Effect of anoxic conditions on the efficiency and bacterial diversity of bio-sludge in a sequencing batch reactor (SBR) system with wastewater containing Cr$^{3+}$ and Ni$^{2+}$

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ABSTRACT

The efficiency and bacterial diversity of bio-sludge in anoxic-sequencing batch reactor (SBR) and anoxic/oxic-SBR systems with synthetic industrial estate wastewater without heavy metals (SIWW) and SIWW containing 3.0 mg/L of Cr$^6+$ or Ni$^{2+}$ (SIWW + Cr$^6+$ or SIWW + Ni$^{2+}$) at a mixed liquor suspended solids of 2,000 mg/L and a hydraulic retention time of 1.5 d were investigated. The highest Ni$^{2+}$ and Cr$^{3+}$ removal efficiencies of 93.1% ± 0.9% and 95.4% ± 0.2%, respectively, were detected in anoxic/oxic-SBR systems with SIWW + Cr$^{3+}$ and SIWW + Ni$^{2+}$, respectively. The average Cr$^{3+}$ and Ni$^{2+}$ adsorption abilities of bio-sludge from the anoxic/oxic-SBR system were 24.0 ± 5.0 mg Ni$^{2+}$/g bio-sludge and 20.0 ± 4.0 mg Cr$^{3+}$/g bio-sludge, respectively. In addition, 3.0 mg/L of Cr$^{3+}$ or Ni$^{2+}$ had a strong repressive effect on the growth and activity of heterotrophic carbonaceous biochemical oxygen demand removal bacteria. However, the addition of an anoxic period in the reaction step increased heavy metal removal efficiency as a result of denitrifying bacteria. The other advantage of the anoxic/oxic-SBR system was that it showed high nitrogenous compound removal yields. To observe bacterial diversity in the anoxic/oxic-SBR system during operation, rDNA analysis technique was applied. It was found that the addition of 3.0 mg/L of Cr$^{3+}$ or Ni$^{2+}$ did not show significant negative effects on nitrifying and denitrifying bacteria, but some species disappeared from the system, particularly nitrifying bacteria, under anoxic conditions.

Keywords: Adsorption; Anoxic; Cr$^{3+}$; Ni$^{2+}$; Sequencing batch reactor; Oxic

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