Comments on "Reverse roll coating of viscous and viscoelastic liquids"

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1 AUTHOR:

Tai-Shung Chung

National University of Singapore

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Comments on "Reverse Roll Coating of Viscous and Viscoelastic Liquids"

Sir: Greener and Middleman, in their recent publication (1981), developed a mathematical model for the reverse roll coating (RRC) process. It appears that there is an error in the formulation of the governing equation.

Starting with eq 10 of their paper and using their Figure 2 as an illustration, they derived the mass balance equation between the rolls as

$$U_f H_f - U_r H_r = 2\lambda H_0 U_f \tag{1}$$

where λ is a dimensionless flow rate through the nip. Equation 1 results in $U_f H_f > U_r H_r$ if λ is positive. Since it is physically possible for $\lambda > 0$ but it is physically impossible for the liquid taken up by the top roll to be larger than the supply from the bottom roll, this equation seems to be in error. An improved formulation would be

$$U_f H_f - U_r H_g = 2\lambda H_0 U_f \tag{2}$$

where H_g is defined in Figure 1. Here we also use their simplifying assumption that the variation of liquid film thickness around the roll is negligible. If we include the simple mass balance statement

$$U_r H_r = U_f H_f + U_r H_g \tag{3}$$

eq 2 becomes

$$2U_f H_f - U_r H_r = 2\lambda H_0 U_f \tag{4}$$

or

$$\nu \equiv \frac{H_f}{H_r} = \frac{1}{2}\frac{U_r}{U_f} + \lambda\frac{H_0}{H_r} \tag{5}$$

Substituting the known relationship between λ and U_r/U_f into eq 5 yields

$$\nu = \frac{1}{2}\frac{U_r}{U_f} + 0.613\left(1 - \frac{U_r}{U_f}\right)\frac{H_0}{H_r} \tag{6}$$

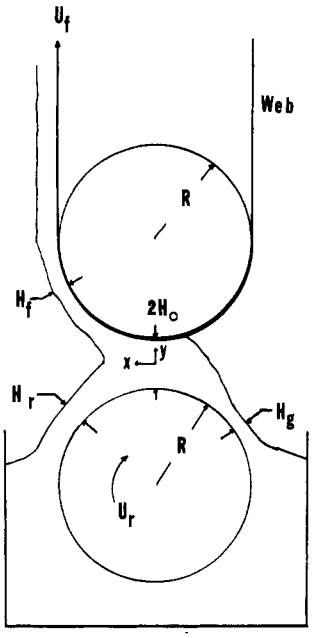

Figure 1. Schematic of reverse roll coating.

Which differs by a factor of two from their equation

$$\nu = \frac{U_r}{U_f} + 1.23\left(1 - \frac{U_r}{U_f}\right)\frac{H_0}{H_r} \tag{7}$$

Comparing the predications based on eq 6 to their experimental results, all data deviate significantly from the theoretical calculation. This deviation appears to be a result of the simplifying assumptions or something else.

Literature Cited

Greener, J.; Middleman, S. *Ind. Eng. Chem. Fundam.* **1981**, *20*, 63.

Celanese Research Company **Tai-Shung Chung**
Summit, New Jersey 07901

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Sir: Equation 1 cannot be in error since it is merely a definition of λ. Chung is free to define a different λ, as in his eq 2. Subsequent equations will then, of course, differ from ours.

Department of Applied Mechanics and Engineering Sciences **Jehuda Greener**
Stanley Middleman*
University of California, San Diego
La Jolla, California 92093

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