



Preparation and properties of hydrous bismuth oxides for nitrate removal from aqueous solutions

Prabhat Kumar Singh^a, Arun Lal Srivastav^b, Deepak Kumar Ghosh^c, Yogesh Chandra Sharma^{b,*}

^aDepartment of Civil Engineering, Institute of Technology, Banaras Hindu University, Varanasi 221 005, India

^bDepartment of Applied Chemistry, Institute of Technology, Banaras Hindu University, Varanasi 221 005, India
Tel. +91 542 6702865; Fax: +91 542 236 8428; email: ysharma.apc@itbhu.ac.in

^cIndian Institute of Technology, Kanpur 208 016, India

Received 23 February 2011; Accepted 26 September 2011

ABSTRACT

With an ultimate objective of developing an inorganic sorptive media for nitrate removal from water for drinking purpose, preparation and properties of hydrous bismuth oxides (HBOs) were studied. Three HBOs, designated as HBO₁, HBO₂ and HBO₃ were prepared using 0.1 M Bi₂O₃ solution in 2 N HCl and 2 N NaOH in 1:1, 1:2 and 1:3 volumetric proportions respectively. In column tests, with 1 meq l⁻¹ (=14 mg N l⁻¹) nitrate in distilled water as influent solution, HBO₁, HBO₂ and HBO₃ were found to remove 0.6, 1.2 and 1.4 mg N g⁻¹ (dry mass basis) at controlled flow rates of 1.20–1.45, 1.45–2.10 and 1.30–2.10 ml min⁻¹ from the respective columns. Regeneration attempt of the used media by passing 0.1 N NaOH solution gave a nitrate recovery ratio (RR) of 0.9 for HBO₁ and HBO₂ and 0.5 for HBO₃. In the second cycle of nitrate laden water application, whereas HBO₂ and HBO₃ showed decreased nitrate removals, HBO₁ exhibited increased uptake. On dry mass basis HBO₁, HBO₂ and HBO₃ precipitates showed a nitrate removal of 1.1, 0.7, and 1.0 mg N g⁻¹ respectively in the second cycle. Thus, in two cycles HBO₁, HBO₂ and HBO₃ precipitates were found to remove 1.7, 1.9 and 2.4 mg nitrate from solution per g (dry mass) respectively. The effluent pH remains fairly in the range of 7.0 to 8.9, indicating that OH⁻ ions are not released from HBOs in significant quantity due to nitrate sorption. The precipitates apparently held appreciable amount of chloride which may play important role in nitrate removal process.

Keywords: Adsorption; Inorganic sorptive media; Nitrate removal; Hydrous bismuth oxide; Regeneration and reuse

*Corresponding author.