# Analysis Of Mechanical Testing Of Particle Board Composites From Corn Cobs Waste With Isocyanate Epoxy Resin Adhesive

**Ady Frenly Simanullang, [2]Apriani Sijabat**

**Abstract:** Research has been done on the manufacture and mechanical testing of particle board using corncob residue and isocyanate epoxy resin mixtures. This research was done using the residue of corncob that has been ground into 60 mesh with a mixture of 75, 70.65, 60 to a mixture of isocyanate epoxy resins 25, 30, 35, 40 to obtain the best mixture conditions, in the composition of corn cob powder in the best mixed conditions used for particle board manufacturing products are 60% corncob powder and 40% isocyanate epoxy resin to produce mechanical properties including fracture strength / MOR 87.56 kgf / $cm^2$, bending strength / MOE 24483, 32 kgf / $cm^2$, 32.12 kgf / $cm^2$ screw pull, 4.41 kgf / $cm^2$ tensile strength.

**Index Terms**: Mechanical, Corn cob, Particle Board

## 1 Introduction

Corn cob is one of the remnants of the agricultural industry which is a source of lignocellulose material. So far, corn cobs are only used as beef food or industrial products that are not processed back into something of high economic value. [15] that corn cobs consist of 26.81% cellulose, 30.91% hemicellulose, and 15.52% lignin. This difference in yield is due to the difference in materials influenced by the variety, age and condition of the soil in which the materials are grown [5]. With its high volume and high content of hemicellulose and cellulose, corn cobs have great potential to be processed into products of high economic value. With the large number of corn cob residues that have been produced in the post-harvest period and only discarded due to the inability of farmers to use them, this is unfortunate as corn cobs have excellent value in this study, hopefully corn cobs can be used as boards. particles that are lightweight, waterproof and have excellent physical and mechanical test results, moreover, corn cob waste will increase farmers' incomes that have been discarded over the years. The methods and processes used in the research to obtain particle board are the preparation of compounds through milling process, compaction process, and sintering process. The sample particle board that has been obtained will be analyzed using several instruments such as: Physical and mechanical including density, moisture content, water absorption, thickness expansion, MOR, MOE, Internal Bonding, Screw Holding Strength, Linear Expansion, Hardness Products targeted in this Research are publications in the Accredited National Journal and accredited international journals. The level of technological readiness to be achieved is TKT.

## 2 RESEARCH METHODS

### 2.1 Material

The material used in this research is corn cob residue channeled in a grain size of 60 mesh with a mixture of epoxy resin weight variations in the manufacture of particle board.

***Table 1.*** *Composition of particle board*

| Heavy composition (Wt - % ) | | | | |
|---|---|---|---|---|
| No. | Sample | Corncob | Boraks | Resin Epoxy |
| 1. | S-01 | 75 | 5 | 20 |
| 2. | S-02 | 70 | 5 | 25 |
| 3. | S-03 | 65 | 5 | 30 |
| 4. | S-04 | 60 | 5 | 35 |

### 2.2 Tools

Corn shredder, hydraulic machine, beaker, sample mold, caliper, digital scale, 60 mesh sieve, knife, hard

## 3 Decisions And Discussion

### 1. Experimental

### 1.1. Ingredients

The material used for the manufacture of Particle Board is the residue of corn cob that has been cut by equating the variation of the size of the corn cob and the addition of borax as a preventative of rapid decay caused by the fungus, as well as the volume variation in Epoxy resin as a binder. Important factors considered in the manufacture of this particle board are physical and mechanical testing, good density, moisture content, water absorption, thickness expansion, MOR, MOE, internal bonding, screw grip strength, linear expansion, hardness.

### 1.2. Preparation of particle board

The design formulation of this particle board material is carried out based on the class of materials, namely fillers, fasteners, reinforcing fibers and property transformers with a fixed percentage based on weight. The various compositions for forming particle board are shown in Table 1. The residue of corn cob is uniform in terms of quality, chemical composition and better properties in terms of physical and mechanical test.

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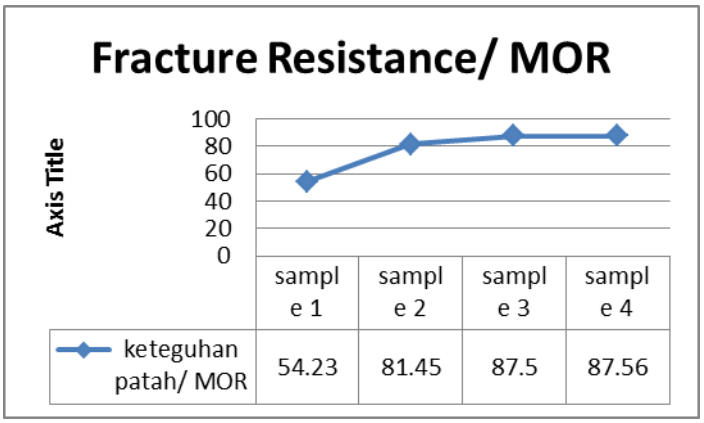
The rest of the dried corn barrel is made into small grains by breaking them into small pieces and fine powder using a milling machine and filtered using 60 mesh sieve paper [14]. The milling machine used to crush the particle Board raw material with the same grid measurements as desired is shown in Figure 1. The amount of corn waste bins, Borax, and

epoxy resins required are measured using digital equilibrium. The ingredients are mixed manually for 90 minutes with the help of using a mortar until a homogeneous mixture is formed. The mixture was then mixed with epoxy resin for 20 minutes using a high-speed magnetic stirrer. The above composite mixture is poured into the prepared metal plate mold. The particle board mold is as shown in figure 2. Then let stand for 40 minutes at which the gel begins to form (the surface of the sample on the hot mold indicates that an exothermic reaction is taking place). In this case, a pressure of 5 kN / m2 is applied using hydraulic press and left for 4 hours after the sample fills the mold and is sintered at a temperature of 100 ℃ for 10 minutes. Then the sample is characterized for various physical and mechanical properties.

## 2. Test Results

### 2.1. Defective firmness / MOR

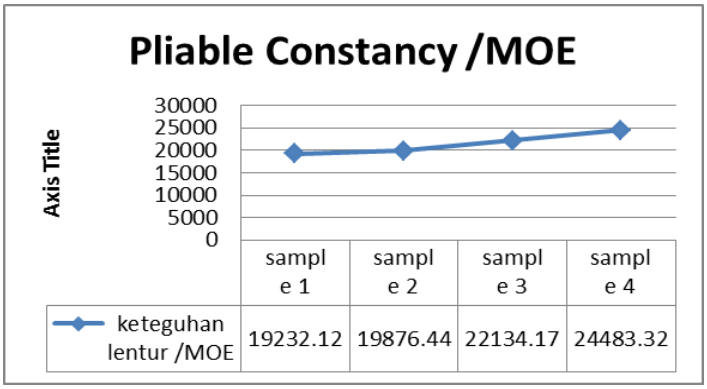
Particle board rigidity test results are between 54.23 and 87.56 kg / cm2 (Figure 1). Particle board made with sample treatment 2 (corn cob 60 + epoxy resin 30) produces a fracture firmness value of 81.45 kg / cm2, and particle board made from sample 3 treatment yields a hardness value of 87.50 kg / cm2 and meets SNI requirements. . 03-2105-2006 (exceeding 82 kg / cm2). From the data analysis, it is shown that the mixture of corn cob residue with 35% epoxy resin adhesive is very influential on the fracture rigidity value (Table 1). Particle boards made using more epoxy resins will result in greater fracture strength than the use of less epoxy resin mixtures. In this situation, it is possible that there are similarities in the physical and chemical properties of the raw materials for the particle board used. [10] that the fracture strength of wood products including particle board tends to decrease in line with the depletion of wood composite elements in this case particle board constituents. [8] The 2.0 mm particle size has a higher MOR, MOE, and swelling value than the 1.0 mm particle size.




***Picture. 1:*** *MOR / fracture strength test chart*

### 2.2. Bending stiffness / MOE

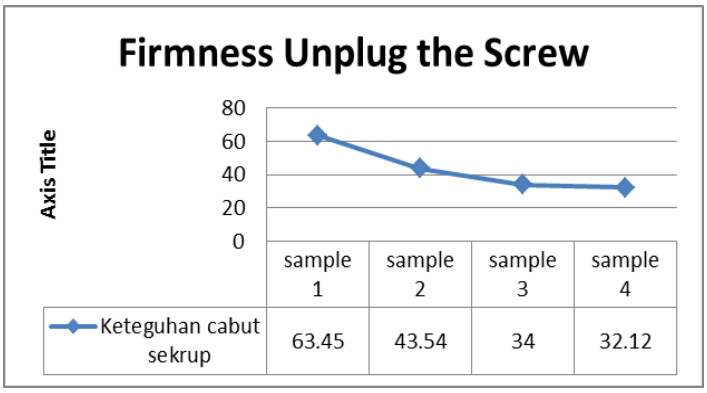
The test results for the bending strength of the particle board are between 19232.12 and 24483.32 kg / cm2 (Figure 2). From the data analysis in Table 1, it was found that sample 4 (corn cob 60+ epoxy resin 35) showed a very significant effect on the bending strength of the particle board. From the test data, this shows that all treatments produced very significant differences in the bending strength of the particle board (Table 2). Particle boards mixed with corn cob residue with 35% epoxy resin adhesive produce higher bending strength values than particle boards with a smaller percentage of epoxy resin mixtures. Requirements for bending of particle board according to SNI. 03 - 2105 - 2006 is 2.04. 104 kg / cm2. Eligible treatment produces a flexible rigidity value, i.e. particle board made of 100% wood powder with a value of 24483.32 kg / cm2. The treatment that sample 4 (corn cob 70 + epoxy resin 25) produces a bending strength value does not meet the requirements SNI 03-2105 - 2006. [8] The use of coarse shaving particles results in higher bending strength than using fine. [1] Coarse particles have a higher MOE than the particle board properties of fine particle materials. [9] The MOE value is influenced by the content and type of adhesive material used, the adhesive binding force and the length of the fiber and the type of wood particles. While [13] bending strength / MOE and fracture / MOR have a linear relationship with the properties of increasing board density.




**Picture.2** Flexural tension test chart / MOE

### 2.3. Firmly remove the screw

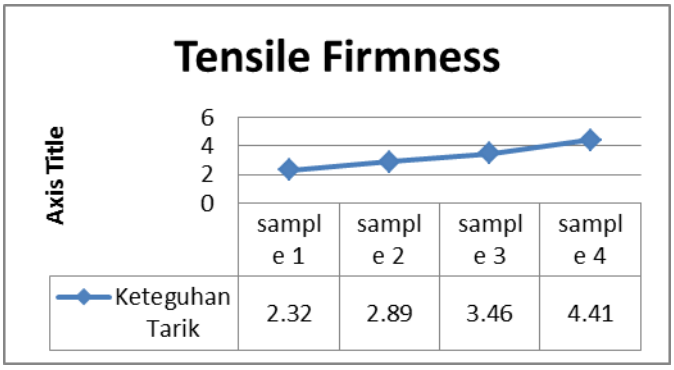
The results of the particle board screw pull resistance test range from 32.12 to 63.45 kg / cm2 (Figure 7). The largest screw pull strength (63.45 kg / cm2) was produced on particle board made with sample 1 and the lowest (32.12 kg / cm2) was produced on particle board using sample treatment 4. 03 - 2105 - 2006 is a minimum of 31 kg. All particle boards made produce screw pull resistance that meets the requirements SNI.03 - 2105 - 2006. The above data analysis shows that sample 4 (corn cob 60+ epoxy resin 35) has a very significant effect on the hardness value of particle board screws (Table 1). Data from test results indicate that all behaviors produced significant differences in the tensile value of the screw puller. Particle boards with a 35% epoxy resin mixture produce higher screw extraction values than particle boards with 25% epoxy resin. This condition indicates that a longer or larger particle size produces a stronger value for removing screws than a particle board made of small / short particles. [10] Coarse particles have higher screw-holding and MOE properties than fine-grained particle board properties. [9] that the MOE value is influenced by the content and type of adhesive material used, the adhesive binding capacity and the length of the fiber and the type of wood particles.




***Picture.7*** *Graph of screw pull toughness test*

**2.4. Attraction resistance**

The test results for the tensile strength of the particle board are between 2.32 to 4.41 kg / cm2 (Figure 3). All particle board voltage strengths meet SNI requirements. 03 - 2105 - 2006 (over 1.5 kg / cm2). From the data analysis, it is shown that the mixed treatment of corn cob 60+ epoxy resin 35 has a very significant influence on the tensile strength value of particle board (Table 1). Test results data show that the treatment of corn cob 60+ epoxy resin 35 has a very significant difference in the tensile strength of the particle board. And not all treatments produce significant differences (Table 2). This condition is possible by the influence of differences in the physical and chemical properties of the raw material used. [12] Chemicals in this case, cellulose and lignin on bark and wood have an influence on mechanical strength (MOR, bending strength / MOE and particle board tensile strength, further argued that the greater the cellulose content, the greater the fracture / MOR strength. , bending strength / MOE and particle board tensile strength, and increasing lignin content resulting in decreased fracture / MOR strength, bending strength / MOE, and particle board tensile strength.




***Picture.3*** *Tensile stability test chart*

## 4 Conclusion

The rest of the corn cob that has been ground to 60 mesh grain size can be used as a material to make particle board with mechanical properties equivalent to SNI. 03 - 2105 - 2006, and the use of corn cob waste can increase the income of corn farmers and reduce waste that can damage the environment.

**Thank you**

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