Flat sheet MBRs: analysis of TMP rise and surface mass transfer coefficient

Robert William Field\textsuperscript{a,}\textsuperscript{*}, Kaisong Zhang\textsuperscript{b}, Zhanfeng Cui\textsuperscript{c}, Byung-Kook Hwang\textsuperscript{c}

\textsuperscript{a}Department of Engineering Science, Oxford University, Oxford OX1 3PJ, UK
Tel. +44 1865 273118; Fax: +44 1865 283273; email: robert.field@eng.ox.ac.uk
\textsuperscript{b}Institute of Urban Environment, Chinese Academy of Sciences, Xiamen 361003, China
\textsuperscript{c}Department of Environmental Engineering, Hoseo University, Asan 336795, South Korea

Received 9 February 2011; Accepted 15 June 2011

ABSTRACT

Aeration in MBRs mitigates membrane fouling but the energy consumption for aeration is still one of the major operating costs. Two areas related to this are addressed. Firstly the reasons for the TMP jump that has been observed in certain MBRs are explored. The data is presented in terms of Resistance vs time which is considered superior to TMP vs. time. Also Resistance vs volume of permeate collected is informative. Five possible reasons for the TMP jump were suggested in 2006 and for the current data, this is reduced to the loss of connectivity/change in percolation hypothesis. Secondly data on the effect of bubble distribution on electrochemically determined surface mass transfer coefficients in an aerated flat sheet module are presented. This study particularly focuses on the effect of bubble distribution on the spatial variation of surface mass transfer with intermittent slug bubbling. This mode of operation will delay the onset of the TMP jump if biomass removal is more dependent upon maximum shear stress than mean shear stress. Two basic set-ups were considered: an orifice in the middle of the aeration tube, at the base, and two symmetrically placed orifices in the aeration tube. In the latter case the spacing between the two orifices was varied from 80–200 mm. Surface mass transfer was evaluated at 20 positions. With relatively low air rates a single orifice generates a higher average enhancement than two orifices but the reverse is found at a relatively higher air rate. The enhancement in the centre area of the module is relatively higher than that of the edge regions when using a single orifice but more uniformity was achieved with two.

Keywords: Membrane Bioreactor; Bubble distribution; Flat sheet membrane; Mass transfer; Wall shear stress; Slug bubble; TMP jump

*Corresponding author.