The Tensile Strenght Properties Effect Of Rice-Husk Ash As On The Composite Of Plastic Drinking Bottle Waste

Maulida, Syahri Dani, Faisal Bukhory

Abstract: Rice-husk ash has a potential to be filler in composite. The study on rice-husk ash utilitation as afiller in polyethylene terephthalate (PET) matrix of plastic drinking bottle waste was conducted in order to find the ratio of rice-husk ask and PET matrix that would result the best tensile strength, which was characterized by using scenning electron microscopy (SEM). In this study, the PET of plastic drinking bottle waste firstly was cut into smaller pieces and was extruded with the temperature of 265 ^{o}C. Then, it was mixed with rice-husk ash on ratio of PET plastic drinking bottle waste and rice-husk ash of 95:5, 90:10 and 85:15. After that, it was extruded at temperature of 265 ^{o}C before it was pressed by hot press at temperature of 265 ^{o} C for five minutes. The highest tensile strength was achieved at 3,462 MPa with elongation at break a round 143,75 % and young's modulus of 348,82 MPa for the ratio of 85:15.

Index Terms: composite, extruder, tensile strength, rice husk ash, plastic drinking bottle waste.

1 Introduction

According to Mittal (1997) rice-husk is one of the biggest silica's producer_complete combustion. Rice husk ash as a result of the undercontrolled combustion at the higher temperature (500 – 600 ^{o}C). It will produce silica's ash that can be utilized for chemical processes[1] and at the higher temperature than 1000 ^{o}C, it will produce crystalline silica[2]. Rice-husk ash contain 86% - 97% of silica in dry weight[3]. Composites can be defined as compounds that are made by combining two or more physical material, the selection of filler (filler) or a reinforcing agent and a binder matrix should be compatible to produce a multiphase system with different properties of the starting materials but retains the characteristics of the material [4]. Plastic waste can cause environmental pollution because not biodegradable [5]. Types of polymers commonly used as a drinking water packaging is PET (polyethylene terephthalate). This polymer hard, strong, material is also stable and does not absorb water, has good properties for protection against gases and chemicals, crystallinity varies from amorphous to crystalline. Crystalline melting point is 265 ° C [6]. Tereflatat polyethylene (PET) has good thermal stability, excellent electrical properties, very low water absorption, excellent surface properties [7].

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2 Procedure

2.1 Material

Rice Husk ash from rice plant Ginter Jl. Tanjung survived Medan Tuntungan as filler (filler). Waste plastic bottle beverage packaging serves as a matrix derived from scavengers which are in the surrounding area and the environment University of Sumatera Utara Medan Setia Budi.

2.2 Equipment

The tools used in the manufacture of hybrid composites are: Ball Mill, Extruder, Hotpress, sieve, test equipment tensile strength (tensile strength) / universal testing machine (UTM) grid 7000m Gotech al-tensile.

2.3 Preparation

Milled rice husk ash in using Ball mill sieving then performed using a 100 mesh sieve size. After it is inserted into the oven at a temperature of 70^{o}C to remove the water content in rice husk ash. Waste plastic bottle beverage containers cleaned first and then cut into small pieces.

2.4 Processing

Comparison between beverage packaging waste plastic bottles with rice husk ash is 95: 5, 90:10 and 85:15 (w / w). First of all beverage packaging plastic bottle waste input into ekxtruder to be melted at a temperature of 265^{o}C after the it is mixed with rice husk ash and in hotpress at 265^{o}C temperature.

3 Result And Discussion

3.1 Characteristic FTIR (Fourier Transform Infra Red)

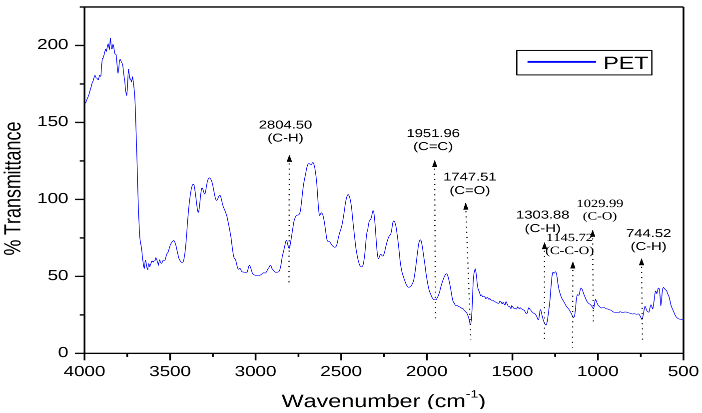

Fig. 1

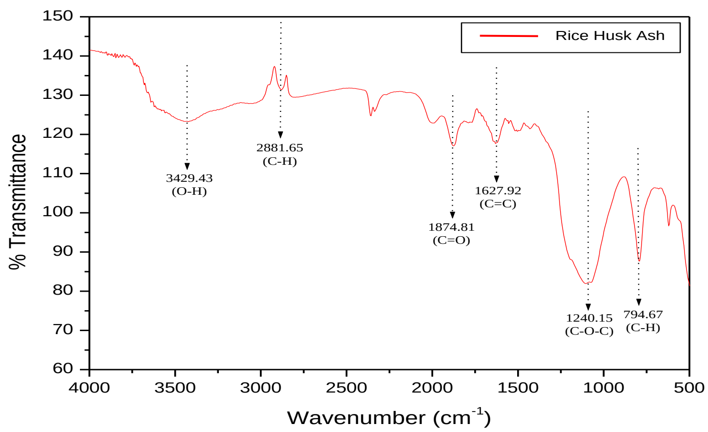

Fig. 2

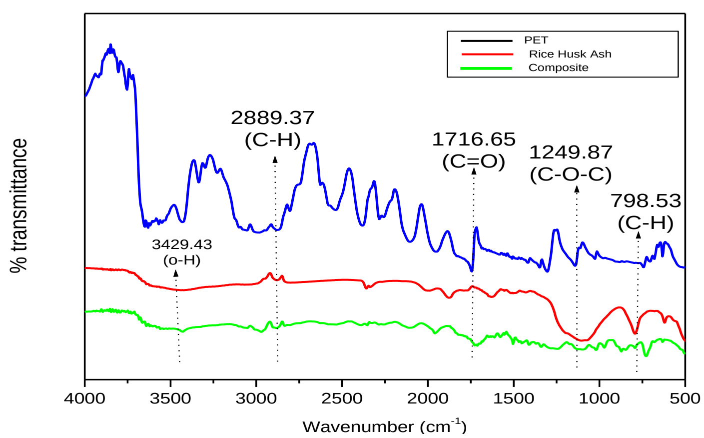

Fig. 3

From Figure 1 FTIR characteristics PET plastic bottle beverage packaging waste can be seen that at a wavelength of 2804.50 cm^{-1} shows the CH of strain alkane, at a wavelength of 1951.96 cm-1 shows the group C = C of the aromatic benzene ring strain, at a wavelength of 1747 , 51 cm-1 shows the group C = O of the ester strain, at a wavelength of 1303.88 cm-1 shows the CH of strain ester, at a wavelength of 1145.72 cm-1 shows the COC group of strain ether, at a wavelength of 1029 , 99 cm-1 shows the CO group of strain ester, and at a wavelength of 744.52 cm-1 shows the CH bending aromatic ring of benzene [9]. In Figure 2 FTIR characteristics of rice husk ash can be seen that at a wavelength of 3429.43 cm-1 shows the strain alcoholic OH groups of cellulose and lignin in the chain, at a wavelength of 2881.65 cm-1 shows the CH of strain alkanes, in the long wave 1874.81 cm-1 shows the group C = O of the carbonyl and acetyl strain on components of hemicellulose and lignin xylene [10], at a wavelength of 1627.92 cm-1 shows the group C = C of the aromatic benzene ring strain, the length wave 1240.15 cm-1 shows the COC group of strain ether in lignin and hemicellulose, and at a wavelength of 794.67 cm-1 shows the CH bending aromatic ring of benzene [9]. In figure 3 the characteristic FTIR plastic bottle beverage packaging waste composite rice husk ash can be seen that at a wavelength of 3429.43 cm-1 shows the strain alcoholic OH groups of cellulose and lignin in the chain, at a wavelength of 2893.22 cm-1 shows the CH of strain alkanes , at a wavelength of 1720.50 cm-1 shows the group C = O of the carbonyl stretch and acetyl xylan in kompenen of hemicellulose and lignin [10], at a wavelength of 1235.73 cm-1 shows the COC group of strain ether in lignin and hemicellulose , and at a wavelength of 794.67 cm-1 shows the CH bending aromatic ring of benzene [9]. And of figure 3 above is also seen that there are no new peaks appeared when compared with PET plastic bottle beverage packaging waste FTIR characteristics, rice husk ash and rice husk. This shows there is no chemical reaction in the resulting hybrid composite. Merger between matrix and filler material is a reaction physics (mechanics) only. This is because the nature of the polarity between matrix and filler material that allegedly still different blocking the interaction between the two. There are three factors that affect the bonding: mechanical anchoring (mechanical anchoring), chemical bonding between the filler and the matrix, and the molecular attractive force (van der Waals forces and hydrogen bonding) [11].

3.2 Tensile Strenght

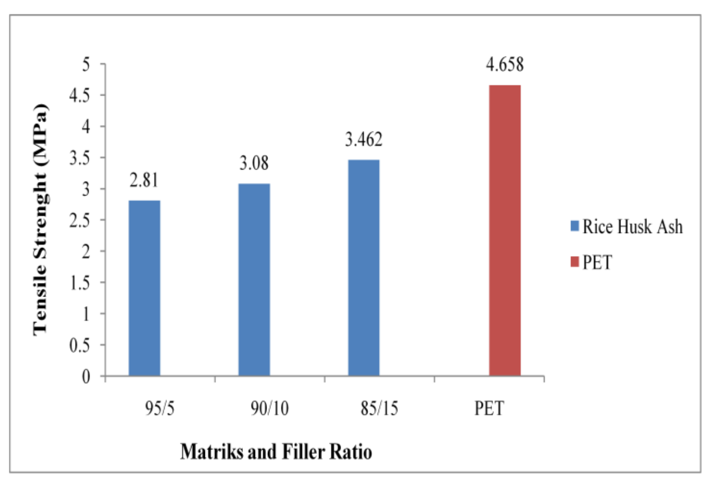

Fig. 4

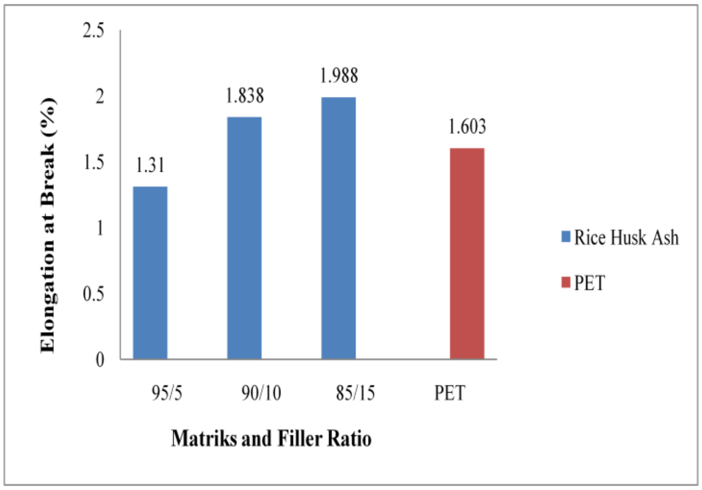

Fig. 5

From Figure 4 it can be seen that for the composite tensile test with 85/15 ratio shows that the maximum tensile strength of rice husk ash filler, that is equal to 3.462 MPa. Maximum tensile strength values of filler are under tensile strength values for PET plastic bottle beverage packaging waste that is equal to 4.658 MPa. This is due to the irregular size of the palm empty fruit bunch fibers can make the matrix is not able to withstand stress (stress) are given so that the value of the tensile strength of the composite under pure matrix [12]. From the results of tensile testing of composite berpengisi rice husk ash was found that the tensile strength of composite materials increased significantly with increasing filler content, namely 2.810 MPa (95/5 ratio); 3.080 MPa (90/10 ratio); 3.462 MPa (85/15 ratio). This is caused by the addition of rice husk ash filler which can increase the strength in the interphase region between matrix with filler so that the composite material has a strength capable of withstanding voltage (stress) are given in the matrix [13]. From Figure 4 composite test results show that the elongation at break increases with increasing filler content of rice husk ash. Elongation at break of the lowest obtained at 95/5 ratio, amounting to 1.310%, while the highest was obtained in 85/15 ratio that is equal to 1.988%. This suggests that the increasing filler will result in a composite material becomes more elastic. Increasing the value of elongation at break showed the ability of filler material to support the displacement voltage (stress) of the polymer material to the matrix [14].

TABLE 1 *VALUE OF YOUNG,S MODULUS*

Material	Young Modulus [MPa]
PET	274.626
Composite PET 95/5	245.409
Composite PET 90/10	263.688
Composite PET 85/15	258.819

Young's modulus is a parameter that indicates the nature of the material stiffness (stiffness) where the value of Young's modulus are small shows a flexible material and a large Young's modulus values indicate that the material stiffness and embrittlement (stiffness and rigidity) [15]. Table 1 above shows that the value of Young's modulus for the composite PET -rice husk ash 95/5 has the smallest value of Young's modulus. And the value of Young's modulus for the composite ratio of 90/10 has the largest value of Young's modulus. It shows that PET plastic bottle beverage packaging waste already stiff brittle nature when added filler with rice husk ash and rice husk will make composites more rigid and brittle. But the 85/15 ratio Young's modulus values down, this is caused because of the materials such as lignin, pentosan which can reduce the level of fragility and embrittlement of the matrix composites [16].

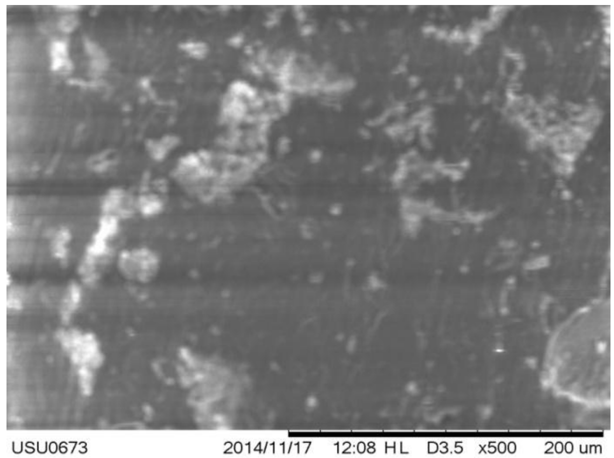

Fig. 6

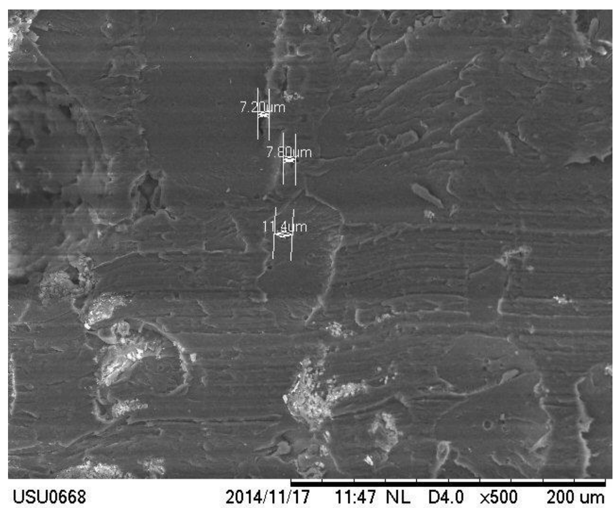

Fig. 7

From Figure 6 shows the fracture morphology uj tensile strength of the composite PET-Rice Husk Ash 90/10 indicates that the uneven spread of the filler and the persistence of agglomeration of fillers. While Figure 7 shows the fracture morphology of the composite hybrid PET- Rice Husk Ash 95/5 shows that the spread of the filler is uneven and there are few empty fraction (void) in it. The emergence of voids in the composite composite showed weak. Voids can also affect the bond between the fiber and the matrix, ie the gap in the fiber or fiber is less than perfect form which can cause the matrix will not be able to fill the empty space in the mold. When the composite receives a load, the voltage area will be moved to the void that will reduce the strength of the composite [17].

4 Conclusion

From the analysis of FT-IR characterization of the waste PET plastic bottle packaging beverages, rice husk ash and composite waste PET plastic bottle packaging beverages berpengisi rice husk ash is known to be significant changes in the group due to the lack of reaction that occurs during mixing process. From the analysis of tensile strength properties of composites with filler rice husk ash, indicating that the value of tensile strength will increase in the ratio of 85/15 in the amount of 3.462 MPa. From the analysis of the nature of the elongation at break of composites, the higher the content of rice husk ash properties of elongation at break will increase.

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