CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

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Project Number
38624

Project Title
Removal of Dye Nanoparticles Using a Natural Coagulant with Electrocoagulation in Series to Remediate Wastewater

Abstract

Objectives/Goals
Dye waste generated by the textile industry is now the second leading pollutant of water worldwide and is expensive to remediate due to its chemical and physical properties. The objective of my study is to examine if pre-treatment with a natural coagulant, Chickpea, can be combined, in series, with a novel process of electrocoagulation to remove dye nanoparticles from wastewater.

Methods/Materials
5 cm x 1.5 cm Aluminum, Iron, and Zinc electrodes, Methylene Blue Dye, Digital Scale, Magnetic Stirrer, 12 V Solar Cell Charger, alligator clips, 400 ml beakers, Glass jars, Funnel, Coffee Filter, 1000 ml Flask, TDS digital meter, UV-Vis Spectrophotometer
1. Measure varying amounts of chickpea (.080, .160, .320 g). 2. Add chickpea powder to 225 ml of dye water and stir for 10 minutes using magnetic stirrer. 3.Slide each electrode (AL, Fe, or ZN) into wood block at desired length (0.8 or 1.5) and place in container of chickpea water. 4.Apply 12 V using solar panel with alligator clips for 20 minutes. Allow for settlement time of an hour. 5.Drain through a coffee filter. 6.Take out samples of filtered water for spectrophotometer and TDS measurement. 7. Set the spectrophotometer to calibrated wavelength. Record the absorbance and transmittance and calculate dye removal efficiency as initial absorbance minus final absorbance divided by initial absorbance.

Results
Although dye removal was possible with natural chickpea coagulation, the highest dye removal efficiency achieved was 33.5% with chickpea concentration of 800 mg/L. Electrocoagulation was a more efficient process than using a natural coagulant. The highest dye removal efficiency was achieved with aluminum anode and distance of 1.5 cm between electrodes and was 82%. The best dye removal process involved using a chickpea powder concentration of 800 mg/L with aluminum anode, distance of 1.5 cm, which resulted in dye removal efficiency of 99.1%.

Conclusions/Discussion
My study using the chemical properties of a natural coagulant as well as ions created from electrocoagulation to attract and coagulate dye nanoparticles, made larger by this process, is novel. The larger size allows for more simple ways, like filtration, to remove this pollutant. Given the efficiency seen in coagulating and removing dye nanoparticles, this new process could be tested in future studies for removing other small pollutants, like microbes (including viruses) from wastewater.

Summary Statement
My study shows that natural substances, like chickpea, can be combined in series with a novel technique, electrocoagulation, to be more effective in removing dye nanoparticles from water than either method alone.

Help Received
I learned basics of Chemistry and electrocoagulation using Khan Academy videos. My dad cut wood blocks to hold my electrodes and supervised when I was using the solar cell and alligator clips.