Minimizing Alkali Usage Through Ultrasound Treatment of Oil Palm Empty Fruit Bunch (OPEFB) Fiber Reinforced Poly(Lactic) Acid Composites

John Olabode Akindyoy, Mohammad Dalour Hossen Beg*, Suriati Binti Ghazali, Muhammad Remanul Islam
Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang
Lebuhraya Tun Razak, Gambang 26300, Kuantan, Malaysia.
blessebode@ymail.com; dhbeg@yahoo.com*; suriati@ump.edu.my; remanraju@yahoo.com.
*Correspondence: M.D.H. Beg, email: dhbeg@yahoo.com; Phone: +6019504590; Fax: +6095492816)

Abstract -Removal of the non-cellulosic components of natural fibers with minimum damage to the fibers had been one of the challenges to natural fiber reinforced polymer composites. Alkali treatment had been one of the very efficient means of fiber treatment. However, environmental concerns make it expedient to always reduce the concentration of alkali for any fiber treatment as much as possible. In this study, ultrasonic treatment in an alkali medium of low concentration was used to modify the surface of oil palm empty fruit bunch (OPEFB) fibers. Surface morphology of fibers due to treatment was studied by scanning electron microscopy (SEM) while its structural changes were studied by Fourier transforms infrared spectroscopy (FTIR) and X-ray diffraction (XRD). Composites were prepared from oil palm empty fruit bunch fiber and poly(lactic) acid (PLA) through extrusion followed by injection moulding. Composite characterization was done by mechanical testing such as tensile, flexural and impact, structural analysis was done by XRD and thermogravimetric analysis (TGA) was also to investigate composite thermal stability. Result showed that the treatment of OPEFB fibers with ultrasound produced composites with highly desirable properties.

Keywords: Ultrasound; oil palm empty fruit bunch fiber; composites; interfacial adhesion

1. Introduction
The use of cellulose natural fibers in more sophisticated forms like in composite fabrication had recently gained increased attention. This is especially because they can function as readily available, cheap, environmentally friendly and renewable alternatives to synthetic and non-renewable fibers in composites (Zhou et al., 2011). Natural fiber reinforced thermoplastic composites are also experiencing enormous growth based on their many desirable properties which include reasonable stiffness and strength, reduced abrasiveness and light weight. Preference to natural fiber in composites bores down mainly to its nontoxic, combustible, renewable, light weight, nonabrasive and biodegradable properties (Islam, Beg, Gupta, & Mina, 2013; Moshuil Alam, Beg, Reddy Prasad, Khan, & Mina, 2012). However, natural fiber reinforced polymer composites often present composites with weak interface as a result of the poor interfacial interaction between surfaces of the hydrophilic fibers and the hydrophobic polymer matrices. But chemical and physical treatments can effectively modify the surface of the fibers by cleaning the surface as well as increase its surface roughness (Huda, Drzal, Mohanty, & Misra, 2008; Mohanty, Verma, Nayak, & Tripathy, 2004; Peterson, Kvien, & Oksman, 2007).

Treatment of fibers would either activate the hydroxyl groups of the fiber cellulose, or incorporate new functional groups to the fiber surface which can effectively bond with the matrix (Khalid, Salmiaton, Chua, Ratnam, & Choong, 2008). Treatment of fibers had led to fabrication of property enhanced composites from natural fibers like kenaf, bamboo, jute, ramie, flax, coir, wood and oil palm fibers. It was noted however that most of the conventional fiber treatment methods like mercerization, acetylation, coupling agents, acrylation and peroxide treatment often make use of organic solvents. This therefore led to the release of hazardous substances into the environment (Zhou et al., 2011).