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# Continuous Reactive Coupling of Glycerol and Acetone – a Strategy for Triglyceride Transesterification and In-situ Valorisation of Glycerol by-product

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## Abstract

Methyl esters of fatty acids are widely used as biodiesel, a sustainable replacement for petro-diesel. The conventional biodiesel process produces crude glycerol, which constitutes about 10wt% of the total products. This has led to a surplus of crude glycerol due to global increase in biodiesel use, necessitating increased research into sustainable processes that could convert the crude glycerol into higher value-added products. This study investigates biodiesel processes for continuous transesterification of triglycerides to methyl esters, coupled to conversion of the glycerol by-product into solketal, a value-added product, via reaction with acetone in situ. The study was carried out using one-stage and two-stage catalytic transesterification of triacetin and methanol in mesoscale oscillatory baffled reactors (meso-OBRs). The two-stage process involved two meso-OBRs in series packed with Amberlyst$^{TM}$ resin catalysts: a basic Amberlyst$^{TM}$ A26-OH in the first stage to catalyse transesterfication of triacetin with methanol, and an acidic Amberlyst$^{TM}$ 70-$SO_3H$ in the second stage to catalyse the coupling of glycerol and acetone to form solketal. One-stage triacetin transesterification and glycerol coupling with acetone was carried out in a meso-OBR packed with the acidic Amberlyst$^{TM}$ 70-$SO_3H$ resin. In the two-stage process, the triacetin was converted to 99.1±2.0% methyl acetate and 98.0±1.3% glycerol after 25min residence time in the first reactor and the glycerol was reacted with acetone in the second reactor to achieve 76.5±2.8% solketal conversions after 35min. The single-stage process achieved 48.5±2.7% solketal conversion after 30min. The meso-OBR was operated continuously to achieve high quality steady states and consistent triacetin conversions. The triglyceride transesterification with reactive coupling of