Title	The removal of nutrients and color by single and two-stage membrane bioreactors
Student	Chen Haoyang
Advisor	Taro Urase

Abstract

Membrane bioreactor (MBR) is the combination of a membrane process like microfiltration or ultrafiltration with a suspended growth bioreactor. MBR is increasingly recognized as an effective technology for the treatment of industrial wastewater containing complex and refractory compounds. One of the problems in biological wastewater treatment is the low efficiency in removing refractory organic compounds.

In this study, we designed two experiments； A single-MBR treating fresh/saline wastewater and a two-stage MBR treating fresh wastewater. In both of these experiments the MBRs were operated in long periods (over 2 months), and performances such as tendency of the membrane fouling, ability of removing color and nutrients were evaluated in different conditions, treating fresh wastewater, treating saline wastewater, two-stage treatment progress (low food-to-microorganism ratio in the second stage), O_3 aeration, addition of poly aluminum chloride (PAC) and triolein.

After 4 months' operation, the results of single-MBR experiments showed that stable operation was possible even with saline wastewater after acclimatization of sludge and addition of PAC, while severe membrane fouling was found with abrupt increase in the salinity. The addition of PAC is helpful for the removal of color, and the effect was remarkable in removing phosphorus regardless of salinity of wastewater. Complete nitrification after acclimatization of the sludge was achieved even in the case of the treatment of saline wastewater, though the removal of total nitrogen was below 30% because of the absence of anoxic cycle in the aeration. The direct ozonation to the biological reactor caused the reducing of MLSS and caused membrane fouling, however enhancing O_3 aeration over certain volume can ease the tendency of membrane fouling.

Meanwhile, the latter stage of the two-stage MBR system didn't show a further removal of color as expected, nor the removal of phosphorus. Being fed in biodegradable organics, MLSS of the former stage kept increasing. On the other hand, MLSS of the latter stage kept reducing because of low food-to-microorganism ratio. Nitrification in the latter stage was hardly observed due to the high biological activity of the former stage.

The effect of direct O_3 aeration to the biological reactor was obvious in the removal of color in both experiments.