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PLASTIC FIBRES FOR INTERLOCKING BLOCKS PRODUCTION

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ABSTRACT

This study is aimed at establishing the use of Plastic Fibres for the production of Interlocking blocks. The density, water absorption properties and flexural strength of the Fibre based concrete batches were determined and compared to that of a control batch. The batches were prepared with a fibre to aggregate ratio of 0.25%, 0.5%, 0.75% and 1.0%, and the mix design was done based on relevant concrete mix design codes. The 200mm x 100mm x 60mm block specimens were used for the flexural strength testing and the specimens were cured in water and tested after 7, 14, and 28 days, and the water absorption reduces with addition of fibre. The 0.25 fibre batch absorbed the most water, while 0.83% and 0.5% fibre had the highest density, while 0.25% fibre batch had the lowest density. Test on flexural strength showed that the addition of fibre enhances the strength of concrete. The 0.75% fibre batch produced the highest flexural strength after 28days.

Keywords: **Plastic fibres, production, interlocking blocks.**

INTRODUCTION

Plastic is the term commonly used to describe a wide range of synthetic or semi-synthetic materials that are used in a huge and growing range of applications. Plastic are organic materials which produce natural products such as cellulose, coal, natural gas, salt and crude oil. Plastic have many good characteristics, which include versatility, light mass, hardness, and resistant to chemicals, water and impact. Plastic is one of the most disposable material in the world. It makes up much of the street side litter in urban and rural areas. It is rapidly filling up Landfills as choking water bodies. Plastic bottles make approximately 11% of the content landfills, causing serious environmental consequences. Plastic waste increase annually due to urbanisation and population growth. Nigeria is one of the biggest contributors of solid waste in Africa an estimated 32million for each year. The Nigeria population growth rate from year 2009 to 2017 as at average of 2.37 and this can be directly related to the rate of municipal solid waste generally and by extension plastic waste Recycling of Plastic is essential. To reuse or recycle Plastic for making good products such as interlocking block, such product must have good properties of inflation of heat, cold and acoustic. The main benefits of using these plastic wastes as materials is because it is cheap and usually available at nearly places, and it reduces the manufacturing cost, to achieve economy and most importantly to conserve our environment.

MARTIALS AND METHODS

The materials used in this study are water, ordinary Portland cement (Dangote), coarse aggregate (stone dust) fine aggregate (sand) and waste plastic fibre (polyethylene tereplalate pet), which was collected from local consumers. A concrete mix of 1:1:5:3 cement, sand, stone dust by volume was used for the interlocking blocks with water to cement ratio of 0.62. A conventional concrete mix method was adopted, and with curing as appropriate. The Laboratory test carried out on samples were water absorption test, bulk density test, and flexural strength test. The results were final analyzed.

RESULTS AND DISCUSSION

Density Test

The mass of all test blocks were measured, and the average unit weight of each concrete batch was conducted based on the BS EN328(1993) code shown in Table 4.1.

Density (kg/m^3) *= mass/volume*

Table 4.1. Density of interlocking blocks.

Batch	Block no	Mass	Volume	density	average
	1	2.318	1.2	1931.7	
	2	2.372	1.2	1976.7	
	3	2.382	1.2	1985	
Control					1952.8
	4	2.304	1.2	1923.3	
	5	2.320	1.2	1933.3	
	6	2.360	1.2	1966.7	
	1	2.356	1.2	1963.3	
	2	2.316	1.2	1930	
	3	2.248	1.2	2023.3	
0.25%					1950.6
	4	2.264	1.2	188 6.7	
	5	2.392	1.2	1993.3	

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	6	2.288	1.2	1906.7	
0.5%	1	2.392	1.2	1993.3	1998.9
	2	2.432	1.2	2026.7	
	3	2.382	1.2	1985	
	4	2.390	1.2	1991.7	
	5	2.278	1.2	1981.7	
	6	2.418	1.2	2015	
0.75%	1	2.432	1.2	2026.7	1993.1
	2	2.422	1.2	2018.3	
	3	2.410	1.2	2008.3	
	4	2.428	1.2	2023.3	
	5	2.354	1.2	1961.7	
	6	2.304	1.2	1920	
1.00%	1	2.368	1.2	1973.3	1968.4
	2	2.324	1.2	1936.7	
	3	2.360	1.2	1966.7	
	4	2.414	1.2	2011.7	
	5	2.268	1.2	1890	
	6	2.438	1.2	2031.7	

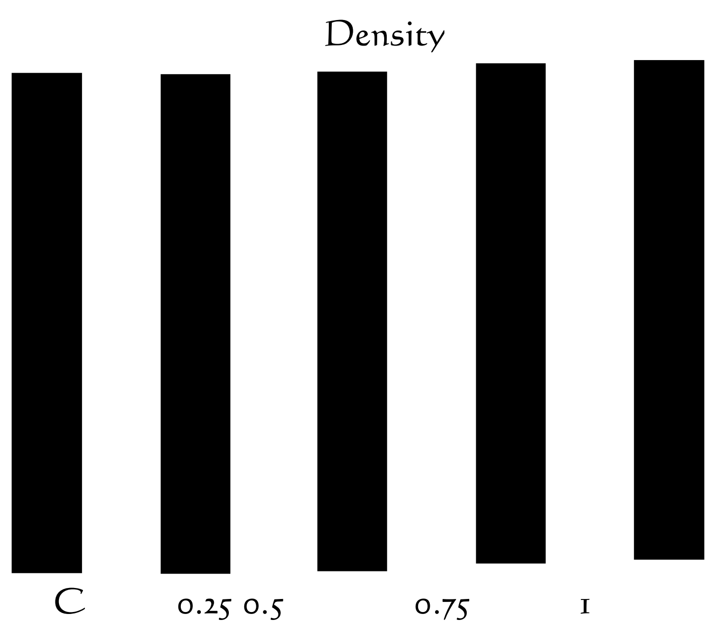

Fig4. 1 Concrete average density vs. Fibre percentage

Water Absorption Test

The results of the water absorption tests are presented in Table 4.2, 4.3 and 4.4 for 7, 14 and 28 days respectively. The results indicate that the control samples for 14 and 2x days absorbed the most water compared to other percentages of added fibre. Fig. 4.2 shows line chart relating the average water absorbed to the percentage fibre.

Table 4.2 Water absorption test results after 7 days

Batch	Block no	Dry mass (kg)	Wet mass (kg)	Water absorbed (%)	Average water absorbed (%)
	1	2.3180	2.329	0.48	
Control	2	2.3720	2.3935	0.91	0.7
	1	2.3560	2.3740	0.76	
0.25%	2	2.3160	2.3365	0.89	0.83
	1	2.3920	2.4135	0.90	
0.50%	2	2.4320	2.4480	0.66	0.78
	1	2.4320	2.4495	0.72	
0.75%	2	2.4220	2.4395	0.72	0.72
	1	2.3680	2.3885	0.87	
1.00%	2	2.3240	2.3360	0.52	0.70

Table 4.3 Water absorption test results after 14 days

Batch	Block no	Dry mass (kg)	Wet mass (kg)	Water absorbed (%)	Average absorbed (%)
	3	2.382	2.400	0.76	
Control	4	2.308	2.33	0.95	0.86
	3	2.428	2.45	0.9	
0.25 %	4	2.264	2.2785	0.64	0.77
	3	2.382	2.398	0.67	
0.50 %	4	2.390	2.410	0.84	0.76
	3	2.410	2.4285	0.76	
0.75 %	4	2.428	2.4455	0.72	0.74
	3	2.320	2.375	0.64	
1.00 %	4	2.414	2.4335	0.81	0.73

Table 4.4 Water absorption test results after 28 days

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Batch	Block no	Dry mass (kg)	Wet mass (kg)	Water absorbed (kg)	Average absorbed (kg)
	5	2.320	2.340	0.86	
Control	6	2.360	2.385	1.06	0.96
	5	2.392	2.412	0.84	
0.25 %	6	2.288	2.306	0.79	0.82+
	5	2.378	2.398	0.84	
0.50 %	6	2.418	2.438	0.83	0.84
	5	2.354	2.374	0.85	
0.75 %	6	2.304	2.324	0.87	0.86
	5	2.268	2.288	0.88	
1.00 %	6	2.458	2.478	0.81	0.85

The average water absorbed by the interlocking blocks at 28days for the control. 0.25, 0.5, 0.75 and 1 were 0.92, 0.82, 0.84, 0.86 and 0.85 respectively. These results show that the control samples absorbed the most water, this entails that the control more permeable than other samples which certain of plastic fibre was added.

Flexural Test

The Flexural strength of a total of 60 specimens as described in chapter three were tested. Two blocks from each mix batch were tested after 7, 14, and 28 days of curing. The modulus of rupture (MOR) was calculated using the formula below.

$$\text{Modulus of Rupture } f_b \text{ (N/mm2)} = \frac{3pl}{2bd^2} \quad \text{(BS 12390-5:2009)}$$

Where p = maximum load (N)

l = distance between supporting rollers (125mm)

b = width of beam (100mm)

d = depth of beam (60mm)

The results of the flexural strength test for 7, 14, and days are shown in Tables 4.5 to 4.7.

Table 4.5 the Flexural strength test results at 7 day

Batch	Block no	maximum	MOR	Average

		Load		MOR
	1	10	5.21	
Control	2	11	5.73	5.47
	1	11	5.73	
0.25 %	2	9	4.69	5.21
	1	15	7.81	
0.50 %	2	10	5.21	6.51
	1	11	5.73	
0.75%	2	15	7.81	6.77
	1	12	6,25	
1.00%	2	10	5.21	5.73

Table 4.6 the Flexural strength test results at 7 day

Batch	Block no	maximum Load	MOR	Average MOR
	3	13	6.77	
Control	4	15	7.81	7.29
	3	15	7.81	
0.25 %	4	11	5.73	6.77
	3	18	8.33	
0.50 %	4	13	6.77	7.55
	3	15	7.81	
0.75%	4	18	9.38	8.6
	3	16	8.33	
1.00%	4	13	6.77	7.55

Table 4.7 the Flexural strength test results at 28 day

Batch	Block no	maximum Load	MOR	Average MOR
	5	14	7.29	
Control	6	15	8.33	7.81
	5	16	7.81	
0.25 %	6	12	6.25	7.03
	5	17	8.85	
0.50 %	6	14	7.29	8.07
	5	17	8.85	
0.75%	6	18	9.38	8.86
	5	15	7.81	
1.00%	6	15	7.81	7.81

From the result in table 4.5, it can be seen that the gain of flexural strength of concrete is low at the initial stage (7 days). The flexural strength of the concrete increases with the age of the concrete. The experiment shows that the addition of fibre increases the flexural strength, although the strength does not increate in fibre percentage. Through all concrete batches containing fibre gave higher flexural strength than the control batch, the 0.75% fibre batch yielded the highest value of flexural strength after 7, 14, and 28 days. This result shows that the optimum plastic fibre content to attain maximum flexural strength in unreinforced concrete is 0.75. Fig. 4.3 and 4.5 is a line chart showing the average flexural strength and percentage fibre relationship arter 7, 14, and 28 days

CONCLUSION AND RECOMMENDATION

The study has shown that the rate at which plastic is being converted to solid waste material by effectively converting them to fibre in the production of interlocking blocks. The tensile characteristics of the plastic fibre interlocking blocks was compared with conventional interlocking block. Based on the results and analysis, the following conclusion were drawn. The fibre percentage that yielded the highest density was 0.5% with 1998kg/m. The Control was close with the 0.25% Fibre batches which both yielded 1952.8kg/m and 1950.6kg/m respectively. Hence, the density of the concrete increase with an increase in the fibre content just up to the optimum fibre percentage close with the 0.25% Fibre batches which both yielded 1952.8kg/m and 1950.6kg/m respectively. Hence, the density of the concrete increase with an increase in the fibre content just up to the optimum fibre percentage aft which the density then decreases.

The flexural strength values indicate that the concrete gains high tensile strength at the early stages. It also shows that the addition of the plastic fibre increases the modulus of rupture (MOR) after 7,14, and 28 days although the MOR does not increase with increasing fibre content. The increase in the MOR is only up to a certain fibre content. The 0.75% fibre batch yielded the highest MOR at 28 days with 8.86N/mn. The optimum quantity of plastic fibre for use as an additive is 0.75% (by weight of aggregates) as it yields the highest flexural strength value.

RECOMMENDATION

1. The use of more plastic wastes in the production of construction materials and concrete composites should be encouraged to develop enhance structural composite and aid in the control of plastic wastes.
2. Further researches, it is recommended that the study be done for a longer period of time to test the durability of the composites after 3 or 6 months as this will determine the suitability of the method in construction.

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