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CLEANING OF WHEY PROTEIN FOULING LAYERS USING PULSED FLOW

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ABSTRACT

The use of slow (~ 1 Hz) flow pulsation imposed on a steady flow of liquid has been shown to enhance shear stresses imposed on a surface and to mitigate fouling [Augustin and Bohnet, 2001[1]] or enhance clearing [Gillham *et al*., 2000[2]]. Flow pulsing is an attractive technology for systems where the liquid is too viscous for use of very turbulent flow, or where the inventory of fluid is to be minimised. This work reports the use of slow flow pulsing to enhance the rate of cleaning of a model food soil, namely a whey protein deposit, in a well characterised flow geometry and pulse velocity profile.
Whey protein deposits were generated from recirculated 3.5 wt% WPC solution on an electrically heated annular test section and were then cleaned using recirculating solutions of 0.5 wt% NaOH, simulating industrial cleaning-in-place (CIP) operations. Protein removal was monitored by local measurements of fouling resistance (at low heating power) and a total protein assay. Bulk flow velocities of 0.1 – 0.3 m/s and waviness ratios (amplitude of velocity pulse/baseline flow velocity) of 0.33 – 5.0 were studied at room temperature. Cleaning at these temperatures is a relatively slow process but allows effects of flow regime to be followed easily.
The resulting cleaning profiles showed that protein was removed in two stages: (*i*) an initial rinsing stage, followed by (*ii*) protein swelling and gradual dissolution. Only the rinsing stage was observed in the absence of NaOH, at a noticeably lower rate. Slow flow pulsing enhanced the overall cleaning rate, which exhibited a noticeable increase when the waviness of the flow exceeded unity and backflow of the fluid occurred (figure 1). The results are discussed in terms of cleaning enhancement as a function of extra flow rate and extra energy input to the process.

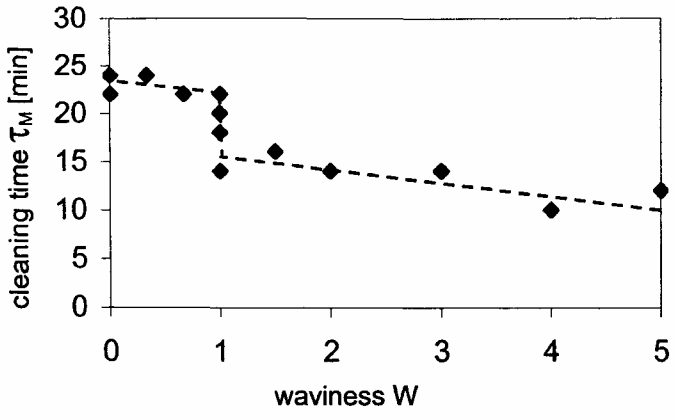

Figure 1 Cleaning time versus waviness

[1] Augustin, W. and Bohnet, M. (2001) ´Influence of pulsating flow on fouling behaviour´, in T.R. Bott et.al.: "Mitigation of heat exchanger fouling and its economic and environmental implications", Begell House, New York 2001, 161-168
[2] Gillham, C.R., Fryer, P.J., Hasting, A.P.M. and Wilson, D.I. (2000) 'Enhanced cleaning of whey protein fouling deposits using pulsed flows' *J. Food. Engineering*, **46**(3), 199-209.