

Research Article

Investigation of the Acoustic Properties of Chemically Impregnated Kayu Malam Wood Used for Musical Instrument

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The chemical modification or impregnation through preparing the wood polymer composites (WPCs) can effectively reduce the hygroscopicity as well as can improve the acoustic properties of wood. On the other hand, a small amount of nanoclay into the chemical mixture can further improve the different properties of the WPCs through the preparation of wood polymer nanocomposites (WPNCs). Kayu Malam wood species with styrene (St), vinyl acetate (VA), and montmorillonite (MMT) nanoclay were used for the preparation of WPNCs. The acoustic properties such as specific dynamic Young's modulus (E_{sd}/γ), internal friction (Q^{-1}), and acoustic conversion efficiency (ACE) of wood were examined using free-free flexural vibration. It was observed that the chemically impregnated wood composite showed a higher value of E_{sd}/γ than raw wood and the nanoclay-loaded wood nanocomposite showed the highest value. The reverse trend was observed in the case of Q^{-1} . On the other hand, chemical impregnation has a minor effect on ACE of wood for musical instruments. The results suggested that the chemically impregnated Kayu Malam wood polymer nanocomposite (WPNC) is suitable for making soundboards of violin and guitar instruments to be played longer without losing tone quality.

1. Introduction

Currently, some selected traditional wood species have been selected for musical instruments by the musical instrument maker. Individual musical instruments require different acoustic properties for their optimal sound for soundboards, xylophone bars, and violin bows. The hygroscopic nature of wood affects the tone quality of wooden musical instruments. Spruce, rosewood, teak, and ebony are commonly used species due to their tight and uniform grain and high content of waxes/oils/resins that reduces the rate of moisture sorption [1]. The high-quality wood are getting harder to find and even more expensive. The musical instrument industry has looked for more available and less expensive wood species but continued to prefer the traditional ones. Although there are a lot of tropical wood species available in Malaysia, very few species such as *Intsia palembanica* (Merbau), *Artocarpus champeden spreng* (Cempedak),

Dialium species, and *Agathis borneensis* have been used for manufacturing traditional musical instrument such as sapeh, gendang, rebana, beduk, and tar [2, 3]. However the Kayu Malam wood species has not been selected by researchers for any musical purposes. Thus, in this research, the Kayu Malam wood collected from Sarawak, Malaysia, was selected to determine the acoustic properties for making musical instruments, and research is conducted dominantly based on trial and/or experience of manufacturer.

On the other hand, the hygroscopic nature of wood affects the tone quality of wooden musical instruments because as the moisture content increases, the acoustic properties of wood, such as the specific dynamic Young's modulus and internal friction (Q^{-1}), are reduced or dulled [4, 5]. In order to improve or stabilize the acoustic properties, varnish can be applied to the wooden parts or wood can be modified using chemical agents. It had been seen that