#17

OPTIMISATION OF CLEANING OF SPIRAL PES ULTRAFILTRATION MEMBRANES OF DAIRY INDUSTRY: PHYSICO-CHEMICAL AND HYDRODYNAMIC ASPECTS

Murielle Rabiller-Baudry*, David Delaunay, Lydie Paugam, Lilian Bégoin & Bernard Chaufer
Laboratoire Rennais de Chimie et Ingénierie des Procédés, Université de Rennes 1 - ENSCR, Institut de Chimie de Rennes FR CNRS 2108, Campus de Beaulieu ,263 avenue du Général Leclerc, CS74205, 35042 Rennes Cedex, France.
** Corresponding author : tel: +33223235752, fax: + 33223235765*
email: murielle.rabiller-baudry@univ-rennes1.fr

ABSTRACT

Ultrafiltration (UF) of skimmed milk is widely used in the world in order to control the proteins' content before the cheese making process. At industrial scale, UF is generally performed with spiral wound membranes of low cut-off (typically 5-10 kg mol-1) made of polyethersulfone (PES). After water rinsing irreversible fouling remained on membranes. Consequently, chemical cleaning is needed in order to restore flux. The cleaning/disinfecting steps are daily performed needing from 2 to 8 hours a day. At industrial scale, cleaning is generally performed via cleaning in place (CIP) stations, fully automated but running in empirical and non-optimised conditions. Finally, the recovered flux is generally lower than that of the virgin membrane.

Bibliography highlight the lack of study on the physico-chemistry of membrane cleaning [1].Thus, in order to optimise the cleaning step it appears that in-depth studies of membrane cleaning are needed, taking into account: (i) the cleaning efficiency, (ii) the consumption of chemicals, water and energy and (iii) the ecological impact of waste produced by this step.

This study deals with cleaning of a PES spiral membrane (6.5 m^2) fouled during UF of skimmed milk.
We propose an original approach including hydrodynamics and physico-chemistry and synergies or limitations of one on to the other. Cleaning results are discussed with respect to model experiments performed either in stirred reactor or plate and frame module.

- For the hydrodynamics point of view, we have chosen to performed fouling and cleaning in same conditions, as some dairy plant have no versatile equipment and must performed production and cleaning in similar way.
- For the physico-chemical point of view, we propose scientific criteria based on quantification of irreversible fouling, by FTIR-ATR [**2**], directly on the membrane to estimate the cleaning efficiency in a more accurate manner than only flux recovery not always reliable as it will be shown. Moreover, scientific criteria based on interfacial energy of detergents are proposed and a guide is proposed to formulate efficient cleaning solutions [**3**].

1- P. Blanpain-Avet, J. F. Maingonnat, Entropie 230 (2001) 2
2- L. Begoin, M. Rabiller-Baudry, B. Chaufer, Membrane News, 66 (2004) 37-40.
3 - M. Rabiller-Baudry, L. Paugam, L. Bégoin, D. Delaunay, M. Fernandez-Cruz, C. Phina-Zieben, C. Laviades-Garcia de Guadiana and B. Chaufer, Desalination (2005) (in press)