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From chemical disinfection to electrodisinfection: The obligatory itinerary?

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ABSTRACT

This review concerns chemical disinfection and electrodisinfection (ED). Chemical disinfection is a common unit process used in water supply and wastewater treatment. Traditionally, chlorination is the most dominant method of disinfection. However, there are serious safety concerns and great ecological risks involved in the use of chlorine. Other methods, such as ozonation, UV radiation and ClO_2 application, are still more expensive or less convenient than chlorination. It has been reported that ED can destroy a wide variety of microorganisms from viruses through bacteria and algae to larger species, such as *Euglena*. The ED process has the potential to be developed as a robust, cost-effective and environment friendly alternative of disinfection, particularly for saline sewage effluent and for seawater in cooling and other industrial usages. During ED, water is forced through a disinfector that is equipped with electrodes on which current is charged. This practice is different from conventional electro-chlorination (E-C), which relies on the production of a concentrated chlorine solution by electrolysing a side-stream of salt water. A number of theories have been proposed to explain ED's major bactericidal actions, including E-C, destruction caused by the electric field, and generation of energy rich but short-lived intermediate ED products. Increasing attention has been recently given to free radicals, such as $^{\bullet}OH^{-}$ and $O_2^{\bullet -}$ that could be produced during electrolysis, for their possible role in ED's strong killing actions, although more evidence remain to be collected. On the other hand, ED has many advantages compared with chemical disinfection. ED reliability has been proven in several practical applications, mainly for the disinfection of drinking water, swimming pool water and industrial cooling water. ED has also been used or tested for the reduction of bacterial contamination in dental water supplies, and for the disinfection of contact lenses and ion exchange resins, etc. However, only a few ED products are currently available in the market. This is due to the relative unfamiliarity of the technology, and fierce market competition with other technologies. Eventually, the cost and performance advantages of ED should lead to its wider use. Finally, electrocoagulation (EC) as an efficient process in mineral and organic matters removal has been also proven efficient in microorganisms removal; hence, this electrochemical process may be presented as promising water/wastewater treatment technology.

Keywords: Drinking water; Disinfection; Electrodisinfection; Electro-chlorination; Electrocoagulation; Disinfection by-products

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