Determining the Rate Law of Crystal Violet and Sodium Hydroxide using Alternative Methods

Shen, Yiting (School: Kambala School)

This report investigates how different concentrations of crystal violet and different concentrations of sodium hydroxide affect the initial rate of reaction for crystal violet hydroxylation, and thus determining the order for each reactant, the rate constant and the overall rate law. The experiment was carried out in several steps. First, a standard solution of CV was prepared. Second, the calibration curve of CV at 591nm was obtained to reduce the possibility of inaccurate measurements. Finally, the order of each reactant was determined. The product of the reaction, CVOH, breaks the conjugation between the aryl groups in CV, so the violet color of the solution of CV and NaOH gradually fades to colorless. Thus, the initial rate of reaction was measured by the intensity of the absorption of light using a spectrophotometer. The absorbance was measured at 591nm, at intervals of 10 seconds from 0 to 100 seconds. By using a pseudo rate constant, the method of initial rates was used to find the order with respect to CV. This was calculated using differentiation to find the tangent equation for the initial rate of reaction, and then the concentration of CV was plotted against the initial rate of reaction. The reaction was 1st order with respect to CV. The method of integrated rate law was used to find the order with respect to NaOH by plotting time against ln[Absorbance]. The reaction was 1st order with respect to NaOH. Thus, the overall rate law was found to be rate = 0.033[CV+][OH-].

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