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Performance of intermittently aerated up-flow sludge bed reactor and sequencing batch reactor treating industrial estate wastewater: A comparative study

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HIGHLIGHTS

- Performance of an USBR and a SBR bioreactor removing CNP was compared.
- The effects of HRT and aeration time on the systems performance were investigated.
- Removal of nitrogenous and carbonaceous components was studied.
- The optimum conditions for two feeding regimes were determined.

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ABSTRACT

In this study, an innovative aerobic/anoxic sludge bed bioreactor with two feeding regimes, continuous-fed (an up-flow sludge bed reactor (USBR)) and batch fed (sequencing batch reactor (SBR)), was evaluated for the treatment of an industrial estate wastewater with low BOD_5/COD ratio. The process performance in the two regimes was compared. Two numerical independent variables (retention/react time and aeration time) were selected to analyze, model and optimize the process. Response surface methodology with central composite design (CCD) was used with five levels of hydraulic retention time (HRT)/react time (12–36 h) and aeration time (40–60 min/h). In order to analyze the process, ten dependent parameters as the process responses were studied. As a result, HRT/react time showed a decreasing impact on the responses measured in both hydraulic regimes, USBR and SBR. The USBR showed better performance than the SBR in removal of total COD, slowly biodegradable COD, total nitrogen and total Kjeldahl nitrogen.

1. Introduction

Rapid population growth and industrial development have threatened precious natured resources such as water. Over the years, problems of water pollution and ways to protect the resource have attracted increasing attention of government bodies, industries, researchers and common people alike. Industrial wastewaters are very diverse in nature, with constituents specific to individual industries and have an extremely wide (minimal to very high) range of pollution potential depending on the type and concentration of the pollutants. If discharged without proper treatment, industrial wastewaters can cause severe adverse effect on receiving waters and their flora and fauna (Botalova and Schwarzbauer, 2011). Appropriate treatment of wastewater and its recycling/reuse would help in environment protection and preservation.

Removal of organic matter and nutrients (N and P) are often the main objectives in the design of biological wastewater treatment systems. Anaerobic, anoxic and aerobic biological reactors are generally used in combination to provide a treatment scheme for organics and nutrients removal. Integration of the different process conditions (anaerobic, anoxic and aerobic) in a single reactor with high biomass concentration is perceived as an efficient and economic solution for CNP (carbon, nitrogen and phosphorus) removal.

Both continuous and batch fed biological reactors have been widely used for treatment of various industrial wastewaters. An aerobic submerged fixed-film (ASFF) reactor treating a synthetic crude oil wastewater and at organic loading rates from 0.84 to 9.41 gCOD/m^3d was able to remove 87% COD (Izanloo et al.,

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