Online Monitoring of Oils in Wastewater Using Ultraviolet Fluorescence and Light Scattering with an Artificial Neural Network

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Ultraviolet fluorescence and light scattering are two analytical methods commonly used in instrumentation for online measurement of oils in water. A major technical challenge for each of these methods is to maintain quantitative accuracy in the presence of chemical and physical interferences such as detergents and salts. To address this issue we have been developing a new monitoring system that combines ultraviolet fluorescence and light scattering spectroscopy. Four major types of oils (lube oils 2190 and 9250, diesel fuel marine, and JP5), each of which had a dozen subtypes of oil samples, were examined to obtain the intensity of both fluorescence and light scattering as a function of oil, detergent (Mil-D and Tide®), and seawater concentrations. Both fluorescence and scattering intensities varied significantly with oil types and subtypes. Mil-D and Tide greatly impacted the fluorescence and scattering of oil samples.

The tremendous variations in fluorescence and scattering intensity with oil types and subtypes, detergents, and seawater make it difficult to calibrate the analytical instrument using traditional methods; hence we have implemented a multivariate, nonlinear calibration of instrumental response through an artificial neural network. The combined use of fluorescence and scattering data significantly improves

quantitative prediction accuracy. The trained backpropagation neural network has been used successfully to predict the concentrations of single oils and their mixtures, even in the presence of detergents and seawater, and appears well suited for calibrations of an online oil content monitor. The newly developed technique permits the online monitoring of oil spills and the accurate determination of oil concentrations in wastewater discharged from ships and the oil refinery industry.