LETTERS TO THE EDITOR

To the editor:

The [*AIChE J*, 28, 868 (1982)] published a review of *Chemical Engineering Communications* written by W. F. Ramirez which is at least four years out of date.

I have no doubt that the printing of this four year old review is a result of some unfortunate accident rather than a deliberate policy, but it could be very damaging to the future of *Chemical Engineering Communications*.

Since 1976/77, when George Standart and I took over the editorship of *Chemical Engineering Communications*, the journal has undergone dramatic changes. The transition was not made easier by the untimely death of George Standart in August 1978. George spent a great deal of time and effort in nurturing CEC, and I felt that I owed it to him; to the founders of the journal, Professors Pings and Seinfeld; and to the whole chemical engineering community to continue in building up the CEC into a forum for fast publication of chemical engineering manuscripts. I was fortunate in that Bill Gill accepted by invitation and joined forces with me after George's death.

Since its inception, *Chemical Engineering Communications* has published hundreds of original research papers, short notes, and invited Reviews. An idea about the extent of the operation can be obtained from the fact that the journal published 575 pages in 1979, 1931 pages in 1980, 2417 pages in 1981, and over 1900 pages in the first three quarters of 1982. I am aware that numbers do not tell the whole story, but it is not for me to pass any other judgement. I know only that we have gone a long way, although there is no room for complacency.

We intend to continue in serving the chemical engineering community by providing a publication vehicle which imposes minimum restrictions on subject area, size, or format of submitted manuscripts and which prints the accepted ones in not more than six months after the receipt of the final version. In this, we have been assisted by a highly competent Editorial Board whose many members have actively contributed towards the development of the editorial policies, and by scores of reviewers who, on average, return the reviews in about four weeks time.

I trust that you will publish this letter in the *AIChE Journal* without any delay in order to rectify the misinformation generated by Dr. Ramirez's delayed book review.

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To the editor.

Updated Comments on *Chemical Engineering Communications*

It is not often that a four-year old review suddenly becomes a current event. I was as surprised as anyone to see my review of *Chemical Engineering Communications*, done in the Summer of 1978, appear in the September 1982 issue of the *AIChE J*. The review, I feel, summarized the situation as of four years ago. However, much has changed since then. We now have over eight times as much material published by *Chemical Engineering Communications* as of the May 1978 issue which was the lastest available when my original review was penned. Also, there has been the addition of Professor Gill as Editor due to the untimely death of Professor Standart in August of 1978. A fitting obituary appeared in the January 1979 issue of *Chemical Engineering Communications*.

In 1979 the editors of *Chemical Engineering Communications* emphasized the rapid exchange of technical information and encouraged shorter communications. These shorter communications were particularly evident in the 1980 volumes. A recent trend seems to be more of a balance between shorter communications and longer full-length papers. The editors have done a fine job in commissioning excellent review papers, particularly for the 1980 and 1981 volumes. They have produced a number of innovative issues including the Standart Commemorative Issue of August 1979, the Churchill Birthday Issue, and the B. F. Ruth Special Issue. Full-length papers have shown considerable breadth with perhaps an emphasis in the area of transport phenomena. Over the past four years this Journal has obtained a reputation for speed of publication which has obvious advantages to the technical community for both research and review articles.

Within the past four years, *Chemical Engineering Communications* has become a lively and innovative publication. The current editors are to be complemented on their achievement. Their hard work and dedication to publishing engineering science research is clearly evident. The international scope of this Journal is excellent. Indeed, the current leadership of this Journal has shown that *Chemical Engineering Communications* is, as I had hoped it would be, an "interesting forum for the serious chemical engineering researcher." I wish the editors continued success.

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To the Editor:

Re: "Dynamic Contact Angles" by Gutoff and Kendrick
[*AIChE J.*, 28, 459 (1982)]

In a recent wide ranging paper[1] the above authors extend the work of myself and Kennedy[2] into new fields where the third phase at the contact line was a fluid other than air.

In particular their dimensional analysis introduced the physical property Number, N_{pp}, where:

$$N_{pp} = \frac{g\mu^4}{\rho\sigma^3} \tag{1}$$

The purpose of this short letter is to show that the physical property number N_{pp} is a more complex form of the group we used, viz:

$$N_{pp} = \mu\left(\frac{g}{\rho\sigma}\right)^{1/2} \tag{2}$$

and that on *dimensional grounds* the more complex form reported by Fulford[3] may easily be reduced to our definition.

The reduction may be effected thus (their equation (7)), writing:

$$N_{pp} = \frac{g\mu^4}{\rho\sigma^3} = \frac{g\mu^2}{\rho\sigma}\left(\frac{\mu^2}{\sigma^2}\right) \tag{3}$$

and using the capillary Number, N_{ca}:

$$V = N_{ca}\left(\frac{\sigma}{\mu}\right) \tag{4}$$

we have:

$$\left(\frac{\mu}{\sigma}\right)^2 = \left(\frac{N_{ca}}{V}\right)^2 \tag{5}$$

Hence, substituting:

$$\text{gives} \quad N_{pp} = \frac{g\mu^2}{\sigma\rho}\left(\frac{N_{ca}}{V}\right)^2 \tag{6}$$

$$\text{or} \quad N_{pp}/N_{ca}^2 = \left(\frac{g\mu^2}{\rho\sigma}\right)\Big/ V^2 \tag{7}$$

Finally, for constant fluid properties:

$$V = k\left(\frac{g\mu^2}{\rho\sigma}\right) \tag{8}$$

$$\text{or } V = k\mu\left(\frac{g}{\sigma\rho}\right)^{1/2} \tag{9}$$

as defined by us previously where k is a constant for given conditions.

The implications of the above are clear in that the correlation represented by equation (9) minimises the power to which variables need to be raised to obtain a dimensionless relationship.

Two further points may be made pertinent to the study of Gutoff and Kendrick[1]:

1. Large powers of variables in dimensionless groups lead to large numerical values and the inherent inaccuracy that lies in plotting ill-posed data, e.g. Fig. (12),[1] plots N_{ca} in the range $0.01 > N_{ca} > 1$, against log

N_{pp} in the range $0.10^{-12} > N_{pp} > 10^4$ (as well as effectively containing μ/σ on both axes).

2. The *relative inaccuracy* $\Delta\epsilon/\epsilon$ also increases with the power to which the variable is raised, i.e. for example:

$$\Delta(\mu^4) = 4\mu^3\Delta\mu, \text{ and } \Delta\epsilon/\epsilon = \frac{4\Delta\mu}{\mu}$$

which we consider would help explain the improved correlation coefficient found when comparing dimensional (simple variable) relationships with dimensionless (multivariable, higher power) correlations. Finally, we would not concur with the view expressed that a suitable characteristic length should be found for this problem. It is precisely because there is *a priori* no characteristic length for this problem, a fact which arises from the underlying physics, that we should seek to use the most accurate form of predictive equation, however empirical.

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NOTATION

g = acceleration due to gravity
μ = fluid bulk viscosity
σ = surface tension
ρ = density
V = entrainment velocity

LITERATURE CITED

Gutoff, E. B. and C. E. Kendrick, *AIChE J.*, **28**, 459 (1982).

Burley, R., and B. S. Kennedy, *Chem. Eng. Sci.*, 31, 901 (1976).

Fulford, G. C., "Advances in Chemical Engineering," **5**, 151, Academic Press, New York, T. B. Drew ed., (1964).

Reply:

We are unable to follow the argument by Burley and Jolly that our physical properties group is related to their $\mu(g/\rho\sigma)^{1/2}$. Their equation 9 is

$$V = k\mu\left(\frac{g}{\rho\sigma}\right)^{1/2}$$

where

$$k = N_{ca}/N_{pp}^{1/2}$$

Thus, contrary to what they say, k is not a constant for a given fluid, because the velocity is involved in the capillary number. Equation 9 is just the definition of that dimensionless group, $N_{ca}/N_{pp}^{1/2}$, and cannot be used to relate V as a function of $[\mu(g/\rho\sigma)^{1/2}]$.

Their point that large powers of variables can lead to problems is certainly correct. However, if we had defined a physical properties group $N'_{pp} = N_{pp}$ to the $\pm 1/3$ or $1/4$ power, as others have done, a graph on log paper would have the same appearance. What is important is the final exponent for the important variable, and in both their work and ours it is $\mu^{-2/3}$. Thus the relative error caused by inaccuracies in viscosity should be the same in both our works. Their point that our dimensionless graph has some of the same variables (viscosity and surface tension) on both axes is correct, and this is normally to be avoided. It is one of the problems with dimensionless graphs. And their final point, that one should use the most accurate form of the predictive equation, is unassailable. Therefore our dimensional equation A6 (1).

$$V = 5.11\mu^{-0.67}$$

with its higher correlation coefficient, is much preferred over our dimensionless equation A5

$$N_{ca} = 0.767N_{pp}^{0.088}$$

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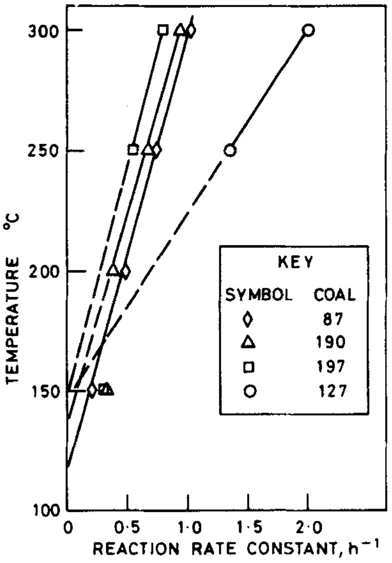
LITERATURE CITED

Gutoff, E. B. and C. E. Kendrick, "Dynamic Contact Angles", *AIChE J.*, **28**, 459 (1982).

To the editor:

Re: "Kinetics of Coal Drying—Decomposition" by Karsner and Perlmutter [*AIChE J.*, **29**, 199 (1982)].

Karsner and Perlmutter use a drying model that assumes zero and first order decompositions of oxy-functional groups to fit their data, providing activation energies as low as 13 to 22 MJ/kmol for CO_2 production.



Reaction Rate Constant as a function of Temperature

I question the use and the usefulness of the Arrhenius equation in this case. As mentioned elsewhere (Brown, 1982) the Arrhenius equation might sometimes be applied mistakenly in conditions where another relationship should be used. One possible relationship is that of heat transfer control of reaction rate constant, of the form

$$k = C(T - T_0) \qquad (1)$$

To test this possibility, the rate constants from Table 3 of the original paper have been plotted directly against temperature, with the results shown in the Figure. The data as plotted could support a linear relationship between k and temperature. The lack of curvature in the plots helps to explain the relatively large values of standard deviation for the E values quoted by Karsner and Perlmutter.

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LITERATURE CITED

Brown, D. J., "The Questionable Use of the Arrhenius Equation to Describe Cellulose and Wood Pyrolysis", *Thermochimica Acta* **54**, 377 (1982).

Reply:

D. J. Brown has raised the question as to whether our data on coal drying-decomposition ought to be considered an example of a process controlled by heat transfer. We argued in our paper for a chemical rate interpretation.

The data in Figure 7 of the reference paper show that transient production rates of CO_2 and H_2O are both independent of particle size over the range tested. If however the rate were heat transfer controlled, one would expect rate to vary inversely with particle diameter, since the Nusselt number is approximately constant in these experiments. Moreover, the rate constants reported in Table 2 of the reference paper are the same for a given coal regardless of particle size.

To cite another line of reasoning, Figure 6 shows the CO_2 production varies among coal types sieved in the same particle size range. If however the rates were heat transfer controlled, coals of the same particle size would be expected to exhibit equal or at least similar rates. The rate constants listed in Table 3 vary from 0.55 to 1.35 hr^{-1} for the four coals tested at 250°C.

Finally, if heat transfer control were in fact the case, the data points on the Figure provided by Brown would be expected to fall along a single line, since the data taken from our Table 3 are all from tests on samples of the same particle size. Brown's Figure evidently does not meet this expectation.

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