Short communication

Bioregeneration of mono-amine modified silica and granular activated carbon loaded with Acid Orange 7 in batch system

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HIGHLIGHTS

► Use of acclimated biomass vital for successful bioregeneration process.
► Quantification of bioregeneration efficiencies of MAMS and GAC loaded with AO7 dye.
► Progressive adsorption capacity loss in multiple bioregeneration of spent MAMS.
► Bioregeneration efficiency improvement of AO7-loaded MAMS with bio-fouling removal.

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ABSTRACT

The objectives of this study were: (1) to investigate the role of mixed culture of biomass in the regeneration of mono-amine modified silica (MAMS) and granular activated carbon (GAC) loaded with Acid Orange 7 (AO7), (2) to quantify and compare the bioregeneration efficiencies of AO7-loaded MAMS and GAC using the sequential adsorption and biodegradation approach and (3) to evaluate the reusability of bioregenerated MAMS. The results show that considerably higher bioregeneration efficiency of AO7-loaded MAMS as compared to that of AO7-loaded GAC was achieved due to higher reversibility of adsorption of MAMS for AO7 and favorable pH factor resulting in more AO7 desorption. The progressive loss of adsorption capacity of MAMS for AO7 with multiple cycles of use suggests possible chemical and microbial fouling of the adsorption sites.

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1. Introduction

The use of microorganisms to renew the surface of the adsorbent for further adsorption is known as bioregeneration. Studies on the role of biomass to extend the service-life of the spent adsorbent have been extensively reported (Ha et al., 2000; Aktas and Çeçen, 2007; Ng et al., 2009). Most of the studies have centered on the bioregeneration of the commercially available activated carbon loaded with environmentally important contaminants such as phenolic compounds. In contrast, reports on bioregeneration studies of activated carbon and other adsorbents loaded with dyes are very limited to date.

The use of activated carbon as an adsorbent faces some difficulties in view of its cost and the difficulties in regenerating spent activated carbon particles (Gupta et al., 2011). Silica modified with different chelating agents has been applied to remove azo dyes from wastewater due to high thermal and chemical stability, high surface area, fast kinetics, good selectivity, shrinking/swelling resistance and possibility of repeated use (Parida et al., 2006; Atia et al., 2009). Silica modified with different chelating agents has good adsorption capacity towards azo dyes and the chemical regeneration of the spent modified silica loaded with azo dyes has been well investigated (Donia et al., 2009). To date, there have been no reports describing microbial regeneration of the loaded silica with azo dyes as a cleanup process.

In the light of the above observation, the objectives of this study were to: (1) investigate the role of mixed culture of biomass for regenerating the mono-amine modified silica (MAMS) and granular activated carbon (GAC) loaded with Acid Orange 7 (AO7) under aerobic conditions, (2) quantify the bioregeneration efficiencies of MAMS and GAC loaded with AO7 using AO7-acclimated biomass, and (3) evaluate the reusability of bioregenerated MAMS adsorbent and estimate the adsorption capacity loss during the process. Complete bio-decolorization of azo dyes including AO7 has been successfully achieved under anaerobic and aerobic conditions and the carcinogenic aromatic amines are readily biodegraded completely under aerobic conditions (Saratale et al., 2011).