Electrochemical incineration of oxalic acid in the presence of NaCl

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Recent researches have demonstrated that electrochemical methods offer an attractive alternative to traditional routes for treating wastewaters containing toxic or/and refractory organic pollutants [1]. The effectiveness of the electrochemical treatment depends on many factors including the electrodic material, the current density, the flow dynamic regime, the pH and the presence in solution of specie able to act as mediators. In particular, the effect of chloride ions on the performances of the process has been the object of numerous researches [2] for two main reasons. First, the addition of chloride ions can cause an increase in the removal efficiency due to the involvement of active chlorine in the oxidation process. Second, chloride ions are often present in liquid effluents and in natural waters, which makes the involvement of active-chlorine in these media inevitable. On the other hand, in spite of the high relevance of this topic, up to now many practical and theoretical aspects of electrochemical incineration performed in the presence of NaCl are not completely clear. In the present work, the anodic incineration of oxalic acid (OA) in the presence of NaCl has been investigated with the aim of studying in a systematic way the influence of numerous parameters, such as the current density, the flow rate, the OA and the NaCl concentrations and the pH on the performances of the process and to individuate the optimal operative conditions. Oxalic acid was chosen as model substrate for its low reactivity toward direct and indirect anodic oxidation, which also results in an incomplete mineralization of more complex organics. Furthermore, the oxidation of this simple molecule does not involve the formation of stable intermediates thus giving rise to a more easy rationalizing of experimental results. Since the effect of NaCl on the process is expected to depend on the nature of the electrodic material, two very different anodes were used: the Ti/IrO2-Ta2O5 which is known to present a quite low oxygen overpotential and to give rise to low efficient removal of organics and in particular of oxalic acid and boron doped diamond (BDD) which conversely presents a high oxygen overpotential and is probably one of the more promising materials for the electrochemical incineration.

[1] G. Chen, Separation and Purification Techn. 38 (2004) 11.
[2] C. A. Martinez-Huitle, S. Ferro. Chem. Soc. Rev. 35 (2006) 1324.