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Abstract

The Effect of Micromixer Geometry on the Diameters of Emulsion Droplets: NIR Spectroscopy and Artificial Neural Networks Modeling †

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Abstract: In this work, teardrop micromixer and swirl micromixer were used for preparation of oil-in-water (O/W) emulsions with Tween 20 and PEG 2000 as emulsifiers (concentrations: 2% and 4%) at different total flow rates (20–280 μL/min). Stability of the prepared O/W emulsions was evaluated based on the droplet size of the dispersed phase. For determination of the droplet size, the average Feret diameter was used. Furthermore, near infrared (NIR) spectra of all prepared samples were collected. Obtained results showed that the change in the droplet size followed the same trend for both micromixers used in the experiment. At higher total flow rates, emulsification resulted in smaller values of the average Feret diameter. Values of the average Feret diameter were higher for emulsions prepared in the swirl micromixer, compared to the teardrop micromixer. Artificial Neural Network (ANNs) models, based on the recorded NIR spectra of emulsions, were developed to predict the droplet size of the dispersed phase. The obtained ANN models have high values of R^2 for training, test, and validation, with small error values and show that NIR spectroscopy, in combination with ANNs, could be efficiently used for evaluation of the stability of oil-in-water emulsions.

Keywords: micromixer geometry; average feret diameter; oil in water emulsions; artificial neural network models; NIR spectra

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