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Some properties of a sequencing batch reactor for treatment of wastewater containing thiocyanate compounds

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Abstract

Thiocyanate (SCN) compounds in photo-processing wastewater (PPWW) could be treated by an SBR system without any release of thiocyanate to the atmosphere during the aeration step. An SCN loading greater than 84 $g m^{-3} d^{-1}$ showed negative effects on the growth of bio-sludge and removal efficiencies of the system. The acclimatization period of the system was increased with an increase in SCN concentration or loading. The COD, BOD_5, TKN, and SCN removal efficiencies were 96.0±1.6%, 72±2%, 49±5%, and 82±3%, respectively, under an SCN loading of up to 84 $g m^{-3} d^{-1}$. The removal efficiency of the system was repressed by SCN due to the repressed growth rate of nitrification bacteria. However, the removal efficiency could be increased with an increase in HRT or a decrease in SCN loading. Also, increases in HRT or decreases in SCN loading led to increased sludge age or solid retention time (SRT) and decreased the sludge volume index (SVI) value. The SRT and SVI of the system with synthetic wastewater containing 840 $mg l^{-1}$ SCN under an HRT of 3 days (SCN loading of 280 $g m^{-3} d^{-1}$) were 3.9±0.7 days and 65±4 $ml g^{-1}$, respectively, while they were 11.2±0.8 days and 55±6 $ml g^{-1}$, respectively under an HRT of 10 days (SCN loading of 84 $g m^{-3} d^{-1}$).

Introduction

Cyanide, cyanate, and thiocyanate compounds are serious hazardous substances due to their strong effects on both the environment and humans (Wilson, 1981). They are found in several types of wastewater, such as photo-processing, electroplating, and chemical-fertilizer wastewaters (Shivaraman et al., 1985; Goncalves et al., 1998). Several researchers have reported that biological processes can be used to remove cyanide or cyanate compounds from wastewater (Hung and Pavlostathis, 1997; Banerjee, 1996; Boucabeilie et al., 1994; Ludzack and Schaffer, 1962). Cyanide, cyanate, and thiocyanate compounds in wastewater can be biodegraded to ammonia, bicarbonate, and sulfate in an activated sludge (AS) system (Ludzack and Schaffer, 1962; Neufeld et al., 1981; Patil and Paknikar, 2000). The removal efficiencies and nitrification rates decreased with an increase in thiocyanate loading, but the system's removal efficiencies could be increased by adding glucose to the wastewater (White et al., 2000).

However, the use of biological treatment processes, especially the AS system, to treat wastewater containing cyanate or cyanide compounds still has some disadvantages. For example, it is difficult to operate the AS system with wastewater containing high concentrations of cyanide or cyanate compounds. The bio-sludge of the AS system may rise or bulk together due to the effects of nitrification and denitrification, and the effluent may contain high concentrations of nitrate and sulfate (Metcalf & Eddy, 1991).

An SBR system is a modified AS system used in solving the low-density bio-sludge and bulking sludge problems due to the large volume of the clarifier (Metcalf & Eddy, 1991). Also, an SBR system can easily be modified for both carbon and nitrogen removal with the appropriate operational program.

In this study, an SBR system was used to treat synthetic wastewater containing thiocyanate compounds (SWWCC) under various thiocyanate loadings to determine the effects of thiocyanate on removal efficiency and the qualities of the bio-sludge in the system. Some operational parameters, such as sludge age (solid retention time: SRT), F/M ratio, and sludge volume index (SVI), were also investigated.

Section snippets

Synthetic wastewater containing thiocyanate compounds (SWWCC)

SWWCC was prepared according to some chemical properties of the photo-processing wastewater collected from a photo-processing factory in Thailand, as shown in Table 1. The thiocyanate compound used was ammonium thiocyanate (Am-SCN). The concentration of Am-SCN in the SPPWW was varied at 314, 630, 943, 1100, 1310 and 1572 mgl^{-1}, as shown in Table 2. …

Bio-sludge and acclimatization of bio-sludge for SBR system

Bio-sludge collected from the central municipal wastewater treatment plant of Bangkok municipality, Thailand (Sriphaya central wastewater treatment …

Effects of aeration on the release of SCN from SWWCC in an SBR system

The SWWCC containing various concentrations of Am-SCN (shown in Table 2) was fully aerated under the SBR system without any addition of bio-sludge for 24h. The results showed that SCN was not released from the wastewater during the 24h aeration period. …

Effects of SCN concentration on the SBR system

The SBR system was operated with SWWCC containing various concentrations of Am-SCN, as shown in Table 2, under an HRT of 10 days to observe the effects of SCN concentration on both the efficiencies and performance of the system. The effluent …

Discussion

The operation of the SBR system with SWWCC using bio-sludge from a municipal wastewater treatment plant required a long period of time to acclimatize and reach steady state because the bio-sludge was not exposed to the SCN. To reduce the acclimatization period of the system, the bio-sludge had to acclimatize with SCN before being used as the inoculum (Metcalf & Eddy, 1991; Neufeld et al., 1981). Additionally, the acclimatization period of the system was increased with an increase in SCN …

Conclusion

This study showed that the SBR system could be applied to treat wastewater containing SCN compounds. The SCN compounds, especially Am-SCN, were not released to the

atmosphere during the aeration step of the SBR system. Am-SCN was biodegraded in the SBR system into a precursor for bacterial cell (bio-sludge) growth and nitrogen gas. The SBR system showed high removal efficiency and good performance under SCN loadings up to $84 g m^{-3} d^{-1}$. The COD, BOD_5, and TKN removal efficiencies of the SBR system …

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Recommended articles

References (17)

C.H. Hung *et al.*
Aerobic biodegradation of thiocyanate
Water Research (1997)

N. Shivaraman *et al.*
Microbial degradation of thiocyanate, phenol and cyanide in a completely mixed aeration system
Environment Pollution (1985)

D.M. White *et al.*
Biological treatment of cyanide containing wastewater
Water Research (2000)

H.Q. Yu *et al.*
The effect of fill mode on the performance of sequencing batch reactor treating various wastewater
Bioresource Technology (1996)

Standard Methods for Examination of Water and Wastewater
(1992)

G. Banerjee
Phenol and thiocyanate based wastewater treatment in RBC reactor
Journal of Environment Engineer (1996)

R.S. Bernard *et al.*