IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

DENSIFICATION OF SOFTBOARD THROUGH THE IMPREGNATION OF PHENOLIC RESIN: A VALUE ADDED SUBSTITUTE FOR STRUCTURAL PURPOSE UTILIZATION

[1]Akhil Saji, [2]Sreejanya R Nambiar, [3]Aruna M. V, [4] Sruthi K

[1,2,3,4]Department of Wood Science and Technology, Kannur University, Kannur, Kerala, India.

ABSTRACT

Softboards are commonly used for non-structural applications due to their poor mechanical property and higher water absorption. With the help of phenolic resin impregnation, we can make it more moistureproof and stronger. Phenolic resin impregnation improves the physical, mechanical strength properties and dimensional stabilization of the softboard. The improved properties of this low-density fibreboard can be utilized as a substitute for other engineered wood boards. Which will help to hinder the overexploitation of widely used natural timber resources sustainably by enabling the utilization of most underused timber species.

Keywords: Dimensional stabilization, Softboard modification, Wood Fiberboard, Phenol Formaldehyde resin, Impregnation, Low-density fiberboard

I. INTRODUCTION

Softboards have a specific gravity of between 0.15 and 0.45 and are used for sound and thermal insulation due to their highly porous nature (Rowell, 2014). Furuno et al., 2004; and Hill, 2006 said that impregnation using Phenol-Formaldehyde (PF) resin followed by heat curing has been shown to improve dimensional stability and mechanical property. Chemical and densification treatment is useful for utilizing underutilized timber species (Zaidon et al., 2009). Low molecular weight formaldehyde resin (LmwPF) was utilized by Kajita and Imamura (1991) to improve the physical and biological characteristics of particle boards, while Anwar et al., 2006 and Loh et al., 2011; Hartono, 2019 utilized it to modify the nature of laminated bamboo and oil-palm. The LmwPF resin managed to swell the cell wall without bonding to it (Stamm and Seborg, 1936; Stamm and Elwin, 1953; Farmer, 1967), also reducing water absorption (Wang et al., 2004; Alireza et al., 2010). This method is simple and cost-efficient.

II. MATERIALS AND METHODS

Preparation and treatment of samples

The preparation and testing of all the specimens during this work were carried out as per the procedures followed by IS 3348:1965 and IS 2380:1977. Softboard samples are collected and these collected samples were cut into sizes such as 20x10x1cm for the measurement of density, water absorption, thickness swelling, and 30x7.5x1 cm for measurement of modulus of rupture (MOR). To obtain a consistent mass, the specimens were originally maintained in a hot air oven. Specimens were submerged in the low consistent phenol-formaldehyde solution for 3 minutes. After drying it in an air dryer for 24 hours. Then soft board samples are heated at 135℃ for 6 hours in Oven.

Testing parameters

The preliminary density and ultimate density were determined and recorded. For the water absorption and thickness swelling, the initial weight and thickness from different points were measured then the specimen was submerged horizontally under fresh water for one day. Then the sample was wiped off with damped cloth, and the final weight was measured. The MOR was calculated with Universal Testing Machine (UTM).

Fig.1 (a) Untreated soft board (b) PF resin-impregnated softboard

III. RESULT AND DISCUSSION

The treatment gives a significant gain in density as shown in fig 2. The treated soft board became 41.9% denser than the untreated soft board (control). It's due to the deposition of (67.559 g resin intake found in the treated specimen) phenolic resin in the free space of the board.

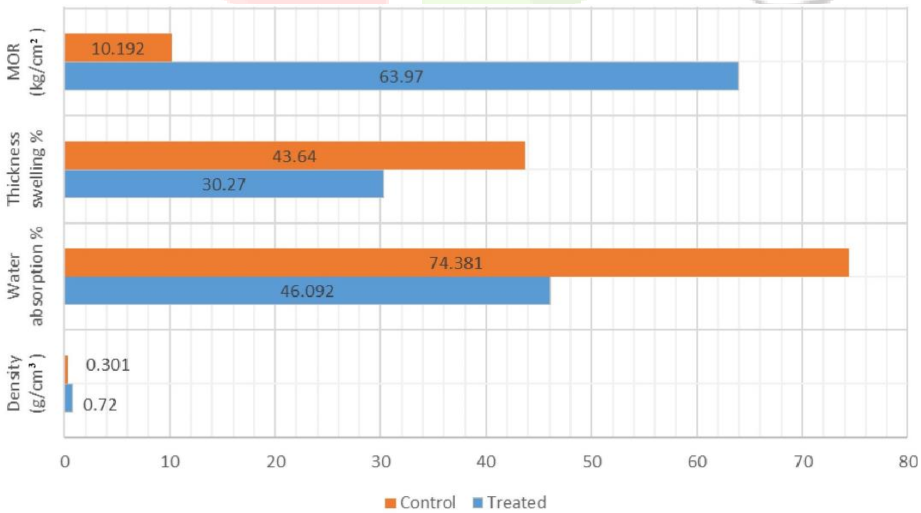

Fig.2 Graphical representation of density, water absorption, thickness swelling, and MOR of treated and untreated soft board.

The water absorption property of the treated specimen was considerably reduced (fig 2). The non-treated specimen has a three times higher water absorption percentage. Low-density boards can absorb more water by virtue of their greater proportion of internal free space. And phenol-formaldehyde has a good water repellence and decreases the hygroscopicity of the wood fiber. The thickness swelling of the untreated specimen is 13% higher than that of the treated specimen (fig 2). Because the phenol-formaldehyde is entering into the porous area and turns into a solid state while curing. The loosely packed fibers become hard and stiff. And the internal bond will dimensionally stabilize the specimen; there for deformation is prevented. The result shown in this figure 2 indicates that the highest modulus of rupture (MOR) was obtained by Phenolic resin impregnated soft board specimen, which has five times greater than the MOR of the control.

IV. CONCLUSION

The treatment of softboard with Phenol Formaldehyde resin improved the dimensional stability and strength properties of the board. The treatment improved density, water absorption, and thickness swelling. The hardness and MOR have also improved. This advancement process helps to utilize agro fibers in structural applications. This method is simple and cost-efficient. However, the treated product releases free formaldehyde into the surroundings but it can be reduced by adding formaldehyde scavenger.

V. ACKNOWLEDGMENTS

The authors thank the Western India Plywoods Ltd, Baliapatam, Kannur, Kerala for providing the necessary facilities for undertaking this research project and all M.Sc. students 2017-2019 batch, Department of Wood Science & Technology, Kannur University, Kerala for their support.

REFERENCE

1. Furuno, T., Imamura, Y., and Kajita, H (2004). The modification of wood by treatment with low molecular weight phenol-formaldehyde resin: a properties enhancement with neutralized phenolic-resin and resin penetration into wood cell walls. Wood Sci. Technol. 37, 349–361.

2. Anwar., U.M.K., Paridah, M.T., and Hamdan, H., Zaidon, A and Baker, E.S (2006). Impregnation of bamboo with (Gigantochloa scortechinii) strips molecular weight phenol-formaldehyde resin. J. Bamboo Rattan, 5: 159-165.

3. Hill and C.A.S (2006). Wood Modification: Chemical, Thermal, and Other Processes. In: Modifying the Properties of Wood, Hill, C.AS. (Ed) John Wiley and Sons Ltd, London, ISBN: 978-0-470-02172-9, pp: 19-97.

4. Kajita, H and Y. Imamura (1991). Improvement of physical and biological properties of particleboards by impregnation with phenolic resin. Technol., 26: 63-70.

5. Loh, Y.F., Paridah, M.T., Hoong, Y.B., Bakar, E.S., Hamdan, H and Anis, M (2011). Properties enhancement of oil palm plywood through veneer pretreatment with low molecular weight phenol-formaldehyde resin Int. Biodeterior. Biodegrad, 65: 14-17.

6. Zaidon, A (2009). Improvement of raw materials from underutilised timber species through chemical and densification treatments for value-added laminated products: Rep. No. 06-01-04-SF0656. Ministry of Science and Technology, Malaysia.

7. Stamm A.J and Elwin E.H (1953). Chemical processing of wood. Chemical Publishing Co. Inc, New York

8. Stamm, A.J and Seborg R.M (1936). Minimizing wood shrinkage and swelling–treating with synthetic resinforming materials. Ind Eng Chem 28(10):1164–1169

9. Farmer RH (1967). Chemistry in the utilization of wood. Pergamon Press, New York

10. Alireza, S and Ali, G (2010). Water absorption and thickness swelling behaviour of polypropylene reinforced with hybrid recycled newspaper and glass fiber. Appl compos mater. 17: pp183-193, DOI :10.1007/s10443-009-91119-9

11. Wang, W and Morrell, J.J (2004). Water sorption characteristic of two wood/plastic composites. Forest Prod.J.54:pp209-212

12. Anonymous (1965). IS 3348: Specification for fibre insulation boards, Bureau of Indian standards, New Delhi.

13. Anonymous (1977). IS 2380: Methods of test for wood particle boards and boards from other lignocellulosic materials, Bureau of Indian standards, New Delhi.

14. Rowell, R.M (2014). The use of biomass to produce bio-based composites and building materials. Woodhead Publishing Limited. 24:pp 803-818, DOI:10.1533/9780857097385.2.803

15. Hartono R (2019). The effect of phenol formaldehyde impregnation at various concentrations on quality of densified-oil palm trunk. IOP Conf. Series: Earth and Environmental Science. DOI:10.1088/1755-1315/374/1/012011