Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2015.1024752

57 (2016) 8097–8108
April

Taylor & Francis
Taylor & Francis Group

An innovative non-thermal plasma reactor to eliminate microorganisms in water

Derek C. Johnson[a], Justin P. Bzdek[a], Christian R. Fahrenbruck[a], Jeffrey C. Chandler[b,c], Bledar Bisha[c], Lawrence D. Goodridge[b,d], Brooks M. Hybertson[a,*]

[a]*Symbios Technologies, Inc., Fort Collins, CO, USA, Tel. +1 970 222-9178; emails: derek@symbiostechnologies.com (D.C. Johnson), justin@symbiostechnologies.com (J.P. Bzdek), cfahre@rams.colostate.edu (C.R. Fahrenbruck), brooks@symbiostechnologies.com (B.M. Hybertson)*
[b]*Department of Animal Sciences, Colorado State University, Fort Collins, CO, USA*
[c]*Department of Animal Science, University of Wyoming, Laramie, WY, USA, emails: jchandl3@uwyo.edu (J.C. Chandler), bbisha@uwyo.edu (B. Bisha)*
[d]*Department of Food Science and Agricultural Chemistry, McGill University, Ste. Anne de Bellevue, Quebec, Canada, email: lawrence.goodridge@mcgill.ca (L.D. Goodridge)*

Received 30 October 2014; Accepted 14 February 2015

ABSTRACT

The growing need for scalable systems that can inactivate microbiological contaminants and recycle water in industrial operations has led to the development of a variety of new advanced oxidation process (AOP) technologies. In this paper, we report on the capability and techno-economics of a new AOP method to generate aqueous plasma species for inhibition of microbiological contaminants. The test microorganisms in this work were *Acidithiobacillus ferrooxidans* (a motile, Gram-negative bacterium that oxidizes sulfides to sulfates and ferrous iron to ferric iron, used as a model biofouling organism) and *Legionella gratiana* (a Gram-negative bacteria used as a surrogate of the human pathogen *Legionella pneumophila*, which can be a dangerous contaminant in cooling water systems). The cultured bacteria were dispersed in water and treated within a non-thermal plasma treatment system for varied exposure times, and then the bactericidal effects were measured. The results demonstrated plasma inhibition of *A. ferrooxidans*, with an approximate 6 log decrease in viability (assayed as most probable number) with 40 s of aqueous plasma treatment in the plasma treatment system. Likewise, *L. gratiana* viability was decreased, with an approximate 6 log decrease in viability with 20 s of aqueous plasma treatment (assayed as colony-forming units). Modeling the techno-economic aspects of these disinfection reactions in the treatment system indicated the potential for the technology to be competitive with existing AOP and aqueous chemical-based disinfection methods.

Keywords: Non-thermal plasma; Oxidation; Disinfection; Water treatment

*Corresponding author.