UNIVERSITI TEKNOLOGI MARA

MODIFICATION OF DRYING TECHNIQUE USING ORGANIC SOLVENTS TO OIL PALM WOOD ENGINEERING PROPERTIES

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ABSTRACT

This study explores the use of organic solvents ethanol, acetone, and toluene as moisture extraction agents to improve the drying process and enhance the engineering properties of Oil Palm Wood (OPW). The biomass from oil palm trunks (OPT) is significantly underutilized, leading to environmental and economic challenges. Traditional drying methods like air-drying and kiln-drying are inefficient and time-consuming, causing material loss and production issues. These methods fail to address OPW's high moisture content and density variations, resulting in defects like warping, cracking, and cell collapse during drying, which reduce the recovery of usable material. An innovative drying technique is urgently needed to efficiently remove moisture from OPW while maintaining its structural integrity. This research proposes organic solvents as a promising alternative for moisture extraction, potentially reducing drying defects and enhancing OPW's physical and mechanical properties. The methodology involved treating OPW samples with ethanol, acetone, and toluene through a 24-hour soaking process, followed by oven drying at 80°C until constant moisture content was achieved. The study evaluated the physical properties, including volumetric shrinkage, moisture content, and density, as well as the mechanical properties compressive, bending, shear, and tensile strength of both treated and untreated OPW samples. These assessments followed British Standard BS ISO 13061 and ASTM standards. Results showed ethanol as the most effective in moisture reduction, achieving reductions of 38.09% in the outer layer and 60.57% in the inner layer. However, ethanol-treated samples showed reduced mechanical properties, indicating a trade-off between moisture reduction and structural integrity. Acetone-treated samples, though less efficient in moisture extraction, maintained superior mechanical properties, with a 9.23% reduction in inner layer moisture content and minimal impact on strength. Toluene provided intermediate results in both moisture reduction and mechanical properties. The findings suggest that acetone offers a balanced approach for drying OPW, effectively reducing moisture content while preserving structural integrity. This study concludes that organic solvents, especially acetone, present a viable alternative to conventional drying methods for OPW, offering potential solutions for the industry to enhance drying efficiency and material quality.

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CHAPTER 1
INTRODUCTION

1.1 Research Background

Malaysia is one of the largest producers of oil palm. Oil palm has become a staple crop in Malaysia after 25 to 30 years of crop maturity and planting of new trees (Tshovrebov, Velichko, Niyazgulov, & Sadchikova, 2019) is being cultivated on over 5.81 million hectares or about 65% of the country's agricultural land (Husin, Amar, Bakar Sajak, & Sallehin Mohd Kassim, 2021). Thus, the three main parts of the oil palm affected during replanting are the trunk, front and empty benches, with an average annual yield of cubic metres of 15 million in the oil palm trunk (OPT) (Ching, Yaman, Khoon, Hong, & Melayong, 2019)

In this thesis, oil palm wood (OPW) derived from the oil palm trunk (OPT) was investigated as a viable alternative to conventional wood. With approximately 0.14 million hectares of oil palm trees being replanted, the management of felled OPTs poses a significant challenge due to the high costs associated with their disposal. Moreover, improper handling of these trunks can impede replanting efforts and increase the risk of new seedlings being exposed to infestations by harmful insects and diseases. (Ching et al., 2019). Therefore, the OPT must be considered to reduce the issues by turning it into something more practical, such as forth oil palm wood (OPW) for low-cost applications such as wood panels, wood composites, furniture and more. Most of the felled trees are available for replanting, but unfortunately, there is a significant waste of biomass.

Many scientists and lumber corporations worldwide are concerned about the drying of wood in general, applicable to oil palm wood and other hard and soft wood (Haslett, 1990; Kueon, 2008; Rais et al., 2021). Freshly cut oil palm trunks (OPT) contain substantial amounts of water, but if used in their dry state, they will undergo significant moisture loss. Nowadays, scientists focus on faster, cheaper, and more effective drying methods for OPW (I. ul H. Bhat, Abdul Khalil, Awang, Bakare, & Issam, 2010; Burridge et al., 2021). Through traditional methods, it takes weeks or months for air-drying, kiln-drying, or oven-drying, and it is costly. It must be conducted carefully according to the timber species, dimensions, potential values, and prospective users. Although many methods of drying timber have been tried over the years, only a