Photocatalytic biodiesel production from feedstocks with high fatty acid content

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Biodiesel was produced by TiO_2-photocatalysis via simultaneous esterification and transesterification. Using a feedstock with high content of free fatty acid (89% triglycerides and 11% free fatty acid) and methanol high conversions of 89% ±1.24 were obtained under optimized conditions (1mol feedstock:55mols MeOH, 20% TiO_2 $w/w_{feedstock}$, 65°C, batch reactor, 4 hours, UVA light). The recovered photocatalyst was reused and a conversion of 59% was achieved after 5 cycles. The kinetic data was adapted to a mathematical model which considered pseudo-first forward and second-order backward reactions. The predicted data showed high accuracy (R^2 of 0.996, Matlab®). The thermodynamic properties indicate that the endothermic reaction is irreversible, but feasible only at temperatures higher than 65°C. This study demonstrates that heterogeneous photocatalysis can be efficiently applied to biodiesel production [1]. The developed procedure overcomes some of the challenges frequently found in the traditional thermal process using strong acids and bases. It avoids elevated temperatures, extreme pH ranges, unfavourable catalyst conditions (removal, reuse) or low product purity, respectively.

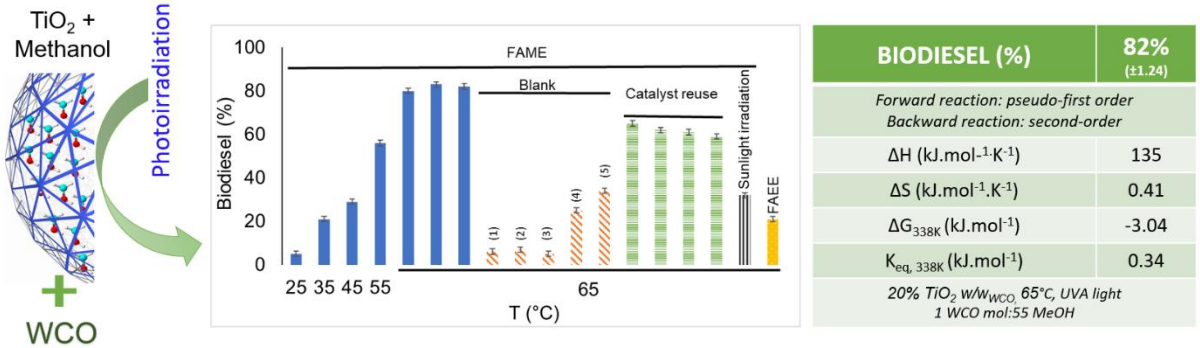

Figure 1. Biodiesel production of waste cooking oil (WCO) using TiO_2-photocatalysis [FAME: fatty acid methyl ester; FAEE: fatty acid ethyl ester; Blanks: (1) absence of TiO_2, (2) absence of irradiation, (3) absence of TiO_2 and irradiation, (4) absence of stirring and (5) absence of TiO_2 pretreatment].

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