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# On the Fractionation of Polymers by Membrane-Diffusion

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In a recent article by Almin [1] the concentration change in a membrane-diffusion unit was considered and an exact solution for special boundary conditions was derived. In addition an approximate solution was presented and its use in connection with multi-stage fractionation was indicated. In the present note some complementary remarks on the subject are made. Especially, a comparison between Almin's formula and an earlier approximate formula by the author [2] is made, and it is shown that for small values of the exponent $2bDl/v$ (*i.e.* for most cases of practical interest) the two formulae are nearly equal.

Using Almin's symbols and writing $2bDl/v = \alpha$ eqns. (14) and (15) in Ref.[2] give for small $\alpha$

$$\frac{c(t)}{c(0)} = \exp\left(-\tfrac{1}{2}y\,\frac{\alpha\gamma}{1+\gamma-(\alpha\gamma/4)}\right) \qquad (1)$$

On the other hand, the variable $r$ in Ref.[1] is defined by

$$\tfrac{1}{2}(1+e^{-\alpha})\gamma e^{\gamma} = re^{r} \qquad (2)$$

which gives for small $\alpha$

$$r = \gamma - \tfrac{1}{2}\,\frac{\alpha\gamma}{1+\gamma} \qquad (3)$$

With (3) eqn. (8) in Ref.[1] becomes

$$\frac{c(t)}{c_1(0)} = \frac{1}{1+\gamma-\frac{1}{2}[\alpha\gamma/(1+\gamma)]} \times \left(\exp - \tfrac{1}{2}y\,\frac{\alpha\gamma}{1+\gamma}\right) \qquad (4)$$

Comparing (1) with (4) we must keep in mind that in the two cases different boundary conditions are used. Eqn. (1) is a steady state solution with $c(0)$ being the steady state concentration at $t = 0$. In Almin's paper the exact formula (eqn. (7) in Ref.[1]) refers to boundary conditions with solution of concentration $c_1(0)$ in the container A and pure solvent in the diffusion cell. The same boundary conditions are retained in the approximate formula (4), but the approximation requires that $t$ is large, *i.e.* that steady state conditions are established. Thus, the initial (extrapolated) steady state concentration is according to (4)

$$c(0) = \frac{c_1(0)}{1+\gamma-\frac{1}{2}[\alpha\gamma/(1+\gamma)]} \qquad (5)$$

With (5) in mind we see that for small $\alpha$ (1) and (4) are essentially the same. However, in multi-stage experiments (eqns. (16)—(23), Ref.[2]) the steady state concentration $c(0)$ has to be used in the interconnected fractionation units. Therefore, in this connection it is essential that a formula of the form of (1) is used.

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