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Membrane based direct pH parametric pumping

L. Peters^a, G. Linz^b, M. Wessling^{a,b,*}

^aChemical Process Engineering, RWTH Aachen University, Forckenbeckstr. 51, 52074 Aachen, Germany

^bDWI - Leibniz Institute for Interactive Materials, Forckenbeckstr. 50, 52074 Aachen, Germany

Abstract

Membrane adsorbers have emerged as a promising alternative for classical chromatography since they have lower pressure drops and shorter diffusion paths. They are usually used in frontal flow-through configurations. Such membranes are regenerated using elution steps having the disadvantage of large dead volumes and extensive prior purification. Parametric pumping is an alternative process and is used in a variety of configurations. It uses a driving force perpendicular to fluid velocity for the adsorptive separation of mixtures utilizing a fixed adsorber bed. Here, we report a combination of a new mixed matrix hollow fiber membrane and its simultaneous use as a membrane contactor and membrane adsorber. The hollow fiber contains protein adsorbing ion exchange particles in the fiber wall. The fiber contacts the lumen-side protein containing solution with a pH-shifting gas (CO₂ or NH₃) on the shell side which in fact controls the pH inside the membrane wall. A silicone coating on the outside prevents a gas breakthrough from the outside. Switching between the two gasses and pH allows adsorption and desorption of proteins, enabling parametric pumping and protein recovery. As the feed flows on the inside of the hollow fiber adsorber, the dead volume can be minimized. Potentially, the solution would not even require prefiltration, as the adsorption particles are hidden and protected by the porous fiber wall.

*Corresponding author. Tel.: +49 241 80 95488
Email address: manuscripts.cvt@avt.rwth-aachen.de (M. Wessling)

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