Microfluidic tools to investigate and improve membrane processes

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Microfluidic devices are known for their accurate control on liquid flows, reactions, temperature effects, etc. It is however, less known that these devices can also be used to develop novel process technology. In this contribution, we will show how microfluidic tools can be applied in membrane separation, and illustrate how we used them to broaden the current knowledge base far beyond the state of the art, and designed new separation processes based on it.

We monitored particles when flowing through a microfluidic device with a fast CSLM, and found that larger particles are mostly in the centre of the channel, while small ones are found more closely to the wall[1]. This facilitated filtration greatly; due to the segregation in flow the actual pore size did not matter that much anymore. Te ratio between transmembrane flow and cross-flow velocity determined the transmission of particles when using a membrane with uniform pores. When the process conditions were chosen appropriately, large particles could be kept out of the permeate completely[2], and the starting material could be fractionated effectively.

Besides we prepared microfluidic devices with which we can investigate pores in order to elucidate pore blocking[4], flow of very concentrated dispersions through pores (see figure 1 a and b), and also layer formation during cross-flow operation[5]. The geometry of the pore, and the interaction between the particles were found to be of great influence on the occurrence of clogs; particle interaction being the dominant factor.

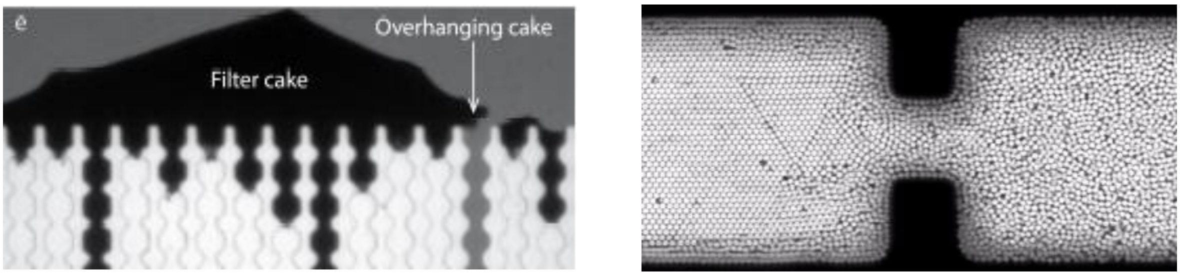

Figure 1a + b. Examples of microfluidic devices used to monitor pore blocking; flow is from top to bottom (left)[3] and flow through pores from left to right (right)[4].

In summary, microfluidic tools have helped us greatly in understanding processes at the micrometre scale (and millisecond range), and this has allowed us to develop tools relevant for microfiltration. Besides that, the generated insights have also allowed us to take the next step toward development of new process technology based on our findings. There are still numerous options, such as particle / pore size ratio, particle / surface interactions etc., that are currently under investigation, and of which we hope to give you a preview in Kentucky.

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