OFFICIAL ABSTRACT and CERTIFICATION

A Comparison of Photocatalysis and Electrocoagulation for Azo Dye Treatment and the Use of H2 PEM Fuel Cells to Increase Coagulation Efficiency

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Two potential methods for breaking down contaminant azo dyes are photocatalysis (catalysis via light) and electrocoagulation (which uses electrodes to coagulate pollutants and produces hydrogen gas as a byproduct). Our study's purpose was to optimize these processes by testing the effects of pH, TiO2 concentration (the photocatalyst), and initial dye concentration (methyl orange) on photocatalysis over a 24 hour period under UV-B light exposure, and voltage, pH, and dye concentration on electrocoagulation in a 20 minute time span with DC power. In addition, we sought to recapture some of the energy put into the electrocoagulation system by 3D-printing lids to collect H2 gas and directing it to two PEM fuel cells. All data was run in SPSS v. 26 with a post-hoc Scheffe test ($p<0.05$). It was found that fully optimized photocatalysis- pH 9, 0.1 g/L of TiO2, and 50 mg/L of dye, could break down 97.8% of all dye. TiO2 concentration was statistically insignificant while pH and dye concentration parameters were. Electrocoagulation was able to break down over 98% of dye at 5 V, pH 7, and 50 mg/L, but only the data for dye concentration was statistically significant. Lastly, up to 20% of the energy being put into electrocoagulation could be recaptured, doubling our pre-study prediction. While both photocatalysis and electrocoagulation were successful, electrocoagulation was 11.18 times more energy efficient than photocatalysis, and the energy recapture process could have a large effect on the efficiency of electrocoagulation.

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