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Review JoTCSTA

Production of Floor Tile Using Recycle Low Density Polyethylene and Groundnut Shell As a Filler

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Abstract

The production of flow tile using recycled low density polyethylene and groundnut shell as filler with the particle size of 120 µm was carried out in this project. 10 pphr of all the fillers were weighed and mixed with recycled low density polyethylene on two roll mill machines. The result on this work showed that on FTIR five functional groups were identified and they are; OH, C-H, CH_2/CH_3, C-O, C=H. While for water absorption showed that the sample was absorbed in water that is to show that production is possible when there is availability of water. For the hardness test, it showed that the product has good mechanical properties. A steady temperature of 120°C was selected for the two roll mill machines in order to facilitate the compounding of plastic. Recycled low density polyethylene was fed into the two roll mill machine's nip until it was masticated. After adding half of the filler, the material was cut diagonally and cross-mixed. Then, the remaining filler was added and the material was cross-mixed diagonally until a bond was formed. After that, the product was shot into a compression molding machine and compressed for ten minutes at a temperature of roughly 160°C before being moved from the heating chamber to the cooling chamber (a process known as vulcanization).

Keywords: Recycle Low Density Polyethylene, Groundnut Shell, Sand, Processing Oil, Distilled Water

INTRODUCTION

Plastic have become on wergild part of our daily lives. Plastic consumption and generation of plastic waste continue to pore environmental concern globally Ayo MD, Chukwu N, Tenebe OG, (2015) [1]. It is increase usage could be attributed to it is low density, strength long life, and low cost. Other reason includes it's resistance to rusting, flexibility of shape, heat conservation BK sharma, (2002) [2]. Various uses of plastic include packaging, automation and industrial application. with such varying applications, the amount of plastic consumption and the resulting wastes generated in the developed countries had witnessed sporadic growth in the last two decades, plastic consumption in United Kingdom (UK) in 2003 amounted to 4.7 million trucks, out of which 3.0 lories ended up as a waste Premamoy G, (2018) [9]. In the United States of America (USA), plastic consumption rate for the period was 26.7 million tones of with 11 millions ending up as a waste. In addition annual plastic consumption in west europeis approximately 60 millions tones out of which plastic bottles between 2005 and 2006 was approximately 20 trillion (Sharma 2000) [3]. Recycling of plastic waste is difficult owing it's commingled nature and the difficulty in the identification, separation and classification Fried J R, (2009) [4],. The common

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practice of land filling is becoming unattracting owing to the inert nature and poor biodegradability of plastic waste it uses high volume to weight ratio decreasing land fill space and it is increasing cost. Live wires incineration of plastic waste in land fill result in environment concern such as CO_2, NOx, (nitrogen oxide) SOx (sulphur oxide), volatile organic compound, smoke, heavy metals ploy chlorinated dibenzofurans and poly cyclic aromatic hydro carbons which are carcinogenic (sharma 2000) [5].

Aim and Objectives of the Research

The main aim of the study is to evaluate agricultural waste on the recycle low density polyethylene using groundnut shell as filler in the production of floor tile.

The aim can be achieved by the following objectives

1. To produce floor tile that have higher ability and durability for use.
2. To compare market standard with ceramic floor tile and the one produce using plastics.
3. To convert waste into useful product.
4. To reduce the dumping of agricultural waste (groundnut shell) in our community.

To characterized the filler using FTIR, ash content, moisture content [6]

MATERIALS

The materials used for this research are as follows

- Recycled low density polyethylene (LDPE)
- Groundnut shell
- Processing oil
- Distilled water (for other analysis carried out on the filler) etc

METHODOLOGY

Collection and preparation of samples

The low density polyethylene was obtained at Hussaini Adamu Federal Polytechnic, Kazaure Jigawa State. At the school premises. After all the collections it was washed and dried in the sun to remove all form of dirty on the low density polyethylene. It was later recycled using recycling machine in the department of polymer technology at NILEST Zaria. The groundnut shell was obtained at Kazaure livestock market (Kara) JigawaState. When the shell was collected, it was washed using distilled water and dried in sun light, before it was found using grinding machine and sieved using (145 um) sieve so that it will be smooth. (Powdered form) [7].

Preparation Process

The temperature of the two roll mill machine was set to 120^{o}C which is a stable temperature for compounding plastic. The recycled low density polyethylene was introduced into the nip of the two roll mill machine until masticated, half of the filler was introduced then the material was cut diagonally and cross mixed before the remaining half of the filler was introduced and cross mixed diagonally until bond is achieved. Then the product was shoot out to the compression molding machine to compress for about 10 minutes at the temperature of about 160^{o}C then transferred from heating chamber to cooling chamber (Vulcanization process) [8].

DESCRIPTION AND RESULT

Tensile Strength Test

Hounsfield (Monsanto) testsiomter ASTM standard (D648-10). (Universal testing Machine) (model No. S/N8889) in the department of mechanical engineering, ABU Zaria was used to determine the percentage elongation of the materials. The specimen geometry was in a dumb-bell shape and was sectioned to 100 mm × 15 mm × 3 mm, with gauge dimension 40 mm × 10 mm × 3 mm. Uni–axial load was applied to each ends of the respective samples unit it fails (rupture) [9].

Hardness Test

Hardness test was conducted using (ASTM D1412, 1983), the Durometer Tester of Indentech, UK (Model 8187.5 LKV) the dimension of the prepared test samples was measured (in mm) and surfaces smoothness was maintained. An average was taken after three times of test by summing the values by total number of tests taken.

$$\text{Average hardness} = \frac{1st+2nd+3rd+readings}{3}$$

FLEXURAL TEST

The method of conducting the test is that the sample were cut into triangle, the sample is placed into two supporting pins set apart on universal testing machine (UTM) after the reading is taken, the sample is then removed.

Water Absorption Test

Water absorption test (ASTMD570) is to determine the rate of absorption of water firstly you are to take the initial weight of the sample then you are to immerse the samples in water for 24 hours. The sample was removed from the water and re-weighed immediately, the percentage loss/with gain of the samples was evaluated using this equation below.

$$\%\text{weight} = \frac{W2 - W1 \times 100\%}{W1}$$

Where W1 = initial weight of the sample
W2= final weight of the sample

FTIR TEST

The sample is held in a holder in the path of the IR source. Adetector reads the analog signal and converts the signal to a spectrum. A computer is used to analyzed the signals and identify the peaks. An IR bean goes through a partially silvered mirror, which splits the beam into two beams of equal intensity. The infrared spectroscopy method is used to identify organic polymeric and in some cases, inorganic materials. The FTIR analysis and observed bond properties. FTIR analysis services can identify compounds and the general types of material being analyzed when there are unknowns [10, 11].

RESULTS AND DISCUSSION

From the sample above, the result shows that sample C (0.347) has a better mechanical properties while sample B (0.281) has moderate mechanical properties and sample A (control) has poor mechanical properties because it has no any filler and this product can be used in houses, office or schools e.t.c b Table 1 Figure 1 and Tables 1–4

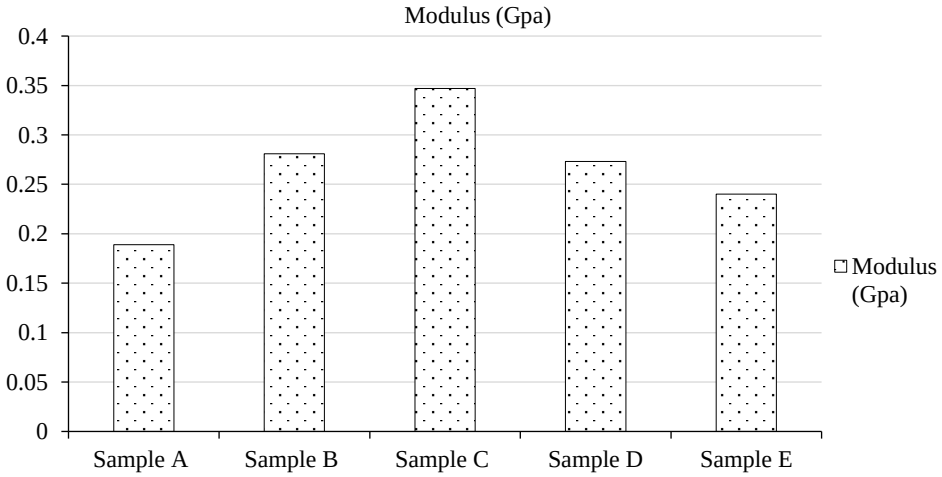


Figure 1. Table 1 tensile strenght test.

From the above sample E and sample D (30g&40g) gave the highest hardness value respectively.

However, sample A has lowest value because it has no filler. So the results showed that sample E and sample D has good mechanical properties Figure 2 Table 2.

From the sample above, the result revealed that sample E(12.11) has a better mechanical properties due to excess of filler, while sample C(10.626 mm) and sample D (10.685 mm) has moderate mechanical properties and sample B (9.03 mm) has poor mechanical properties Figure 3 Table 3.

From the above result, it shows that sample (A,B,C,D) has no effect on water and only sample E has less effect that is to show it has poor physical properties, so the product can be used in an area where there is water. Examples are toilets, schools, houses etc Figure 4 Table 4.

FTIR TEST

The result shows that sample Ahas a peak at 2847 and 2914 and there is present of C-H stretching. That is to show their intensity is high. Next peak is 1748 cm^{-1} which is for carbonyl group c=o for the filler. This indicates the presence of lignin. Next peak is at 1465 there is present of methyl group i.e CH_3 or CH_2. These shows the present in both lignin and hemicellulose from the filler. Lastly the peak is at 1156 means the peak is for C-O stretching for primary alcohol in pectin, hemicellulose and lignin from the filler Figure 1 Figure 5.

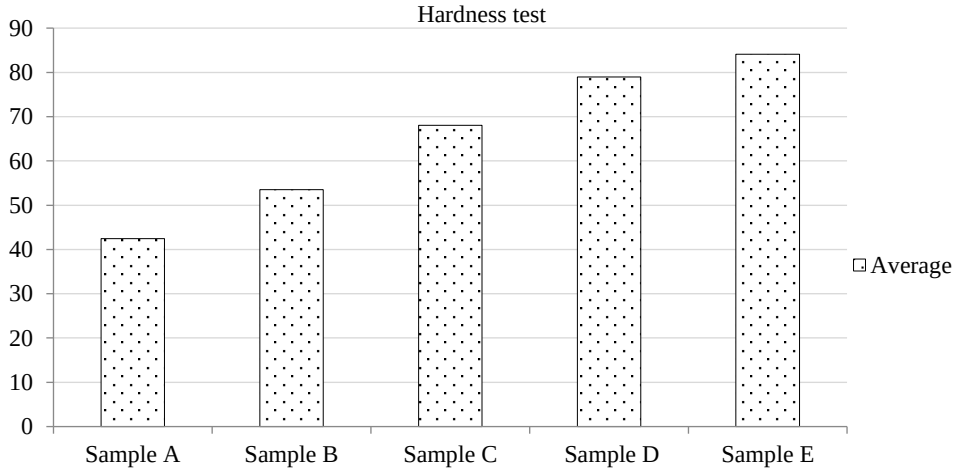


Figure 2. Hardness Test.

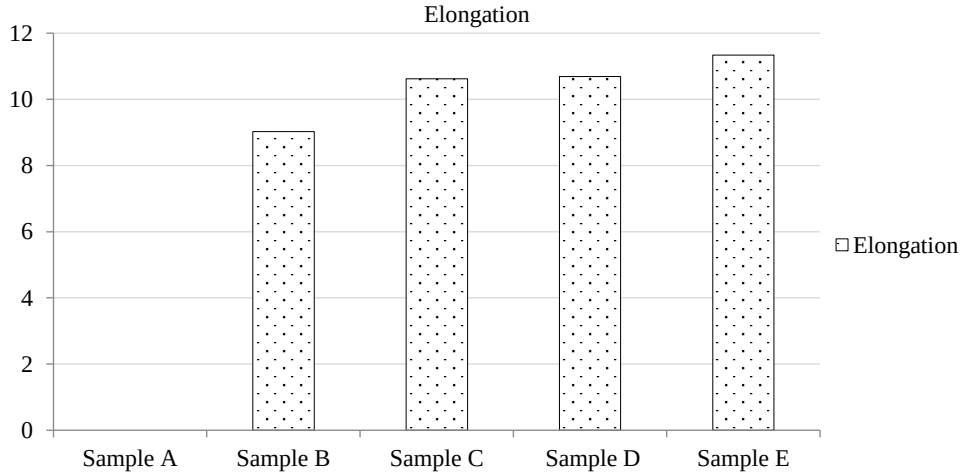


Figure 3. Table 3 Flexural Test.

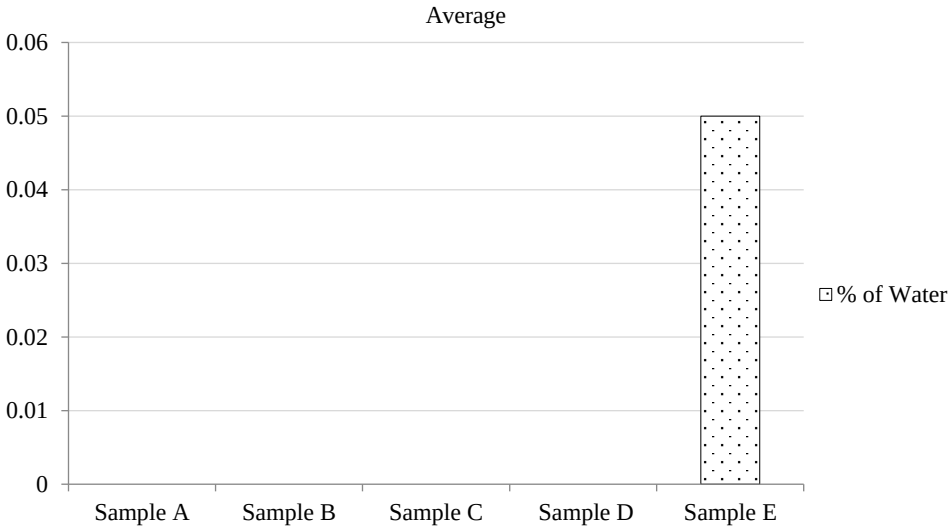
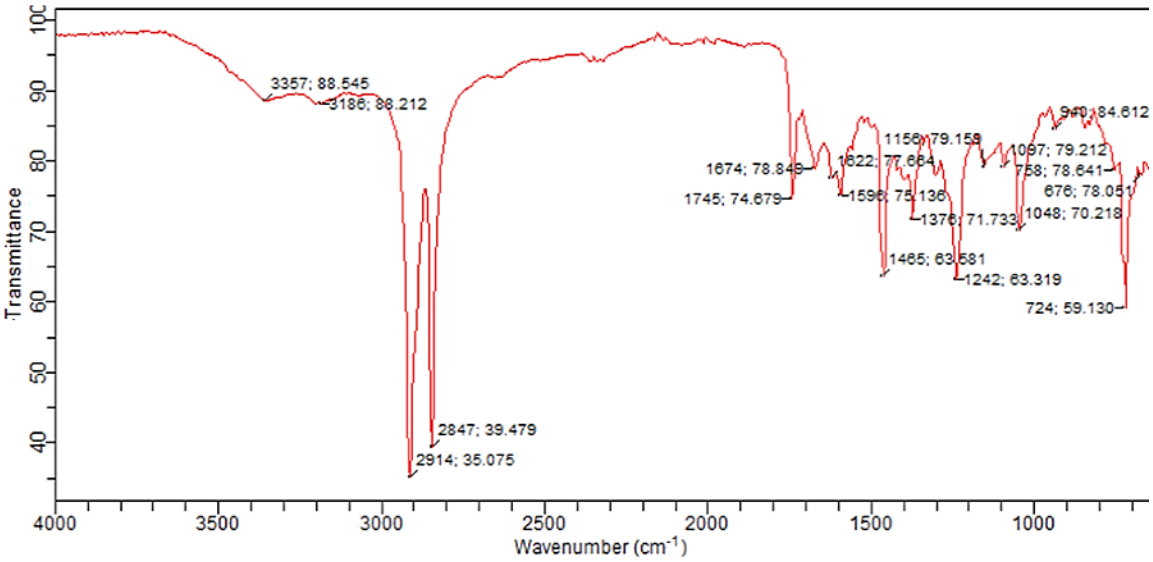


Figure 4. Table 4 Water Absorption Test.



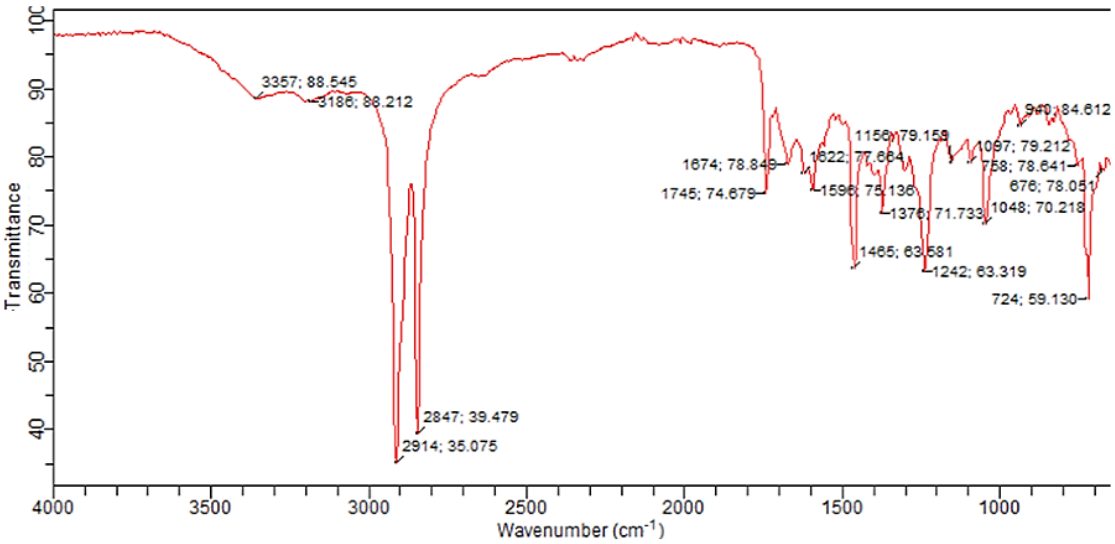
Sample ID:	**Sample B**	**Method Name:**	**Default**
Sample Scans:	32	User:	admin
Background Scans:	32	Date/Time:	11/12/20233:19:25PM
Resolution:	8 cm^{-1}	Range:	4,000.00-650.00
System Status:	Good	Apodization:	Happ-Genzel
File Location:	C:\ProgramFiles\Agilent\MicroLabPC\Results\SampleB_2023-11-12T15-20-55.a2r		

Figure 5. Figure 1 Ftir Test Sample A.

The result shows that sample B has a peak of 2847 and also there is present of C-H stretching. The next peak is 1745 cm^{-1} is for carbonyl group C=O for the filler it indicates the presence of lignin. The next peak of 1465 which shows the present of methyl group I eCH_3 or CH_2. Last peak at 1156 are for C-O stretching for primary alcohol in pectin, hemicellulose and lignin from the filler Figure 2 Figure 6

The result shows that sample C has a peak at 2847 and 2914 and there is present of C-H stretching that is to show their intensity is high. The next peak is 1748 cm^{-1} while the next peak is at 1465 cm^{-1} there is present of methyl group i.e CH_3 or CH_2 that is to show that they all have both lignin and

hemicellulose from the filler. Next peak at 1030 are for C-O stretching for primary alcohol in pectin, hemicellulose and lignin from the filler Figure 3 Figure 7.



Sample ID:	**Sample B**	**Method Name:**	**Default**
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Background Scans:	32	Date/Time:	11/12/20233:19:25PM
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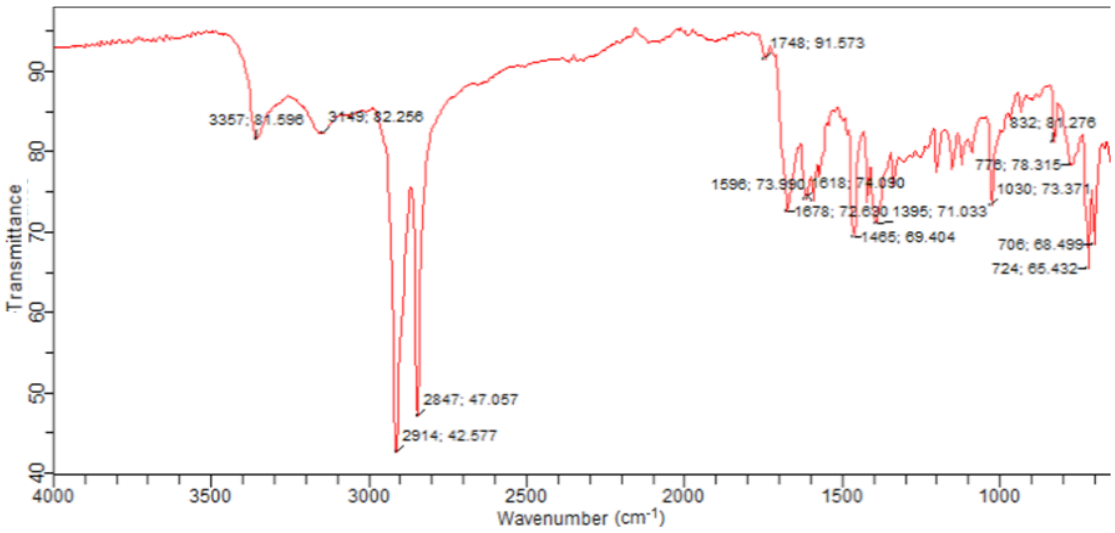
System Status:	Good	Apodization:	Happ-Genzel
File Location:	C:\ProgramFiles\Agilent\MicroLabPC\Results\SampleB_2023-11-12T15-20-55.a2r		

Figure 6. Figure 2 FTIR Sample B.



Sample ID:	**Sample C**	**Method Name:**	**Default**
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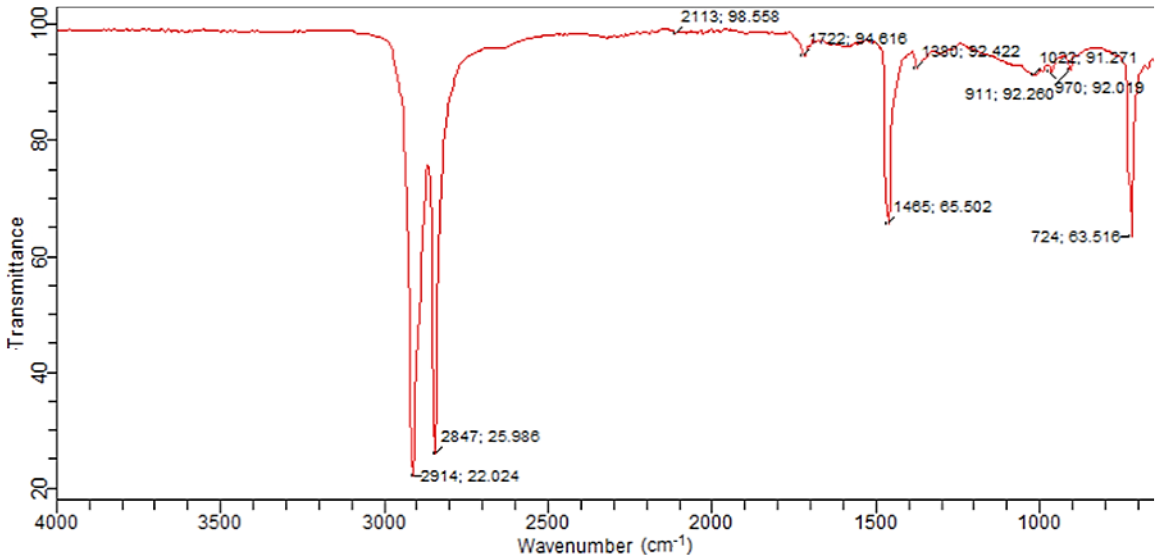
Background Scans:	32	Date/Time:	11/12/20233:14:44PM
Resolution:	8 cm^{-1}	Range:	4,000.00-650.00
System Status:	Good	Apodization:	Happ-Genzel
File Location:	C:\ProgramFiles\Agilent\MicroLabPC\Results\SampleC_2023-11-12T15-16-02.a2r		

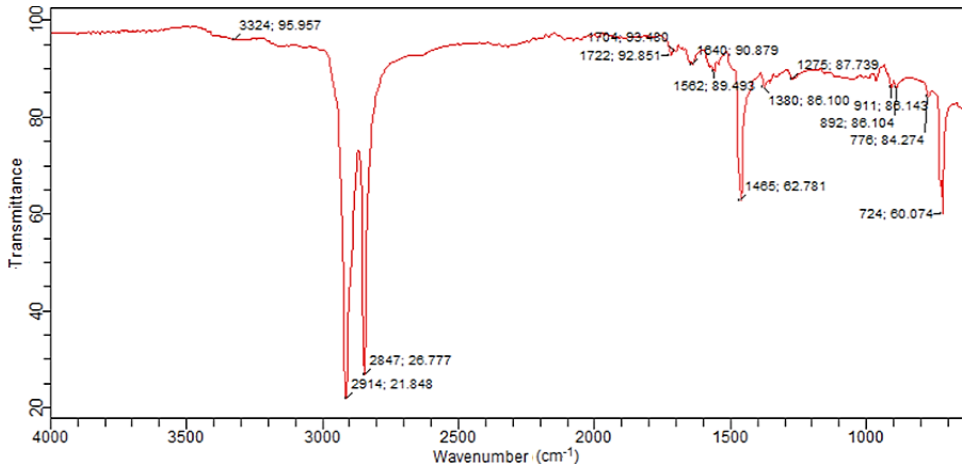
Figure 7. Figure 3 FTIR Sample C.

The result shows that sample D has a peak at 2847 and 2914 and there is present of C-H stretching. Next peak at 1722 cm^{-1} which shows the presence of of carbonyl group C=O filler this indicates the presence of lignin. Next peak at 1022 which is for C-O stretching for primary alcohol in pectin, hemicellulose and lignin from the filler Figure 4.



Sample ID:	**Sample D**	**Method Name:**	**Default**
Sample Scans:	32	User:	admin
Background Scans:	32	Date/Time:	11/12/20233:12:19PM
Resolution:	8 cm^{-1}	Range:	4,000.00-650.00
System Status:	Good	Apodization:	Happ-Genzel
File Location:	C:\ProgramFiles\Agilent\MicroLabPC\Results\SampleD_2023-11-12T15-13-25.a2r		

Figure 8. Figure 4 FTIR Sample D.



Sample ID:	**Sample E**	**Method Name:**	**Default**
Sample Scans:	32	User:	admin
Background Scans:	32	Date/Time:	11/12/20233:03:18PM
Resolution:	8 cm^{-1}	Range:	4,000.00-650.00
System Status:	Good	Apodization:	Happ-Genzel
File Location:	C:\ProgramFiles\Agilent\MicroLabPC\Results\SampleE_2023-11-12T15-04-31.a2r		

Figure 5. FTIR Sample E.

The above result shows that sample E has a peak at 1722 cm^{-1} which shows the presence of C-H stretching. Next peak is at 1465 which shows the presence of methyl group I.e CH_3 or CH_2, these shows that both lignin and hemicellulose are presented from the filler. Last peak is at 1275 cm^{-1} which shows the presence of C-O stretching for primary alcohol in pectin hemicellulose and lignin from the filler. Figure 5 Figure 8

CONCLUSION AND RECOMMENDATION

Conclusion

This research work is done to work at the possibility of using recycled low density polyethylene in the production of floor tiles using Agricultural waste products as filler. The result under the FTIR shows that we are able to identify five functional groups OH, C-H, C=H, CH_3, CH_2 C-O at 33, 29/28, 17,14 and 11/12 cm^{-1} and the result shows the properties of the product shows to some extent the recycled LDPE can be workable, alternative as base polymer in the production of tiles, using groundnut shell as filler.

Recommendation

Due to the challenges faced during this research work, here are my recommendation.

1. The school management should install the following machines; two roll mill ma hine, compression molding machine, recycling machine and universal testing machine in polymer department.
2. For further research, the following analysis should be carried out, impact strength test, abrasion resistance test, and also SEM test need to be carried out on the samples to determine the filler mature interaction.
3. Furthermore, chemical/physical test should be conducted such as flame test.
4. Government should assist farmers in the production of groundnut so as to make the filler available.

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APPENDIX

Table 1. Table 4.1 Tensile Strength Result.

S/N	Samples	Modulus (Gpa)
1	Sample A	0.189
2	Sample B	0.281
3	Sample C	0.347
4	Sample D	0.273
5	Sample E	0.240

Table 1. Table 4.2 Hardness Test Result.

S/N	Samples	1st Reading	2nd Reading	3rd Reading	Average
1	Sample A	42.1	42.7	42.5	42.43
2	Sample B	53.2	53.5	53.9	53.53
3	Sample C	67.5	68.1	68.5	68.03
4	Sample D	79.8	79.2	77.9	78.96
5	Sample E	83.3	84.8	84.2	84.1

Table 3. Table 4.3 Water Absorption Test.

S/N	Samples	Initial weight	Final weight	% of water
1	Sample A	10.50	10.50	0.00
2	Sample B	10.46	10.46	0.00
3	Sample C	9.102	9.102	0.00
4	Sample D	10.017	10.017	0.00
5	Sample E	11.00	10.50	0.50

Table 4. Table 4.4 Flexural Test.

S/N	Samples	Force of peat	Elongation
1	Sample A	0.007	12.116
2	Sample B	0.010	9.03
3	Sample C	0.010	10.626
4	Sample D	0.016	10.685
5	Sample E	0.016	11.341

