Temperature Compensation in Determining of Remazol Black B Concentrations Using Plastic Optical Fiber Based Sensor

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Abstract
In this study, the construction and test of tapered plastic optical fiber (POF) sensors, based on an intensity modulation approach are described. Tapered fiber sensors with different diameters of 0.65 mm, 0.45 mm, and 0.35 mm, were used to measure various concentrations of Remazol black B (RBB) dye aqueous solutions at room temperature. The concentrations of the RBB solutions were varied from 0 ppm to 70 ppm. In addition, the effect of varying the temperature of the RBB solution was also investigated. In this case, the output of the sensor was measured at four different temperatures of 27 degrees C, 30 degrees C, 35 degrees C, and 40 degrees C, while its concentration was fixed at 50 ppm and 100 ppm. The experimental results show that the tapered POF with d = 0.45 mm achieves the best performance with a reasonably good sensitivity of 61 x 10⁻⁴ and a linearity of more than 99%. It also maintains a sufficient and stable signal when heat was applied to the solution with a linearity of more than 97%. Since the transmitted intensity is dependent on both the concentration and temperature of the analyte, multiple linear regression analysis was performed to combine the two independent variables into a single equation. The resulting equation was then validated experimentally and the best agreement between the calculated and experimental results was achieved by the sensor with d = 0.45 mm, where the minimum discrepancy is less than 5%. The authors conclude that POF-based sensors are suitable for RBB dye concentration sensing and, with refinement in fabrication, better results could be achieved. Their low fabrication cost, simple configuration, accuracy, and high sensitivity would attract many potential applications in chemical and biological sensing.

Keywords
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