Excellent Disinfection and Fluoride Removal Using Bifunctional Nanocomposite

Ankita Dhillon, Sapna Nehra, B.L. Choudhary, Dinesh Kumar, Surendra Prasad

PII: S1385-8947(17)32143-5
DOI: https://doi.org/10.1016/j.cej.2017.12.030
Reference: CEJ 18191

To appear in: *Chemical Engineering Journal*

Received Date: 20 August 2017
Revised Date: 3 December 2017
Accepted Date: 6 December 2017

Please cite this article as: A. Dhillon, S. Nehra, B.L. Choudhary, D. Kumar, S. Prasad, Excellent Disinfection and Fluoride Removal Using Bifunctional Nanocomposite, *Chemical Engineering Journal* (2017), doi: https://doi.org/10.1016/j.cej.2017.12.030

Excellent Disinfection and Fluoride Removal Using Bifunctional Nanocomposite[†]

Ankita Dhillon[1], Sapna Nehra[1], B.L. Choudhary[2], Dinesh Kumar[3*], Surendra Prasad[4*]

[1]*Department of Chemistry, Banasthali University, Rajasthan–304022, India*

[2]*Department of physics, University of Rajasthan, Jaipur–302004, India*

[3]*School of Chemical Sciences, Central University of Gujarat, Gandhinagar–382030, India*

[4]*School of Biological and Chemical Sciences, Faculty of Science, Technology and Environment, The University of the South Pacific, Private Mail Bag, Suva, Fiji*

Abstract

Bacterium (*Staphylococcus aureus*) and fluoride are considered as acute dental infectants. Simultaneous bacterial and fluoride decontamination for healthy teeth is therefore of high priorities. Hence, we have fabricated a Ca–Ce nanocomposite (NC) for dual decontamination of bacteria and fluoride from drinking water. The antibacterial activities were performed against *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* (*S. aureus*) using bacterial growth curves based on optical density and colony growth using the well diffusion method. The dose-dependent antibacterial activity showed 50% bacterial inhibition (IC_{50}) at 31.5 and 27.0 μg mL^{-1} Ca–Ce NC concentrations for *E. coli* and *S. aureus* cells, respectively within 4 h of exposure. The mechanism of antibacterial action was evaluated using membrane protein leakage studies as well as dehydrogenase enzyme activity analysis of treated bacterial cells coupled with scanning electron microscopy (SEM) analysis. The fluoride adsorption mechanism was confirmed using FTIR and X-ray photoelectron spectroscopy (XPS) studies which supported the involvement of –OH groups on Ca and Ce ions where Ce–OH was the preferred adsorption site even at low Ce concentration in the nanocomposite as Ca:Ce ≈ 2:1. The prepared Ca–Ce NC proved to be very promising for water purification.

Keywords: Nanocomposite; Decontamination; Fluoride removal; Disinfection; Reusability; Adsorption.

Corresponding authors,
E–mail: prasad_su@usp.ac.fj *(S. Prasad),*
dinesh.kumar@cug.ac.in (*D. Kumar*)

[†]Electronic supplementary information (ESI) available