

Physical Properties of Sago Bark

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Abstract. This study aim was to determinate physical properties of sago bark. This research was a descriptive research with five repetitions. Physical properties observed included moisture content, acid resistance, alkaline resistance, compressive strength, and modulus of rupture. The results obtained were then compared with JIS A 5908-2003 and SNI 01-0608-89. The results showed that water content of sago bark was 33.74%, resistant against acid and alkaline, compressive strength equal to 64.09 N/mm², and modulus of rupture 87.29 N/mm². The water content was not conform to JIS A 5908-2003 and SNI 01-0608-89 standards, but resistance against acids and alkaline corresponded to JIS A 5908-2003. The compressive strength and modulus of rupture were classified in strong classes I and II in SNI 01-0608-89 wooden strength class.

1. Introduction

Wood is a very important material for human life, for example for building materials. Utilization of very large timber for human leads to deforestation (1). Several attempts have been made to solve the problem, but the restoration of forest condition takes a long time so alternative wood raw material is required.

Sago is one of the commodities in South Sulawesi, especially in North Luwu district. Sago plantation area in North Luwu is 1,635.13 hectares in 2013 and increased to 1,739.92 hectares in 2014 with sago flour production of 1,319.28 tonnes in 2013 and 1,440 tonnes in 2014 (2). High sago production is accompanied by high waste production as well. One is hard bark with a thickness of about 2 cm (3). The sago bark produced for each process of sago flour production was about 17% of the total processed rods, with an estimated production of 5-15 tonnes of bark per day (4). Most of the sago bark is wasted into the environment. The bark of sago is also used by communities in North Luwu as replacement for boards and temporary bridges.

The bark of sago contains lignin as its main component (4) so it can be an alternative substitute of wood. However, research on the utilization of sago bark as a substitute raw material of wood is still insignificant. This phenomenon increases the researcher's curiosity to study the physical properties of sago bark. Physical property is a matter to consider before determining the use of wood as a product. Physical properties include moisture content, acid and base resistance, compressive strength, and modulus of rupture (MOR). The results of this study would be used as a consideration to utilize the bark of sago as a wood substitute material.



2. Methods

This study was a descriptive study with five repetitions. Sample preparation referred to the Indonesian National Standard (SNI) ISO 3129: 2011 (5). The sample was cleaned and dried at a temperature of less than 60°C until the moisture was close to balance. Physical properties test included moisture content, acid resistance, alkaline resistance, compressive strength, and modulus of rupture (MOR).

Procedures for water content test, acid resistance, resistance against base referred to JIS A 5908-2003 (6). The water content was measured by weighing the wet weight of the sago bark sample, then dried in an oven at $103 \pm 2^\circ\text{C}$. The dry sample was then weighed again and its water content was calculated. The results obtained were then compared with JIS A 5908-2003 (6) and SNI 01-0608-89 (7) standards.

The acid and base resistance test was carried out by dripping 3 drops of 5% acetic acid solution (for acid test) and 1% sodium carbonate (for the alkaline test) to the sample surface. Afterward, covered with watch glass for 2 hours. After that, the sample was washed with water and left indoors for 24 hours, then being observed for sample surface conditions. The results obtained were further compared to JIS A 5908-2003 (6).

Compressive strength and MOR were measured using universal testing machine. The compressive strength testing method referred to SNI 03-3958-1995 (8) and the MOR test method referred to ASTM C-293-02 (9). The load was given on the sample surface size of 30 x 2 x 3 cm gradually until the sample was damaged. The test was conducted in parallel position with wood fiber. Furthermore, compressive strength and MOR were calculated and compared with SNI 01-0608-89 (7).

3. Result and Discussion

The physical properties of sago palm bark are presented in Table 1. The parameters of physical properties observed were moisture content, acid resistance, resistance against alkaline, compressive strength, and MOR. All tested samples were cleaned and dried at temperature of less than 60°C until moisture content approached the balance.

Table 1. Physical properties of sago bark.

Testing Parameter of Physical Properties	Result
Moisture content	33,74%
Acids resistance	No discoloration
Alkaline resistance	No discoloration
Compression strength	64,09 N/mm ²
MOR	87,29 N/mm ²

Table 1 shows that the average moisture content of sago bark was 33.74%. Water content according to JIS A 5908-2003 standard was 5-13% and based on Indonesian Standard SNI 01-0608-89 is maximum 15%. It showed that water content in sago bark was higher than both standards. This meant that the moisture content in the bark of sago did not meet JIS A 5908-2003 standard and Indonesian Standard SNI 01-0608-89. The results also indicated that the bark of sago was not completely dried, so for the utilization of sago bark, it is necessary to dry it first before it is used. Water content is one of the basic parameters for determining timber utilization (10). Water content decreases with increasing temperature and will lead to reduced wood weight, tangential and wood radial sizes (11) (12).

Wood and wood substitutes, should have resistance to some wood damage factors other than pressure, such as acidic and alkaline substances. Based on the acid and alkaline resistance test results as shown in table 1, sago bark did not experience color change after giving acid solution and alkaline solution. This indicated that the sago bark met the JIS A 5908-2003 (6) standard and also meant that the bark of sago was resistant to acids and alkaline. However, to optimize these capabilities, the bark of sago should be in advance given a protective layer of acid and alkaline to minimize the damage caused by exposure to acid or alkaline substances in a long time.

Another very important parameter in utilization of wood is compressive strength (10). The compressive strength of the sago bark fiber as shown in Table 1 is 64.09 N/mm² or 653.54 kg/cm². SNI standards for compressive strength are grouped into 5 classes of wood strength. The compressive strength of sago bark was classified as strong I (7) (compressive strength over 650 kg/cm²). Wood compressive strength for building structures and furniture should be no less than class III (7). This meant that the compressive strength of sago bark complied with SNI standard. Wood compressive strength is affected by tree age, density, cell size, environment (13), and temperature (12). The form of damage of the sample after the compressive strength test was broken press and elongated crack. The form of sample damage after testing is shown in the following figure.



Figure 1. The form of sample damage after testing.

Table 1 shows that the Modulus of Rupture (MOR) of sago bark was 87.29 N/mm² or equivalent to 890.11 kg/cm² and 87.29 MPa. Based on the wood strength class in SNI 01-0608-89 (7), the sago bark MOR was classified into Class II (MOR range 725 - <1,100 kg / cm²). The MOR standard of wood for building and furniture structures should not be less than class III (7). This meant that the bark of sago can be used for the needs of building structures and furniture. Wood MOR is affected by density, cell wall thickness, fiber length, and fiber count (13).

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