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RESEARCH ARTICLE

Physico-mechanical and morphological properties of rice husk-coconut husk fiber reinforced epoxy composites

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Abstract

In the recent years, many researches focus on "waste to wealth" concept, where agro-waste is converted into various valuable products especially on natural fiber polymeric composites. Selected fibers for this research were rice husk (RH) and coconut husk (CH). This research focused on the property enhancement of RH-CH fiber reinforced epoxy composites and comparison RH reinforced epoxy composites, CH reinforced epoxy composites, and RH-CH reinforced epoxy composites. RH-CH reinforced epoxy composites were well-fabricated by mixing epoxy resin and different ratios of two types natural fibers via compression molding and stir casting methods. All the fabricated RH-CH reinforced epoxy composites were characterized using Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), Vickers Hardness Test (VHT), and tensile test (TT). FTIR results showed that 10wt% RH-CH reinforced epoxy composites created the strongest covalent bonding between cellulose inside RH-CH fiber and epoxide group compared to RH reinforced epoxy composites and CH reinforced epoxy composites. The combination of RH and CH fiber with the introduction of epoxy resin reduced the hydroxyl groups compared to either RH or CH fiber composites, respectively. This proved that mixture of RH and CH with epoxy matrix improved the properties of pure RH and CH and thus, better composites were fabricated. SEM images of 10wt% RH-CH reinforced epoxy composites showed better dispersion of RH-CH fiber within polymer matrix compared to RH reinforced epoxy composites and CH reinforced epoxy composites under the magnification of 2000. Both RH reinforced epoxy composites and CH reinforced epoxy composites showed porosity within the matrix. VHT showed that 10wt% RH-CH reinforced epoxy composites showed the smallest indentation value compared to RH reinforced epoxy composites and CH reinforced epoxy composites due to the highest interfacial adhesion between matrix and filler, which was proven by the SEM images. Tensile test of 10wt% RH-CH reinforced epoxy composites showed the highest tensile modulus with value of 2.6MPa. RH-CH reinforced epoxy composites showed higher tensile strength and modulus compared to RH and CH reinforced epoxy composites. Overall, it could be concluded that 10wt% RH-CH reinforced epoxy composites performed the best in terms of physical, mechanical, and morphological perspective than RH reinforced epoxy composites and CH reinforced epoxy composites. This proved that RH and CH could be well-introduced as reinforcing filler in epoxy matrix to fabricate better composites for structural application.

Keywords: rice husk, coconut shell, stir casting method, FTIR, SEM, VHT, TT

INTRODUCTION

Renewable energy such as biomass is currently not adequately utilized to replace the non-renewable sources [1]. The depletion of natural resources results on the urgency to exploit clean renewable energy to reduce the bad impacts on the environment. The advantages of renewable energy are numerous such as maintainable, clean, and do not pollute the environment [2]. One of the promising sources of renewable energy is biomass as it can be found extensively in both developing and developed countries. In general, biomass can be defined as the organic matter derived from living organisms such as human, plant, and animal [3]. Agriculture wastes from harvesting or processing are biomass that can be transformed into different vast array of valuable products. This waste should be utilized due to its low cost, reproducible, decomposable, easy to be accessed from various sources, and environmental-friendly [4]. Agriculture waste can be found abundantly in Asia including rice producing industry. One of biomass resources, rice plantations, has recently developed consecutively under high demand as essential food resources in several countries, especially across Asia [5]. It has been reported that 90% of the world's rice is consumed and produced in Asia where China and India are the largest Asian producers [6]. The research stated that half of the world production and consumption in 2011 dominated by China and India. From this large-scale production, the waste from rice plantation consisting of rice straw and husk is about 1,370,000 million t per year [5].

Rice husk (RH) is a by-product from rice industry which is produced during the earliest stage of rice milling and is commonly burnt or dumped as waste [7]. The burning of RH results in air pollution and damage to land and surrounding area where it is discarded. Extensive