



Characteristics of proteins involved in membrane fouling in membrane bioreactors (MBRs) treating municipal wastewater: the application of metaproteomic analyses

Taro Miyoshi^{a,*}, Tomoyasu Aizawa^b, Katsuki Kimura^c, Yoshimasa Watanabe^a

^aCenter for Environmental Nano and Bio Engineering, Hokkaido University, Sapporo, Japan

Email: jms-mbr@eng.hokudai.ac.jp

^bDivision of Biological Sciences, Hokkaido University, Sapporo, Japan

^cDivision of Built Environment, Hokkaido University, Sapporo, Japan

Received 3 September 2010; Accepted 3 January 2011

ABSTRACT

We investigated the relationship between the nature of proteins and their fouling propensities in pilot-scale membrane bioreactors (MBRs) treating real municipal wastewater with two-dimensional polyacrylamide gel electrophoresis (2D-PAGE). In 2D-PAGE, proteins are separated based on their isoelectric points and molecular weights, and therefore, information can be obtained on the nature of the proteins. Foulants extracted from fouled membranes at the end of continuous operation and organic matter contained in mixed liquor suspension were analyzed by 2D-PAGE, and the results were compared. This analysis was performed for two identical MBRs operated under different solid retention times (SRT) to investigate the effect of the operating condition on the types of proteins with high fouling propensities. In the MBR operated with a long SRT, the presence of proteins that appeared in the neutral pH range was more pronounced in the extracted foulant. Because the pH of the mixed liquor suspension was in the range of 6–7 throughout the continuous operation, the difference in protein profiles between the extracted foulant and the organic matter contained in the mixed liquor suspension in the MBR operated with a long SRT can be explained by a decrease in solubility of a protein at its isoelectric point. In contrast, in the MBR operated with a short SRT, the presence of proteins that appeared in the acidic region (pH 3–5) was more prominent in the extracted foulant compared with the organic matter contained in the mixed liquor suspension. The results obtained in this study imply that dominant fouling mechanisms differed depending on the operating condition.

Keywords: Membrane bioreactor; Membrane fouling; Operating condition; Characteristics of foulant; Protein; Two-dimensional polyacrylamide gel electrophoresis (2D-PAGE)

*Corresponding author.