SOLAR PHOTOCATALYTIC DETOXIFICATION OF INDUSTRIAL WASTEWATER IN TRINIDAD AND TOBAGO

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ABSTRACT

Solar Photocatalytic Detoxification of Industrial Wastewater in Trinidad and Tobago

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This study involved building a thin film fixed bed reactor, with the photocatalyst being immobilized onto the reactor area. Testing was done to determine the most efficient reactor for this region and a semi – empirical model formulated to predict the performance of an optimized photoreactor.

Four materials readily available in Trinidad namely glass, PlexiGlas, concrete and galvanized sheet metal were tested using two different photcatalysts, *Degussa P25* and *Hombikat UV100* each at 5% and 10% and 15% weighting. A simulated pollutant *Dichloroacetic acid (DCA)* was used at concentrations, of 1mmol/L, 3mmol/L and 5mmol/L. The most efficient photoreactor was found to be glass coated with *Hombikat UV100* catalyst at 10% weighting. After establishing the physical parameters of an optimized reactor a semi-empirical model was developed. This model was influenced by mass balance, radiation source and the reaction kinetics of the system. The focus was on the radiation factor in the model as well as the reaction kinetics namely the rate constant as the mass balance has been well established and documented.

From the study, the modeled photonic equation was determined to be:

$$Photonic Efficiency\,(\varsigma) = \frac{k * C_0}{I_{uv,b}\left(1 - 0.10\left(\frac{1}{Cos\,\theta} - 1\right)\right) + 0.5\left(1 - 0.10\left(\frac{1}{Cos\,\theta} - 1\right)\right)\left[I_{uv,d}\left(1 + \cos\lambda\right)\right] + \rho_{uv,gr} I_{uv,h}\left(1 - \cos\lambda\right)}$$

From knowledge of the initial concentration, and a linear rate constant from experimentation and incident light intensity developed from the radiation model, the modeled photonic efficiency equation predicted the photonic efficiency within ± 5 %.

The model was not designed to be used as an instantaneous model but a model where the UV data was expanded to cater for the whole day including the night time period where the UV radiation is zero or almost zero. By broadening the model to include the full twenty four hours of the day it became more applicable when it comes to designing a scale up application.

Keywords: Dale Ramlakhan, Solar Photocatalytic Detoxification, Titanium Dioxide, Wastewater, Photonic Efficiency