LETTERS TO THE EDITOR

To the Editor:

On: "Influence of Surface Tension on Jet-Stripped Continuous Coating of Sheet Materials" by E. O. Tuck and J.-M. Vanden Broeck (page 808 of this issue).

This paper [1] derives a formula (equation (28)) for the withdrawal flux on a flat surface emerging vertically from a bath of liquid under the influence of gravity, pressure, surface shear and surface tension effects. The theory is claimed to be an improvement on the Thornton and Graff theory [2]. It should be pointed out, however, that an investigation of air knife-generated surface shear effects has been made in Reference 3, where it is shown that shear stresses give an important correction to the withdrawal flux predictions based only on pressure gradient effects [2].

Reference 1 only gives results for the case of zero jet shear stress. If shear stresses are not included one cannot differentiate between the effects of jets operating at low pressures close to the surface and jets operating at high pressure farther from the surface, both of which can theoretically be set up to achieve exactly the same effects on the coating. When shear stresses are included there are distinct differences between these operating conditions, manifest as significant variations in the liquid film surface velocities. For cases in which solidification of the coating takes place soon after the jet stripping, variations in film velocities can cause different frozen surface effects.

Furthermore it can be shown that there is better agreement between data collected from galvanizing lines and the theory which includes the jet shear stress effects [4]. The theory of Reference 2 gives an estimate of the withdrawal flux which can be, for plane jet normal impingement, 40% larger than that predicted by Reference 3.

Reference 1 concentrates on the influence of the coating surface tension in modifying the pressure stripping conditions (Section 4). Because of the extremely small rates of change of coating thickness, as the coating passes through the stripping zone, surface curvature can be shown to be very small. Reference 3 has investigated this issue and has concluded that surface tension corrections are unnecessary for accurate prediction of jet-stripped withdrawal fluxes of metallic coatings. In terms of the parameter, introduced in Reference 1, the values of τ (equation (38)) relevant to a jet-stripped metallic coating would not exceed 0.02 in practice. Thus, it would appear, at least for jet-stripped metallic coatings, that Figure 2 of Reference 1 while covering an unnecessarily wide range of values of τ, merely confirms that surface tension effects can indeed be safely ignored.

A final comment may be made concerning the space given in Reference 1 to a comparison of stripping based on impingement pressure distributions of Gaussian and piece-wise quadratic types (two sets of curves being given in Figure 2). There appears to be little value in this comparison since numerical calculations are necessary to generate the results and no benefit can be gained analytically from using a simple, but physically inaccurate, quadratic expression in preference to Gaussian representations of the impingement pressure distributions.

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LITERATURE CITED

[1] Tuck, E. O. & Vanden Broeck, J.-M., 'Influence of Surface Tension on Jet-Stripped Continuous Coating of Sheet Materials', *J. American Inst Chem Engineers* (1983).

[2] Thornton, J. A. & Graff, H. F., 'An Analytical Description of the Jet Finishing Process for Hot-Dip Metallic Coatings on Strip', *Metallurgical Trans* (Ser B) 7,607 (1976).

[3] Tu, C. V., 'An Investigation of the Jet Stripping Process', M.E. Thesis, University of Wollongong, Australia (February, 1983).

[4] Ellen, C. H. & Tu, C. V., 'An Analysis of Jet Stripping of Molten Metallic Coatings', *Proc Eighth Australasian Fluid Mech Conf*, Newcastle, Australia (1983).

Reply:

The authors have no quarrel with the factual information provided in this Letter regarding the galvanising application. We believe that our parameter τ in Figure 2 is valuable as a tool for confirming exactly when surface tension can be ignored in any particular application. Although we included surface shear in our theory, our numerical computations were restricted to the special case of negligible shear stress relative to normal stress, in order to concentrate attention on the role of surface tension. Ellen and Tu have now carried out such computations, for cases of relevance to their industry, in which the effects of shear stress appear to be comparable with those of normal stress, and their work can be considered as complementary to ours.

The final paragraph of the Letter is a matter of opinion, with which we do not agree. Our reason for using two different idealized mathematical forms for the pressure distribution is precisely to show that there is little influence of this shape on the final coating thickness, providing that the maximum pressure and maximum pressure gradient are fixed. Having established that this is true, we can then be confident that essentially the same results would hold if (for example) actual experimental data were used for the jet's pressure distribution.

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BOOKS

Mass Transfer with Chemical Reaction in Multiphase Systems, Volume II: Three-Phase Systems, Edited by Erdogan Alper, Martinus Nijhoff Publishers, Boston, 1983. 1078 pages, $140.00

This two-volume set is comprised of the invited reviews and original contributions presented at a NATO Advanced Study Institute held in Turkey in 1981. There are 30 papers by 12 invited lecturers including E. Alper, J. C. Charpentier, W. D. Deckwer, H. Sawistowski, Y. T. Shah, and others, and nine other contributions. The collection includes several papers addressing the narrow subject of mass transfer enhanced by chemical reaction. However, it also includes reviews and contributions to the general problems of multiphase contacting and reactor design in multiphase systems. There are several reviews that attempt to scope these general problems and other excellent reviews of mass transfer parameters for gas-liquid, liquid-liquid, solid-liquid, and 3-phase contactors. Other specific reviews cover facilitated transport, coal technology, trickle-bed reactors, slurry reactors, and biochemical reactors. The level of presentation varies from very general wordy reviews to highly specific mathematical derivations. The volumes should be of interest to chemical engineers involved in R&D with interphase mass transfer with or without chemical reactors.

The books are printed from camera-ready papers. At times the tables and figures are poorly labeled and the nomenclature is difficult to follow. There are only two English-speaking authors and the balance of the papers generally reflect the poor sentence structure and odd choice of English vocabulary by European authors. Most of the reviews however, have a wealth of references and data which make the English tolerable.

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