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Mechanical Properties and Morphology Of Composite Nano Rice Husk Ash As Filler Materials HDPE Thermoplastic With Compatibelizer PE-g-MA And Without PE-g-MA

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ABSTRACT

The purpose of this study was to determine the mechanical properties and morphology of nano composite thermoplastic rice husk ash with High Density Polyethylene (HDPE) with compatibelizer Polyethyelene grafted Maleic Anhidride (PE-g-MA) and without PE-g-MA. The method is performed ways nano rice husk ash particles mixed with HDPE, with variations in the composition of nano rice husk ash (2,4,6,8,10) weight % and compatibeliser PE-g-MA and Without compatibelizer with an internal mixer at a temperature laboplastomil 150 ^{0}C at a rate of 60 rpm for 10 minutes. Results of nano composites characterized mechanical properties and morphology.

Results of analysis of the mechanical properties obtained with the addition of rice husk ash nanoscale mechanical properties increased in the composition of 2 to 6% compared with pure HDPE .In general compatibilizer tensile strength without PE-g-MA greater than compatibelizer. Morphological analysis results seen happen even distribution of nano particles of rice husk ash premises thermoplastic HDPE

Key words: Rice Husk Ash, analysis, Mechanic, Morphology

1. INTRODUCTION

Have been carried out of research on the preparation of nano silica from rice husk ash by way of synthesis, among others, (Thuadaij.N. et al, 2008), (Supakorn Pukird, et al, 2009) as well as (Ezzat Rafiee, et al, 2012) ,
Rice husk is an agricultural residues from rice milling process. Ingredients rice husk ash has been widely used as filler. Silica has been used widely as a catalyst, and various kinds of organic-inorganic composite materials (Sun .L et al, 2001). In addition in the form of processed products, silica has also been utilized directly for oil refining, as an additive in pharmaceutical products and detergents, as the stationary phase in a chromatography column, filler and as an adsorbent polymer (Kamath and Proctor, 1998; Sun L, et al , 2001;
From the results of previous studies have reported that approximately 20% of the weight of the rice is rice husk, and varies from 13 to 29% of the composition is the chaff husk ash that is always generated whenever the burnt husk (Krishnarao.R, et al., 2000). Rice husk has now been developed as a raw material to produce ash which is known in the world as Rice Husk Ask (RHA) . RHA is one of the raw materials containing silica richest.

The most common value content of silica (SiO2) in the rice husk ash is 90-96% and if its value is close to or below 90% may be caused by chaff samples that have been contaminated by other substances that lower the silica content (Prasad.CS, et al., 2001), (Ginting, E.M, et al, 2014). Rice husk ash when burned in a controlled manner at high temperatures (500-600 ^{0}C) will produce silica ash which can be utilized for a variety of chemical processes.

Nano-sized fillers, better known as the nano filler can be applied to the polymeric material that produces nano composite material with improved some basic properties of polymers, such as thermal resistance properties, mechanical properties, chemical resistance and flammability. Manufacture of polymer composite made by combining two different materials so as to improve the mechanical properties of the material. Material modifications can be made in the nanoscale size, from several studies say that the manufacture of composites with nano-sized fillers can improve .

From several studies conclude that the nature of a filler material to be compatible with the polymer matrix, is influenced by several factors, among others, the particle size of a filler material, wherein the particle size of a small excipients can improve the degree of reinforcement of polymers compared to the larger size, (Leblance, J, 2002), as well as the smaller the particle size the higher the bond between the filler to the polymer matrix, (Khols J, et al, 2002), the amount of surface area can be increased by the presence of porous surfaces on the surface of the filling material as well as with the addition of nano can improve the mechanical properties and thermal nano composites, (Bukit.N , 2012), as well as by adding nano bentonite filer on HDPE (Bukit.N, et al, 2013). Nano $CaCO_3$ with HDPE, (Zebarjad, S. M, et, al. 2006), nano-carbon with HDPE, (Fouad, H., et al, 2011), rice rusk ash with HDPE (Ginting, E.M, et al 2014) ,), rice rusk ash blend zeolite with HDPE (Ginting, E.M, et al 2015).

This research aims to determine the mechanical properties and morphology of nano composites rice husk ash with thermoplastic HDPE using PE-g- MA compatibilizer as much as 2% by weight and without PE-g-MA. From the results of this study are expected to obtain a new material that can be used in any industry outomotive.

2. METHOD

2.1 Equipment and Materials

The tools used in this study, magnetic stirrer, and the Internal Mixer Labo Plastomill 30 RI50 models chember volume of 60 cc. Hydraulic Hot Press and cold press 37 tons Genno Japan, cutting Dumb Bell, tensile testing machine stograph R-1 brand Toyoseki Japan., Scanning Electron Microscope (SEM)

Materials, Nano rice husk ash particle size of 53 nm results of preparation (Ginting E.M.et al 2014),HDPE (produced by PT Titan Petrochemical Nusantara), PE-g-MA (Sigma Aldrich No. 9006-26-2).

2.2 Preparation of Nano Composite

The manufacture of nano-composites performed in an internal mixer with volume chamber laboplastomil 50 cc with presentation charging 70% equivalent to 40 g. The temperature of the mixture at 150^0C with a rotor speed of 60 rpm for 10 minutes. where HDPE is mixed with nanoscale particles of rice husk ash in the composition of the mixture (2,4,6,8,10) weight% and compatibelizer PE-g-MA 2 % weight and without PE-g-MA .

2.3 Characterization.

Analysis of Mechanical Properties nano composites produced Tests conducted with a tensile testing machine stograph R-1 brand Toyoseki Japan, the obtained mechanical properties include the maximum tensile strength, elongation at break and modulus of elasticity by using standard JIS K 6781, with a drawing speed of 50 mm / min at room temperature .

3. RESULTS AND DISCUSSION

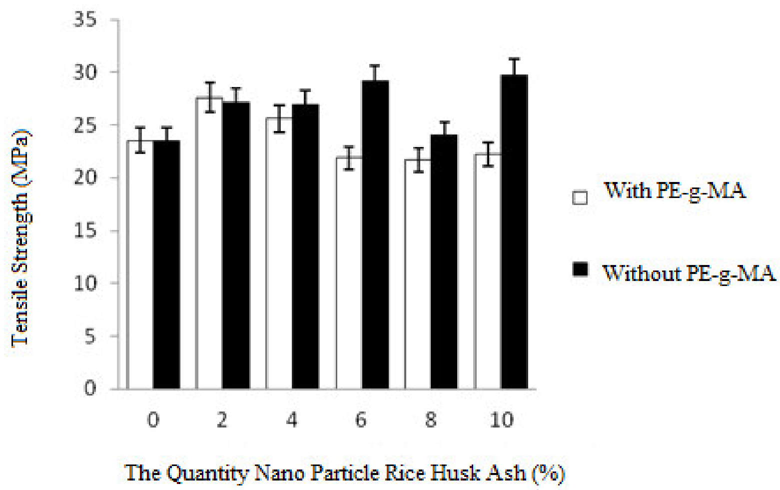

Figure 1. Relationship Tensile Strength Against Quantity Nanoparticle Rice Husk Ash.

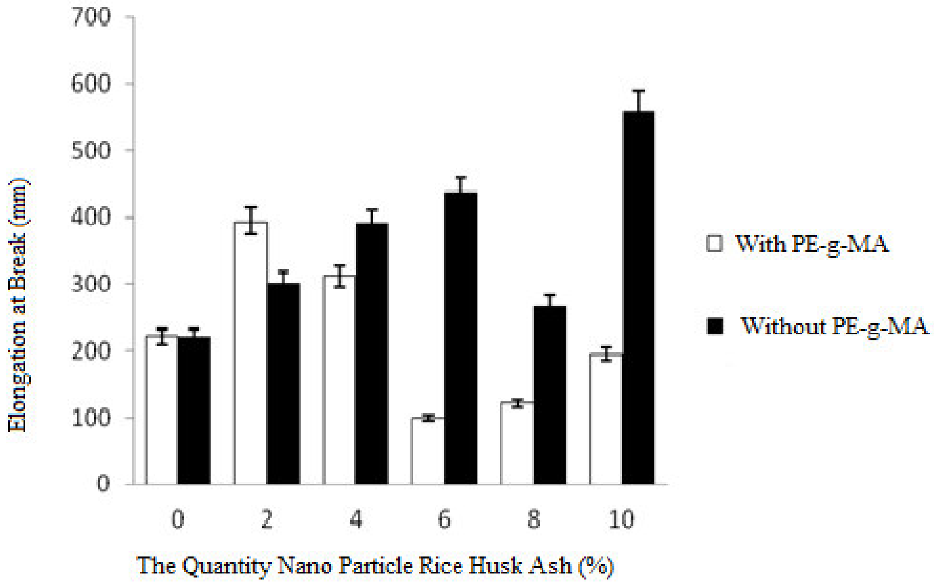

Figure2. Relationship Elongation at Break Against Quantity Nano particle Rice Husk Ash.

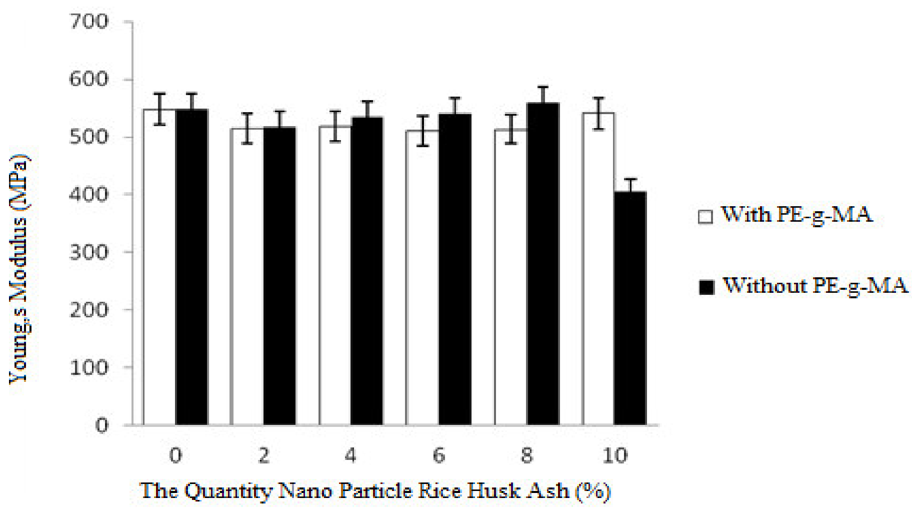

Figure2. Relationship Young,s Modulus Against Quantity Nano particle Rice Husk Ash.

The result from the data on the mechanical properties of tensile strength increased compared with a mixture of pure HDPE with nano particles of rice husk ash with compatibelizer PE-g-MA. With comatibelizer on the composition of 2% to 4% and decrease the maximum tensile strength on the composition of nano rice husk ash 6 to 10% by weight while without kompatibeliser occurred in the composition of 8% by weight, this was due to the particular composition occurs clots thereby reducing the rice husk ash tensile strength of this can be seen from the results of morphology, while the yield stress are relatively the same with the addition of rice husk ash. In the tensile strength of HDPE composites with nanoscale mixture of rice husk ash particles without compatibelizer a significant increase from the composition of 2% to 10% by weight, generally without compatibelizer tensile strength is greater when compared with using compatibelizer PE-g-MA, as well as with elongation at break and Young's modulus decreased with increasing nano rice husk ash (Ginting .E,M et al ,2014) . An increase in tensile strength due to an increase in covalent and hydrogen bonding with the Group OH and oxygen from the group carbosil each add bond between filer with this matrix according to the study (Bhat ,et al, 2011)

Filler particle size increases the degree of reinforcement polymer small compared with the large particle size (Leblanc, 2002). The particle size has a direct relationship with the surface area by g filler. Therefore, small particle size provides a large surface area for interaction between the polymer matrix and filler material so increasing the reinforcement of polymeric materials. In summary, the smaller the particle size the higher the interaction between the fillers and the polymer matrix. This is consistent with the results of the study (Kohls & Beaucage, 2002) reported the results of his research stating that the surface area can be increased with the shaft surface or cavity on the surface of the filler, it is possible that the polymer can penetrate into the pore surfaces when mixing process carried out by the internal mixer.

Particles dispersed or distributed homogeneously increase the interaction through the polymer adsorption on the surface of fillers. Instead, the particles are not dispersed homogeneously may produce agglomerates that reduce the surface area and so weaken the interaction between filler and matrix and result in a decrease in the physical properties of polymer materials.
From Figure 1 obtained tensile strength for nano particles biggest rice husk ash obtained on the composition of the mixture of 6% by weight, whereas, for without the use of nano particles compatibelizer rice husk ash 2 wt% equivalent to 27.62 while the tensile strength of HDPE Pure obtained by 23 543 MPa tensile strength. Generally large tensile strength is better to use a mixture of nano particles without the use of rice husk ash compatibilizer PE-g-MA. This is probably due to a layer of silicate on rice husk ash can be dispersed nanometer sized randomly and evenly which gives structure to the nanocomposite exfoliation. Silicate layer existing on rice husk ash scattered individually have a large surface contact area so that it can bind strongly with HDPE matrix which further gives effect to the increase in tensile strength. The incorporation of nano rice husk ash with compatibelizer PE-g-MA more than 6% wt contrary negative effects that lower the tensile strength but to a mixture of HDPE without compatibelizer greater if without fillers. This is probably due to the decrease in the degree of spread of exfoliation of the silicate layer of rice husk ash on nano-particle nanocomposite containing rice husk ash high (> 6% by weight). In addition, the nano particle agglomeration rice husk ash as shown in the SEM photograph also led to a decrease in tensile strength. Rice husk ash agglomeration is believed to be a stress concentration and becomes the beginning of the crack so that the power will go down. The same thing from the study (Kusmono, et al, 2008).

The use of rice husk ash as filler material naturally improving the mechanical properties of the composite polyethylene as rice husks contains cellulose, hemicellulose and lignin, while rice husk ash contains inorganic materials such as CaO, MgO, Fe_2O_3, K_2O, Na_2O, Al_2O_3, P_2O_5 and SiO_2. The smaller the particle size of the filler, the surface area and power will be greater interaction / adhesion between the two materials will be greater so that the mechanical properties will be better has proven that particle size affects the properties of the resulting composites.

From Figure 5 to 10 visible morphological mixture of HDPE with Nano rice husk ash with and without compatibelizer , mechanical analysis of the data indicates more silica content, there will be algomerat which in turn reduces the tensile strength and elongation at break. This is due to the increasing number of silica content mengakaibatkan a decrease in tensile strength, which is in line with the research, (Koo, et al, 2002; Wu, et al, 2007; Lei, et al, 2007; Kord, et al, 2010 ; Samal, et, al, 2008). Improved tensile strength of the composition of nano rice husk ash 2-6% by weight, this is due to an increase covalent and hydrogen bonding with the Group OH and oxygen from the goup carbosil each add bond between the filler with a matrix which is in line with studies (Bhat et al, 2011). Improved properties depend on many factors including the aspect ratio of the filler material, the degree of dispersion and orientation within the matrix, and adhesion at the interface matrix - filler (Macadia, et al, 2000)

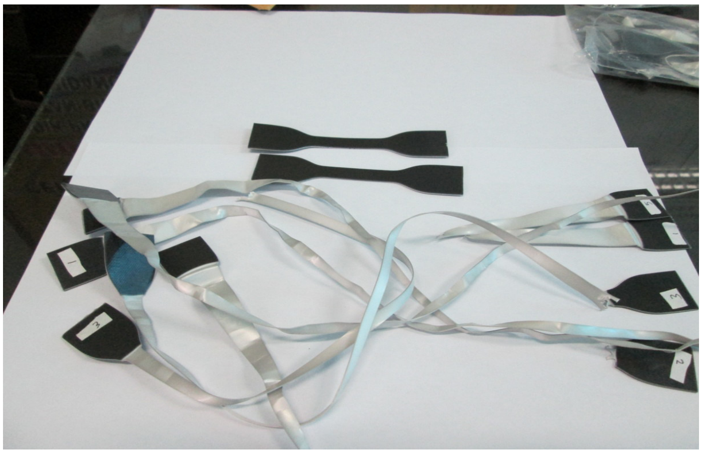

Figure 4 The Results Sample Testing Tensile Strength Nano Composite Rice Husk Ash .

3.2. Analysis of Morphological Properties

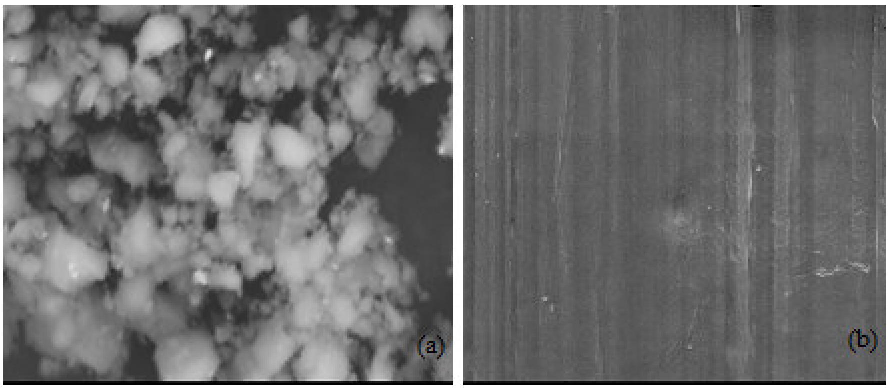

Figure 5 .Morphology (a) Nano particles of rice husk ash (b) Thermoplastic HDPE

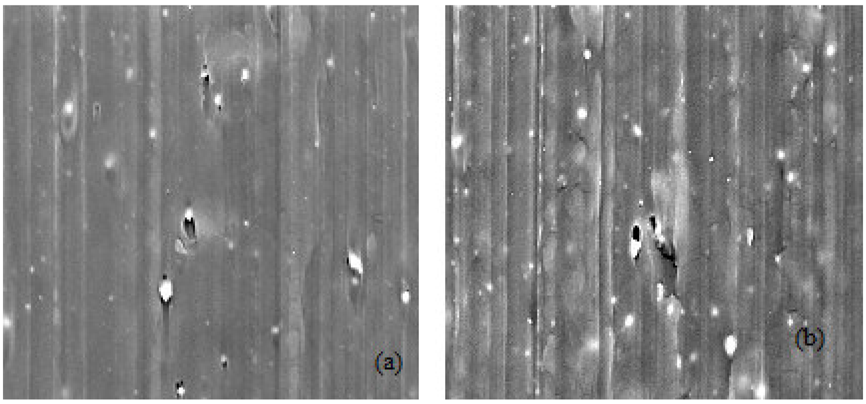

Figure 6.Morfologi mixture of HDPE / Nano Abu Rice Husk 2% wt
(a) with PE-g- MA (b) without PE-g-M

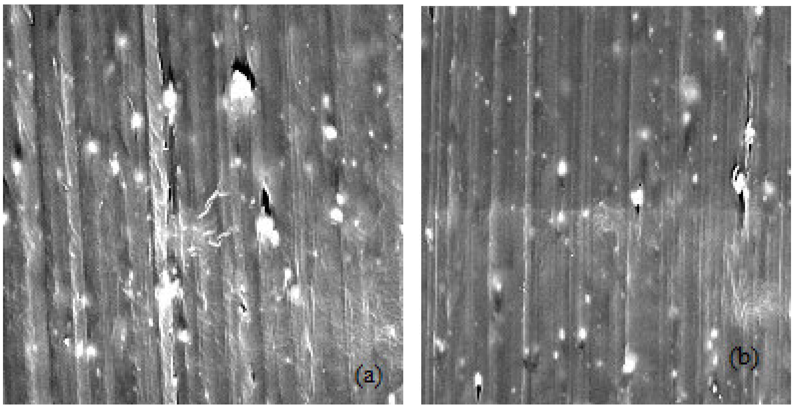

Figure 7.Morfologi mixture of HDPE / Nano Abu Rice Husk 4% wt
(a) with PE-g- MA (b) without PE-g-M

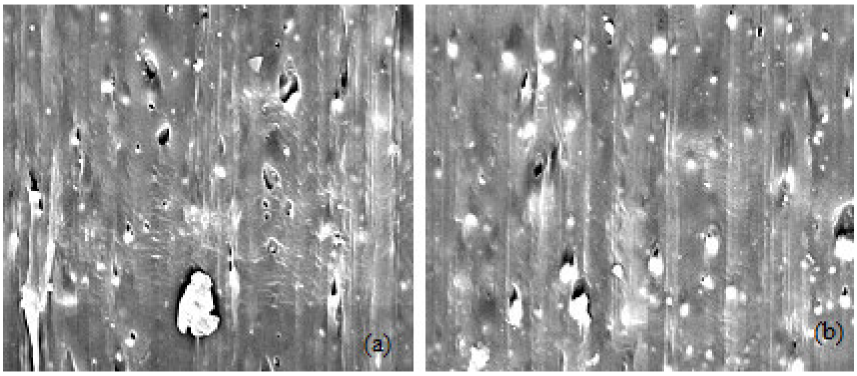

Figure 8.Morfologi mixture of HDPE / Nano Abu Rice Husk 6% wt
(a) with PE-g- MA (b) without PE-g-M

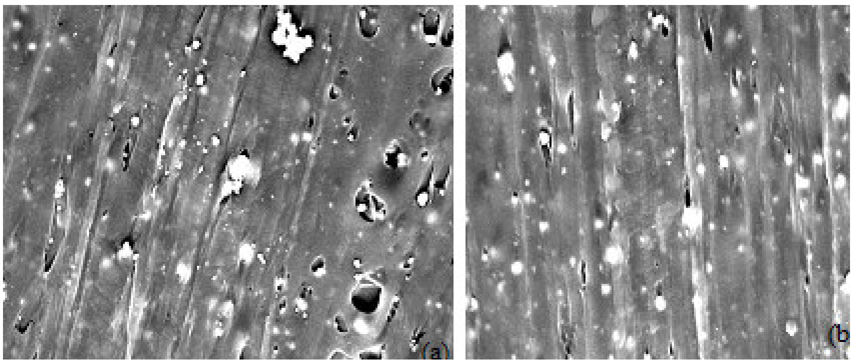

Figure 9.Morfologi mixture of HDPE / Nano Abu Rice Husk 8% wt
(a) with PE-g- MA (b) without PE-g-M

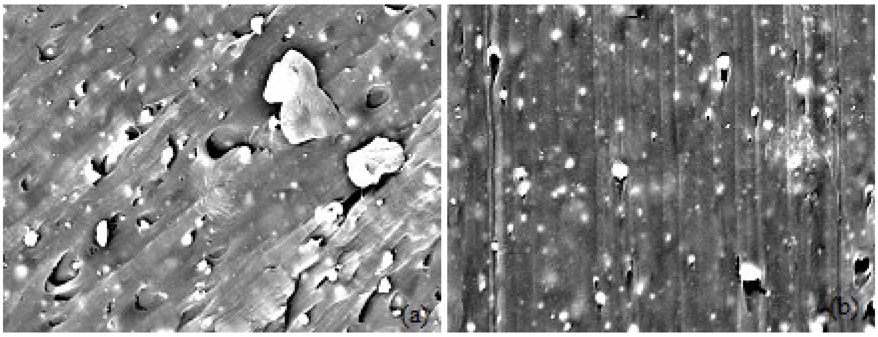

Figure 10.Morfologi mixture of HDPE / Nano Abu Rice Husk 10% wt
(a) with PE-g- MA (b) without PE-g-M

Figure 5 and Figure 10 shows the morphology of the nano-composite thermoplastic blends compatibilizer HDPE with PE-g-MA without compatibilizer PE-g-MA with nano filler morphology rice husk ash with rice husk ash, HDPE as well as the composition of the mixture of 2% to 10%, which homogeneous mixture of images seen this shows that nano composites with evenly distributed. with a composition of 10% visible clumping occurs, from mechanical analysis this causes tensile strength and elongation at break decreased. but the composition of the 2- to 6%wt increase in tensile strength. this is due to an increase in the process of good adhesion between matrix with fillers, it can be seen in the reduced gap arising and small particle size can produce a good interaction between the face of the excipients (Bukit.N,2011)

Improved tensile strength between the matrix of HDPE with nano fillers rice husk ash, it indicates that the pressure of the load can be moved between the two materials is in accordance with studies conducted (Kim et al, 2007). But on the composition of 8% to 10% occur clumping, of the results of the mechanical analysis resulted in decreased tensile strength and elongation at break decrease, this is due to the increasing number of silica content resulting in a decrease in tensile strength, it is in accordance with the results of the research, (Koo, et al , 2002; Wu, et al, 2007; Lei, et al, 2007; ; Kord, et al, 2010; Samal, et, al, 2008).

4. Conclusions

Results of analysis of the mechanical properties obtained with the addition of rice husk ash nanoscale mechanical properties increased in the composition of 2 to 6% by weight compared with pure HDPE .In general tensile strength and elongation at break without using compatibilizer PE-g-MA greater than by using compatibelizer. Morphological analysis results seen happen even distribution of nano particles of rice husk ash with thermoplastic HDPE.

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