Electrochemical Disinfection of Synthetic and Urban Wastewater. Use of Single and Combined Processes

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Abstract: The electrochemical disinfection has gained much progress in recent years as a water disinfection technology characterized by easy and mild operation conditions, along with environmental compatibility and the in-situ production of oxidants. The most relevant parameter in the electro-oxidation (EO) of water contaminated with bacteria is the anode material, being boron-doped-diamond (BDD) the most promising one. The use of other electrochemical technologies such as electrocoagulation (EC) and electro-Fenton (EF), alone or combined, opens different interesting alternatives.

This communication presents relevant results found in our laboratory by applying the above methods to inactivate common bacteria [1,2]. EO with a BDD anode was used to treat 100 mL of 7 mM Na_2SO_4 with 10^6 CFU mL^{-1} of bacteria at 33.3 mA cm^{-2}. A quick disinfection process was obtained for Gram-negative (*Escherichia coli* and *Pseudomonas aeruginosa*) and Gram-positive (*Bacillus atrophaeus*) bacilli, whereas Gram-positive cocci (*Staphylococcus aureus* and *Enterococcus hirae*) were more resistant to the attack of physisorbed $^{\bullet}OH$. SEM highlighted the inactivation of cells with a highly altered morphology lying on dirty filters with plenty of cellular debris. Larger damage was observed for Gram-negative cells, indicating that inactivation can be related to the chemical composition of the outer layers of the cell structure and the modification of the transmembrane potentials upon current passage.

A study on *Pseudomonas aeruginosa* suspensions in 7 mM Na_2SO_4 at pH 5.8 by EO revealed a faster inactivation with DSA® as compared to BDD by the larger adsorption of bacteria at the surface of the former anode, favoring the oxidation with physisorbed $^{\bullet}OH$. Similar results were found by adding paracetamol. Best performance was obtained in 7mM Na_2SO_4 + 7 mM NaCl at 8.3 mA cm^{-2}, with total inactivation in 2 min and energy consumption of 0.059 kW h m^{-3}, due to the contribution of active chlorine.

EC and/or EF were used to disinfect urban wastewater at pH 7.4. Best results were obtained by combining both methods. In primary effluents, Enterococci and Somatic Bacteriophages were rapidly inactivated and *Clostridium perfringens* was the most resistant. In secondary wastewater, such microbiota and *Escherichia coli* were totally reduced in 10 min, being the Heterotrophic Bacteria more persistent.

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References:

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