

# Effect of Rice Husk Waste and Rice Husk Ash Composition as Filler in Plastic Bottle Drink Waste Composites on Water Absorption Properties

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**Abstract:** This study aims to determine the effect of the composition of rice husk and rice husk ash to plastic bottle drink waste composites water absorption. Composites are made by extrusion method at a temperature of 265°C by mixing waste plastic bottle beverage containers with rice husk, rice husk ash and with a particle size of 100 mesh respectively. Comparison matrix with filler that is 100/0, 95/5, 90/10 and 85/15 (wt%). The parameters used are the absorption of water every 24 hours for each sample of each composite to water absorption in each composite constant. The result is an increase in water absorption for each increase of each filler composite of rice husk and rice husk ash. Water absorption test results indicate that the composite waste plastic bottle with the beverage packaging filler rice husk and rice husk ash at a 85/15 ratio of the composite with the highest water absorption respectively 3.6602% and 2.5262%.

**Keywords:** rice husk ash, rice husk, beverage packaging plastic waste, ash, composite, water absorption.

## 1. Introduction

Polymer composites are currently competing with metal and ceramic matrix composites. Various composite processing continues to be driven, directed products are much in demand. The polymer composites for general commercial use thermoset polymer material. Limited supply of raw materials resulted in this material is relatively expensive compared to thermoplastic polymers [15].

Composites can be defined as compounds that are made by combining two or more physical material, the selection of 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. Surface adhesion between the fibers and polymers perform an important role in relation to the matrix tensile strength of the fiber and thus contribute to the performance of the composite [5].

Garbage is a consequence of human activity. The majority of this waste is household waste which consists of a variety of organic and inorganic materials. One belonging inorganic garbage is garbage / waste plastic in the form [11]. Plastic waste can cause environmental pollution because not biodegradable [2].

Rice is the main agricultural products in the agrarian countries, including Indonesia. Rice husk is an abundant by-product of rice milling results, and so far only used as fuel for burning red stones, burning for cooking or thrown away. Handling of rice husk which is less precise will cause pollution to the environment. Rice husk ash results in a controlled burning at high temperatures (500-600°C) will produce silica ash that can be used for a variety of chemical processes [12].

## 2. Theory

Composite materials is a kind of new material engineered consisting of two or more materials where each material

properties different from each other both chemical and physical properties and remain separate in the final outcome of the material / composite materials [17].

Plastic is a polymer material that is not easily decomposed by microorganisms decomposing, so the old plastic buildup will cause problems for the environment [16]. Plastic waste can cause environmental pollution because not biodegradable [2].

Chaff is categorized as a biomass that can be used for a variety of needs such as industrial raw materials, feed and energy or fuel. Of the rice milling process is usually around 20-30% obtained husk, bran between 8- 12% and from 50 to 63.5% of milled rice between the beginning of the data weight of grain. Husk with a high percentage of these can cause environmental problems [12]. Chemical composition of rice husk ash can be seen in Table 1 below.

**Table 1:** Chemical composition of rice husk ash

Component	% Weight
water content	32,40 – 11,35
crude protein	1,70 – 7,26
fat	0,38 – 2,98
Nitrogen-free extract	24,70 – 38,79
fiber	31,37 – 49,92
ash	13,16 – 29,04
pentose	16,94 – 21,95
cellulose	34,34 – 43,80
lignin	21,40 – 46,97

Rice husk ash contains silica as 86%-97% dry weight [6]. In terms of chemical composition data, husk ash contains some important chemical elements such as can be seen in Table 2 below.

**Table 2:** Chemical composition of rice husk ash [4]

Komponen	% Berat
SiO <sub>2</sub>	86,90 – 97,30
K <sub>2</sub> O	0,58 – 2,50
Na <sub>2</sub> O	0,00 – 1,75
CaO	0,20 – 1,50

MgO	0,12 – 1,96
Fe <sub>2</sub> O <sub>3</sub>	0,00 – 0,54
P <sub>2</sub> O <sub>5</sub>	0,20 – 2,84
SO <sub>3</sub>	0,10 – 1,13
Cl	0,00 – 0,42

Extrusion is a continuous manufacturing process used to print products with a cross section of a fixed length. This technique can be used to process the majority of thermoplastic polymers and thermoset polymers. Usually plastic that can be processed by extrusion method has a high viscosity, so that the newly extruded products can maintain the shape of the product is the result of printing up to the stage of rapid cooling (water bath, water quench or chill roll) [13].

### 3. Methodology

The material used is rice husk and rice husk ash as filler. The filler material derived from rice plant Ginter Jl. Tanjung survived Tuntungan field. Waste plastic bottle beverage packaging serves as a matrix derived from scavengers who are in the surrounding area and the environment USU Medan Setia Budi. The equipment will be used as follows: Ball Mill, Extruder, Hotpress, sieve and Beaker Glass as a container for water absorption composite plastic waste packaging drinks .

Rice husk smoothed by using a Ball Mill. Then sieved using a 100 mesh sieve to size. Then put in the oven at a temperature of 70 °C [1] to reduce the amount of water present in the rice husk particles. Rice husk ash directly in 100 mesh sieve using a sieve. Then put into an oven at 70°C. And beverage packaging waste plastic bottles cleaned first and then cut into pieces using Guting with any size. Comparison between particle hybrid rice husk and rice husk ash is 1: 1 (w/w). Comparison between beverage packaging waste plastic bottle with particles of rice husk, rice husk ash and hybrid (rice husk and rice husk ash) is 95: 5, 90:10 and 85:15 (w/w) and then input into the glass beaker and stir until well blended. Particle mixture of rice husk and rice husk ash put into an extruder to be melted at a temperature of 265°C. The results of the extruder in print form a specimen according to the standard ASTM D-570 with a sample size of 25 mm x 25 mm were put in hotpress then pressed for 5 minutes at a temperature of 265°C. Then do the cooling at a temperature of 25°C-30°C for 5-10 minutes so not too hot at the time of issuance of the composite mold. Composites are removed from the molds that have formed specimens [18].

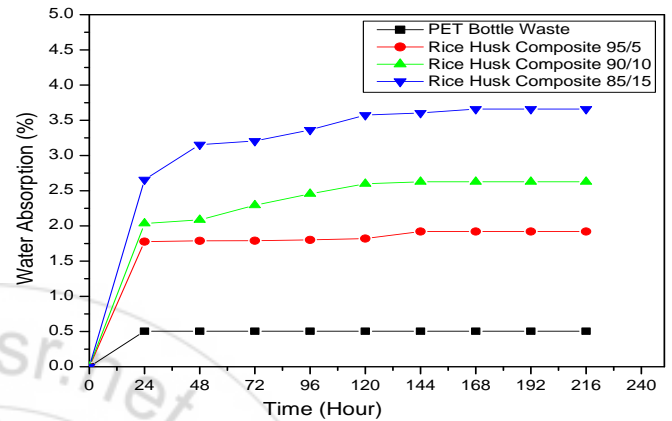
#### Water Absorption

Composite waste plastic bottles PET (polyethylene terephthalate) filled rice husk and rice husk ash each composite were tested by immersion in water at room temperature every 24 hours until the composite material is no longer absorb water (saturated). Before dipping into the water, each composite weighed before hand to note first period. Then each composite dipped into a container of water with each container has the same water level. After that every span of 24 hours immersion, the samples were taken and cleaned with a paper towel until the surface is dry composites respectively. Each composite was dried weighed

to note the addition of mass. Then the procedure is performed every 24 hours until the addition of the composite has a constant mass.

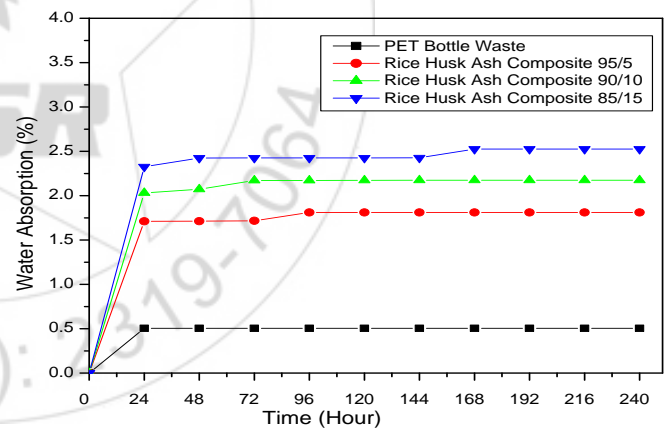
### 4. Results and Discussion

Figure 1 shows the effect of the addition of rice husk filler ingredients to water absorption (water absorption) composite plastic waste bottled drinks.



**Figure 1:** Effect of Addition Ingredients Ingredients Rice Husk filler Against Water Absorption Composite Plastic Bottle Waste.

And in the following Figure 2 shows the effect of filler content penambahan rice husk ash to water absorption (water absorption) of composite plastic waste bottled drinks.

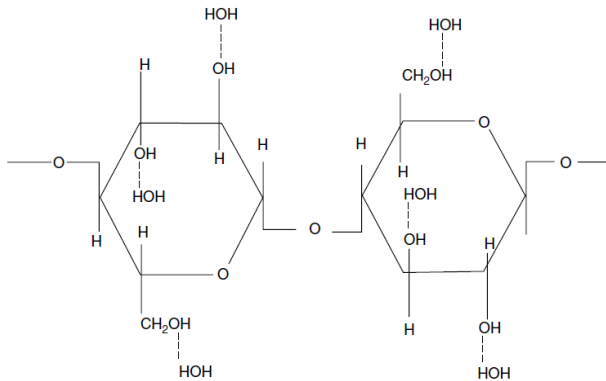


**Figure 2:** Effect of Adding Content Material Abu filler Rice Husk Against Water Absorption (Water Absorption) Composite Packaging Waste Plastic Bottle

From Figure 1 and 2 can be seen that the water absorption of the composite material will increase with the addition of filler ingredients. Water absorption was greatest in the first 24 hours, followed by 48, 72 and 96 hours. After the absorption of water is not so significant to a constant. From Figures 1 and 2 can also be seen that the% water absorption in the first 24 hours the highest for filler rice husk ash and rice husk are in the ratio of 85/15, followed more recently the ratio of 90/10 and 95/5 ratio. This is because most filler compositions are in the ratio of 85/15 [8]. At the beginning of immersion time, the level of water absorption will take place depending on the amount of filler that interacts with water. This process is very short until all the filler has interacted with water. In these circumstances the composite

has become saturated and has lost the power absorption. During this process, the air cavities (voids) are trapped in the polymer matrix can be penetrated by water and fill the cavity when soaked in water [7].

The absorption of water by a composite due to the hydrogen bonds formed between the -OH group on natural fibers, such as cellulose, with -OH in the water. Figure 3 below shows the absorption of water by natural fiber filler. First water molecule adsorbed on hydrophilic group in the fiber and then another water molecule also began to be attracted to another hydrophilic group so that later these molecules can form a layer on the water molecules that have absorbed [10].



**Figure 2:** Binding of Water Molecules By Natural Fiber [14]

## 5. Conclusion

The increasing content of filler in each composite plastic waste bottled drinks the water absorption will be even greater. Based on water absorption test each composite plastic waste bottled beverage known that water absorption composite plastic waste packaging bottle with rice husk ash filler is better than rice husk filler at a ratio of 85/15 (% w / w) is equal to 2.5262 % and 3.6602% and 2.5262%.

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