Perennial, 2023
Vol. 19 No. 2: 1-7
p-ISSN: 1412-7784

Available Online:
http://dx.doi.org/10.24259/perennial.v19i2.30516
e-ISSN: 2685-6859

THE EFFECT OF PAINT VISCOSITY ON THE ADHESION OF TOP COATING ON RAJUMAS WOOD (*Duabanga moluccana* Blume)

Pengaruh Viskositas Cat Terhadap Daya Lekat Bahan Pelapis Akhir pada Kayu Rajumas (Duabanga moluccana Blume)

Liza Umitasari[1], Hairil Anwar[1], Andi Tri Lestari[1]✉

[1] *Department of Forestry, University of Mataram*
✉*Corresponding author: atlestari@unram.ac.id*

ABSTRACT

This research aims to analyze the effect of paint viscosity on the adhesion of the top coating to the radial and tangential surfaces of Rajumas wood. The samples were sanded with abrasive papers and coated with water-based paint. The variations in Aqua Politur mixtures are based on percentages of 10%, 20%, and 30% from 1L of water. The viscosity of the Aqua Politur mixtures measured by the viscometer was 2.32 poise, 2.41 poise, and 2.44 poise, respectively. Paint adhesion testing uses the Cut Test method, which refers to ASTM D 3359-09. The research results show that variations in paint viscosity significantly affect the adhesion of the top coating to the radial and tangential surfaces of Rajumas wood. A viscosity of 2.32 poise produces the best paint adhesion compared to a viscosity of 2.41 poise and 2.44 poise, and the difference in surface (radial and tangential) does not show a significant difference in the adhesion value of the top coating to Rajumas wood.

Keywords: adhesion strength; paint viscosity; Rajumas wood

A. INTRODUCTION

Wood is one of the raw materials used to support various needs, such as building materials, furniture, and industrial raw materials. The wood processing industry continues to grow and relies heavily on supplies of high-quality grade wood. It is due to the high-quality wood providing many advantages, one of which is high durability. Martha *et al.,* (2020) stated that the increased demand for commercial wood is not in line with the availability of existing wood. The gap in wood supply in Indonesia has reached 56.73%. One of the reasons for the decline in wood availability is slow growth. Fast-growing wood species can be an alternative to fulfill wood needs in Indonesia (Astari, 2017). One type of fast-growing wood is Rajumas (*Duabanga moluccana* Blume).

Rajumas is a timber forest product and a superior local plant of the West Nusa Tenggara (NTB) Regional Government. Rajumas are widely cultivated on Lombok Island and are usually used for building materials, plywood, furniture, carpentry, and household utensils (Lestari, 2020). Rajumas wood has strength and durability classes IV-V (Bonita, 2015). Wood-destroying organisms quickly attack low-quality wood, so the useful life of the wood will decrease (Bakri *et al.,* 2012). This low strength and durability results in minimal utilization of Rajumas wood. Wood quality can be improved by giving it appropriate treatment to improve durability and appearance, thereby reducing the utilization of commercial wood. One effort that can be done is finishing.

Wood finishing is a process of coating the surface of the wood with a specific coating material to protect and improve the appearance of the wood, thereby increasing the lifespan and aesthetic value of the wood (Darmawan et al., 2011). Wood surfaces without finishing treatment will experience changes due to environmental degradation. One crucial factor in the finishing process is the excellent adhesion of the finishing material to the wood surface. Good adhesion of finishing materials is influenced by the natural characteristics of each type of wood (physical, anatomical, and chemical properties) and surface texture (tangential and radial) (Darmawan and Purba, 2009). Apart from that, the adhesion ability of paint to wood is also influenced by the paint and the coating process carried out (Kamke and Lee, 2007).

The problem often found when finishing is a mismatch between the amount of paint and solvent used. People generally do finishing without considering the viscosity of coating. As a result, the resulting paint is too thick or too thin, so the final result obtained is not optimal. This is because the references to paint viscosity have not been thoroughly studied for wood types in Indonesia, including Rajumas wood. Permana and Anwar, (2014) stated that an incorrect paint mixture ratio will cause defects such as a rough surface, melting of the paint layer, and a rough surface resembling orange peel. This research aims to analyze the effect of paint viscosity on the

Received: 20 September 2023; Accepted: 11 October 2023

adhesion of the top coating to the radial and tangential cross-sections of Rajumas wood.

B. METHODS

Material Preparation

The wood samples were made from Rajumas wood obtained from Masbagik village, East Lombok regency (8° 37'58" S, 116° 29'6" E) with a log length of 4 m, diameter of 31 cm and tree age of around six years. Wood samples were made by cutting wood logs into planks using a bandsaw and coded R (radial) and T (tangential) on each plank. Next, the boards were cut into sizes 20 cm x 12 cm x 2 cm using a circular saw.

The moisture content of the samples before and after drying was tested based on ASTMD 358 – 98 (1998), then all samples were dried outdoors for 14 days and followed by kiln drying using an oven at a temperature of 103C°C±2°C for 24 hours. Samples that have met the specified water content are then sanded with 150-grit sandpaper in the direction of the wood grain. 150-grit sandpaper is generally used for final sanding before coating (Davim, 2011). After that, a code is given according to the treatment that will be given.

The finishing material for testing paint adhesion was Propan Aqua Politur AQP-360 (water-based paint), with a paint and water volume ratio of 90%:10% (RV1), 80%:20% (RV2), and 70%:30 % (RV3) of 1 L. Paint viscosity was measured using a Brookfield viscometer (spindle number 63 and testing time of 5 seconds at a speed of 80 rpm) to obtain a viscosity value of RV1 = 2. 44 poise, RV2 = 2. 41 poise and RV3 = 2.32 poise.

Paint Application

Aqua polish finishing was applied to the wood sample using a brush on all sides of the wood surfaces. The paint was applied twice with a time interval of 2 hours to ensure the paint was completely dry. After the first coat was complete, the surface of the top coating was sanded using 400-grit sandpaper.

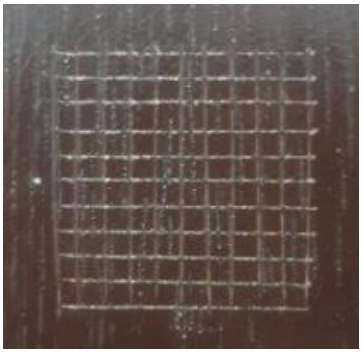
Paint Adhesion Testing

Testing the adhesion of paint on a wooden surface was carried out using the cross-cut test method. Cross-cut test is a method carried out to assess the adhesion of paint to a substrate (wood, metal, etc.) by applying and removing tape on scratches made on the paint layer (D3359-09, 2009). The appearance of wood samples using the cross-cut test method can be seen in Figure 2. Paint adhesion testing was done once for each wooden surface (one sample). The paint layer was etched with a cutter in 11 lines with a distance between the lines of 2 mm. The same strokes were made perpendicular to the first stroke to form 100 small squares. The scratches were made only on the paint layer and were guaranteed not to scratch the surface of the wood. After that, the duct tape was applied evenly and covered the entire surface of the scratches made. The end of the tape was pulled quickly in a 450 direction. The number of paint layers removed on the wood surface showed the paint adhesion quality. The paint adhesion test results were classified into six quality classes referring to the ASTM D3359-09 standard, as presented in Table 1 and 2.

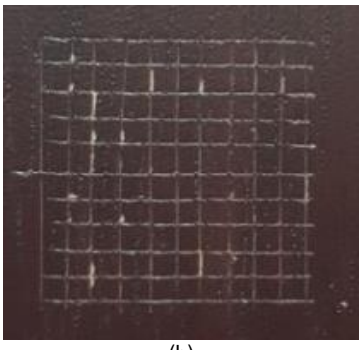
(a)

(b)

Figure 1. Samples of wood before (a) and after painting (b)



(a)



(b)

Figure 2. The surface of wood samples (a) before and (b) after tape was applied in the cross-cut test

Table 1 Classification of coating adhesion values on wood surfaces

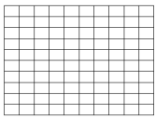
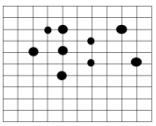
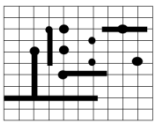
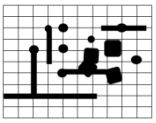
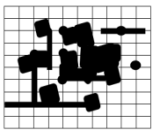
Description	Surface appearance	Quality class
The condition of the paint layer along the knife lines is smooth, without any loose paint parts.		5B
Parts of the paint/coating come off at the intersection points between the vertical and horizontal knife lines. The surface area of the delaminated paint is not more than 5%.		4B
There is loose paint/coating at points along horizontal and vertical lines, with a delaminated paint surface area of no more than 15%.		3B
There is paint/coating separated from knife lines along horizontal and vertical lines and extending into several squares, with a delaminated paint surface area of no more than 35%.		2B
Paint/coating comes from the blade lines along horizontal or vertical lines, extending over most of the square, with a delaminated paint surface area of no more than 65%.		1B
Paint/coating is coming off the surface with an area of more than 65%.		0B

Table 2 Criteria for the quality of paint adhesion

Delaminated paint layer	Quality of paint adhesion	Information
0%	5B	Very very good
1 - 5%	4B	Very good
6 - 15%	3B	Pretty good
16 - 35%	2B	Not good
36 - 65%	1B	Not good
66 - 65%	0B	Very Not Very Good

Experimental design

The design used in this research was a factorial completely randomized with two factors: viscosity (paint thickness) and the direction of the wood cross-section with nine replications. The equation model was as follows (Safutra, 2018).

$$\gamma_{ij} = \mu + \tau_i + \varepsilon_{ij} \quad (1)$$

Where, γ_{ij} is the observation value at level i of the j repetition, μ is the middle value or general average of observations, $\tau_i$is the effect of paint viscosity at level i, ε_{ij} is error at level of i and j repetition.

The following formula was used to determine the number of repetitions (Puspitasari *et al.,* 1996).

$$(t-1)(r-1) \geq 15 \quad (2)$$

Where t is the number of treatments, r is the number of repetitions.

Data analysis

The data analysis used in this research was a two-way analysis of variance (ANOVA) at the 5% level and a Least Significant Different (LSD) further test at the 5% level. For this LSD test, SPSS 26 was used.

C. RESULTS AND DISCUSSION

Effect of Paint Viscosity on the Adhesion of Top Coating on Radial Sections

The results of testing the effect of paint viscosity on the quality of paint adhesion to the radial section can be seen in Table 3.

Table 3 Frequency distribution of paint adhesion quality values on radial sections

Treatment	Quality of paint adhesion	Frequency	%
RV1	3B	6	22.2
	4B	3	11.1
RV2	3B	2	7.4
	4B	7	25.9
RV3	4B	7	25.9
	5B	2	7.4
Total		27	100

Note: R for radial, V for paint viscosity, % for percentage

The results show that most paint adhesion quality values in the radial section were 4B, namely 7 (25.9%) in the RV2 and RV3 treatments. It showed that the quality of paint adhesion on the radial cross-section was excellent (4B), according to Table 2. The anatomical structure of Rajumas wood could cause it. Darmawan *et al.,* (2020) explained that anatomical structure is one of the main factors influencing the interaction between *coating* and wood material. Rajumas wood has a distribution of single radial pores and a small number of multiple radial pores (Figure 3). This was similar to research by Marbun *et al.,* (2019), which states that the distribution of pores in Rajumas wood is mostly single radial and a small number are double radial. In diffusely porous wood, the pores are almost the same size and are more evenly distributed in the year rings. A large number of pores and an even

distribution of pores will make it easier for the paint solution to enter (Darmawan, 2011). Good coating absorption and penetration can improve the bond quality between the paint layer and the wood material (Darmawan *et al.,* 2020).

Apart from the arrangement of pores in Rajumas wood, the formation of good paint adhesion is also thought to be caused by sanding technique factors. In this study, wood samples were sanded toward the wood grain. (2013) explained that sanding is essential in forming raised fibers and final quality. Sanding perpendicular to the grain produces a more significant increase in grain lift than sanding in the direction of the wood grain. Raised fibers are one of the factors that can hinder the application process of finishing materials, impacting the quality of the resulting *finishing.*

The quality value of paint adhesion is related to the durability of the wood. The high-quality value of paint adhesion can increase the durability of wood, impacting the lifespan of Rajumas wood. Table 3 shows that the lowest adhesion quality was obtained in the RV1 treatment, namely 3B (reasonably good), and the highest in the RV3 treatment, namely 5B (excellent). This is in line with the research results of Safitri (2016), which stated that the scratch test results showed that paint adhesion increased as paint viscosity decreased. This is thought to be caused by the wettability of wood. Gray (1962) stated that the formation of good painting quality is partly due to the wettability factor of wood or the ease with which liquids can wet the surface of the wood. Different paint viscosity will produce different paint viscosity. Based on the paint viscosity test results, the viscosity value is obtained, which decreases as the solvent used increases. Safitri (2016) explained that low liquid viscosity results in high wettability values, which has implications for high paint adhesion values.

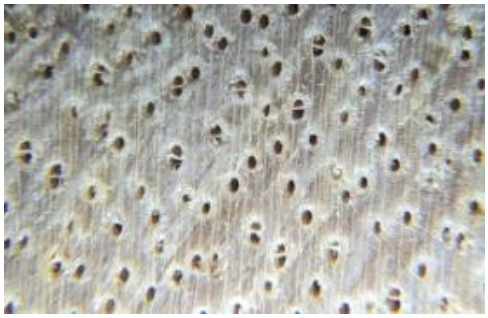


Figure 3. Distribution of pores in Rajumas wood in radial cross-section

A variance analysis test was carried out to determine the effect of paint viscosity on the adhesion, the results of which can be seen in Table 4.

Table 4 Two-way analysis of variance of the effect of paint viscosity on paint adhesion on the radial section

Source of diversity	Degrees of freedom	Sum of squares	Middle square	$F_{cal.}$	$F_{table\ (5\%)}$	Sig.
Treatment	2	3,556	1,778	8,348	3,403	0.002
Error	24	5.111	0.213			
Total	26	8,667				

The analysis of the variance test in Table 4 shows a significant difference in *the* variation of paint viscosity on the adhesion of the top coating (paint) to the radial cross-section of Rajumas wood. This is shown by the calculated F value of 8.348 > F table of 3.403 or significant at p= 0.002 < 0.05. Next, a further LSD test was carried out at the 5% level to determine which treatments were significantly different in terms of paint adhesion by comparing one treatment with another. The results of further LSD tests on the effect of paint viscosity on paint adhesion to the radial section can be seen in Table 5.

Table 5 LSD test results on the effect of paint viscosity on paint adhesion

Treatment	Average LSD Test	Notation
RV1	3,333	b
RV2	3,778	ab
RV3	4,222	a

Description: test level of 5%

The results of the LSD further test in Table 5 show that the treatment of RV1 with RV2 and RV2 with RV3 shows that there is no significant difference at the 5% test level. This can be seen from the same notation between the treatments of RV1 and RV2 have the notation "b" and RV2 and RV3 have the notation "a", meaning that the treatments produce the same good paint adhesion quality values (not much different). Meanwhile, RV1 treatment and RV3 treatment showed significantly different results at the 5% test level. This is shown by the different notations of the two treatments. RV1 has the notation "b" and RV3 has the notation "a", meaning these treatments produce significantly different paint adhesion qualities.

The value of the paint produced will have an impact on the quality of the adhesion of the paint produced. Good paint adhesion can improve product quality, especially in durability. Darmawan *and* Purba (2009) explained that using finishing materials can prevent damage to the wood surfaces, so the useful life of the wood will be longer. The results of the LSD test on the influence of paint viscosity on paint adhesion to the radial section can be depicted in Figure 4.

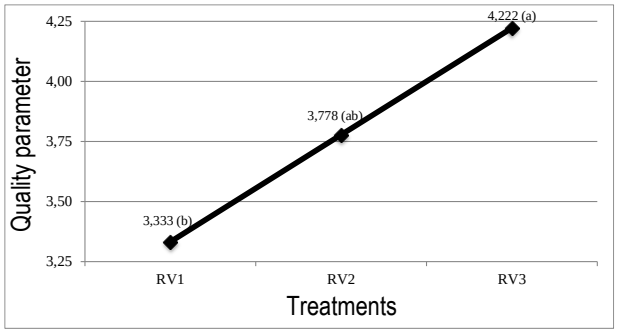


Figure 4. Graph of advanced LSD test values on the effect of paint viscosity on paint adhesion on the radial cross-section

Effect of Paint Viscosity on the Adhesion of Top Coating on Tangential Sections

The results of testing the effect of paint viscosity on the quality of paint adhesion on tangential sections can be seen in Table 6.

Table 6 Frequency distribution of paint adhesion quality values on tangential sections

Treatment	Quality of paint adhesion	Frequency	%
T V1	3B	6	22.2
	4B	3	11.1
T V2	3B	3	11.1
	4B	6	22.2
RV3	4B	7	25.9
	5B	2	7.4
Total		27	100

Description: T for tangential, V for paint viscosity, % for percentage

Table 6 shows that most paint adhesion quality values obtained in the tangential section, namely 4B, were 7 (25.9 %) in the TV3 treatment. This is thought to be caused by the anatomical structure of Rajumas wood. Darmawan *et al.,* (2020) explained that anatomical structure is one of the main factors influencing the interaction between *coating* and wood material. Rajumas wood has a distribution of single radial pores and a small number of multiple radial pores (Figure 6). This aligns with research by Marbun *et al.,* (2019), which states that the distribution of pores in Rajumas wood is mostly single radial and a small number are double radial. In diffusely porous wood, the pores are almost the same size and are more evenly distributed in the year rings. A large number of pores and an even distribution of pores will make it easier for the paint solution to enter (Darmawan, 2011). Good coating absorption and penetration can improve the bond quality between the paint layer and the wood material (Darmawan *et al.,* 2020).

Apart from the arrangement of pores in Rajumas wood, the formation of good paint adhesion is also thought to be caused by sanding technique factors. In this study, wood samples were sanded toward the wood grain. (2013) explained that sanding is essential in forming raised fibers and final quality. Sanding perpendicular to the grain produces a more significant increase in grain lift than sanding in the direction of the wood grain. Raised fibers are one of the factors that can hinder the application process of finishing materials, impacting the quality of the resulting *finishing.*

Table 6 shows that the lowest paint adhesion quality value was obtained in the TV1 treatment, namely 3B (reasonably good), and the highest in the TV3 treatment, namely 5B (excellent). This is in line with the results of Putri (2018), which states that the lower the viscosity of the paint, the better the adhesion of the paint produced. This is thought to be caused by the wettability of wood. Gray (1962) stated that the formation of good painting quality is partly due to the wettability factor of wood or the ease with which liquids can wet the surface of the wood. Different paint viscosity will produce different paint viscosity. Based on the paint viscosity test results, the viscosity value is obtained, which decreases as the solvent used increases. Low viscosity results in a high wettability value, generating a high adhesion value for the paint (Safitri, 2016). Ozgenc *et al.* (2012) also explained that a high wettability value will impact the high adhesive strength produced.

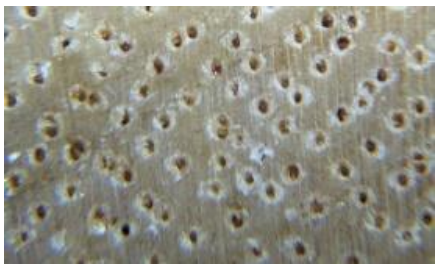


Figure 5. Distribution of pores in Rajumas wood on tangential section

Based on this, it is necessary to carry out a diversity analysis test to determine the effect of paint viscosity on the adhesion of the paint produced. The results of the diversity analysis test on the influence of paint viscosity on paint adhesion on tangential sections can be seen in Table 7.

Table 7 Two-way analysis of variance of the effect of paint viscosity on paint adhesion on tangential sections

Source of diversity	Degrees of freedom	Sum of squares	Middle square	$F_{cal.}$	$F_{table\ (5\%)}$	Sig.
Treatment	2	3.63	1,815	7.84	3,403	0.002
Error	24	5,556	0.231			
Total	26	9,185				

The results of the variance analysis test in Table 7 show a significant difference in *the* variation of paint viscosity on the adhesion of the top coating (paint) to the tangential cross-section of Rajumas wood. This is shown by the calculated F value of 7.84 > F table of 3.403 or significant at p= 0.002 < 0.05. Next, a further LSD test was carried out at the 5% level to determine which treatments were significantly different in terms of paint adhesion by comparing one treatment with another. The results of further LSD tests on the effect of paint viscosity on paint adhesion to the resulting radial cross-section can be seen in Table 8.

Table 8 LSD test results on the effect of paint viscosity on paint adhesion

Treatment	Average LSD Test	Notation
T V1	3.333	b
T V2	3.667	b
T V3	4.222	a

Description: test level 5%

The results of the LSD further test in Table 8 show that there is no real difference between the TV1 and TV2 treatments at the 5% test level. This can be seen from the notation that is the same between the treatments, namely that they both have the notation "b", meaning that the TV1 and TV2 treatments produce the same good paint adhesion quality values (not much different). Meanwhile, treatment TV1 with TV3 and treatment TV2 with TV3 show significantly different results at the 5% test level. This is shown by the different notation of the two treatments, namely treatment TV1 has the notation "b" and TV3 has the notation "a", treatment TV2 has notation "b" and TV3 has notation "a". This means that between these treatments the quality of paint adhesion is significantly different. The viscosity of the paint will impact the quality of the paint adhesion. Good paint adhesion can improve product quality, especially regarding product durability.

The LSD test results table for the effect of paint viscosity on paint adhesion to the tangential section can be depicted in Figure 6.

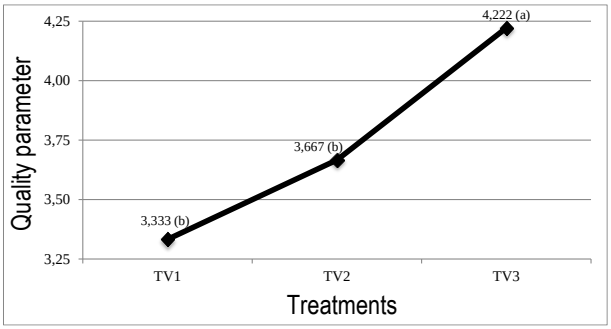


Figure 6. LSD test values on the effect of paint viscosity on paint adhesion on tangential cross-section

The results of the t-test in Table 9 show that the significance value of the difference in the direction of the wood cross-section (radial and tangential) on paint adhesion is 0.817 > 0.05, meaning that the paint adhesion value on the radial and tangential cross-sections does not have the difference at the test level is 5%. This is in line with research by Lestari *et al.,* (2016), which states that there is no significant difference in the quality of paint adhesion between radial and tangential cross-sectional patterns. This is in line with research by Lestari *et al.,* (2016), which states that there is no significant difference in the quality of paint adhesion between radial and tangential cross-sectional patterns. This is because the wettability properties in the radial and tangential sections tend to be the same. Lestari (2020) in his research stated that the wettability of the radial and tangential cross-sections of Rajumas wood showed no significant differences. The wettability of wood has a directly proportional relationship to the adhesion value. The higher the wettability of the wood, the better the adhesion of the resulting paint and vice versa.

Table 9 Results of the t-test for differences in adhesive strength on radial and tangential cross-sections of Rajumas wood

Wooden Cross Section	N	Mean	SD	T (t-test)	P-value
Radials	27	3.78	0.577	0.232	0.817
Tangential	27	3.74	0.594		

D. CONCLUSION

It could be concluded that paint viscosity significantly affects the adhesion of the top coatings to the radial and tangential sections of Rajumas wood. It is recommended that further research be carried out regarding testing the quality of the top coating on Rajumas wood, such as testing the weather resistance of paint. The same research on Rajumas wood with an age of over six years also needs to be researched so that information and data related to the adhesiveness value of Rajumas wood at various age levels are complete.

REFERENCES

[ASTM] American Society for Testing and Materials. (1998). ASTM D 358 - 98: *Standard Specification for Wood to Be Used as Panels in Weathering Tests of Coatings*. ASTM.

[ASTM] American Society for Testing and Materials. (2009). ASTM D3359-09: *Standard Test Methods for Measuring Adhesion by Tape Test 1*. *July*, 1–8.

Astari, M. (2017). *Pengaruh kekasaran permukaan dan kekentalan bahan finishing larut minyak terhadap keterbasahan kayu sengon dan jabon melinda astari*.

Bakri, s., Fahriza, A. & Tricahyana, B. (2012). Serbuk gergajian kayu jati (*Tectona grandis*) sebagai bahan pengawet kayu durian (*Durio zibethinus*). *Jurnal Riset Industri Hasil Hutan*, *4*(2), 1.

Bonita, M. . (2015). Bonita, M. K. 2015. Efektifitas ekstrak biji mimba (*Azadirachta indica* A Juss) terhadap ketahanan kayu rajumas (*Duabanga mollucana*) dari serangan rayap tanah (*Nacutitermes* Spp). *Jurnal Sangkareang*, *1* (1), 7-14.

Darmawan, W., Ginting, M. B., Gayatri, A., Putri, R. L., Lumongga, D., & Hasanusi, A. (2020). Influence of surface roughness of ten tropical woods species on their surface free energy, varnishes wettability and bonding quality. *Pigment and Resin Technology*, *49*(6), 441–447.

Darmawan, W., & Purba, I. (2009). Daya tahan lapisan finishing eksterior beberapa jenis kayu terhadap pengaruh cuaca. *Jurnal Ilmu Dan Teknologi Hasil Hutan*, *2*(1), 1–8.

Darmawan, W., Rahayu, I.S., Padlinurjaji, I.M., & Pandit, K.N. 2011. *Pengerjaan Kayu: Ilmu-Ilmu Penunjang dan Teknologi Proses*. Bogor, ID: IPB Pr.

Davim, J. P. (2013). *Wood machining*. John Wiley & Sons.

Gray, V. (1962). The wettability of wood. *Forest Product Journal, 12*(9), 452- 461.

Kamke, F. A., & Lee, J. N. (2007). Adhesive penetration in wood - A review. *Wood and Fiber Science*, *39*(2), 205–220.

Landry V, Blanchet P, & Cormier L.M. (2013). Water-based and solvent-based stains: impact on the grain raising in yellow birch. *Bioresource, 8*(2), 1997-2009.

Lestari, A.T. (2020). Sifat keterbasahan pada bidang tangensial dan radial kayu rajumas (*Duabanga moluccana* Blume). *Perennial*, *16*(1), 7–10.

Marbun, S. D., Wahyudi, I., Suryana, J., & Nawawi, D. S. (2019). Anatomical Structures and Fiber Quality of Four Lesser-Used Wood Species Grown in Indonesia. *Journal of the Korean Wood Science and Technology*, *47*(5), 617–632.

Martha, R., Dirna, F.C., Hasanusi, A., Rahayu, I.S., & Darmawan, W. (2020). Surface free energy of 10 tropical woods species and their acrylic paint wettability. *Journal of Adhesion Science and Technology*, *34*(2), 167–177.

Ozgenc, O., Hiziroglu, S., & Yildiz, U. C. (2012). Weathering properties of wood species treated with different coating applications. *BioResources*, *7*(4), 4875–4888.

Permana, I.P., & Anwar, S. (2014). Pengaruh Kualitas thinner pada campuran cat terhadap hasil pengecatan. *Jtm*, *3*(2), 53–61.

Puspitasari, D., Nugroho, S., & Swita, B. (1996). Kajian Multivariate analysis of variance (manova) pada rancangan acak lengkap (ral). *Jurnal Statistika*, *2*(5), 5–8.

Putri, F.R. (2018). Pengaruh Kekasaran permukaan dan kekentalan bahan cat terhadap keterbasahan serta daya lekat lapisan cat pada kayu eboni (*Diospyros celebica* Bakh.) FIRYA. *Angewandte Chemie International Edition, 6*(11)*, 951–952.*, *3*(1), 10–27.

Safitri, I.F. (2016). Pengaruh viskositas cat terhadap keterbasahan dan daya lekat bahan finishing pada kayu jati rakyat dan jati perhutani *[Skripsi]*. Institut Pertanian Bogor.

Safutra, E., & Zuriat, Z. (2018). Kajian potensi bioaktif kanglung laut (*Ipomea pascaprae*) Asal pesisir aceh barat sebagai inhibitor tirosinase dan antioksidan. *Jurnal Akuakultur Universitas Teuku Umar*, 2(1).

Setyanto, A.E. (2006). Memperkenalkan Kembali metode eksperimen dalam kajian komunikasi. *Jurnal Ilmu Komunikasi*, *3*(1), 37–48.