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A Kinetic Analysis of Bleaching Synthetic Indigo in Solution

Emily Fry

emily.fry@pop.belmont.edu

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Indigo's ability to dye a wide variety of fabric types gives it a prominent place in the textile industry. As a vat dye, indigo must be reduced to leuco-indigo to dissolve in water and dye fabric. It is common practice in the textile industry to bleach indigo-dyed denim to alter the final appearance of the garment. This research aims to determine the kinetic order of this bleaching process, using hydrogen peroxide as a bleaching agent for synthetic indigo. Vat solutions of synthetic indigo were made using fructose as the reducing agent and sodium hydroxide to create a reducing environment. Four indigo solutions of varying concentration were prepared from a synthetic stock solution. UV-Vis spectroscopy was used to measure the absorbance values ($\lambda = 610 \text{ nm}$) of each indigo solution to generate a calibration curve. Hydrogen peroxide solutions of varying concentrations ($4.0 \times 10^{-3} \text{ M} \pm 1.0 \times 10^{-4} \text{ M}$ and $7.0 \times 10^{-3} \text{ M} \pm 1.0 \times 10^{-4} \text{ M}$) were related with a synthetic indigo solution. Changes in absorbance were monitored over time, for systems in which hydrogen peroxide was the limiting reactant and in excess. Graphical analysis determined hydrogen peroxide cannot adequately oxidize indigo on its own.