Removal and transformation of hexavalent chromium in sequencing batch reactor

Siew-Leng Loo, Kwok-Yii Leong and Poh-Eng Lim*
School of Chemical Sciences, Universiti Sains Malaysia, 11800 Penang, Malaysia

Abstract

The objectives of this study are to evaluate the efficiency of removal of hexavalent chromium (Cr(VI)) in a sequencing batch reactor (SBR) and to ascertain the fate of Cr(VI) in the treatment process. An SBR was operated with the FILL, REACT, SETTLE, DRAW and IDLE periods in the time ratio of 2:12:2:1.5:6.5 for a cycle time of 24 h. The study was divided into 5 phases with the addition of 0.5, 2.0, 3.0 and 5.0 mg/ℓ of Cr(VI) in Phases II, III, IV and V for a duration of 46, 75, 43 and 16 operational cycles, respectively. The Cr(VI) removal efficiencies for SBR were found to be 79.8, 88.4 and 99.8% in Phases III, IV and V, respectively. The results revealed that Cr(VI) removal efficiency improved with acclimated activated sludge. Determination of Cr in the suspended sludge showed that around 95% of the Cr species were Cr(III). Determination of Cr concentration profiles during the FILL and REACT periods showed that the predominant species was Cr(III) as Cr(VI) was bio-reduced. The proposed Cr(VI) removal mechanism involves bioreduction to Cr(III) which was subsequently precipitated and adsorbed by activated sludge. Precipitation rather than sorption is envisaged to be the main path of removal of Cr(III) from the solution.

Keywords: Sequencing batch reactor, hexavalent chromium, removal, transformation, mechanism