Fouling and Cleaning in Food Processing, Cambridge, UK 22-24 March 2010

THE APPLICATION OF FLUID DYNAMIC GAUGING TO THE INVESTIGATION OF SYNTHETIC MEMBRANE FOULING PHENOMENA

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ABSTRACT

In order to improve the performance of membrane processes, there is a need to understand interactions occurring between the membrane and the bulk fluid. Such interactions can lead to irreversible and reversible fouling, and concentration polarisation. *In situ* measurement techniques enable such filtration resistances to be monitored without moving the sample from its original position [1], thereby minimising the introduction of artefacts.

Fluid dynamic gauging (FDG) is a technique that has applications in the measurement of the thickness and deformation behavior of soft fouling layers deposited on a substrate [1]. FDG has been used here to investigate the nature of fouling deposition on microfiltration (MF) membranes in a cross-flow filtration process using industrially relevant liquors. In this paper we report the use of FDG to track the thickness of the cake layer during the microfiltration of a 45º Brix molasses solution using a 1.5 μm polysulphone (P*sf*) membrane. Feed flows at a constant rate through the gauge, and differential pressure is measured to infer the distance from the surface. Permeate flux through the membrane is also continuously measured.

Molasses is a thick syrup by-product from the processing of sugar beet and contains mainly (*i*) sugars (sucrose, glucose and fructose), (*ii*) water and (*iii*) inorganic matter (crystals containing calcium sulphate, calcium oxalate dihydrate, and calcium oxalate monohydrate). Industrial filtration of this liquor to remove the crystals yields a mineral-rich deposit. Knowing the size of particles (ranging from 1 to 10μm) and the permeability of the deposit, the Carman-Kozeny equation has been used to determine the theoretical porosity of the deposit using experimental values, while taking into account the thickness of deposit and flux.

Results presented show changes in polymer thicknesses when the membranes are conditioned and contacted with water, molasses, and a range of cleaning agents. The cohesive and adhesive forces of different classes of fouling layers have been investigated in a cross flow system with a permeate flux.

The rate at which fouling occurs and the effect of cleaning upon foulant thickness has also been investigated, with particular attention paid to the effect of multiple fouling and cleaning cycles. The dynamic gauge has also been used as a sampling device, taking material from the concentration polarisation region. The study of this phenomenon will enable real rejection ratios to be calculated and compared to existing models for the estimation of solute concentration at the membrane surface.

The information provided by FDG should improve our understanding of the interaction between surface chemistry and surface physics during the membrane filtration of complex food based materials.

References

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