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Natural Composites Reinforcement of Empty Bunch Palm Oil Powder for Blower Impellers Manufacturing

Muhammad Rafiq Yanhar[1], Suhardi Napid[2], Ahmad Bakhori[3], Abdul Haris Nasution[4], Wans Pahlevi[5]

[1,2,3,4,5]Faculty of Engineering, Mechanical Engineering, Universitas Islam Sumatera Utara, Indonesia

ABSTRACT. The purpose of this study is to design and build a composite blower impeller from natural fiber material of empty oil palm bunch powder with resin as a binder. The designed and built composite blower impeller consists of 3 variables, namely variables 5%, 10% and 15%. Variable 5% uses 5% empty oil palm bunch powder and 95% resin, variable 10% uses 10% powder and 90% resin, while variable 15% uses 15% EFB powder and 85% resin. The method used to determine the characteristics of empty oil palm bunch powder is done by tensile test and impact test. The results obtained from the maximum tensile stress test on the 15% powder variable are 16.127 MPa and the highest elastic modulus value is on the 10% variable of 170.85 MPa. Then in the impact test, the casting results are obtained that are able to absorb the greatest energy on the 15% variable with a value of 31.201 J/cm2. The conclusion obtained from this study is that the more powder is mixed, the higher the tensile and impact test values.

KEYWORDS: blower, impeller, empty oil palm bunch powder, tensile test, impact test

1. INTRODUCTION

The development of science and technology has made significant progress, evident in the technology that makes life easier for people, both in everyday life and in industry. Blowers are now commonplace in industries and laboratories, while in buildings and homes, they are used as air circulation devices.

Oyelami et al (2012) said that the impeller is a rotating component of a centrifungal blower which is used to channel energy from the motor by accelerating the air out from the center of rotation.

According to Austin (1990) Centrifugal blowers with an increased number of blades and their arrangement is such that the air sucked into the blower by the rotating blades is pushed by centrifugal force and directed towards the casing wall which is formed into a spiral so that the air is directed back into almost the beginning of the air entering the blower as mentioned above that the air output pressure on this regenerative blower is almost equivalent to the air output pressure on a multi-stage blower.

A composite is a material formed from a combination of two or more materials, formed through a mixture of non-homogeneous materials. Composite materials have generally been applied in the automotive and shipping industries (Mattews. 1993) .

This research focuses on the study of alternative impeller materials using composite materials as its composition. This research aims to design, build and analyze the characteristics of the blower impeller from the powder of Oil Palm Empty Fruit Bunches using BQTN 157 EX Resin and MEKPO Catalyst. The desired composite impeller in this research is to have a light mass, strong, resistant to corrosion and has a relatively low price.

2. THEORITICAL REVIEW

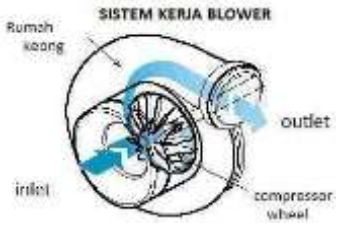

Figure1. Centrifugal Blower

The impeller is the rotating component of a centrifugal blower, usually made of iron, steel, bronze, brass, aluminum, plastic, or wood. Its function is to transfer energy from the motor by accelerating air outward from the center of rotation (Khairul et al., 2019). The blower components are:

1. *Air inlet*
   The air inlet is one part of the blower component as the entry point for air into the blower before proceeding to the next process.
2. *Air outlet*
   The air outlet is one part of the blower component as the outlet for air from the Components blower after carrying out the process that occurs in the blower.
3. *Impeller* and blades
   The impeller and blades are part of the lower component which functions to rotate the air that enters

from the air inlet which goes through various processes to reach the air outlet.

4. Blower house
   The blower housing is the outer part of the blower that protects all the blower components inside the blower housing. There must not be any leaks in this blower housing component so that the blower can function smoothly.
5. Bearings
   Bearings are one part of the blower components that function to withstand vibrations from the process of rotating air entering through the impeller and blades so that friction does not occur due to greater speed.

Palm oil is an industrial plant whose oil from the fruit can be used as raw material for industry, oil and fuel.

Herawan and Rivani (2013) said that based on the material mass balance, each fresh fruit bunch (FFB) of oil palm which is processed in a palm oil factory will not only produce palm oil but also will produce around 25–26% of Empty Oil Palm Fruit Bunches. In a way visual, TKKS is a group fiber Which thick brown pulp that is deliberately set aside after the fruit boiling process through *a rotary drum thresher* in a palm oil processing plant. TKKS is in the form of regular with weight approximately 3.5 kg And own thickness 130 mm withlength varies 170-300 mm and width 250-350 mm (Chang, 2014). Results calculation of 200 TKKS samples at the Palm Oil Research Center (PPKS), obtained weight average 5.1 kg, long bunch 44.8 cm, wide 35 cm And thickness19.4 cm.

Figure 2. Empty Oil Palm Fruit Bunches

Tensile Test

Tensile testing is a method or procedure for testing the strengthone or more materials by applying a force load of the same magnitude to the axis. same. Ability a material can withstand a tensile load of the amount called tensile strength which can be measured in megapascal (MPa), 1N/mm2, psi (Sehono et al. 2022).

On stem test Work voltage that is as big as :

$$\sigma = \frac{F}{A} \quad \text{.....[1]}$$

Information :

σ = Voltage (kg/mm ^{2}), or (N/mm ^{2})

F = Style pull (N), or P = burden pull (kg)

A = wide cross section at first (mm^2)

On stem test Work stretch that is as big as :

$$\varepsilon = \frac{\Delta L}{L^\circ} = \frac{(L\text{-}L^\circ)}{L^\circ} \quad \text{..... [2]}$$

Information :

ε = stretch (%)

L° = long " stem initial test (m)

L = length of the "test rod" when receiving the load (mm)

The relationship between stress and strain is connected by the equation:

Impact *Test*

Testing impact is testing loading (pendulum) designed for know strength or toughness material (sample) Which tested with loading impact. Testing This executed until sample experience maximum collision (Vishnu Santoso et al. 2022)

On the test rod, the value of the impact energy (Joules):

$$E = m \times g \times r\,(\cos\beta - \cos\alpha) \quad \text{.....[4]}$$

Information:

E = Impact Energy (J)

m = Weight of pendulum (kg)

g = Gravity (m/ s^2)

r = Length of pendulum arm (m)

α = Initial angle (°)

β = End angle (°)

On the large test rod the *impact strength value* (Is)

$$HI = \frac{E}{A} = W\,L\frac{(\cos\beta - \cos\alpha)}{A} \quad \text{.....[5]}$$

Information :

HI = *Impact strength value* (J/mm ^{2})

E = Energy absorbed by the test object (J oule)

A= Cross-sectional area under the notch (mm ^{2})

RESEARCH METHODS

This research uses an experimental method. The independent variable used is the ratio of empty oil palm bunch powder with variations of 5%, 10% and 15%.

The dependent variables used are tensile strength and impact strength. Materials and tools used include:

Ingredients: Oil Palm Empty Fruit Bunch Powder, Yucalac 157 BQTN Polyester Resin and MEKPO catalyst.

Figure 3. Powder TKKS

Tool:

1. Specimen Print
2. Digital Scales
3. Vernier caliper
4. Tensile testing machine
5. Impact testing machine
6. Other tools include a mixing bowl, knife, sandpaper and ruler.

In this study, the powder used as a reinforcement was empty oil palm bunch powder with variations of 5%, 10%, and 15%. Using the open mold method, namely:

1. prepare composite molds using glass molds
2. the drying process of TKKS powder to remove moisture from the powder.
3. The powder is weighed according to the variation calculations of 5%, 10% and 15%.
4. The process of mixing polyester resin and catalyst with a ratio of 100:1.
5. Mixing TKKS powder with polyester resin to which a catalyst has been added.
6. Then pour the powder that has been mixed with resin into the specimen mold.
7. Smooth it out until the entire mold space is filled and there are no voids/air bubbles.
8. Wait for the drying process.

RESULTS AND CONCLUSIONS

Results

Based on the tensile test and impact test, a graph of the relationship between tensile strength and variations in TKKS powder was obtained as in Figure 4, and a graph of the relationship between impact strength and variations in TKKS powder was obtained in Figure 5.

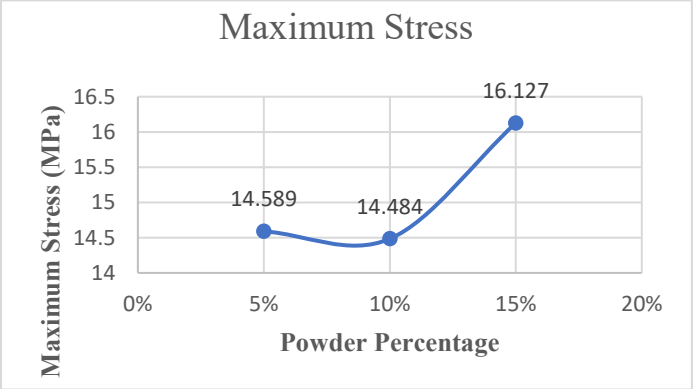

Figure 4. Tensile test vs. powder variation

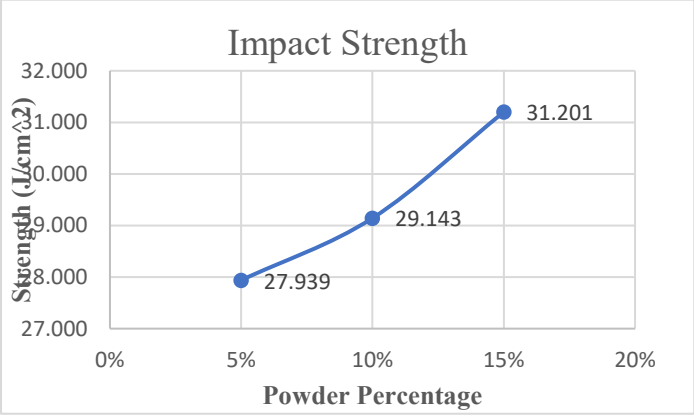

Figure 5. Impact strength vs powder variation

DISCUSSION

Tensile Test

From the results of the tensile test, the highest tensile strength was obtained in the 15% powder variation, namely 16.127 MPa, while the lowest stress value was in the 10% empty oil palm bunch powder variation, namely 14.484 MPa.

This strength is influenced by the addition of powder, which can increase tensile strength. The decrease in tensile strength at 10% powder variation is due to the presence of numerous *voids/* air bubbles during the sample preparation process, which results in a decrease in tensile test values.

Impact Test

The results of the impact test showed the highest impact strength value at 15% powder variation with a value of 31.201 (J/cm2) and the lowest impact strength value at 5% powder variation with a value of 27.939 (J/cm2) . The addition of the volume of empty oil palm bunch powder affected the impact strength of the specimen.

Each additional percentage of powder variation affects the adhesion of the reinforcing material to the matrix, making it stronger and more stable. A good bond between the matrix and the reinforcement will result in a composite with higher strength.

CONCLUSION

Based on the description above, the research can conclude that:

Variations in empty oil palm bunch powder of 5%, 10% and 15% have the effect of increasing the strength value with each additional amount of powder variation. The 15% powder variation produces the highest tensile strength and impact strength values.

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