HIGH SALINITY WASTEWATER TREATMENT USING YEAST AND BACTERIAL MEMBRANE BIOREACTORS

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ABSTRACT

Two laboratory-scale membrane bioreactor systems were investigated to treat high salinity wastewater containing high organic (5,000 mg/L COD) and salt content (32 g/L NaCl), namely: (1) the Yeast Membrane Bioreactor (YMBR) and; (2) Yeast pretreatment followed by Bacterial Membrane Bioreactor (BMBR). In the YMBR system, experimental runs were conducted with a mean biomass concentration of 12 g MLSS/L. Here the maximum COD removal rate of 0.93 g COD/g MLSS.day was obtained at F/M of 1.5 g COD /g MLSS.d. Whereas, the BMBR system was operated with a biomass concentration of up to 25 g MLSS/L, resulting in maximum COD removal rate of 0.32 kg COD /kg MLSS.day at F/M ratio of 0.4. In comparison to BMBR, YMBR could obtain higher COD removal rate at higher organic loading, indicating the potential of yeast reactor system to treat high salinity wastewater containing high organic concentration.

Transmembrane pressure in BMBR was progressively increased from 2 to 60 kPa after 12d, 6 d and 2 d at hydraulic retention time (HRT) of 14h, 9 h and 4h, with average biomass concentration of 6.1, 15 and 20 g MLSS/L, respectively. Whereas the transmembrane pressure in YMBR has only increased from 2 to 60 kPa only after 76 days of operation, with an average biomass concentration of 12 MLSS/L and an operating HRT range of 5 - 32 h

KEYWORDS

Yeast, high salinity, membrane bioreactor, hollow fiber membrane, wastewater treatment.

INTRODUCTION

During the biological treatment of wastewater, increase in salt concentration results in reduction of biodegradation rate. Furthermore, salt content in wastewater also reduces the population of protozoa and filamentous organisms resulting in low settleability. High effluent suspended solids of saline wastewater treatment units are commonly reported in the literature (Woodlard and Irvine, 1995). Dalmacija (1996) showed that the nature of pollutants and high salinity (about 29 g/L) of oil-field brine had an unfavorable effect on the activated sludge process. Higher hydraulic loadings increased wash-out of the activated sludge from the reactor. Kargi and Dincer (1998) reported that saline wastewaters with more than 2% salt resulted in low BOD removal and flocculation efficiencies of conventional biological processes such as activated sludge, attach-growth processes and nutrient removal by nitrification and denitrification stages. Anaerobic processes were much more sensitive to chloride ion concentration than aerobic processes. Biogas production and COD removal of anaerobic treatment processes were inhibited significantly at salt concentration above 20g/L NaCl. Thus, the presence of salts may cause inhibition and toxicity problems in the methanogenic activity or dehydrate bacterial cells because of osmotic effect or inhibit one or more of the reaction pathways in the substrate degradation process

Application of membrane bioreactor (MBR) concept in a high salinity wastewater treatment unit could overcome the above stated problems of low biodegradation rate and poor sludge settling in the secondary sedimentation tank. MBR process can be operated at high MLSS and thus organic removal can be improved and simultaneously sludge wastage and the plant size can be minimized (Visvanathan et al. 2000). Moreover, the selection of microorganisms present in the membrane bioreactor is no more dependent on their ability to form biological flocs and the settling characteristics.