Optimal Performance of an Airlift Immersed Membrane Bioreactor for Domestic Wastewater Reclamation

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Abstract

Membrane BioReactor (MBR) in which membrane separation process is combined with biological processes is an efficient alternative for wastewater treatment and reuse. However, the major process problem with MBRs remains the membrane fouling due to the physicochemical interactions between the membrane material and the components in the mixed liquor. Along with the fouling, membrane permeability decreases and energy demand increases. One of the options to prevent membrane fouling in flat membrane systems is to implement air lifting that can improve the cake removal from membrane surface. This study investigated the influence of hydrodynamic conditions on fouling in a pilot-scale immersed membrane bioreactor (IMBR) using a hollow fiber membrane module of ZW-10 under ambient conditions. In this system, the crossflow across the membrane surface were induced by a cylindrical draft tube (Ø=235 mm). This crossflow creates a shear stress and generates a mass back-transport of the deposited particles along the membrane surface. The membrane fouling rates under different operating conditions were evaluated using Flux-step method. The study demonstrated that the introduced draft tube minimized membrane fouling rate and enhanced the system performance significantly, and an optimization for the performance of a long-term (70 days) application was reached for domestic wastewater reclamation. The system was stable without external chemical cleaning. The results showed that the permeate were of high quality, and the removal of COD and BOD was 94.0% and 98.8%, respectively.

Several conclusions were reached from this study:

(i) Permeate flux is a major controlling parameter affecting membrane fouling;
(ii) Crossflow induced by draft tubes reduced fouling significantly at high permeate flux;
(iii) Fouling rate decreases significantly with the increase of aeration rate, however the fouling rate tends to be very close above an aeration rate of 3.4 m³/hr;
(iv) Under optimum operating conditions, the system was stable without external chemical cleaning at least 70 days, and high quality of effluent was obtained for the domestic wastewater reclamation.