DECOLORIZATION OF ACID YELLOW 23 BY PHOTO-ELECTRO-FENTON PROCESS USING USED ALKALINE BATTERIES

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Clinton Brinyang Anak Dris.

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ABSTRACT

DECOLORIZATION OF ACID YELLOW 23 BY PHOTO-ELECTRO-FENTON PROCESS USING USED ALKALINE BATTERIES

Wastewater, a pressing environmental issue worldwide, is exacerbated by substances like azo dyes, such as acid yellow 23, and increasing volumes of electronic waste, including alkaline battery waste. Alkaline batteries contain pollutants like lead, cadmium, and lithium and the use of novel materials in batteries raises environmental safety concerns. Reusing materials from used batteries for wastewater treatment is gaining interest since this can create a closed-loop system, turning e-waste into useful products and reducing the need for new raw materials. Thus, the objective of this study is to determine the removal efficiency of acid yellow 23 when used alkaline batteries are being used as graphite electrodes in photo-electro fenton (PEF) process and subsequently the optimal conditions that can maximize this efficiency. PEF is a fenton reaction variant that uses light to generate hydroxyl radicals (OH·) rather than relying solely on electrochemical methods. In this process, hydrogen peroxide (H_2O_2) and a photosensitizer, which absorbs light and initiates chemical reactions, are added to a solution with the target pollutant. The combination of hydrogen peroxide (H_2O_2), ultraviolet (UV) radiation, and ferrous ion, Fe^{2+} or ferric ion, Fe^{3+} (as oxalate ions) produces more OH· than the traditional fenton method. The results indicated that the system achieved the highest removal rate of 88.2% when the optimum conditions were recorded at the initial concentration of acid yellow 23 was 40 mg/L, the catalyst concentration $[FeSO_4]_0$ was 6 mM, and the applied voltage was 4.5 V. Under this condition, kinetic study of dye removal fitted more with second-order reaction. Hence, the results obtained demonstrate significant improvement when light is introduced as photo-electro fenton in the system.

CHAPTER 1

INTRODUCTION

1.1 Background of study

Wastewater is a critical environmental concern that affects every corner of the globe. Wastewater can be defined as any water that has been affected by human activities, rendering it unsuitable for direct use or consumption. It encompasses many varieties of contaminants, including organic and inorganic substances, chemicals, pathogens, and nutrients. The sources of wastewater are from municipal, industrial, and agricultural activities. Processed wastewater is commonly utilized for non-drinking applications such as agriculture, land maintenance, irrigation, replenishing groundwater, golf course watering, vehicle cleaning, toilet flushing, firefighting, and construction activities. Additionally, it can serve as a cooling agent in thermal power plants (Kesari *et al*., 2021). On a worldwide scale, the utilization of treated wastewater in irrigation contributes to the productivity of agriculture and sustains the livelihoods of numerous small-scale farmers (Sato *et al*., 2013). The global utilization of treated wastewater for agricultural uses displays considerable diversity, spanning from 1.5% to 6.6%. A significant portion, exceeding 10% of the world's population relies on agricultural products cultivated through wastewater irrigation (Ungureanu *et al*., 2020).