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Comparative evaluation of yeast and bacterial treatment of high salinity wastewater based on biokinetic coefficients

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Abstract

This paper compares the performance of the aerobic treatment of high organic–high salinity wastewater by yeast and bacterial systems. The biokinetic coefficients for both the systems were determined and used to analyze the behavior of the yeast and bacterial systems under high salinity conditions. It was found that the yeast culture was more efficient compared to the bacterial culture, especially for high salinity conditions that severely inhibit growth and performance of bacterial systems. The values of the biokinetic coefficients obtained from this study are in agreement with the observations. Nutrient removal capacity has also been found to be better for yeast due to higher nutrient uptake in the yeast biomass.

Keywords: Yeast; Respirometric method; Biokinetic coefficients; Saline wastewater treatment

1. Introduction

Vegetable, tanning and seafood processing industries generate large quantities of saline wastewater with high concentration of organic pollutants. In seafood factories located in arid zones, unit processes such as defrosting, butchering and washing produce high organic–high salinity wastewater due to using treated seawater as the raw water source (Woolard and Irvine, 1995). High salt content in wastewater is known (Kargi and Uygur, 1996) to significantly reduce the treatment efficiency of conventional activated sludge, attached-growth, anaerobic, nitrification and denitrification processes. As a result, BOD removal efficiency decreases, effluent turbidity and solid loss increases due to poor solid settling in the secondary sedimentation tanks, and mixed liquor floc protozoan population changes (Dalmacija et al., 1996). Application of salt-tolerant bacteria for biological treatment of wastewater has been found to improve treatment efficiency under such conditions. For example, the use of halophilic microorganisms (e.g. *Halobacter halobium*) in an activated sludge process resulted in better treatment performances at salt contents above 2% (Kargi and Dincer, 2000).

As an alternative to salt-tolerant bacteria, osmotolerant yeast can also be used to treat high organic–high salinity wastewater. Yeast is traditionally used in high substrate concentrations (or high loading) in the fermentation industries such as soy sauce and beer production. Nishihara ESRC (2001) carried out research on treatment of marine products processing wastewater, containing 8.5 g NaCl/l and 5450 mg/l BOD_5, by the yeast cycle system (YCS). BOD_5 and total nitrogen removals obtained were 99% and 86%, respectively. Excess sludge could be reused. A specific yeast strain (*Pichia guilliermondii* A9) has been found (Park and Choi, 1999) to tolerate a very high salt content (up to 100 g NaCl/l) during growth phase. In brine waste treatment this yeast could remove about 90% of the BOD within 24 h. Further, the structure of the yeast flocs facilitates oxygen diffusion, leading to reduction in air requirement and energy consumption.

This study attempted to compare the performance of the yeast and bacterial systems by systematically studying biokinetics coefficients by respirometery. The nature of the reactions as well as the observations made during the course of the study have been explained in light of these biokinetic coefficients.

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