THE UNIVERSITY OF HONG KONG

DEPARTMENT OF CIVIL ENGINEERING

SEMINAR

Modulation rather than mitigation of membrane fouling layers for improved permeability during membrane ultrafiltration

by

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ABSTRACT

A circular economy encompassing resource recovery and energy efficiency is an established engineering objective for the coming decade. Scalable and commercially sustainable resource recovery will rely on the development of engineering processes which will provide high concentration and purity of an economically valuable product from an otherwise considered waste source (e.g., polymer recovery, caustic recovery, water reuse). Membrane technology is as an essential downstream unit operation for the purification and concentration of industrial products and so too, for value retention from waste-streams. However, biofilm growth on the surface of membrane filters remains an unavoidable process limiting event (Flemming, 2002, Flemming et al., 2015, Vrouwenvelder et al., 2016). The development of a biofilm on the surface of a membrane imposes a resistance to forced water passage requiring increased energy input. Decades of research were dedicated to failed attempts to control microbial biofouling by means of disinfection or biofilm solubilisation by non-specific reagents (e.g., enzymes, surfactants) (Nguyen et al., 2012). However, the realisation that membrane filters could maintain permeability without removal of the fouling layer under continuous dead-end conditions prompted fundamental investigations into factors determining the hydraulic resistance of membrane biofilms (Peter-Varbanets et al., 2010, Peter-Varbanets et al., 2011, Peter-Varbanets et al., 2009). Compositional and structural (e.g. morphology) features of membrane biofilms were linked to biofilm hydraulic resistance (Chomiak et al., 2014, Derlon et al., 2012, Martin et al., 2014). Identification of compositional and structural determinants of biofilm hydraulic resistance offers the potential for their modulation, which may help engineer a biofilm lower hydraulic resistance. If so, operator intervention can focus on modulating rather than mitigating biofilm formation in anthropogenic environments for improved system performance by increasing biofilm permeability (i.e. net water production). The purpose of this presentation is to juxtapose existing paradigms of filtration resistance with recent developments in biofilm structure and hydraulic resistance with a view of ascertaining a framework for cultivating membrane biofilms with low hydraulic resistances allowing confident utilisation of membrane technology as a reliable process tool for resource recovery in the circular economy.

ABOUT THE SPEAKER

Peter Desmond (Dr. Sc. ETH; 2018) is responsible for R&D efforts at MMS AG; a membrane solution provider based in Zurich Switzerland. Current R&D efforts at MMS AG focus on value retention from process manufacturing streams incl. industrial resource recovery, caustic/acid regeneration and polymer recovery and purification. Additionally, Peter remains active in academic research through collaborations with leading European (ETH, EMPA and University of Applied Sciences Switzerland) and Arabian universities (KAUST) in the area of resource recovery and membrane biofouling, with specific focus on (a) influence of membrane configuration on recovered polymer solubility, (b) flux recovery strategies in novel membrane systems e.g., forward osmosis, osmotic backwash, (c) hydraulic and mechanical properties of microbial biofilms and (d) process development for application of novel membranes. Peter is using his time at the interface of research and system integration to better define fundamental research questions addressing industrially relevant process limiting events.

- ALL ARE WELCOME -