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Use of conductive-diamond electrochemical-oxidation for the disinfection of several actual treated wastewaters

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HIGHLIGHTS

- Electrolysis with conductive-diamond anodes assures the disinfection of urban treated wastewaters.
- It assures the total removal of coliforms without the addition of any reagent.
- Hypochlorite and chloramines have been identified as the main disinfectants produced.
- Formation of hazardous compounds is not obtained by this technology using low current densities.
- Power consumptions as low as 0.2 kW h m^{-3} is enough to assure the complete disinfection of treated wastewater.

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ABSTRACT

This work assesses the disinfection for reuse of treated urban wastewaters using electrochemical-oxidation with conductive-diamond anodes, without adding any external chemical reagent. Three actual effluents of municipal wastewater treatment plants (sample collected from the secondary clarifiers) have been treated using this technology, in every case, a complete removal of *Escherichia coli* have been achieved. In addition, it has been found that working within the range of current densities proposed in this work (1.3–13.0 A m^{-2}), this technology does not form any hazardous by-products (neither perchlorates nor halo-compounds), even at trace level. Combined effects of chloramines and hypochlorite seem to be the main mechanisms to explain disinfection. The primary disinfectant produced in every electrolyses depends on the current density, and on the concentration of both: chlorides and non-oxidized nitrogen, present in the raw treated wastewater. Power consumption as low as 0.2 kW h m^{-3} is enough to assure the complete disinfection of a particular treated wastewater. The lower the applied current density, the lower the energy required to get the disinfection of the treated wastewater.

1. Introduction

Regeneration of treated urban wastewater for reuse is a promising choice to provide new sources of water, especially in countries in which the lack of water resources has become a serious problem. In fact, nowadays, many countries are making a great effort to provide water from the effluents of municipal Wastewater Treatment Facilities (WWTFs), for many different uses such as irrigation, repletion of aquifers, and industrial uses. Typically, a WWTF consists of a series of treatments including pre-treatments to remove large objects and sands, primary treatments to remove suspended solids, secondary treatments to bio-oxidize the organic content of the sewage, and, in some cases, tertiary treatments, in which the quality of the wastewater is progressively improved until achieving the standards proposed in the national regulations of every country for discharge. Further treatments should be applied in order to raise the quality of a WWTF effluent up to the standards required for reuse. These additional treatments could be included in the tertiary treatment of a WWTF (in this case they are not looking for discharge quality but for reuse quality) or they can also be grouped in a new type of facility called as Water Regeneration Facility or Wastewater Reuse or Recycling Facility (WRF) [1].

The sequence of treatments used depends on the particular use which it is looked for, although it usually consists of a reduction of the pollution associated with the colloids that escape from the secondary clarifiers of the WWTF (by physico-chemical treatment and filtration) and of the removal of pathogens (by a disinfection unit) to prevent health issues related to the wastewater reuse). Regarding disinfection treatments, chlorination is the most widely used disinfection technology in water supply but it shows many significant drawbacks in water reuse which cannot be easily overcome

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