



**CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY**

Name(s) Shyamal Buch	Project Number J0507
Project Title Half-Life! Spectroscopic Study of the Kinetics of Decontamination Reactions using New Programmable Colorimeter	
Abstract Objectives/Goals This project analyzes chemical reactions of decontamination using spectroscopy to determine kinetic parameters. Synthetic organic dyes are the model contaminants, as they are widely used, often toxic, and resist biodegradation. Objectives: (1) Build a programmable Colorimeter to measure change in concentration, (2) Determine the rate law, reaction order and half-life of the reaction of dyes with hypochlorite. It is hypothesized that the reaction is 1st order in dye and in hypochlorite. Methods/Materials Solutions of known concentration of synthetic dyes in distilled water are prepared using a 200g x 0.01g balance, 1mL/3mL/10mL pipettes, 10mL/25mL/100mL graduated cylinders, and test tubes. A Colorimeter is designed and programmed to take measurements near the dye's wavelength of maximum absorbance. Calibration curves are obtained. The reaction of dye and hypochlorite is begun and temperature noted. The control is a dye solution alone. The method of isolation and method of initial rates are used to find reaction orders for dye and hypochlorite, respectively. Data is mathematically analyzed to find the rate law and half-life. Results Dye solutions were found to follow the Beer-Lambert Law within certain ranges (e.g. Methylene Blue (MB) range extended up to about 7.82×10^{-5} mol/L). Reaction rates were quite slow for some dyes (e.g. for MB, the half-life was 1777 sec. at 24C). Analysis showed a 1st order dependence on concentration of both MB and hypochlorite, which supported the hypothesis. Results for other dyes & reactions are also tabulated. Conclusions/Discussion The Colorimeter was successfully built and tested; it is programmable and extensible. The hypothesis was partially supported; Eosin-Y (EY) data showed interesting anomalies. After further research into its spectroscopic properties, an explanation is proposed. Kinetics is important for industrial productivity and the environment. Applications of decontamination range from wastewater remediation to toxic chemical agent neutralization.	
Summary Statement The rate law and half-life of decontamination reactions are determined using spectroscopic analysis by a colorimeter which I designed and programmed.	
Help Received Thanks to my teacher Mr. Doe for clarifying concepts. Mr. Reinking introduced me to robotics & programming. Dad supervised my experiments & helped with soldering. Mom & Sister took pictures and gave suggestions for board layout.	