CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

S0608

Project Title

Sunlight Assisted Water Remedial: The Photocatalytic Removal of the Toxic Organic Dye Rhodamine B from Wastewater

Abstract

Objectives/Goals

My objective was to understand the role of TiO(2) content, reaction time and temperature on photocatalytic removal of Rhodamine B (RhB). This project could be used to help the environment by creating a more efficient way to decontaminate industrial wastewater.

Methods/Materials

Method: In a specially designed reactor, the pink solution of RhB (7.92 micro M) was mixed with a corresponding amount of TiO(2) and was stirred continuously by a magnetic stir bar. The reactor was equipped to a light source, which resembled sunlight (Solar Simulator). The reaction temperature was controlled by an external water bath, which was circulating water around the reactor. As soon as the target temperature was reached, the light source was turned on. Once the reaction time completed, the power source was turned off. The samples were transferred by a pipette into small vials, which were kept in dark to allow the settlement of TiO(2). The concentrations of the dye in transparent solutions were monitored by UV-VIS absorption spectroscopy. RhB has a large absorbance in visible range (maximum wavelength = 552 nm). According to the Beer-Lambert law the absorbance is directly proportional to the concentration of the absorbing substance. Accordingly, one could relate the recorded absorbance to the concentration of remaining RhB.

Materials: TiO(2), Rhodamine 610 Perchlorate (RhB), MilliQ water, analytical balance, sonicator, para film, UV-VIS spectrophotometer, specially designed reactor, solar simulator, computer (with Microsoft Excel and Overture Spectroscopy), glass pipettes and bulbs, 1.5 mL vials, UV protection goggles, UV-VIS 1cm cells (cuvettes), nitrile gloves, lab-coats, 1 and 2 L volumetric flasks, 100 mL Beakers, Water Bath, magnetic stir bar.

Results

The absorbance decays exponentially over a period of time.

Reaction rate initially increases as a function of TiO(2) content and then remains unchanged.

Absorbance decays faster while the temperature increases.

Conclusions/Discussion

1) Time dependence study: The observation is consistent with a first order chemical reaction.

2) TiO(2) content dependence study: As the amount of TiO(2) increased, absorbance decrease faster until a saturation point. Beyond it, absorbance was not dependent of concentration.

3) Temperature dependence study: As temperature increased, the reaction rate increased.

Summary Statement

The ultimate goal is to find the optimized reaction condition for the photocatalytic removal of Rhodamine B from industrial waste-water.

Help Received

Mr. Daniel Tran an undergraduate research student in Professor Mezyk's lab at CSULB showed me how to work with the solar simulator and the spectrophotometer.