MECHTA
International Journal of
Mechanical Engineering Technologies and Applications
V. 01 N. 1
Article No. 1, pp. 1 - 5, 2020

Teguh Dwi Widodo
Lecturer
Department of Mechanical Engineering
Brawijaya University
Malang - Indonesia

Rudianto Raharjo
Lecturer
Department of Mechanical Engineering
Brawijaya University
Malang - Indonesia

Victor Yuardi Risonarta
Lecturer
Department of Industrial Engineering
Catholic University of Darma Cendika
Surabaya- Indonesia

Redi Bintarto
Lecturer
Department of Mechanical Engineering
Brawijaya University
Malang - Indonesia

Haslinda Kusumaningsih
Lecturer
Department of Mechanical Engineering
Brawijaya University
Malang - Indonesia

Muhamad Hendra Saputra
Undergraduate Student
Department of Mechanical Engineering
Brawijaya University
Malang - Indonesia

The Effect of Sand Blasting on Shear Stress of Fiberglass – Shorea spp. Composite

A coating is widely applied to protect base material during contact with surrounding. One important application in engineering is to protect a boat hull. The coating is applied to boat hull to prevent a decrease of mechanical properties of base materials particularly with corrosive seawater. Composite coating is applied since the composite coating provides better protection compared to paint coating. Additionally, sandblasting prior to composite coating is worked out to improve the mechanical properties of the coating. This work investigated the influence of the projection angle of the sandblasting process on the shear strength of the coated surface. The projection angle of sandblasting was varied from 30 to 90 °. The result shows that a higher projection angle decreases the strain strength of the coating surface. The experiment work showed that the shear strength of 30°, 45 °, 60 °, and 90°projection angle are 1.02, 0.66, 0.38, and 0.24 MPa, respectively.

Keywords: *Hand lay-up; Fiberglas-Shorea spp composite; shear stress; sandblasting*

1. INTRODUCTION

Nowadays wood is applied in many engineering products. Of these applications, wood is used as a hull in a traditional boat. Wood as carbon neutral and abundant resource is used as the hull for traditional boat due to its low cost, low density, and its good recycle ability. Red Meranti (*Shorea Coriacea Burck.*) (**Figure 1**) is a native tree to Southeast Asia and can easily grow in Malaysia, Indonesia and the Philippines. The red Meranti can grow up to 50 m height and up to 100 cm in diameter. Its skin thickness can be up to 20 cm. Due to its abundant supply in Indonesia, the red Meranti is applied for a traditional boat hull. To extend the service life of wood boat hull, the hull is coated with paint. By applying paint coating, this wood hull can be in service for app. 10 years. In order to extend the service life, the wood hull is not only coated with paint but also with fiberglass composite. Composite is used as coating materials also due to its high stiffness to density ratio [1,2] which results in lower boat weight.

Sandblasting prior to coating is widely applied for metal [3-5]. In this study, sandblasting using abrasive materials, e.g. silica sand, steel grit is worked out to wood surface prior to composite coating. These materials are blasted to the wood surface at high pressure for two main purposes, i.e. increase the surface roughness and removal of dirt in the form of salt, rust, and oil [6]. Air pressure, size of blasted materials, blasting period, and blasting distance influence the sandblasting result, e.g. surface roughness, surface cleanness [7,8]. A certain range of surface roughness is required to achieve good mechanical bonding between composite as coating and wood as the base material [8].

Corresponding Author: widodoteguhdwi@ub.ac.id Received on: October 2019 Accepted on: January 2020

Figure 1. The red Meranti tree

2. METHODOLOGY

After the red Meranti wood was cut and prepared following the ASTM D1037 -12 [9], the wood surface was smoothened by using sandpaper. In this work, the wood thickness was constant at 5 mm for all experiments. After wood preparation finished, sandblasting on the wood surface was applied prior to coating. In this work, the projection angle for sandblasting was varied at 30 °, 45 °, 60 ° and 90 °. For all projection angles, air pressure was 5 atm, blasting distance was 20 cm, sand-size was in the range between 16 to 30 meshes and blasting duration was 1 minute. After sandblasting, the wood surface was coated with a mixture of fiberglass –resin by using a hand lay-up technique (**Figure 2**). The fiberglass volume in the fiberglass-resin mixture was constantly held at 40 %Vf. Meanwhile, the thickness of the fiberglass-resin mixture was constant at 2 mm. In order to achieve good bonding between wood and fiberglass-resin mixture, the wood and fiberglass-resin were pressed at room temperature. Finally, the shear test was worked out following ASTM D905- 08 [10].

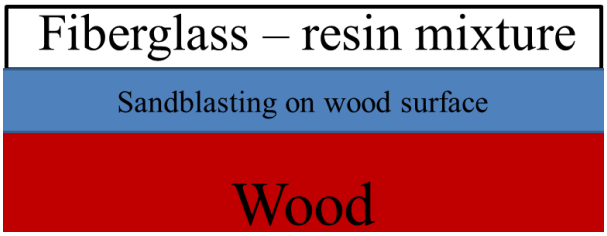

Figure 2: Sketch of wood coated with and fiberglass-resin in this work

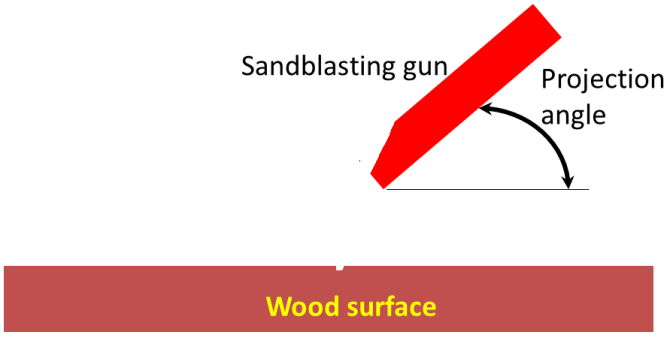

Figure 3: Sketch of the sandblasting process on wood surface

3. RESULTS AND DISCUSSION

Shear stress of the composite decreases as the projection angle increases (**Figure 4**). The shear stresses for 30 °, 45 °, 60 ° and 90 ° projection angles are 1.02, 0.66, 0.38, and 0.24 MPa, respectively. The highest reduction of shear stress occurs when the projection angle increases from 30 to 45 °. Meanwhile, the shear stress decreases slower as the projection angles increases from 60 to 90°. As the projection angle increases, the roughness of wood surface increases due to the higher penetration depth of the blasted sand. In this circumstance, there were increasing depth variations between the wood surface and fiberglass (**Figure 5**) which leads to insufficient mechanical bonding between the wood surface and mixture of fiberglass-resin.

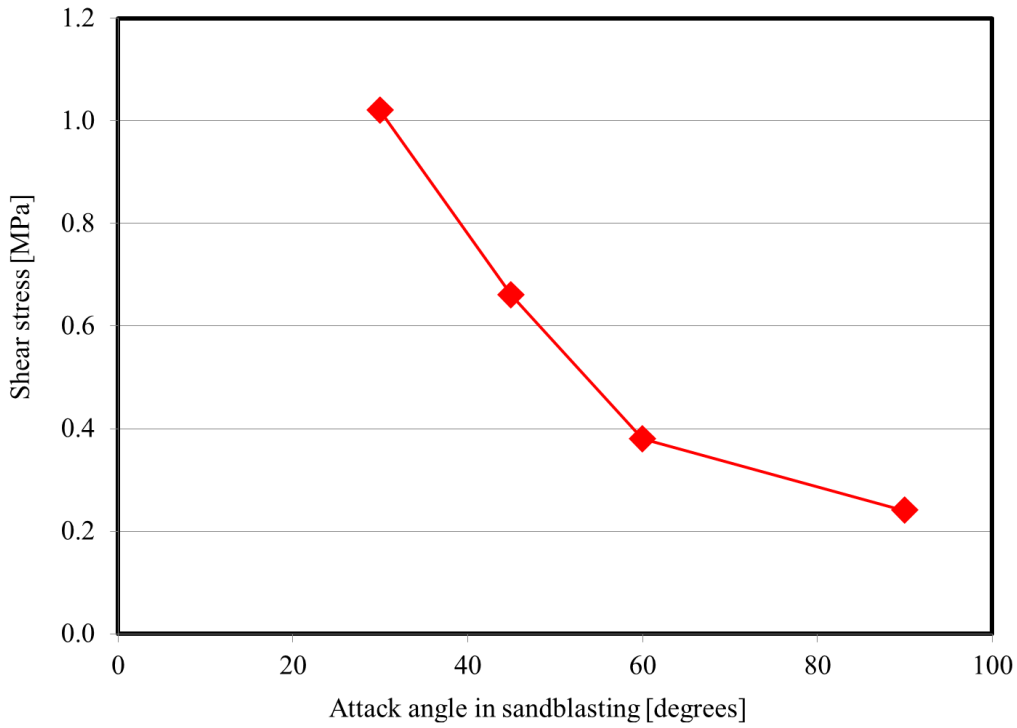

Figure 4: Shear stress as a function of projection angle in sandblasting prior to coating

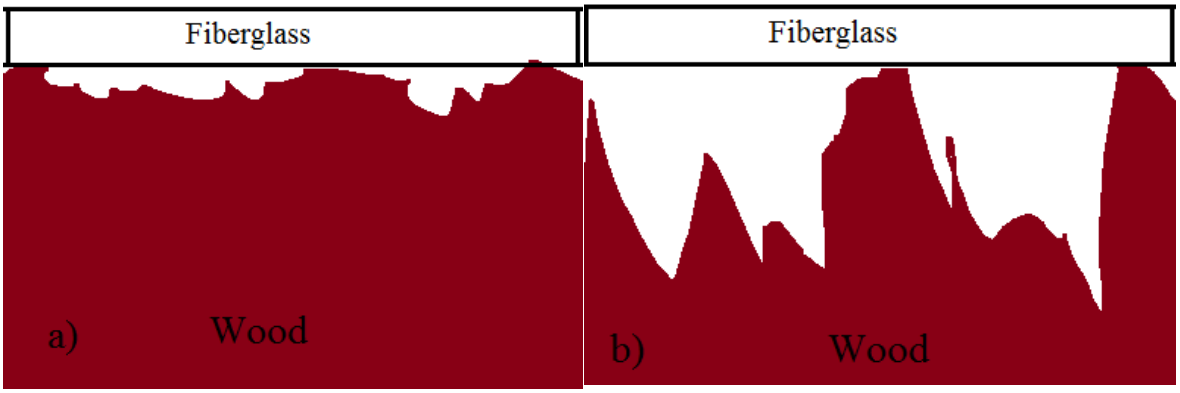

Figure 5: Sketch of depth variation developed by a) low projection angle; b) high projection angle

The insufficient mechanical bonding for high projection angle which leading to low shear stress was deeper investigated by using photograph analysis on the wood surface after coating (**Figure6**). The dark area in Figure 6a, which is indicated by a yellow circle, shows a shallow basin that creates sufficient mechanical bonding between the wood surface and mixture of fiberglass-resin. On the specimen surface for projection angle 45° (**Figure 6b**), it was observed that this shallow basin still exists. However, there was a gap on the

fiberglass-resin surface which reduce the bonding strength. The gap grew for the projection angle 60 ° (**Figure 6c**) which contributes to a further decrease in the bonding strength. The decrease in bonding strength is also due to sharp wood fiber. This wood fiber was formed by a deep basin as the projection angle increases since the abrasive force increases as the projection angle increases. This basin becomes deeper as the projection angle increases to 90 ° (**Figure 6d**).

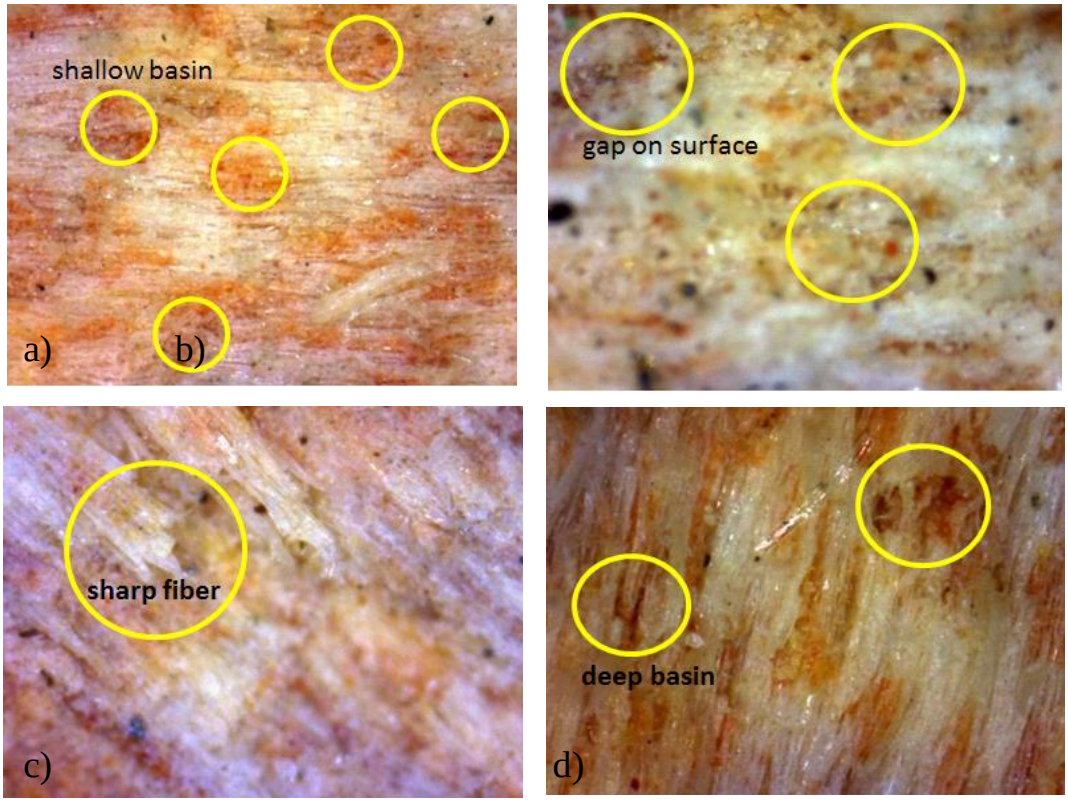

Figure 6. Wood surface after coating with the fiberglass-resin mixture for various projection angle: a) 30°; b) 45°; c) 60°; d) 90°

4. CONCLUSION

This work investigated the influence of projection angle during sandblasting prior to resin coating. The higher shear strength occurs for projection angle 30 °. As the projection angle increases, the shear strength of the coated wood surface decreases. This circumstance occurs since a higher projection angle results in a deeper basin on the wood surface which leads to decreasing strength of mechanical bonding between wood surface and resin.

5. REFERENCES

[1] LUKKASEN, D., MEIDEL, A. Advanced Materials and Structures, and Their Fabrication Process. Narvik University Colleg, HIN, 2007.

[2] KIRBY, R.H. *Vegetable fibers, botany, cultivation and utilization*. Leonard Hill Limited, London, 1963.

[3] FIRMANSYAH, H.I; PURNOWIDODO, A.; SETYABUDI, S.A."Pengaruh mechanical bonding pada aluminium dengan serat karbon terhadap kekuatan tarik fiber metal laminates, *Jurnal Rekayasa Mesin*, v.9, n.2 2018, p. 127-134

[4] SETYARINI, P.H.; SULISTYO, E., "Pengaruh Waktu Dan Sudut Penyemprotan Pada Proses Sand Blasting Terhadap Laju Korosi Hasil Pengecatan Baja AISI 430", *Jurnal Rekayasa Mesin*, v.2, n. 2, 2011, p. 205-208.

[5] HASANANTO, N., "Analisis perbandingan metode peningkatan wear resistance", *Jurnal Rekayasa Mesin*, v.6, n. 3, 201, p. 153-156

[6] AUTAR, K.K., Mechanics of Composites Material, CRC Press-Taylor & Francis Group: New York, 2006.

[7] CALLISTER, W.D., Material Science and Engineering, 7th edition, John Willey & Sons, Inc., New York, 2007.

[8] HARRIS, B., Engineering composites. The Institute of Materials, London, 1999.

[9] ASTM D1037 – 12, "Standard test methods for evaluating properties of wood-based fiber and particle panel materials", ASTM International, 2018

[10] ASTM D905 -08, "Standard test method for strength properties of adhesive bonds in shear by compression loading", ASTM International, 2013