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A STUDY OF THE EFFECTS OF SURFACE COATING ON THE INITIAL DEPOSITION MECHNISMS OF DAIRY FOULING

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ABSTRACT

The initial deposition mechanisms taking place during dairy fouling, and the effect of surface coating are the main aspects of this study. The research draws from the expectation that suitable modification of heating surfaces may minimise the effects of fouling and improve cleaning. A preliminary experimental rig has been set up, where samples are attached to a shaft which is rotated in a fouling solution for 3 minutes. Whey protein isolate (WPI) solutions at elevated temperatures were used to produce protein deposits on uncoated, and titanium nitride- (TiN-) coated stainless steel samples. Similar studies using simulated milk ultrafiltrate (SMUF) have commenced, to investigate the mechanisms of mineral fouling during milk processing. The latter stage of the research will combine the effects of whey protein and mineral fouling using reconstituted milk solutions. A flow-through rig is currently being constructed such that the deposit formed represents the industrial situation more closely. Scanning Electron Microscopy (SEM) images of air-dried, whey protein fouled samples showed a thin layer of deposit which follows the surface topography. Larger clusters of fouling material were also found deposited on this sub-layer. For the operating conditions used, no significant differences in deposit characteristics were observed for the two surfaces. X-ray Photoelectron Spectroscopy (XPS) spectra showed C, O, and N as the main deposit components present. Depth profile analyses of whey protein fouled stainless steel surfaces showed some key differences in the proportion of C components with increasing sputtering time, suggesting the composition is not uniform through the thickness of the deposit. A more detailed analysis is currently being carried out to further investigate this, and the effect of surface modification.

Freeze-dried samples will also be analysed in the proceeding stages of the research to eliminate any changes taking place during air-drying. The use of the Environmental SEM (ESEM) will also prove useful in this aspect. Deposit adhesion strength is a good indication of fouling and cleaning performances for the different surfaces. Currently, a method to measure this parameter is being developed. Additional surfaces that will be studied include, diamond-like carbon (DLC), and DLC doped with a suitable element. The use of surface specific techniques such as XPS will cater to the need to study the surface chemistry during fouling, in more detail. As such, it is possible that a suitable surface may be tailored specifically for the interactions that take place during fouling and cleaning in dairy processing.