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# 1 Electrochemical carbamazepine degradation: effect of 2 the generated active chlorine, transformation pathways 3 and toxicity

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## 10 Abstract

11 Carbamazepine (CBZ) is a biorecalcitrant pharmaceutical compound frequently detected in  
12 wastewater and water bodies which has numerous negative effects on living organisms. In  
13 this investigation the effect of electrocatalytically generated active chlorine on CBZ  
14 degradation was studied using Nb/BDD or Ti/IrO<sub>2</sub> anodes. Subsequently, a response  
15 surface methodology based on a factorial plan and central composite design was carried out  
16 to determine the contribution of individual factors and to obtain the optimal experimental  
17 parameters for CBZ abatement. Electric current and treatment time were found to be the  
18 pivotal parameters influencing the degradation efficiency with respective contributions of  
19 45.19% and 35.44%. The anode material had lower influence on the response, however,  
20 using an Nb/BDD anode, the oxidation was more effective due to the increased production  
21 of •OH radicals as well as HClO, Cl<sup>•</sup> and ClO<sup>-</sup> species. Considering CBZ degradation and  
22 energetic consumption, the percentage of degraded CBZ was 88.70 ± 0.35% consuming  
23 1.07 kWh m<sup>-3</sup> (at 1.0 A, NaCl concentration of 14 mM after 12.45 min, using Nb/BDD  
24 anode). First order kinetic constant (*k*) value of 0.189 min<sup>-1</sup> was obtained at optimal  
25 conditions when demineralized water was used for the NaCl supporting electrolyte, while *k*  
26 was lower when tap water or treated wastewaters were used for this purpose. Oxidation of  
27 CBZ yielded six aromatic intermediates, identified by gas chromatography - mass  
28 spectrometry technique and degradation pathways were proposed. The performed acute  
29 toxicity tests indicated an increase during the treatment, which was demonstrated to be  
30 mainly attributed to the remnant active chlorine.

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