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BDD anodes: from conventional flow cell to solid polymer electrolyte system to treat parabens low conductive solution

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Solution conductivity plays a fundamental role in the employment of Advanced Electrochemical Oxidation Processes and in the definition of their energy consumptions and costs. To overcome this issue that affects several effluents [1] different approaches have been proposed in the literature [1,2]. Among them, the most common is the addition of supporting electrolyte, such as sodium sulphate [2]. Nevertheless, the use of high concentration of other compounds can introduce problems related to the formation of recalcitrant by-products as well as the increasing of costs. Microfluidic reactors provide another interesting approach, where the gap between the electrodes is reduced in the order of microns to limit the ohmic drop [1].
A third system is proposed here, based on a solid polymer electrolyte (SPE) cell setup, that does not require electrolyte addition; in this configuration, a Nafion® membrane has been sandwiched between a Boron-doped diamond (BDD) anode and DSA® electrode used as cathode[3,4]. SPE-system has been tested for the removal of three different parabens (Methylparaben, Ethylparaben and Propylparaben) and its performance has been evaluated in terms of pollutant removal, COD removal and energy consumption. The advanced oxidation processes reported in the literature for the treatment of paraben-polluted solutions work with the addition of supporting electrolyte to increase the conductivity, because of these compounds are often detected in low conductive media [5]. Then, to make a stronger process evaluation, the removal of parabens with SPE-cell was compared with a conventional flow cell system based on BDD anode that requires supporting electrolyte addition to working properly. Results highlighted that both systems are able to treat solutions with a pollutant removal higher than 95%. Nevertheless, SPE-system showed better performance not only in the parabens oxidation but even in terms of COD abatement. The comparison between the two systems demonstrated that, fixed the operating conditions, the substitution of supporting electrolyte dissolved in solution with a polymer membrane increase the COD removal (from 81% to 91%) maintaining the energy consumptions comparable.
Analysis at different current density, flow condition and solution conductivity suggested that SPE-system can be a promising technology for the treatment of parabens in wastewater, and to treat effluents with low conductivity.

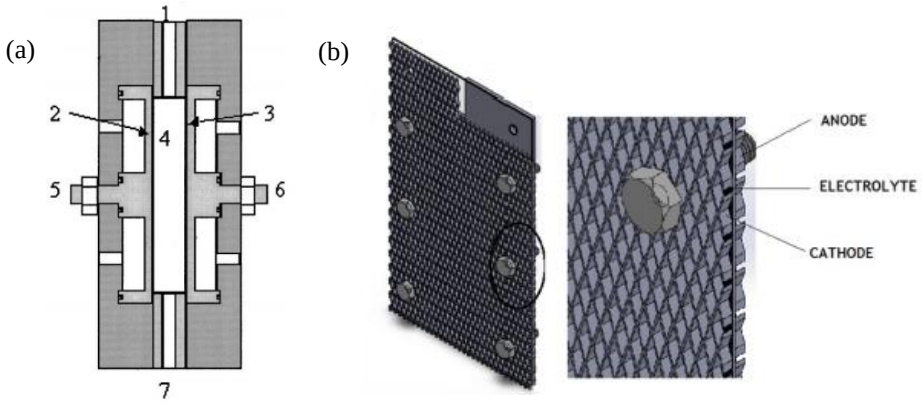

Figure 1 (a) Setup for conventional BDD cell: 1: electrolyte outlet, 2: anode, 3: cathode, 4: electrolysis compartment, 5 and 6: electrical contacts, 7: electrolyte inlet [6]. **(b)** Setup for SPE based cell [3]

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