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Electrochemical degradation of antivirus drug-lamivudine formulation: photoelectrocoagulation, peroxi-electrocoagulation and peroxi-photoelectrocoagulation processes

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Introduction

This study evaluates the performance of photoelectrocoagulation, peroxi-electrocoagulation and peroxi-photoelectrocoagulation for the removal of the antiviral drug lamivudine formulation from wastewater by a stainless-steel electrode. To investigate matrix effects for this oxidation process, the influence of substrates such as urea and simulated wastewater (SWW) was studied. Moreover, degradation kinetics and energy efficiency are also discussed. Results indicate that the removal efficiency was in the order of peroxi-photoelectrocoagulation > peroxi-photoelectrocoagulation (in the presence of urea) > peroxi-photoelectrocoagulation (in the presence of SWW) > peroxi-electrocoagulation > photoelectrocoagulation. In peroxi-photoelectrocoagulation, the 96% degradation of lamivudine formulation indicates a nearly complete degradation of lamivudine. In this process, the presence of urea and SWW resulted in a substantial reduction of chemical oxygen demand (COD) decay. Kinetic studies using linear pseudo-first and pseudo-second-order reaction kinetics showed that the pseudo-first-order equation effectively described the removal of lamivudine formulation. The highest energy consumption per kg-COD decay (i.e., kWh kgCOD−1) was obtained for the photoelectrocoagulation process, while the lowest energy consumption was obtained for peroxi-electrocoagulation, for all electrolysis times. The peroxi-photoelectrocoagulation process was shown to be an effective and energy-efficient technique for removing the antiviral drug lamivudine formulation from wastewater.

This study evaluates the performance of photoelectrocoagulation, peroxi-electrocoagulation, and peroxi-

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photoelectrocoagulation for the removal of the antiviral drug lamivudine formulation from wastewater by a stainless-steel electrode. To investigate matrix effects for this oxidation process, the influence of substrates such as urea and simulated wastewater (SWW) was studied. Moreover, degradation kinetics and energy efficiency are also discussed. Results indicate that the removal efficiency was in the order of peroxi-photoelectrocoagulation > peroxi-photoelectrocoagulation (in the presence of urea) > peroxi-photoelectrocoagulation (in the presence of SWW) > peroxi-electrocoagulation > photoelectrocoagulation.

In peroxi-photoelectrocoagulation, the 96% degradation of lamivudine formulation indicates a nearly complete degradation of lamivudine. In this process, the presence of urea and SWW resulted in a substantial reduction of chemical oxygen demand (COD) decay. Kinetic studies using linear pseudo-first and pseudo-second-order reaction kinetics showed that the pseudo-first-order equation effectively described the removal of lamivudine formulation. The highest energy consumption per kgCOD decay (i.e., kWh kgCOD− 1) was obtained for the photoelectrocoagulation process, while the lowest energy consumption was obtained for peroxi-electrocoagulation, for all electrolysis times. The peroxi-photoelectrocoagulation process was shown to be an effective and energy-efficient technique for removing the antiviral drug lamivudine formulation from wastewater. The accelerating deployment of renewables has set in motion a global energy transformation with farreaching geopolitical implications. The report “A New World”, released in 2019 by IRENA’s Global Commission on the Geopolitics of the Energy Transformation, was the first foray into this area. It highlighted how the advent of a new energy age would reshape relations between states and communities and bring about a “new world” of power, security, energy independence and prosperity.

Given the fast pace of change, it is critical to monitor the geopolitical drivers and implications of the transition, stay abreast of developments and play an active role in shaping the future. In 2020, the IRENA Assembly requested the Agency to advance this work under the Collaborative Framework* on the Geopolitics of the Energy Transformation. Hydrogen was identified as a prominent area for further analysis, given the recent surge of interest. Several times in the past, hydrogen attracted much attention but remained a niche in the global energy discourse. Today, the policy focus is unprecendented, given its central role for decarbonisation of harder-to-abate sectors*.

(*This work is partly presented at 11th European Chemistry Congress, June 21-22, 2021 Barcelona, Spain)

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