Parameter evaluation of the anodic oxidation of phenol in wastewater using a Ti/RuO$_2$-IrO$_2$ anode

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The influence of different operational parameters (i.e., applied current density, chloride concentration, stirring rate, initial pH and temperature) on the electrochemical oxidation of phenol in a chloride-rich synthetic wastewater by a Ti/RuO$_2$-IrO$_2$ anode was investigated in a lab-scale batch reactor. A design of experiments (DoE) was developed to define the most important parameters in the process. It was observed that the initial pH, chloride concentration and the applied current density had the highest influence on the relative COD removal. The use of sulphate as a supporting electrolyte only resulted in a limited improvement of COD removal: only 10% more COD was degraded after 3 h of treatment. On the contrary, in the presence of chloride, already 90% of the initial COD was degraded after a reaction time of only 90 min. A kinetic and energetic evaluation of the electrochemical oxidation process showed that a high current density, applied in combination with a high initial pH, high chloride concentration and low initial COD concentration results in a fast degradation of phenol. In terms of energetic feasibility, a low applied current density combined with a high initial pH, high chloride concentration and low initial COD concentration was shown to be the most appropriate.

Keywords: Design of experiments; Electrochemical oxidation; Phenol; Ti/RuO$_2$-IrO$_2$ anode