# BIODIESEL PRODUCTION FROM WASTE COOKING OIL UTILIIZING $Cu/Ca/Al_2O_3$ CATALYST

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## ABSTRACT

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Currently, biodiesel has been successfully yielded by transesterification of waste cooking oil (WCO) by using heterogeneous basic catalysts dissolved in methanol. The transesterification of waste cooking oil involves some challenges. For example, waste cooking oil usually contains a large amount of free fatty acids (FFAs), which could react with base catalyst to form soap, resulting in a decrease in percentage of biodiesel yield. So, this study focused on the synthesis, optimization and characterization of base heterogeneous catalyst, bimetallic $Cu/Ca/Al_2O_3$ with different parameters to test their effectiveness towards biodiesel production using WCO. The physicochemical properties of the catalyst were determined by TGA, FTIR, XRD and BET. The activity of the catalyst in transesterification reaction was evaluated at reaction temperature of 65°C, 3 h reaction time and 12:1 M ratio of methanol to oil. The investigation of the synthesized $Cu/Ca/Al_2O_3$ catalyst showed that the calcination temperature of 800, 900 and 1000°C, catalyst loading of 3, 4 and 5 wt.% as well as reaction time of 3, 4 and 5 hours have significant effects on the catalytic performance. These critical parameters were investigated in order to determine the optimum operating conditions for biodiesel production. The optimum conditions were 900°C calcination temperature, 3 wt.% catalyst loading and 3 hours reaction time which gave 10.9% biodiesel yield. Due to very low biodiesel yield, the study was continued with two steps reaction (esterification-transesterification). This two-step process could lower the content of FFAs in waste cooking oil in the first step and also improve conversion of transesterification in the second step. The acid value of treated waste cooking oil was successfully reduced from 5.16 mg KOH/g to 3.63 mg KOH/g by using acidic catalysed esterification reaction with sulfuric acid as catalyst, methanol to oil ratio of 12:1 and reaction time of 1 hour at 65°C. The combination of these processes gave higher biodiesel yield (36.16%) under the optimum conditions. The biodiesel synthesized was analysed using FTIR and GCMS to confirm the present of FAME.

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