

# FOULING OF MILK COMPONENTS WITH VARYING SURFACE AND PROCESS PARAMETERS

Cristiane Boxler, Wolfgang Augustin\* & Stephan Scholl  
Technische Universität Braunschweig, Institute for Chemical and Thermal Process  
Engineering, Langer Kamp 7, 38106 Braunschweig, Germany

## ABSTRACT

*In this work two approaches against milk fouling in plate heat exchangers were investigated: (i) the temporary increase of the shear forces acting on the surface by superimposing an oscillating flow on the steady flow and thus increasing the mechanical flow forces and (ii) the modification of the energetic surface properties to reduce the adhesive strength between deposit and heat transfer surface. For the first approach, a reciprocating pump with a shut inlet generated the flow pulsation. For the second approach, the stainless steel (SS) plate were replaced by DLC-coated SS plates with different energetic properties:  $\alpha$ -C:H (DLC),  $\alpha$ -C:H:Si (SICAN) and  $\alpha$ -C:H:Si:O (SICON<sup>®</sup>). A calcium phosphate-rich whey protein solution was used as model fluid. The influences of the pulsed flow and of the coatings on deposit formation and its composition were examined.*

*The flow pulsation showed an enhancement of the heat transfer as well as an increase of the wall shear stress around the plate contact points, enhancing the removal process in these stagnation or dead zones. Less protein deposited under pulsed flow, while the variation of the pulsed flow conditions had a negligible effect on the deposits' protein content. The mineral deposition however was significantly decreased with increasing pulsation amplitude. Furthermore, the deposition was strongly dependent on the energetic properties of the surface. A relationship between the electron donor component ( $\gamma^-$ ) and the deposit growth and composition was found and an optimum value of  $\gamma^-$  for minimal fouling was suggested. Hence, the milk heating processing can be improved with respect to economic as well as ecological aspects by systematic optimization of the flow conditions and surface properties.*