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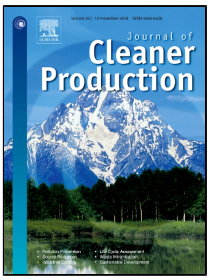

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Energy Intensified Integrated Advanced Oxidation Technology For The Treatment Of Recalcitrant Industrial Wastewater

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Abstract

This work aimed at providing additional information and knowledge on the possibility to overcome the limitation of conventional advanced oxidation processes (AOPs) through hybridization. In the present work, a number of photochemical and non-photochemical AOPs such as direct photolysis (UV), photolysis of hydrogen peroxide using UV light (UV/H_2O_2), UV assisted coagulation (UV-Fe^{2+} coagulation), Fenton process, Fe^{2+} coagulation and photo-Fenton process were compared to determine their feasibility to treat real textile wastewater. The Batik industry, which is a textile cottage industry in Malaysia has reported problems related to safe environmental disposal of its pollutants, mainly dyestuff. The comparison was made in terms of Chemical oxygen demand (COD), Total organic carbon (TOC) and colour removal together with electricity consumption. Among the processes evaluated, the highest COD removal was achieved for photo -Fenton oxidation (91.2 %) , followed by Fenton oxidation (81.4 %) , UV/H_2O_2 (68.0 %), UV- Fe^{2+} coagulation (55.0 %), Fe^{2+} coagulation (43.0 %) and UV photolysis (10.0 %). At the optimal operating conditions (room temperature, undiluted contaminants), the photo-Fenton hybrid process achieved complete decolourization and higher removal of COD (91.2%) and TOC (78.5%) with minimum electrical energy per order of 0.02 kWhr/m^3 compared to other AOPs. About 13% reduction in the total chemical cost and 10% increase in the degradation were observed by combining the Fenton process with UV radiation compared to the conventional Fenton process. The GC/MS analysis revealed that the photo-Fenton process successfully removed 87% of organic compounds. The sludge characterization studies by Particle Size Distribution proved that the Fenton-generated sludge achieved quality suitable for disposal. Photo-Fenton is the cheapest option with highest removal (91%) as it's required only \$0.0016 to degrade 1g of COD compared to Fenton which cost \$0.0021. Therefore, this study concluded that the photo-Fenton process was an economically viable and appropriate treatment method for enhancing biodegradability of recalcitrant contaminants.

Keywords: AOPs, hybrid Fenton, batik, ultraviolet, elemental analysis, cost

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