

Critical Assessment of Quasi-steady-state Method to Determine Effective Diffusivities in Alginate Gel Membranes

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The application of the quasi-steady-state (QSS) method for measuring effective diffusivities (De) using the diffusion-cell technique was evaluated critically. Diffusion experiments with glucose and lactic acid across a gel membrane containing immobilized *Lactobacillus rhamnosus* were used as illustration cases. The correct estimation of De is based on the assumption that a QSS is satisfied. A theoretical error analysis was performed to quantitate the impact of estimating De when some conditions result in the QSS not being fulfilled.

These conditions may be caused by: (1) not measuring/calculating the solute mass in the gel ($M_{m,t}$); (2) errors in measurements of solute concentration; and (3) when the volume of sample withdrawal is not factored in. It was found that the errors in esti-

imating De when $M_{m,t}$ and the concentration measurement errors were not taken into account would be over 200%, depending on the prevailing conditions. In addition, the errors associated with the sample withdrawal increased linearly with the relative sampling fraction. In order to apply the QSS method, a procedure based on an accurate mass balance has been proposed to qualitatively, and quantitatively, validate the QSS assumption. This procedure uses a statistical t-test to check whether the solute flux-in equals the flux-out. To estimate De accurately, it is essential that the attainment of the QSS is validated, the accuracy of concentration measurement is established, and the effect of sample withdrawal taken into account.

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RESEARCH PUBLICATIONS

Zhang W, Berry A and Franco C.M.M (2001) An improved procedure for characterisation of spatial and temporal evolution of immobilised cells in gel membranes, *Appl. Microbiol. Biotechnol.*, 56 (5/6): 693-699.
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