Extraction and Esterification of Fatty and Resin Acids from Tall Oil Soap: a co-product of Pulp and Paper mills

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The process of converting pulp mills into biorefineries has led to the creation of a wide range of bioproducts. This is achieved by upgrading the waste and by-products of the Kraft process. In the specific case of the softwood Kraft pulping process, fatty and resin acids (extractives) react with the white black liquor and are saponified, resulting in the production of Tall Oil Soap (TOS). From TOS, we can extract Crude Tall Oil (CTO). In this study, CTO was extracted using standard methods, resulting in residual lignin and an aqueous fraction as co-products. Subsequently, esterification reactions were conducted using microstructured acid catalysts (Beta Zeolites) with different Si/Al ratios to produce biodiesel. TOS and CTO were analyzed for viscosity, density, and elemental content. They were also characterized using various techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), thermogravimetry (TG), and differential scanning calorimetry (DSC). The XRD results of dry TOS revealed the presence of crystalline sodium salts, including sodium oleate and linoleate. EDS analysis of dry TOS showed high levels of Ca, Na, O, and C, as well as trace amounts of K, S, Cl, and Si. SEM images displayed non-uniform particles dispersed on the sample holder. TG analysis indicated that TOS starts to lose mass at 100 °C and the loss is gradual up to 546 °C, with the maximum rate at 500 °C. DSC results showed exothermic and endothermic events at 85 °C and 150 °C, respectively. Finally, the use of Beta zeolites was found to be effective in converting CTO into biodiesel and potentially other renewable fuels.

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