The Effect of Coal Bottom Ash Powder Particle Size on The Physical and Mechanical Properties of Composites Polyester Matrix

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Abstract- ***Bottom ash is formed from inside the boiler furnace in the form of solids not carried by the flue gas. In CFB systems, bottom ash is between coal ash, quartz sand and fragments of the furnace wall that are eroded during the combustion process. Composite materials made from bottom ash fillers were made using variations in bottom ash powder size, namely 200 mesh and 300 mesh with a weight fraction between epoxy resin and bottom ash powder, 10% volume of bottom ash powder vs 90% volume of resin; 20% volume of bottom ash vs 80% volume of resin; and 30% volume of bottom ash vs 70% volume of resin. This research uses 2 tests, namely, tensile testing and water absorption testing. The results showed that the specimen with the maximum tensile strength and strain values was found in the 200 mesh grain size specimen with a composition of 30% bottom ash powder volume vs. 70% resin volume, which amounted to 28.1 Mpa and 3.9%. While the minimum water absorption is found in the 200 mesh size specimen with a water absorption of 0.003%.***

Indexed Terms- ***Bottom Ash, Tensile Test, Water Absorption Test.***

I. INTRODUCTION

The power plant with the largest capacity in Indonesia is the steam power plant (PLTU). The capacity of PLTU is the largest compared to other types of power plants, until the portion reaches 31.55% of the total national power generation capacity.

According to Misbachul, (2008). Bottom ash is ash formed from the combustion process in the furnace in the form of solids that are not carried away by flue gas. In the Circulating fluidized bed (CFB) system, bottom ash is a mixture of coal ash, quartz sand and furnace wall fragments eroded during the combustion process. The huge volume also creates a new problem, because it requires a lot of space to accommodate it, requiring a very large place for the ash stockpile. The ash needs to be reused into useful materials so that the volume of ash can be reduced. Innovation is needed to add value to this ash into a material that can be reused either as the main material or a mixture of materials, in this case composites. Some research on the use of bottom ash as a composite filler, one of which is (Purnomo, 2021) conducting research on the analysis of the strength of polymer composite materials (polypropylene) with coal bottom ash fillers (bottom ash) and sisal fiber reinforcement where the results of tensile testing composite specimens reinforced with sisal fiber do not affect tensile strength because there are several modes of failure that affect composite specimens such as fiber pullout, voids, and matrix rich. (Kamagi, 2023) conducted research on the use of coconut fiber and palm fiber powder as reinforcement for polyester matrix composites, where in the study using tensile testing and water absorption, the difference between this research and this research is the fly ash material used in the study.

II. RESEARCH GOALS

The purpose of this study is to analyze the relationship between bottom ash powder size on tensile strength and water absorption in polyester matrix fly ash composites.

III. LITERATURE REVIEW

2.1 Bottom Ash

Bottom Ash is the ash from burning coal as an energy source in the steam generating unit of a steam power

plant (PLTU) (Azwar, 2019). In its characteristics, bottom ash has coarse grains like sand, black to grayish color that is not shiny and is non-plastic, non-cohesion, and has a size like fine aggregate (Susilowati & Oktaviana, 2021).

2.2 Composites

Composites are material structures consisting of several combinations of materials formed on a macroscopic scale and fused physically. Composite materials generally consist of two elements, namely fibers (fibers) as fillers and binding materials for these fibers called matrices (Setyawan, 2020). Composites are materials formed from a combination of two or more forming materials, with the properties of each of these

2.3. Water absorption

Water absorption is one of the physical properties of composites that shows the ability of the composite to absorb water after being immersed in water for 2 hours and 24 hours (Luthfi Hakim & Fauzi, 2005).

2.4 Tensile Testing

Tensile testing is the application of tensile force to the material with the intention of knowing the strength of a material. The tensile testing standard used in this tensile test refers to the ASTM D638 standard. Tensile stress can be calculated with the equation:

$$\sigma = \frac{F}{\Delta_0}$$

Where

σ = tensile stress (Mpa)

F = Force (N)

A_0 = Initial cross-sectional area (mm2).

The composite strain can be calculated by the equation (Gibson, 1994):

$$\varepsilon = \frac{\Delta L}{l_0} \times 100$$

Where:

ε = Strain (%)

ΔL = Length increase (mm)

L_0 = Specimen initial length (mm)

IV. RESEARCH METHODOLOGY

The research procedure carried out according to the following stages. Stage 1. Sample preparation. Stage 2. Producing Sample testing following ASTM ASTM D638 standard tensile Test, and the ASTM D570-98 standard water absorption test. Stage 3. Preparation of test specimens. Stage 4. Specimen testing. Stage 5. Sample testing data analysis

V. DISCUSSION AND RECOMMENDATION

The tensile test results on each test specimen were graphed for each grain size. For 200 and 300 mesh grain size specimens, the figure 1 below is obtained.

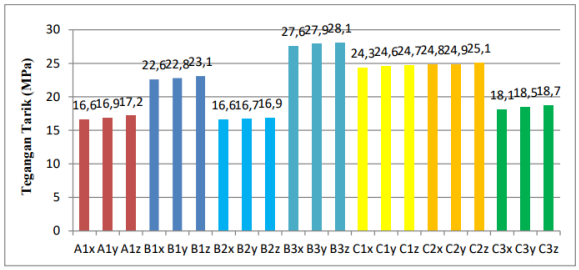

Figure 1 Tensile Strenght vs Bottom ash Compotition

the largest tensile strength is found in the A1z specimen, in the 200 mesh grain size specimen the tensile strength is found in B3z, namely 27.86 Mpa, and in the 300 mesh grain size specimen the tensile strength in the C2z specimen is 24.93 Mpa.

The results of the calculation of water absorption (%) on various other test specimens can be seen in table 1

Tabel 1 Water absorption of some specimens

Variasi Butiran	Nama Spesimen	Daya serap air(%)
200 Mesh	A	0,004
	B	0,004
	C	0,003
300 Mesh	X	0,005
	Y	0,005
	Z	0,006

Of the six specimens that have the smallest water absorption, namely specimens X and Y amounting to 0.005%.

Discussion

The largest tensile strength obtained is in the 200 mesh grain size specimen the tensile strength is in B3z, and in the 300 mesh grain size specimen the tensile strength is in the C2z specimen.

Based on the analysis of water absorption of two types of specimens obtained results that specimens with grain size 200 mesh each have water absorption specimen A 0.004%, specimen B 0.004%, specimen C 0.003%. Of the three specimens that have the smallest water absorption is specimen C 0.003%, for the largest water absorption is specimens A and B 0.004%, in 300 mesh grain size specimens each have water absorption specimen X 0.005%, specimen Y 0.005%, specimen Z 0.006%. Of the three specimens that have the smallest water absorption are specimens X and Y 0.005%, for the largest water absorption is specimen Z 0.006%

CONCLUSION

1. The composition and size of bottom ash powder greatly affects the tensile strength of the composite, based on the results of the tensile testing that has been carried out, the specimen that has the maximum tensile strength and strain value is in the 200 mesh grain size specimen with a composition of 30 grams of bottom ash powder vs. 70 grams of resin, which is 28.1 MPa and 3.9%.
2. The composition and size of bottom ash powder greatly affect the water absorption of the composite. The test results showed that the larger the grain size given, the greater the water absorption of the specimen. The minimum water absorption is found in the 200 mesh size specimen with a water absorption of 0.003%.

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