Nonlinear observer for a real-time estimation of outlet concentration in a fixed-bed adsorption process

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Real-time knowledge of concentration profiles inside the adsorption bed is essential for the feedback control of a pressure swing adsorption process. A difficulty encountered when developing an observer for this purpose is that the fixed-bed adsorption model is very stiff; thus, either a large number of grid points or an adaptive grid allocation is required to solve the model accurately through discretization. The objective of this study is to present a nonlinear observer with an adaptive grid allocation for an adsorption bed to estimate a spatially distributed state. Experimental verification revealed that the proposed technique can accurately and rapidly predict the breakthrough curve in addition to other process variables despite uncertainties in the model parameters and in the feed composition.