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# Acoustical, thermal, and morphological properties of zein reinforced oil palm empty fruit bunch fiber bio-composites

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ABSTRACT: In this research, biodegradable composites were prepared with zein as a polymer matrix and oil palm empty fruit bunch (OPEFB) as fiber reinforcement. The fibers were treated with sodium hydroxide (NaOH). The effects of sodium hydroxide treatment on sound absorption, thermal stability, and fiber-polymer matrix interaction in composites were examined. The acoustical sound absorption coefficients of the composites were evaluated using two-microphone transfer function impedance tube method. The spectral, thermal, and morphological studies of the composites were analyzed and characterized using scanning electron microscope (SEM), thermogravimetric analysis (TGA), and Fourier transform infrared (FTIR) spectroscopy. It was found that in all the biodegradable composites, the sound absorption coefficients increased as the frequency increased. Increases in fiber loading caused sound absorption coefficients of the composites to increase. The sodium hydroxide treatment showed a better interface adhesion on fiber and zein matrix. It was also found that this treatment increased the sound absorption coefficients. This was supported by qualitative analysis on the SEM micrographs and FTIR spectrum. © 2016 Wiley Periodicals, Inc. J. Appl. Polym. Sci. 2016, 133, 44164.

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## INTRODUCTION

Applying sound absorbing materials as acoustic absorbers is a known technique for sound proofing. A wide range of sound absorbing materials exist, their sound absorption properties are dependent upon the frequency, composition, thickness, surface refinement, mounting method, and design. Acoustic panels are usually made from synthetic fibers, which are quite expensive for trivial needs. Besides that, it is hazardous to human health and the environment as well. Thus, some researchers showed keen involvement in putting diligent efforts to create alternative sound absorber from recycled fabrics, such as textile, foam, rubber, or plastic.[1] Commercially available sound absorption materials, which are used for dealing with acoustic sound absorption, are usually made from glass or mineral fiber materials. Wang and Torng[2] had investigated some fibrous porous materials made from rock wool and glass. They showed that the rock wool sound absorption characteristic is comparable to those of glass fiber. However, by considering the health and safety aspect, these types of synthetic fibers can harmfully affected living life and the environment. Thus, this cause an increase in the exploration on the use of organic materials and opportunity to look for substitute materials made from organic fibers, especially those extracted from agricultural plant waste to be used as sound absorption materials. Organic fiber materials fabricated or used for sound absorber had various benefits, such as renewable, non-abrasive, cheaper, abundance, harmful, and safety. Various researchers[3,4] have succeeded in developing particle composite boards using agricultural wastes. Moreover, Yang et al.[5] managed to produce urea formaldehyde reinforced rice straw–wood particle composites as insulation boards. An oil palm agricultural industry generated huge quantities of oil palm biomass or fiber waste such as oil palm frond (OPF), oil palm empty fruit bunch (OPEFB),, and oil palm trunk (OPT). The OPT and OPF usually obtained from oil palm agricultural plantation, while the OPEFB obtained from oil palm processing industrial plant.[6] Researchers specified a large amount of oil palm residues harvested plant can be utilized byproducts, and it used to reduce environmental hazards.[7] In examples, OPEFB fibers depicted a great potential in use as a reinforcing material in a polymer matrix. Malaysia and its surrounding South East Asian countries were also known to generate a large amount of OPEFB fiber as waste. In some countries, these wastes were