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Removal of the metal ions Zn^{2+}, Ni^{2+}, and Cu^{2+} by biogenic sulfide in UASB reactor and speciation studies

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ABSTRACT

This work evaluated the effects of the chemical oxygen demand (COD)/SO_4^{2-} ratio on sulfate removal efficiency of an upflow anaerobic sludge blanket reactor inoculated with sludge from an industrial brewery. The removal of nickel (Ni^{2+}), zinc (Zn^{2+}), and copper (Cu^{2+}) by precipitation with the biogenic sulfide was also studied as well as the metals speciation through the reactor height with scanning electron microscopy/energy-dispersive X-ray spectroscopy/X-ray fluorescence (SEM/EDX/XRF) techniques. Ethanol was used as organic carbon source for electron donor, the hydraulic retention time was 18 h, and the organic loading rate was 1.5 kg COD m^{-3} d^{-1}. The experiment was divided in five periods, evaluating the system capacity in terms of sulfate reduction (COD/SO_4^{2-} of 2.26, 1.13, and 0.57) and metals (50 and 100 mg L^{-1}) removal by biogenic sulfide. High removal (higher than 98.5%) of the metals was achieved in the bioreactors, which were directly related to the solubilities solubility product of NiS, ZnS, and CuS. Metals dosage had a positive effect in COD removal by decreasing the toxicity caused by biogenic sulfide. SEM/EDX/XRF analyses indicated that Cu^{2+} was the most concentrated metal at the sludge samples collected at the reactor bottom, which also followed the lowest solubility properties of CuS, and was the least concentrated metal in both mid-height and upper sludge samples.

Keywords: Sulfate reduction; Metals; Speciation; SEM/EDX/XRF analyses

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