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Biofuel production via thermal cracking of castor methyl ester

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Diminishing oil reserves, deteriorating health standards because of greenhouse gas emissions and associated environmental impacts have emerged biofuel production. Vegetable oils are proved to be valuable feedstock in these growing industries as they are renewable and potentially inexhaustible sources. Thermal cracking of vegetable oils (triglycerides) leads to production of biofuels which are similar to fossil fuels in terms of composition but their combustion and physical properties have limits. Acrolein (very poisonous gas) and water production during cracking of triglycerides occurs because of presence of glycerin in their molecular structure. Transesterification of vegetable oil is a method to extract glycerol from triglycerides structure and produce methyl ester. In this study, castor methyl ester was used for thermal cracking in order to survey the efficiency of this method to produce bio-gasoline and bio-diesel. Thus, several experiments were designed by means of central composite method. Statistical studies showed that two reaction parameters, namely cracking temperature and feed flow rate affect products yield significantly. At the optimized conditions (480 °C and 29 g/h) for maximum bio-gasoline production, 88.6% bio-oil was achieved which was distilled and separated as bio-gasoline (28%) and bio-diesel (48.2%). Bio-gasoline exposed a high octane number and combustion heat. Distillation curve and Reid vapor pressure of bio-gasoline fell in the criteria of standard gasoline (class AA) by ASTM D4814. Bio-diesel was compatible with standard diesel by ASTM D975. Water production was negligible and no evidence of acrolein production was distinguished. Therefore, thermal cracking of castor methyl ester could be used as a method to produce valuable biofuels.

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