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# Reply to the letter to the editor

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We consider that the statements in Mr. M.C. Amiri and J.A. Moheb's letter concerning our article "Mass transfer at fixed bed dissolution" published in Chemical Engineering Journal 66 (1998) 39–45 are not founded. That is why we present our opinion in the subsequent sections.We believe that the statements made at Section 1 of the forementioned letter are not correct because Eq. (1) in our article used for the determination of the individual mass transfer coefficient is

$$\bar{v}_\mathrm{D} = k_l(C_A^* - C_A)_\mathrm{mean}$$

and not,

$$\bar{v}_\mathrm{D} = k_l(C_A^* - C_A)$$

as the authors of the letter presented. In addition, the surface for mass transfer ($S$) used in determining the dissolution rate is defined correctly in "Appendix A. Nomenclature" where we precisely say that $S$ is the "Area of the particles exterior surface". As for the contact surface between the particles, it is very difficult to be determined because the particles are continuously decreasing in size due to dissolution. Since the urea particles are very close to the spherical form and since during dissolution their size is continuously decreasing we believe that the contact surface between particles may be neglected. Consequently, the surface for mass transfer could be considered equal to the exterior area of all particles in the fixed bed.We do not agree with the statement in Section 2 of the letter which says that the particles in one fixed bed dissolve nonuniformly (those near the wall dissolve more quickly than the interior ones). This is true for fixed bed columns with large diameters, with large particles and large liquid flow rates. In our case liquid flow rate is small (the liquid flow rate is between 2 and 6 l/h, the particle diameter is small, the column diameter is also small, and thus a constant dissolution rate for all particles may be assumed. Either the statements made in Section 3 of the letter are not correct since Eq. (6) in our article

$$d_\mathrm{p} = d_\mathrm{p}^0\left[\frac{H}{H_0}\right]^{1/3} \tag{6}$$

does not involve time and Figs. 3–8 present the time dependence of urea particles. In Section 4 of the letter it is said that Eq. (4) in our article is not fit for determination of the dissolution rate. In the opinion of the authors of the letter the dependences $d_\mathrm{p}=f(t)$ in Figs. 3–8 should be linear for Eq. (4) to be correct. We believe that this is true when $V_\mathrm{D}$ is constant, but in our case the dissolution rate changes in time.Also in Section 4 of the letter, the authors propose a wrong equation for the dissolution rate

$$-\rho_s S\frac{\mathrm{d}h}{\mathrm{d}t} = K_l N\pi d_\mathrm{p}^2(C_A^* - C_A). \tag{I}$$

The mistake propagates in the other equation (III, IV, V). The correct equation should be

$$-\rho_s S'(1-\varepsilon)\frac{\mathrm{d}h}{\mathrm{d}t} = K_l N\pi d_\mathrm{p}^2(C_A^* - C_A), \tag{1$'$}$$

where $S'$ is the column cross-section area. The relation between $d_\mathrm{p}$ and $h$ is given by

$$\frac{N\pi d_\mathrm{p}^3}{6} = S'h(1-\varepsilon). \tag{2$'$}$$

Differentiating Eq. (2′) we obtain

$$\frac{N\pi d_\mathrm{p}^2}{2}\mathrm{d}d_\mathrm{p} = S'(1-\varepsilon)\mathrm{d}h. \tag{3$'$}$$

Substitution of Eq. (3′) in Eq. (1′) gives

$$-\frac{\rho_s}{2}\frac{\mathrm{d}d_\mathrm{p}}{\mathrm{d}t} = K_l(C_A^* - C_A). \tag{4$'$}$$

As may be seen the first member in Eq. (4′) is identical with the second member in Eq. (4) of our article.The fact that the experimental results are only slightly different from those obtained by other authors makes us believe that the method we propose for the determination of the individual mass transfer coefficient is correct.

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