Title: The dynamic process model for the filtration of carboxylic acid in forward osmosis: Modeling, experimental validation and simulation

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<AT>The dynamic process model for the filtration of carboxylic acid in forward osmosis: Modeling, experimental validation and simulation

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<ABS-HEAD>Highlights► The dynamic modeling of forward osmosis was proposed and validated. ► The formation mechanism of true carbonic acid was evidenced by mathematical model. ► The CO_2 permeability coefficient of the membrane was defined. ► The simulation model could predict all dependent variables over time.

<ABS-HEAD>ABSTRACT
<ABS-P>This research intends to develop the mathematical model of forward osmosis process during the filtration of a single carboxylic acid and a mixture of two carboxylic acids by investigating and compiling each single logical phenomenon to formulate simultaneous equation models of the associated process variables in the operation of forward osmosis system (Dynamic Modeling). The developed model demonstrates that the dissolved CO_2 in NaCl draw solution performs the major role in sequentially generating the true carbonic acid ($Pk_a = 3.45$), causing the substantial impact on the pH reduction in acid feed solution. Based on inverse problems techniques, the dynamic model, which takes into account the presence of true carbonic acid formation, was fitted to experimental pH profiles. The unobserved membrane CO_2 permeability (0.0025 L/m^2/h) could directly be obtained. Referred to Levenberg-Marquardt algorithm, all time-dependent process variables could be defined by the dynamic simulation model at any point in simulating time.
<KWD>Keywords: Forward osmosis; Carboxylic acid; Filtration; Dynamic modeling; True carbonic acid

H. Nomenclatures

A : water permeability coefficient of the membrane

A_I : temperature-dependent constant

A_M : effective membrane area

B_a : acid permeability coefficient of the membrane

$B_{a'}$: acid type 2 permeability coefficient of the membrane