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Response of Membrane Bioreactor to Feed Starvation Shock Load

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Abstract: The impact of feed starvation condition on the biological characteristics and the performance of an aerobic submerged Membrane Bioreactor (MBR) system was investigated. The synthetic wastewater treated in MBR under steady-state condition showed 95% removal of COD, 98% removal of TOC and suspended solids, 88% of TKN removal and 30% removal of phosphate. The system was subjected to a feed starvation shock load for five days and the response of the system in the process of recovering back to pre-shock steady-state condition was studied. After five days of shock loading, the effluent quality deteriorated showing traces of substrate leakage in effluent, large fraction of biomass wash off and reduction in microbial activity inside the reactor. The biological solids in the reactor reduced gradually from 15 g/L to 6 g/L, which took around a month for the biomass to revert back to its normal growth phase. The system required seven days to recover back to steady condition. Overall, the study showed a faster recovery of organic, solid, nutrients removal; however, the system took a month to regain the amount of biomass lost during feed starvation shock load.

Key words: Membrane bioreactor, feed starvation, shock load, activated sludge, wastewater treatment.

Introduction

Tighter controls on discharge limits of wastewater treatment systems have necessitated more elaborate and perhaps more expensive solutions than conventional biological treatment process (Cicek, 2003; Visvanathan et al., 2000). One of the recent modifications of conventional biological treatment processes is the Membrane Bioreactor (MBR) process. MBR is a combination of activated sludge process with membrane filtration where membrane system is used to separate the sludge from the effluent instead of a settling tank (Ye et al., 2005). Membrane bioreactor process has been applied widely in different wastewater treatment (Yamamoto et al., 1989; Trouve et al., 1994) and for water reuse and reclamation (Monti et al., 2001). MBR has proved to be an innovative technology with considerable advantages over conventional treatment methods and has provided a greater degree of treatment for varied pollutants than any other treatment process under steady state conditions.

Potential harmful environmental changes are usually called shock loads (Gaudy and Gaudy, 1981). Because of the variable nature of industrial wastes, reactor stability to shock loading is one of the most important aspects to be considered in the design of biological treatment systems. A reactor must show tolerance to fluctuations in characteristics of wastewater such as COD, temperature, pH and flow as these are most difficult to control in wastewater streams. In recent years significant attention is given in examining the behaviour of reactors after upsets or shock loads.

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