#39

REVIEW ON FOULING CONTROL IN THE DAIRY INDUSTRY: WHAT DO WE HAVE AND WHAT NEEDS TO BE DONE

Peter de Jong* & Arjan J. van Asselt
Processing Division, NIZO food research, PO Box 20, 6710 BA, Ede, The Netherlands

ABSTRACT

In the dairy industry the operation costs are governed by fouling. Typically, dairy processes operating below 80 °C are limited by adherence and growth of micro-organisms in the equipment. Above 80 °C the run time is limited by deposition of proteins and minerals. Most of the research has been performed on the latter type of fouling. In the 1980s first attempts to describe the fouling mechanism in a more qualitative way were reported. It was determined that β-lactoglobulin is the key component in milk responsible for the deposition of proteins and minerals. In the 1990s more quantitative fouling models were developed, enabling the prediction of the location and amount of deposition as a function of product composition and process conditions. Nowadays, these models are applied in process design and even in process control.

With some delay, a similar path was followed in the control of biofouling. Although it was assumed for a long time that, for example, in pasteurization processes adherence of thermophilic bacteria causes the contamination of the pasteurized product during processing, this was proven in the early 1980s. In the late 1990s the first attempts were made to develop a quantitative model that predicts the bacterial counts in heated milk as a function of raw milk quality, equipment design and operating time.

Predictive models are nowadays applied successfully in reduction of the amount of fouling and optimization of the operating time of dairy production lines. Whereas the models were developed for (skim) milk, in many cases they turn out to be robust enough for application to other milk-based products after some explorative experiments to adjust the model parameters.
Although the results of fouling research have benefited the dairy industry a lot, in daily practice a number of fouling phenomena are still not well understood and needs more research efforts; for example:

- the fouling mechanism of milk-related products such as concentrated products, whey products, sweetened condensed milk
- the effect of ingredients such as stabilisers
- the fouling mechanism at temperatures from 130-180 °C
- the effect of steam injection on fouling behaviour
- the role of crystallization of milk components such as lactose

This paper gives an overview of the state-of-the-art in fouling research in the dairy industry: what do we have achieved, not only in the laboratory but also in industrial daily practice. Based on the experience in the dairy industry some research needs for the future are listed.