THE EFFECT OF AGEING ON FOULING-CLEANING SYMBIOSIS

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ABSTRACT

Fouling and cleaning are symbiotic processes in food manufacturing plant, as outlined by Wilson (2005). The effectiveness of a cleaning protocol dictates the initial conditions for subsequent fouling, while the state of the deposit at the end of the production run determines the nature and dynamics of cleaning. In many food applications the deposit undergoes a transformation over the lifetime of the run from the initial precursor form to another, often more resistant, form.

The impacts of ageing on fouling and cleaning dynamics have not received much attention, mainly due to the paucity of data on the subject. We have recently presented a mathematical formulation of ageing in deposits generated by chemical reaction fouling where ageing was described by a simple reaction model exhibiting Arrhenius temperature dependency (Ishiyama *et al*., 2009). This model highlighted how different operating modes (*e.g*. constant heat flux *vs*. constant wall temperature conditions) could promote noticeably different fouling behaviours. Ageing was quantified in terms of deposit thermal conductivity, which was supported by rudimentary heat transfer measurements reported by Wilson *et al*. (2009).

In this paper we use the mathematical framework presented in the Ishiyama *et al*. model to explore the impacts on fouling and cleaning cycles. We firstly compare the results of this distributed model with the two-layer modeling concept presented by Crittenden and Kolaczkowski (1977) and demonstrate where they agree and differ. In that model the two layers are described as a 'gel' and a 'coke', *i.e*. differing in their ease of removal. The two-layer concept is then used to explore aspects of fouling and cleaning dynamics whereby cleaning-in-place, which takes less time, may be used to remove the gel layer but extended cleaning is required to remove the 'coke' layer. The impact on heat transfer, productivity and microbiology are discussed.

The approach is designed to lend itself to other instances where fouling reduces production effectiveness.

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