Determination of biodiesel purity through feature mapping to the multi-dimensional space by the LS-SVM approach

Published: 13 March 2021
Volume 145, pages 1739–1750, (2021) Cite this article

Journal of Thermal Analysis and Calorimetry

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Abstract

Purity is one of the essential properties of biodiesel. Since the purity parameter depends on different operating conditions, its direct measurement is too hard and can only be obtained for specific ranges of conditions. Therefore, this work considers the least-squares support vector machines (LS-SVMs) that transform operating conditions to a multi-dimensional space to simulate biodiesel purity in wide ranges of operating conditions. Indeed, we develop a reliable LS-SVM approach for modeling the biodiesel purity as a function of catalyst type and its concentration, reaction time, temperature, methanol-to-oil volume ratio, frequency, and amplitude of ultrasonic waves. The designed LS-SVM's predictive performance is compared with four available artificial intelligence (AI) techniques in reliable literature. The obtained results confirm that the LS-SVM paradigm outperforms other considered AI-based techniques regarding five different statistical criteria. Our LS-SVM model provides AARD = 2.2%, RMSE = 3.46, and R^2 = 0.9868 for the prediction of 267 experimental data points, which includes 267 data points. This model is finally employed for investigating the effect of different influential variables on biodiesel purity.