workability [12] hence an increased drive to discover newer forms of additives as construction materials. A lot of research works have been carried out to ascertain the possibility of utilizing various plastic wastes in various forms as additives in concrete [1] [11]. In a research work, coarse aggregate in concrete specimens of M25 grade was partially replaced with plastic waste (polythene bags) in 0, 2, 5 and 7 % replacement in order to determine the split tensile strength. An increase in the values of the split tensile strength with increase in plastic waste replacement of coarse aggregate was observed [14]. Fine aggregates in grade M25 grade of concrete was partially replaced with PET bottles in fiber form in 0.5, 1, 2 4 and 6 % replacement in another research work [13]. It was observed that the split tensile strength increased with increase in Polyethylene Terephthalate (PET) fiber replacement up till 2 % then decreased with further replacement. Waste unwashed PET bottles ware used to partially replace fine aggregate in concrete [7], polythene fibers (domestic waste plastic) were added at 0.5 % by weight of cement in M20 mix of concrete [9], and metalized polythene bags in shredded form were used in concrete at 0, 0.5, 1, and 1.5 % [4]. The effect of these partial replacement and additions on the tensile strength of concrete were observed. A lot more research works have been carried out on addition or partially replacing coarse or fine aggregates with various forms of plastic wastes in concrete as a means of finding solution to plastic wastes disposal problems. This research work focuses on evaluating the effect shredded polythene bags (pure water sachet) 'a major constituent of garbage in developing countries' would have on the slump and tensile strength of Concrete.

2. MATERIALS & EXPERIMENTAL PROCEDURES

2.1. Materials

2.1.1. Polythene Bags

The polythene wastes used for this study were collected from Pure Water sachet bags Recycling Company (Seyolvicwal Nigeria Enterprises) at Alagbado, Lagos, Nigeria.

Sample of the shredded polythene bag waste is shown in figure 1 & 2.

Figure 1 Shredded polythene bags samples.

Figure 2 Shredded polythene bags from recycling company

2.1.2. Aggregates Characterization

Fine aggregates (Sand) and Coarse aggregate (Granite) were obtained from an open market. The fine aggregate was passed through 5 mm BS sieve to satisfy the fine gravel limit see fig 3, while the granite passed through 37mm BS sieve see fig 4 in accordance with standard procedures outlined in appropriate British standards [6].

Laboratory clean tap water was used for both the mixing and curing process while ordinary Portland cement was used as binder.

2.2. Preparation of Specimens

The proportion of shredded polythene wastes used in concrete for this research are 0, 0.1, 0.2, 0.3, 0.4, 0.5, 1.0, 1.5, and 2.0 % and these percentages were factored with respect to the weight of the concrete. Concrete mix of 1:2:4 was used as the mix ratio for the concrete. Slump test was carried immediately after mixing, in order to monitor the workability of the mix. 121mm maximum slump and 0.75 % w/c ratio were maintained.

2.3. Slump Test

The slump test was carried out in accordance to British standards [5]. The consistency of the freshly mixed concrete was checked by this test. The top diameter of the standard slump cone used was 100 mm, 200 mm bottom and 300 mm high. A rule and a slump plate of dimensions 500 mm x 500 mm was also used for the test

2.4. Casting of Test Specimens

Casting procedures used in this research where in accordance to the requirements in British Standards [5] The mould that was used to cast the mixed concrete had a 150 x 150 x 150 mm dimension. To ensue easy de-moulding and smooth surface finishes, mould oil was applied to lubricate the mould. When the concrete was adequately mixed, it was placed into the mould in layers approximately 50 mm each, and then compacted with a compacting rod. A total of 81 cubes where cast for the split tensile test. Table 1 below shows a breakdown of samples

Table 1 Breakdown of Samples

TEST	A	B	C	D	E	F	G	H	I	TOTAL
Percentage of Shredded polythene bag wastes (SPBW)	0	0.1	0.2	0.3	0.4	0.5	1	1.5	2	
Tensile Split Test (7, 14, 28 days)	9	9	9	9	9	9	9	9	9	81

2.5. Split Tensile Test

Tensile splitting test of the specimen was carried out in accordance with British Standards. The test cubes were 150 mm. The Tensile splitting strength was determined using the equation stated below:

$$F_{ct} = \frac{2\times F}{\pi\times L\times d} \qquad (1)$$

Where: F_{ct} = tensile splitting strength, N/mm^2

F = Maximum load, (N)

L = Length of the line of contact of the specimen, (mm)

D = designated cross sectional dimension (mm)

3. RESULTS AND DISCUSSION

3.1. Sieve Analysis Result for Fine Aggregate

Figure 3 shows the grading curve for the fine aggregates used. 98.8 % passed through sieve 4.75 mm BS sieve to satisfying the fine gravel limit.

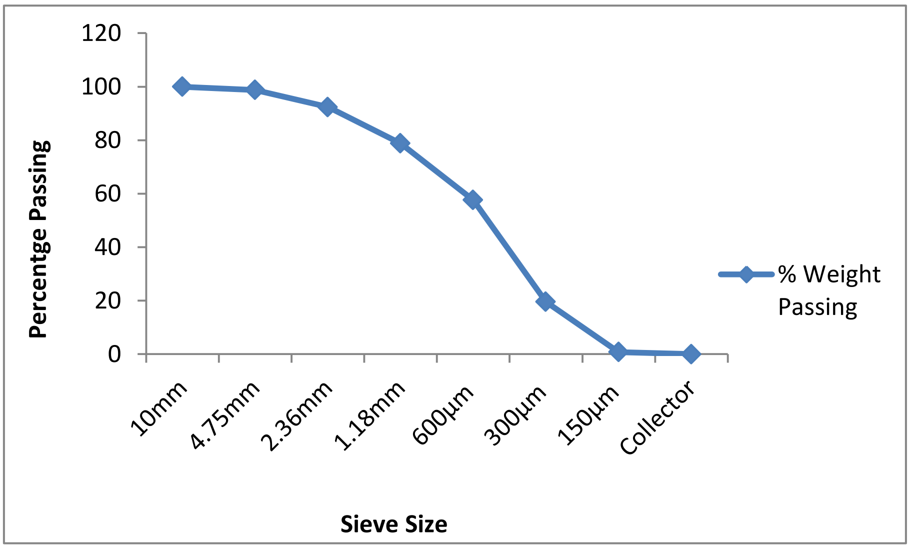

Figure 3 Sieve Analysis Curve for fine aggregates

3.2. Sieve Analysis Result for Coarse Aggregate

Figure 4 shows the grading curve for the coarse aggregate used. 100 % passed through 37mm BS sieve satisfying the coarse aggregate limit.

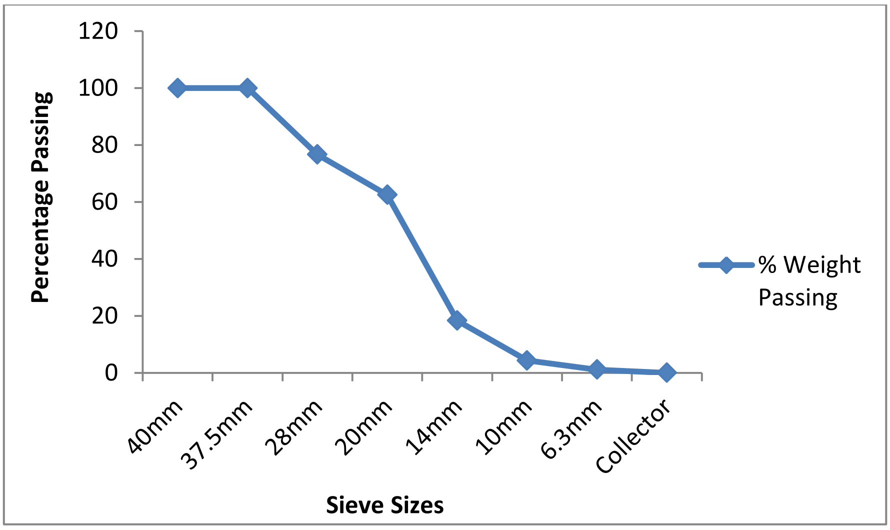

Figure 4 Sieve Analysis Curve for coarse aggregates.

3.3. Slump Test

This test was carried out in order to determine the workability of the freshly mixed concrete. Table 2 below shows the results obtained from the slump test.

Table 2 Slump values for the different mixes ratio of the samples

DESIGN MIX	DOSE OF SPBW	SLUMP in (mm)
A	0	119
B	0.1	98
C	0.2	83
D	0.3	70
E	0.4	57
F	0.5	42
G	1	10
H	1.5	2
I	2	0

Slump is measure of the workability of fresh concrete. The variation of workability of fresh concrete is measured in terms of slump. The highest slumps and compaction factor were recorded for the design mix with 0.0 % dose of SPBW. The overall workability value of the concrete is reduced as the percentage of SPBW is increased.

3.4. Split Tensile Loads

The Tensile Split loads on each of the samples were recorded at the point of split of each of the of the samples, this was achieved by centrally placing a log of wood centrally on the concrete cubes samples with the idea of inflicting a point load on the concrete cube samples.

The tensile split strength of each of the samples was then calculated using equation1 for 7, 14 and 28 days curing age.

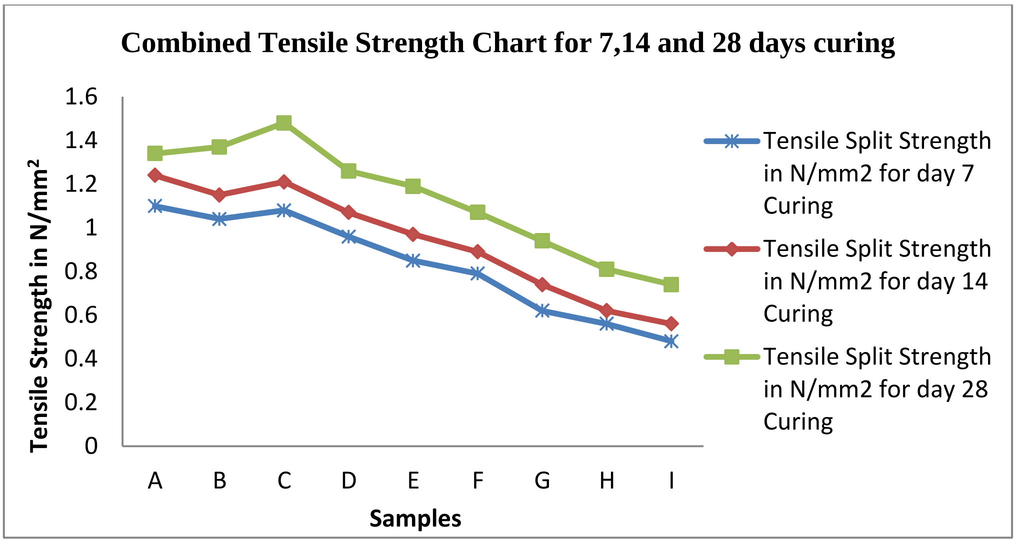

Figure 5 Combined values of the Tensile Split strength of the samples at 7, 14 and 28 days respectively

The graph shows that as the curing age increases, there was in turn an increase in the values of the tensile strength for each of the samples. The tensile strength values were observed to decrease at different curing age with increase in SPBW dosage except for specimen C with 0.2% of SPBW where the tensile strength at 28 days was greater than the tensile strength of 0.0 % SPBW.

4. CONCLUSIONS

The workability of the concrete was observed to decrease with increase in shredded Polyethylene bags waste (SPBW), where the slump values where observed to move from very high slump to high slump through medium slump then low slump, till no slump was observed at 2 % SPBW dosage. Research has shown that concrete is very good in compression and poor in tension hence the need to reinforce. At 0.2 % SPBW dosage and cured for 28 days, the tensile strength of the concrete mix was observed to be greater than that of concrete mix with 0.0 % SPBW dosage and also cured for 28 days. This implies that 0.2 % dosage of SPBW in concrete has similar property with reinforced concrete because the tensile strength of concrete is improved.

This study has revealed that by adding 0.2 % of shredded polythene waste bags in concrete the tensile strength of concrete is improved. This implies that with the thriving construction industry and disposal problem of wastes generated from plastics industries, by introducing just 0.2 % of SPBW in concrete during construction would go a long way in solving plastic waste disposal problems.

ACKNOWLEDGEMENT:

This paper acknowledges Covenant University, Centre for Research, Innovation, and Discovery (CUCRID) for the direct funding of this paper.

REFERENCES

[1] Akinwumi, I. I., Awoyera, P. O., Olofinnade, O. M., Busari, A. A., &Okotie, M. (2016). Rice husk as a concrete constituent: Workability, water absorption and strength of the concrete. Asian Journal of Civil Engineering, 17, 887–898.

[2] Alan W. (2010): "The World without Us," *Harper Collins*, Canada, ISBN 1443400084.

[3] Ankur B. and Arora, N. K**.** (2010): "*Use of Post-Consumer Plastic in Concrete"*. L D College of Engineering Ahmedabad, India.

[4] Bhogayata, A., Shah, K. D. and Arora, N. K. (2013). Strength Properties Of Concrete Containing Post Consumer Metalized Plastic Wastes. International Journal of Engineering Research and Technology 2(3):1-4**.**

[5] British Standard BS 1881 Part 102: (1983) Testing Concrete, Method for determination of slump

[6] British Standard European Norm, (1997). *Tests for geometrical properties of aggregates Determination of Particle size distribution-Sieving method.* BS EN 933-1, BSI, Linfordwood, Milton Keynes MK146LE, U.K.

[7] Frigione, M. 2010. Recycling of PET bottles as fine aggregate in concrete. Waste management, Elsevier 30(6):1101-1106.

[8] Gowri, S. and Rajkumar, N. (2005):*"Behavior of Plastic Mixed Reinforced Concrete Columns Under Axial Compression"*. Department of Civil Engineering, Erode Sengunthar Engineering College, Thudupathi, Erode.

[9] Kandasamy, R. and Murugesan, R. 2011. Fibre reinforced concrete using domestic waste plastics as fibres. ARPN Journal of Engineering and Applied Sciences 6(3): 75-82.

[10] Adebanji S. Ogbiye, David O. Omole, Kehinde D. Ade-Balogun, Olumuyiwa Onakunle & Olugbenga O. Elemile (2018) Treatment of brewery wastewater using electro-Fenton and granulated activated carbon, Cogent Engineering, 5:1, DOI: 10.1080/23311916.2018.1447224

[11] Olofinnade, O. M., Ede, A. N., &Ndambuki, J. M. (2017). Sustainable green environment through utilization of waste soda-lime glass for production of concrete. Journal of Material and Environmental Sciences, 8 ,1139–1152.

[12] Oyekan, G. L. & Kamiyo O. M. (2011). *A Study on the Engineering Properties of Sandcrete Blocks Produced with Rice Husk Ash Blended Cement*. Journal of Engineering and Technology Research, 3(3), 88-98.

[13] Ramadevi, K. and Manju, R. 2012. Experimental investigation on the properties of concrete with plastic PET (bottle) fibres as fine aggregates. International Journal of Emerging Technology and Advanced Engineering **2(6)**:42-46.

[14] Usman, M., Javaid, A. and Panchal, S. (2015). Feasibility of Waste Polythene Bags in Concrete. International Journal of Engineering Trends and Technology (IJETT) 23(6):317-319.