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Electrochemical Inactivation of Toxic Cyanobacteria and Degradation of Cyanotoxins

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Abstract : The potential risks associated with toxic cyanobacteria have raised growing environmental and public health concerns leading to an increasing effort into researching ways to bring about their removal from water, together with destruction of their associated cyanotoxins. A variety of toxins are synthesized by cyanobacteria and include hepatotoxins, neurotoxins, and cytotoxins which can cause a range of symptoms in humans from skin irritation to serious liver and nerve damage. Therefore drinking water treatment processes should ensure the consumers' safety by removing both cyanobacterial cells, and cyanotoxins from the water. Cyanobacterial cells and cyanotoxins presented challenges to the conventional water treatment systems; their accumulation within drinking water treatment plants has been reported leading to plants shut down. Thus, innovative and effective water purification systems to tackle cyanobacterial pollution are required. In recent years there has been increasing attention to the electrochemical oxidation process as a feasible alternative disinfection method which is able to generate in situ a variety of oxidants that would achieve synergistic effects in the water disinfection process and toxin degradation. By utilizing only electric current, the electrochemical process through electrolysis can produce reactive oxygen species such as hydroxyl radicals from the water, or other oxidants such as chlorine from chloride ions present in the water. From extensive physiological and morphological investigation of cyanobacterial cells during electrolysis, our results show that these oxidants have significant impact on cell inactivation, simultaneously with cyanotoxins removal without the need for chemicals addition. Our research aimed to optimize existing electrochemical oxidation systems and develop new systems to treat water containing toxic cyanobacteria and cyanotoxins. The research covers detailed mechanism study on oxidants production and cell inactivation in the treatment under environmental conditions. Overall, our study suggests that the electrochemical treatment process e is an effective method for removal of toxic cyanobacteria and cyanotoxins.

Keywords : toxic cyanobacteria, cyanotoxins, electrochemical process, oxidants
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