Influence of hydrophilicity on membrane fouling in submerged membrane bioreactor with Polytetrafluoroethylene flat-sheet membrane

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Abstract

Membrane bioreactor (MBR) has the advantage of clear-treated water generation and space-saving due to direct separation of activated sludge and liquid by microporous membrane compared to conventional settling tank. Therefore, MBR has been increasingly applied to various wastewater treatment processes for municipal and industrial wastewater. However, MBR has the problem of membrane fouling in its principle, which causes the rapid decline of the permeate flux, thus the suppression of membrane fouling is still main issue for further widespread application. One of the major factors of membrane fouling has been considered to be extracellular polymeric substances (EPS) composed of carbohydrate and protein derived from activated sludge. Therefore, the hydrophilic membrane has been considered better than hydrophobic membrane to prevent membrane fouling so far because of hydrophobic characteristic of EPS. In this study, we investigated the influence of hydrophilicity on development of membrane fouling using symmetrical polytetrafluoroetylene (PTFE) flat-sheet membranes with similar pore size (0.1 μm), surface roughness, and surface morphology but different hydrophobic characteristic (contact angle: 66^{o} and 125^{o}). The hydrophilic and hydrophobic PTFE membranes were first comparatively investigated to confirm the difference in hydraulic resistance by batch-filtration test using bovine serum albumin (BSA) as a model compound of protein. As a result, the ratio of pore fouling resistance (Rp) and intrinsic membrane resistance (Rm) showed no significant difference between two types of membranes. Then, we fabricated membrane modules by combining non-woven supported PTFE membranes with module materials and conducted continuous experiment using bench-scale submerged MBR. Synthetic wastewater was continuously fed to MBR at a flux of 0.3 m^3/m^2 first and the flux was gradually increased to 0.7 m^3/m^2. Trans-membrane pressure (TMP), Mixed liquor suspended solids (MLSS) and pH were regularly measured, and membrane fouling was evaluated on the change in TMP value. As a result of repeated continuous experiments, there was no difference in TMP development between hydrophilic and hydrophobic PTFE membranes. From these results, it was indicated that influence of hydrophilicity on the membrane fouling is not significant when PTFE flat-sheet membrane is applied to submerged MBR process.