

論文内容の要旨
Abstract of Dissertation

氏名Name NGUYEN HO QUE

Electrocoagulation (EC) is a promising technology for the wastewater treatment because of its high efficiency and compact size. Moreover, it combines the benefits of coagulation, flotation, and electrochemistry in a single set. Recently, EC was evaluated as a tool to reduce chemical oxygen demand (COD) of different wastewaters sources. However, there are still uncertainties and challenges that hinder the widespread use of this technology in the wastewater industry. Therefore, investments on R&D are required, for instance, to reduce the energy consumption and prevent electrode polarization and anode passivation. In this study, compares the performance of nanosecond pulse (NSP) and direct current (DC) power supplies for use in a municipal wastewater and textile wastewater treatment by EC was used. Four Al plates connected in monopolar-parallel configuration (MP-P) were used as main electrodes.

For municipal wastewater, the maximum COD removal efficiency reached 68% and 80% using DC and NSP, respectively. Moreover, NSP treatment reduced approximately 15% of the specific energy consumption (SEC) compared with that by DC at a similar COD removal efficiency of $\approx 68\%$, which was used as a benchmark value. In addition, when using NSP, the SEC required to increase the COD removal efficiency from 60% to 68% was two to three times less than that when DC was applied. The results suggest that an NSP operating at 10 kHz frequency (f) and 1 μ s pulse width (pw) are preferred for obtaining higher COD removal efficiencies at a low SEC.

For textile wastewater, results reveal that a maximum COD removal efficiency of 77% can be achieved by utilizing NSP, while a value of only 60% can be achieved by utilizing DC power. Additionally, NSP consumes at least 24% less energy than DC power at a similar COD removal efficiency. The utilization of NSP for textile wastewater treatment allows for high COD removal efficiency with a significantly lower SEC compared to traditional DC-powered EC. It is believed that the low SEC exhibited by NSP power could be useful for promoting the utilization of EC for wastewater treatment and could contribute to the reduction of the carbon footprint of this process.

Moreover, the iron material also was used as the main electrodes to remove COD from municipal wastewater. The obtained results indicated that the maximum COD removal efficiencies were 72 % and 82 % using DC and NSP, respectively. The use of an NSP allows EC operation at high voltage without the breakdown of the medium between the electrodes, promoting iron hydroxide flocs and the quantity of hydrogen bubbles as well as enhancing the COD removal efficiency with low SEC. At a similar COD removal efficiency ($\sim 72\%$), compared with DC, an NSP could reduce the SEC by approximately 40 %. Therefore, compared

with DC, the use of an NSP allows low-cost operation and enhances the COD removal efficiency from municipal wastewater. Analysis of the electrochemically generated byproducts by field emission scanning electron microscopy (FE-SEM), X-ray diffraction (XRD), and energy dispersive spectroscopy (EDS) showed that NSP flocs had higher adsorption properties for pollutants than DC flocs.