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Encapsulated deep eutectic solvent for esterification of free fatty acid

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Abstract

A novel encapsulated deep eutectic solvent (DES) was introduced for biodiesel production via a two-step process. The DES was encapsulated in medical capsules and were used to reduce the free fatty acid (FFA) content of acidic crude palm oil (ACPO) to the minimum acceptable level (< 1%). The DES was synthesized from methyltriphenylphosphonium bromide (MTPB) and p-toluenesulfonic acid (PTSA). The effects pertaining to different operating conditions such as capsule dosage, reaction time, molar ratio, and reaction temperature were optimized. The FFA content of ACPO was reduced from existing 9.61% to less than 1% under optimum operating conditions. This indicated that encapsulated MTPB-DES performed high catalytic activity in FFA esterification reaction and showed considerable activity even after four consecutive recycling runs. The produced biodiesel after acid esterification and alkaline transesterification met the EN14214 international biodiesel standard specifications. To our best knowledge, this is the first study to introduce an acidic catalyst in capsule form. This method presents a new route for the safe storage of new materials to be used for biofuel production. Conductor-like screening model for real solvents (COSMO-RS) representation of the DES using σ-profile and

σ-potential graphs indicated that MTPB and PTSA is a compatible combination due to the balanced presence and affinity towards hydrogen bond donor and hydrogen bond acceptor in each constituent.

Author keywords

Biodiesel; Encapsulated chemicals deep eutectic solvent; Esterification; Methyltriphenylphosphonium bromide; p-Toluenesulfonic acid monohydrate

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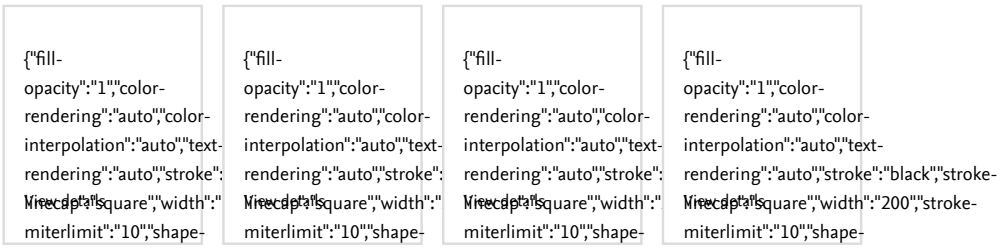

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