COMMUNICATIONS TO THE EDITOR

On the Calculation of Catalytic Cracking Reactor-Regenerator Units with Permanent and Temporary Deactivation

E. E. PETERSEN

University of California, Berkeley, California

This communication concerns the article entitled "On the Interdependence of Temporary and Permanent Deactivation in a Reactor-Regenerator System," by J. E. Gwyn and J. D. Colthart (*1*). The main point of this article is correct in principle, namely, that "catalyst particles that undergo an appreciable degree of permanent deactivation per cycle cannot be considered to have time independent temporary and permanent deactivation." I believe the authors perform a service in pointing out this fact lest the equations derived by Petersen (*2*) be applied to a case where this is true.

What the article does not make clear and what prompts this response is that the hypothetical example at the end of their article indicates an error of 25% in the use of Petersen's equations. This is far different from the result one would obtain if more realistic values for catalytic cracking are substituted for the parameters. In the nomenclature of their article, the constants for catalytic cracking have "first-order" values of the order of:

$P \approx 10^{-6}$/sec.	Assume inventory of, say, 80 tons and makeup of about 1 ton/day.
$\lambda \approx 10^{-3}$/sec.	120 tons/hr. recirculation 40 tons or half of catalyst in the reactor.
$k_r = 10$/sec.	See Blanding (*3*). Although Blanding does not assume a first-order process, this value serves as an order of magnitude.

If these numbers are substituted into their Equation (2), one obtains

$$\bar{A}_0 = \frac{\lambda}{p + k_r + \lambda} = \frac{10^{-3}}{10^{-6} + 10^{-3} + 10} \approx 10^{-2}$$

whereas if the numbers are substituted into Equation (4), one obtains

$$\bar{A}_0 = \frac{\lambda}{p + \lambda} \cdot \frac{\lambda}{k_r + \lambda} = \frac{10^{-3}}{10^{-6} + 10^{-3}} \cdot \frac{10^{-3}}{10^{-3} + 10} \approx 10^{-2}$$

Certainly the answers obtained above are the same to the degree that any of the parameters are known. Hence, for catalytic cracking, which is the system Petersen was analyzing, both sets of equations give the same numerical result.

A note of interest also is that from Blanding's data of $k_r = 10$/sec., if $p = k_r = \lambda$ as assumed in an example by the authors, the total catalyst inventory would have to be replaced on the order of every 10^{-1} sec. in the reactor-regenerator unit.

It should be made clear that while the authors are correct mathematically, the magnitudes of the parameters for catalytic cracking lead to the same numerical results by using either the equations of Gwyn and Colthart or Petersen.

This may not be true, however, in all other catalytic systems.

LITERATURE CITED

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3. Blanding, F. H., *Ind. Eng. Chem.*, **45**, 1186 (1950).

Determination of a Single Set of Unlike Pair Potential Interaction Force Constants from Dilute Gas Thermodynamic and Transport Property Data

ALEXANDER T. HU, PATSY S. CHAPPELEAR, and RIKI KOBAYASHI

William Marsh Rice University, Houston, Texas

Previous work (*1*) has shown that interaction parameters for the pair potential for pure substances can be systematically evaluated by simultaneous solution of transport coefficients and second virial coefficients. An extensive discussion on property estimation techniques by Reid (*22*) noted the multiplicity of (σ,ϵ) sets which would satisfy viscosity data on pure substances. He showed that log ϵ/k vs. σ gave a straight line for each gas. He also noted that the (σ,ϵ) parameters from second virial coefficient data gave quite different lines and sug-