Prevention of fouling during membrane filtration with the aid of hydrodynamics

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ABSTRACT

Membranes are already used in the food industry for over 30 years, covering a wide range of applications. The dairy industry is the largest user of membranes, followed by the beverage industry and producers of egg products [1]. Membrane processes are popular, due to their energy-efficiency and clean way of production [2]. However, a negative aspect associated with membranes is accumulation of components in or on the membrane. This process is called fouling and reduces yield of the process, thereby increasing production costs and possibly environmental load. Besides, product quality might change due to changed retention behavior of the membrane. Understanding of the origin of fouling followed by prevention is therefore crucial in membrane research. Much membrane research is based on investigation of flux reduction (a.k.a. fouling), and surface modification as well as cleaning are suggested as solutions for this. Especially cleaning is commonly studied, because this aspect is everyday practice and the most accessible parameter in process design. Surface modification needs a more complex approach, and changing hydrodynamic conditions in a membrane module is often not taken into consideration, mainly because of the complexity of the matter. Not only liquid flow is influenced, also component behavior changes under different hydrodynamic conditions, and this may lead to prevention of component accumulation. In this study, the focus will be on changing hydrodynamic conditions (through cross flow velocity, channel height etc.) to alter particle behavior during microfiltration. Particle sizes are between 0.1 μm and 10 μm and particles are fractionated on size, leading to understanding of the relative importance of process conditions on back-transport mechanisms. Ultimately, this will lead to improvement of membrane fractionation with regard to fouling. Experimental results show that under certain conditions, accumulation of particles on the membrane can be prevented while fractionation occurs. Retention of large particles was not caused by membrane pore size since pore size is chosen much larger than particle size, and the pore size was not affected by the particles. This means that only back-transport was responsible for separation of particles. From these findings, guidelines could be derived to operate microfiltration membranes under no / reduced fouling conditions, with the aid of hydrodynamic effects only. In the presentation, some illustrative examples of what this new approach to separation technology is capable of, will be shown.

REFERENCES

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