The new mathematical model approaches in biodiesel optimization

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Abstract

Post-pandemic inflationist pressures, climate changes and extremes, regional conflicts, and soaring food prices caused the food crisis to increase rapidly worldwide. This global problem directs producers and researchers to use oils used as feedstock in biodiesel production effectively. In this context, it is important to assay the transesterification parameters and conduct new optimization studies to increase biodiesel yield. In this study, methyl ester was produced from hemp oil by transesterification using sodium hydroxide (NaOH). Next, classical optimization study was carried out to determine the effects of catalyst amount, alcohol:oil molar ratio, reaction temperature, and reaction time variables on biodiesel yield. Secondly, the cubic spline mathematical model (CSMM) and polynomial regression mathematical model (PRMM) was applied to the first data of this optimization. Among these optimization methods, the utmost biodiesel yield registered was 96.115% at hemp seed oil (HSO): methanol molar ratio of 5.59:1, catalyst concentration of 0.531 wt%, reaction temperature of 42.5 °C, reaction time of 62.1 min, and agitation intensity of 600 rpm at PRMM. Some vital fuel properties obtained from HSO biodiesels as a result of three optimizations satisfied the EN 14214 standard. The results illustrated that the optimal yields from CSMM and PRMM are 0.765% and 1.065% higher, respectively, according to the maximum efficiency obtained from the classical optimization. The outcomes showed that CSMM and PRMM are cost-effective, easy to handle and promising new approaches.

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