PRODUCTION OF PAVING BLOCK FROM RECYCLED POLYETHYLENE

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ABSTRACT

The production of paving block from sand and cement is becoming of immense and popular in Nigeria and is being used as finishing material in landscaping. Presently the cost of cement is becoming high and polythene waste is increasing daily causing pollution all over the land. This project researched into recycling of the polyethene and using it as binding agent in the production of paving blocks.

The pure water sachet nylon was collected, washed and dried. It was cut and melted in a machine fabricated to recycled the sachet water nylon. The recyclate was collected and mixed with sand at different temperature range of 200 – 300 ^{O}C. The condensate was mixed with sand poured in a mould and allowed to cool. Compression and hardness test were performed on the paving block produced.

The result shows that increase in temperature increases the compressive test of pave block and the more the content of the sand the higher the compressive strength of the paving block. The hardness test revealed that the pave block produced at 300 ^{O}C has a higher value than that at 200 ^{O}C while the pave block with higher sand content has greater hardness value.

INTRODUCTION

In Nigeria, almost every nook and cranny is littered with sachet of water nylon, popularly called "pure water", the large volume of which in ordinary parlance, constitutes pollution and termed negative externality in economics. This is as a result of millions of used- sachets being thrown on daily basis onto the streets of virtually every city, town, and village in Nigeria. (Edoga, Onyeji, & Oguntosin, 2008).

About 70 percent of Nigerian adults drink at least a sachet of pure water per day resulting in about 50 to 60 million used water-sachets disposed daily across the country. (Adetunji et.al, 2010). These waste are constituting pollution to the environment and coupled with the fact that this waste are not biodegradable. These waste remain in the soil for many years and constitute huge waste to the society. Direct burning causes pollution to the environment and also affect the ozone layer.

The recycle of this material has been carried out by different researchers. Odior et al (2012) developed a polythene recycling machine from locally sourced materials.

Sachet water business for the thirsty transit passengers and household has developed over the years in Nigeria beyond the belief of most as the enterprise has gone several rungs up the ladder, and the "pure water" industry emerged. The business became completely stabilized with the National Agency for Food and Drug Administration and Control (NAFDAC) endorsement. The resulting effect of this polythene put into use is that virtually all our villages, towns and cities are littered with both used and unused polythene bags. (Gbasouzor, Ekwuozor, & Owuama, 2013).

3.0 METHODOLOGY

3.1 Pre-Production Processes

The raw materials used for this project was sachet water nylon and sand. The sachet nylon was collected around Ogbomoso and particularly at LAUTECH. The sand was sieve to remove all impurities.

3.2 Cutting and washing

The air in the bag was forced out, and manual cutting method was adopted to create a better surface area for washing of the sachet, using clean warm water and detergent.

3.3 Drying:

After various washing processes, the material was sundried to remove the water content present, before being fed into the machine, since the presece of water affects the recycling machine and end product of the recyclate.

3.4 Weighing:

This was carried out using weigh balance. It was employed in the calculation of the hardness test.

3.5 Operation of the Polythene Recycling Machine

The machine was switched on to pre- heat the chamber for around 45 minutes so as to ensure that the section of the barrel is heated before the material was fed, in order to prevent clogging along the neck of the barrel. The polythene (sachet water) nylon was fed into the hopper after cutting. The worm on the rotating shaft compressed the nylon and rolled it into the heating barrel where it is heated.

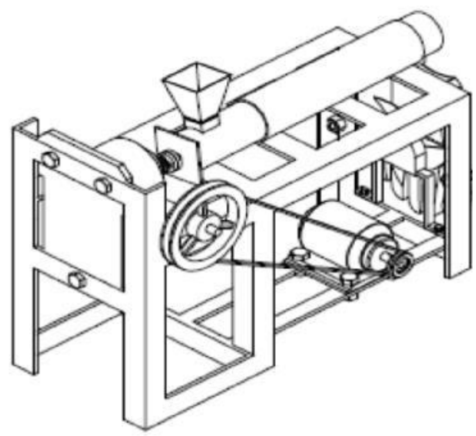


Figure 1:Isometric Projection of the Polyethylene recycling machine

3.6 Mould used for the pave block

A Cylindrical mould was used in the cause of the Experiment

The diameter was 18.5cm and with thickness 4cm.

Figure 3.2: Mould used in the production of the pave block.

3.7 Production Method

The recyclate that was extruded from the recycled polyethene was mixed with sand in different ratio and at different temperatures. It was them allowed to cool. The produced pave block was them taken to the laboratory for test.

3.8 Mixing ratio of the condensate and the sand

The table below depicts the mixing ratio for the produced pave block.

Table 3.1: Mixing ratio of the paving block

Specimen	Sand	Polyethylene	Temperature (^{O}C)
A	2	1	300
B	1	1	200
C	1	2	300
D	2	2	200

3.9 Compression Test

The compression test was carried out in the structural Laboratory of the Civil Engineering Department at Ladoke Akintola University of Technology Ogbomoso using the compression Machine and the readings were tabulated.

3.10 Hardness Test

The Aggregate Impact Value Apparatus was used. It operates by putting the Specimen to be tested in a cone, and punching successive impact of 20 blows on the specimen in the cone.

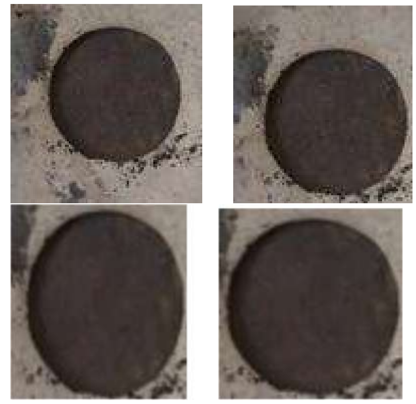
The mass of the cone was measured before putting the specimen, and after the blow the specimen was measured to determine the total mass. After the 20 successive blows, the specimen was extracted from the cone into a 13.2-unit sieve No 4 to sieve out the crumbs from the blows. The specimen was sieved carefully for crumbs to fall into the pan below the sieve. The mass of the pan before putting the crumbs and after including the crumbs was measured, so as to determine the mass of the crumbs.

The Hardness value was calculated from the equation below:

$$\text{Hardness} = \frac{m \quad p \quad thr \quad hs \quad N\ 4}{T \quad M \quad o\ S} \text{ X } 100$$

4.0 RESULTS AND DISCUSSION

The Samples of produced pave blocks produced are shown below.



A B

C D

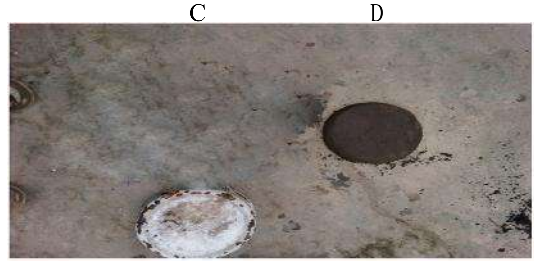


Figure 4.1 : Produced pave blocks and mould

4.3. Compression and Hardness Test for each Specimen

4.3.1 Compression Test

The result for the compression test is shown in table 4.1..

Table 4.1: Compression Test Results

Specimen	Mixing Temperature (^oC)	Sand/Polyethylene ratio	Compression Strength (KN)
A	300	3:1	830
B	200	1:1	415
C	300	1:2	675
D	200	2:2	575

From Table 4.1, it was observed that specimens A and C produced at 300 ^oC have higher compressive strength than specimens B and D produced at 200 ^oC.

It was also noted that the sand/polythene ratio affected the compressive strength. Specimen A with Sand/Polyethylene ratio of 3:1 (more sand and less polyethylene), has higher compressive strength than specimen C with Sand/Polyethylene ratio of 1:2 (more polyethylene and less sand). Specimens D and B with equal sand/Polyethylene ratio have the least compressive strength.

Specimen D with more volume of Sand/Polyethylene ratio, has higher compressive strength than Specimen B with Less volume of Sand/Polyethylene ratio. This implies that compressive strength is highest when the sand constituent is more than the polyethylene content heated at a high temperature.

4.3.2 Hardness Test

The result of the hardness test is shown in table 4.2 below.

Table 4.2: Hardness Test Results

Specimen	Temperature (^{o}C)	Sand/Polyethylene ratio	Hardness Value (%)
A	300	3:1	9.26
B	200	1:1	47.23
C	300	1:2	17.8
D	200	2:2	41.3

From The Table 4.2; it was observed that specimens produced under temperature of 300 ^{O}C have higher hardness value than specimens produced at temperature of 200 ^{o}C. Specimen A and C produced at 300^{o}C possess more Hardness value than Specimen B and D produced at 200 ^{o}C. The sand/polyethylene ratio affects the hardness value. Specimen A with more sand and less polyethylene has higher hardness value than specimen C that contains more polyethylene and less sand. Specimens D and B with equal sand/Polyethylene ratio have the least hardness value.

Specimen D with more volume of sand/Polyethylene ratio, has higher hardness value than Specimen B with Less volume of sand/polyethylene ratio.

This implies that hardness value increases with increase in the sand and at high temperature.

The scale used for hardness is interpreted between 1% – 35%. The lower the value the greater the hardness. Any material with value above 35% has a poor Hardness property.

This means specimen A with hardness value of 9.26% has the highest hardness value and Specimen B with 47.23% has the least hardness value. Table 4.3 combined the result of compression and hardness test all together.

Table 4.3: Test Results for Paving Block Specimens

Specimen	Sand	Polythene	Temperature (^{o}C)	Sand/Polyethylene ratio	Hardness Value (%)	Compressive strength (KN)
A	2	1	300	3:1	9.26	830
B	1	1	200	1:1	47.23	415
C	1	2	300	1:2	17.8	675
D	2	2	200	2:2	41.3	575

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The specimens produced at high temperature (300 ^{O}C) have more compressive strength and hardness value, than those produced at lower temperature (200 ^{O}C). Hence, production of polythene paving block should be carried out at temperature of 300 ^{O}C or a little above for good hardness and compressive strength.
The polythene paving blocks will be a good replacement to concrete paving blocks in areas of light duty applications, as it will withstand an average of 600KN - 1000KN load, depending on the mixture of the constituents.
Also, the thickness can be increase to 7cm as is commonly used in convectional concrete paving blocks and this will increase the strength and hardness of the product.

5.2 Recommendation

The polyethylene(sachet water) recycling machine should be introduce into Nigerian waste management industry to allow for the recycling of nylon waste. Also the following are recommended:

1. Inclusion of granite can be carried out in the production of polyethylene paving blocks to increase the strength and hardness and its result evaluated.
2. Sample of the pave bloch should be tested for over a period of years to see the effect of season and the climate on it.

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