Addition of ferric chloride in anaerobic digesters to enhance sulphide removal and methanogenesis

A. Yuzir, S.S. Yaacob, H.I Tijani, N. Abdullah, Zubair Ahmed

Malaysia-Japan International Institute of Technology (MJIT), Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia, email: muhdaliyuzir@utm.my
Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia
US-Pakistan Center for Advanced Studies in Water, Mehran University of Engineering and Technology, Jamshoro, Pakistan

Received on 2 September 2015; Accepted 19 March 2017

Abstract

A feasibility study on the addition of ferric chloride (FeCl₃) as selective regulator to reduce the sulphide reduction activities of sulphate reducing bacteria (SRB) in anaerobic digester was investigated. A lab-scale up-flow anaerobic sludge blanket (UASB) fed with synthetic sulphate enriched wastewaters were operated continuously for 56 d. The influent sulphate concentrations with an addition of potassium sulphate (K₂SO₄) were operated at corresponding COD/SO₄²⁻ ratios of 5.3, 2.5 and 1.3, respectively. An amount of FeCl₃ at dosages of 10.2, 22.2 and 44.5 mM were added on days 66, 86 and 108, respectively (i.e. 8–10 d after each COD/SO₄²⁻ ratio was introduced). Results showed that sCOD removal efficiencies averaged at 78%, 80% and 70%, respectively while methane yield averaged at 0.35, 0.32 and 0.27 L CH₄ gCOD destroyed⁻¹ when FeCl₃ dosage were added at 10.2, 22.2 and 44.5 mM, respectively. Furthermore, the scanning electron microscopy (SEM) examinations demonstrated that UASB operated at COD/SO₄²⁻ ratio of 1.3 were dominated by several filamentous rod-shaped bacteria attached to the structural matrix of the digesting sludge as compared to COD/SO₄²⁻ ratio of 2.5. However, when UASB was supplemented with FeCl₃ at dosages of 22.2 mM and 44.5 mM, the sludge contained no rod-shape bacterium and the morphology of sludge showed the presence of iron sulphide precipitation.

Keywords: Upflow anaerobic sludge blanket; Sulphate-reducing bacteria (SRB); Ferric chloride (FeCl₃); COD to sulphate ratio (COD/SO₄²⁻); Methane productivity