Constant flux microfiltration with sieves with uniform pores

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Shear induced diffusion (SID) is a result of particles influencing the movement of other particles in flow. Large particles are more affected by this, and preferentially move to the centre of a channel. When using this principle in a closed channel prior to a microfiltration system that has uniform pores, filtration can be enhanced, and even pores bigger than the particles can be used for fractionation (figure 1). It was previously shown that the process can be operated at constant flux and has low energy and water demand.

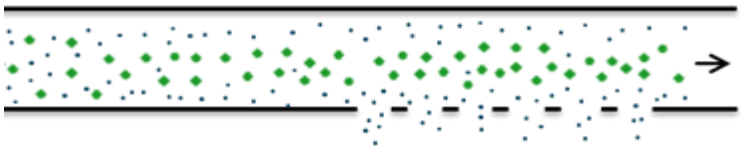

Figure 1. Schematic view on fractionation due to shear induced diffusion

In this NanoNextNL project the focus is on setting up a computational fluid dynamics (CFD) model to describe the phenomena of SID in a porous system, including the transmission / retention of particles for different membrane designs. The first results describe the separation mechanism and flow profile (see Figure 2 and 3) and are validated with literature and experimental data. The results show that there is a very good match between the experiments and the model, and that the particles are more concentrated in the centre of the channel. Next, membrane and process design will be considered to chart optimal separation conditions.

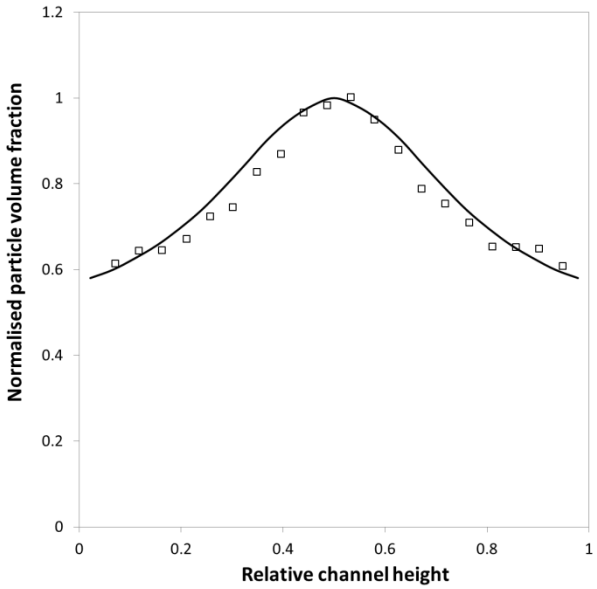

Figure 2. Normalised particle volume fraction (relative to the highest value) vs. the relative channel height, for $\phi_{bulk} = 0.5$. Experimental results by T.X. van de Laar (□); Our model results (line)

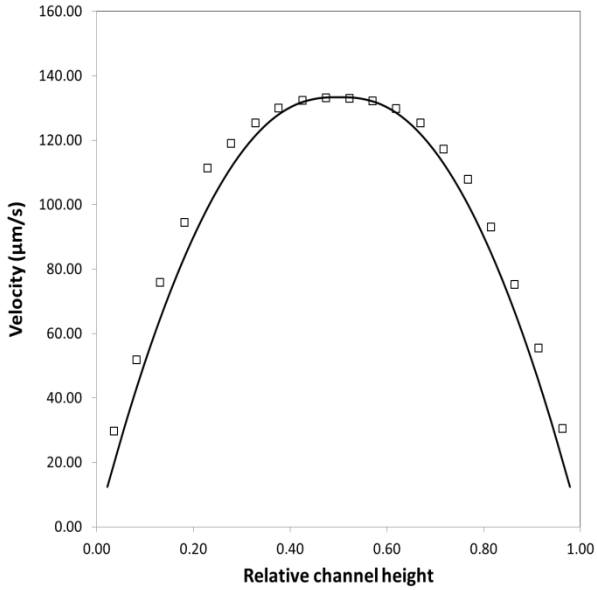

Figure 3. Velocity vs. the relative channel height, for $\phi_{bulk} = 0.3$. Experimental results by T.X. van de Laar (□); Our model results (line).

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