APPLICATION OF FLUID DYNAMIC GAUGING AND OPTICAL IMAGING TO MEMBRANE FOULING

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ABSTRACT

The build-up of unwanted fouling layers on surfaces is a major problem in membrane operations and heat transfer, and in many cases limits the use of a particular technology. Fouling also creates a need for cleaning in order to restore process efficiency, adding further complexity to the system and increasing capital and operating costs. Design to combat fouling and promote cleaning is complicated by the varied mechanisms of deposit formation - principally mineral scaling and biofouling in water applications - and by the heterogeneity of the deposits formed. Furthermore, these layers frequently comprise a weak water-filled matrix material and collapses under mechanical contact, rendering them difficult to study using conventional techniques.

This paper reports the use of a measurement technique, fluid dynamic gauging (FDG), to assess the fouling characteristics of a model suspension of almost neutrally buoyant ballotini on a polymeric microfiltration membrane surface. FDG is a technique based on fluid mechanical phenomena which provides measurements of thickness and strength of fouling layers, *in situ* and in real time. The technique has been described in detail previously[1,2]. The deposition process, *i.e.* the build-up of filter cake, was monitored quantitatively via measurements of thickness and the permeate flux. CFD results reported by Chew *et al*.[3] were exploited to obtain quantitative information about the strength of the filter cake.

For the first time, FDG has been combined with imaging techniques to study deposition and removal processes in membrane systems. The entire process of FDG deformation on the filtered cake was vividly captured and offered qualitative information on cake properties. This is a major achievement and successful implementation these methodologies would allow long-term studies to determine the effect of various factors and to characterise the structural changes associated with the fouling/cleaning cycle in this area, namely fouling in food and membrane systems.

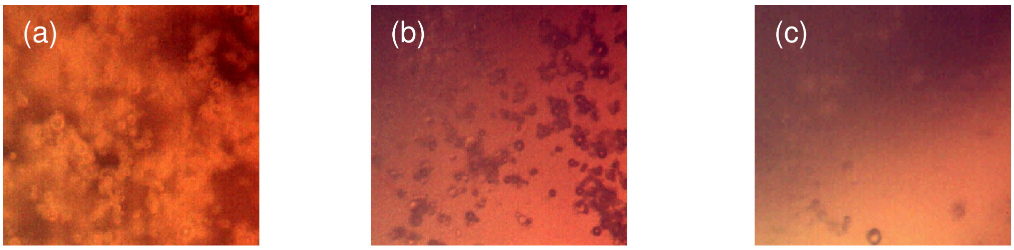

Figure 1: Microscopic images of the cake layer on the membrane surface at different shear stresses imposed by gauging flows. Maximum applied shear stress values: (a) 0 Pa, (b) 5 Pa and (c) 9 Pa.

[1] Tuladhar T.R., Paterson W.R., Macleod N. and Wilson D.I. (2000) *Can J Chem Eng*, **78**, 935-947.

[2] Chew J.Y.M., Paterson W.R. and Wilson D.I. (2004) *J Food Eng*, **65**(2), 175-187.

[3] Chew Y.M.J., Paterson W.R. and Wilson D.I. (2007) *J Membrane Sci*, **296**(1-2), 29-41.