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Authors: Rachel A. Pepper, Sara J. Couperthwaite, Graeme J. Millar



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Value Adding Red Mud Waste: High Performance Iron Oxide Adsorbent for Removal of Fluoride

Rachel A. Pepper¹, Sara J. Couperthwaite* and Graeme J. Millar

Institute for Future Environments and ¹School of Chemistry, Physics & Mechanical Engineering, Science and Engineering Faculty, Queensland University of Technology (QUT), GPO Box 2434, Brisbane, Queensland 4001, Australia.

*Corresponding Author

Dr Sara J. Couperthwaite: Senior Lecturer; Science and Engineering Faculty; Queensland University of Technology; P Block, Level 7, P701A-1, Gardens Point Campus; Brisbane; Queensland 4000; Australia

ph +61 7 3138 4766 | mobile +61 432 989 263 | email sara.couperthwaite@qut.edu.au

ABSTRACT

A novel method for the synthesis of iron oxide based sorbents from bauxite residue (red mud) was developed by way of a sequential digestion and selective precipitation process. The red mud was consecutively digested with phosphoric acid and hydrochloric acid, precipitated by sodium hydroxide addition, and aged for 72 h at pH 3 to 3.5. This process allowed the production of a relatively pure crystalline material, akaganeite (β -FeOOH), comprised of high surface area (223 m²/g). The performance of the synthesised material as a fluoride sorbent was compared with a commercial adsorbent (granular ferric hydroxide). Equilibrium isotherms revealed that both sorbents reduced the amount of fluoride in solution to <1.5 mg/L. Significantly, the red mud derived akaganeite had a higher maximum adsorption capacity than the commercial granular ferric hydroxide (11.40 and 9.23 g/kg, respectively). Performance differences were suggested to relate to the presence of active sites which comprised of iron and aluminium and/or titanium species.

Keywords: akaganeite; bauxite residue; synthesis; fluoride; adsorption

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