

Phenolic Wastewater Degradation by Anaerobic Membrane Bioreactor in Thermophilic condition

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Summary

This study was conducted as part of the project titled as “Phenolic wastewater treatment in AnMBR under salinity conditions: BioXtreme-Following up”.

Phenol is a common industrial wastewater contaminant which is toxic, carcinogenic, mutagenic, and teratogenic in nature. A phenol concentration of as low as 1 mg/L may adversely affect the aquatic ecosystem. Therefore proper treatment of phenolic compounds before discharging them is necessary. Phenol can be degrading into harmless compounds by anaerobic degradation. The major problem faced with anaerobic technology for the industrial wastewater treatment is the low biomass retention or biomass washout. Use of membrane coupled anaerobic treatment technologies can provide complete biomass retention which ensures the accumulation of slowly growing micro-organisms, which are frequently needed for the anaerobic treatment of toxic and recalcitrant wastewaters.

Currently, phenol was fed with acetate (10 g/L) as the substrate source in an AnMBR. It has been reported that the phenol conversion rate is higher when an additional and easily degradable c-source is added. Therefore, in the current work the main objective was to achieve the operation of an AnMBR under thermophilic and saline conditions [16 g NaCl/L] with phenol as the only carbon and energy source. This was made by a step-wise reduction of the sodium acetate concentration that was fed. Phenol and COD removal percentage, particle size distribution in the biomass of the AnMBR, suspended solids in the reactor, and capillary suction test were measured.

Biodegradation of phenol at elevated concentration can inhibit the growth of microorganisms even for those species that can use it as a substrate. At the start of the experiment the phenolic loading rate (PLR) was increased from 0.04 gmPh/gmVSS.d (200 mg/L) to 0.11 gmPh/gmVSS.d (500 mg/L) to observe the effects of high phenol concentrations.

High percentage removal efficiency (97%) was observed with phenol acting as a sole substrate. This might be because of the different set of microorganisms involved in the biodegradation process under thermophilic conditions. The COD removal efficiency increases as the OLR reduced, it reached 52%, 68% and 77% corresponding to OLR rate of 0.90, 0.63, 0.36 kg COD/m³.d respectively. A reduction in the removal efficiency was observed whenever the OLR dropped which took around 2 to 3 days to recover back; it might be because of the high HRT. As the reactor progresses further, the median particle size increased, which are less susceptible to toxic conditions, this was in agreement with the CST values which decrease during the study,

lower the CST values better the sludge filtration characteristics. A reduction in the VSS concentration and an increase in the inorganic fraction were observed.

AnMBR were able to withstand the increase in the phenolic loading rate with phenol acting as a sole substrate in thermophilic conditions. Further results with the reactor operating under current condition will provide a better understanding of phenol degrading capacity in an AnMBR and use of phenol as a sole substrate. Furthermore collecting biomass samples for microbiological analysis will help to identify the microorganism and the pathway for biodegradation of phenol under thermophilic condition.