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Bioregeneration of powdered activated carbon in the treatment of alkyl-substituted phenolic compounds in simultaneous adsorption and biodegradation processes

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Abstract

The role of bioregeneration process in renewing the adsorbent surface for further adsorption of organics during simultaneous adsorption and biodegradation processes has been well recognized. The extent of bioregeneration of powdered activated carbon (PAC) as an adsorbent loaded with phenol, *p*-methylphenol, *p*-ethylphenol and *p*-isopropylphenol, respectively, in the simultaneous adsorption and biodegradation processes were quantitatively determined using oxygen uptake as a measure of substrate consumption. Bioregeneration phenomenon was also evaluated in the simultaneous adsorption and biodegradation processes under sequencing batch reactor (SBR) operation to treat synthetic wastewater containing 1200 mg l^{-1} phenol and *p*-methylphenol, respectively. The SBR systems were operated with FILL, REACT, SETTLE, DRAW and IDLE periods in the ratio of 4:6:1:0.75:0.25 for a cycle time of 12 h. The results show that the percentage of desorption from loaded PAC decreased in the order phenol > *p*-methylphenol > *p*-ethylphenol > *p*-isopropylphenol. For the treatment of phenol and *p*-methylphenol in the SBR reactors, respectively, the simultaneous adsorption and biodegradation processes were able to produce a consistent effluent quality of COD $\leqslant$100 mg l^{-1} when the applied PAC dosage was 0.115 and 0.143 g PAC per cycle, respectively. When no further PAC was added, the treatment performance deteriorated to that of the case without PAC addition after 68 and 48 cycles of SBR operation, respectively, for phenol and *p*-methylphenol. This observation is consistent with the greater extent of bioregeneration for phenol-loaded PAC as compared to *p*-methylphenol-loaded PAC.

Keywords: Bioregeneration; Activated carbon; Simultaneous adsorption and biodegradation

1. Introduction

Many toxic organic compounds such as phenol are known to be treatable using activated sludge system (Herzbrun et al., 1985; Brenner et al., 1992; Yu and Gu, 1996). The problem is that the intermediates formed are normally resistant to further biodegradation. Addition of powdered activated carbon (PAC) to the activated sludge system was found to be effective in improving the removal of these compounds (Scaramelli and DiGiano, 1973; Nayar and Sylvester, 1979; Ceccen, 1994; Lim and Er, 2000). The apparent beneficial effects of the integration of adsorption and biodegradation

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