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I-CReST 2025: 108-071– Acetate-Based Ionic Liquids as Solvents for Pretreatment of Lignocellulosic Biomass from Oil Palm Empty Fruit Bunch

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ABSTRACT

This study investigates the role of ionic liquids (ILs) in the pretreatment of lignocellulosic biomass, focusing on oil palm empty fruit bunches (OPEFB), a promising feedstock for industrial and bioenergy applications due to its high lignin, cellulose, and hemicellulose content. Ionic liquids such as triethylammonium acetate (TEAA) and diethylammonium acetate (DEAA) were selected for their unique properties, including low volatility, wide liquid range, and strong solvation ability, making them effective solvents for biomass decomposition. The synthesis and characterization of TEAA and DEAA were confirmed using thermogravimetric analysis (TGA), nuclear magnetic resonance (NMR), and fourier-transform infrared spectroscopy (FTIR). Pretreatment experiments conducted at 30°C, 80°C, and 130°C revealed significant changes in the composition, crystallinity, and morphology of OPEFB. The highest percentage of breakdown for TEAA and DEAA were recorded over five hours at 130°C, which may indicate the most effective method of lignin removal. When all of these factors are considered, it is clear that higher temperature and greater duration lead to more successful breakdown of the lignocellulose from OPEFB. FTIR and X-ray diffraction (XRD) analyses demonstrated alterations in chemical structure and reduced crystallinity, while field emission scanning electron microscopy (FESEM) showed increased porosity and surface roughness in the treated samples. The FTIR spectra shows transmittance between treated and raw oil palm empty fruit bunch (OPEFB) samples. These findings highlight the potential of TEAA and DEAA as effective pretreatment solvents to enhance the structural accessibility of OPEFB for downstream bioenergy conversion processes.

Keywords: Ionic Liquids (ILs); Pretreatment; Oil Palm Empty Fruit Bunch (OPEFB); Triethylammonium Acetate (TEAA); Diethylammonium Acetate (DEAA)