

Catalytic Valorization of Oil Palm Biomass for Sustainable Bioenergy Production

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The growing demand for renewable energy has driven interest in the catalytic conversion of biomass into clean fuels. Malaysia, being one of the world's largest palm oil producers, generates vast quantities of oil palm biomass waste, including empty fruit bunches (EFB), palm kernel shells (PKS), oil palm fronds (OPF), trunks, and palm oil mill effluent (POME). This biomass offers an abundant and renewable feedstock for sustainable bioenergy production. This study focuses on the catalytic valorization of oil palm biomass through thermochemical and biochemical conversion pathways, with emphasis on advanced catalytic systems that enhance conversion efficiency and selectivity. Particular attention is given to heterogeneous catalysts used in processes such as catalytic pyrolysis, gasification, and transesterification. The role of catalyst type, composition, and physicochemical properties in determining product yield and quality is analyzed. The integration of waste-to-energy technology within the palm oil industry is also explored as a means to promote a circular economy and reduce carbon emissions. Overall, the study highlights the potential of catalytic processes in transforming oil palm waste into valuable biofuels and contributing to national and global renewable energy targets.