# Technoeconomic analysis of bioethanol production from rice straw

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Bio-diesel production from waste cooking oil offers a sustainable solution to waste management and energy challenges. This research focuses on the esterification process, a crucial step in bio-diesel production, to reduce the free fatty acid (FFA) content in waste cooking oil before transesterification. The study presents a kinetic model for esterification, accommodating different FFAs, including oleic acid, linoleic acid, and palmitic acid. The model was developed using Aspen Plus software, considering key factors like alcohol type, alcohol-to-oil ratio, reaction temperature, catalyst type, and the amount of catalyst. Sensitivity analysis was conducted to optimize process parameters, aiming for high bio-diesel yield and low unreacted FFA content. The investigation primarily centered on determining the optimum reaction time while ensuring efficient reduction of unreacted free fatty acid level to facilitate the separation process. To achieve this, the unreacted free fatty acid content was targeted to be reduced to 2.5 wt%, a level chosen to streamline the subsequent separation steps. The research demonstrates that a reaction time of 90 minutes leads to a FAME yield of approximately 97% while the unreacted free fatty acid level is maintained below 2.5% (from an initial level of 10%), thereby presenting a promising pathway to improve the overall efficiency of FAME production. This research contributes to enhancing bio-diesel production efficiency and fostering a greener energy system by utilizing waste cooking oil as a renewable resource for sustainable bio-fuel production.

**Keywords:** Bioethanol, rice straw, economic analysis, select criteria, process selection