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ChE letter to the editor

Dear Sirs,

We welcome the comments of Baird and Rama Rao[1] on our paper concerning a simple experiment on two-phase film flow[2] and hope that this discussion attracts the readers to this somewhat neglected area in lab courses of fluid mechanics.

Baird and Rama Rao point out that the experiment we described must be performed in tubes with internal diameter greater than 15 mm, for otherwise the bubble velocity will not be given by the simple equation

$$U = 0.345(gD)^{0.5} \qquad (1)$$

It is true that for smaller diameters the effect of surface tension becomes important and Eq. (1) ceases to be valid (if the tube is small enough, the slug will not move as pointed out), but in our paper we also present a general analysis for laminar film flow that makes no use of Eq. (1) (see Eq. (7) in ref. 2). However, if smaller tubes are used, the analysis presented is only approximate since the curvature of the film can no longer be neglected, and Nusselt's analysis is no longer applicable. Figure 1 shows the correct film thickness (calculated for cylindrical film flow[3]) as a function of the approximate film thickness given by Nusselt's analysis (neglecting the film curvature). It can be seen that if the dimensionless film thickness is greater than about 0.2, the errors in film thickness become larger than 10%.

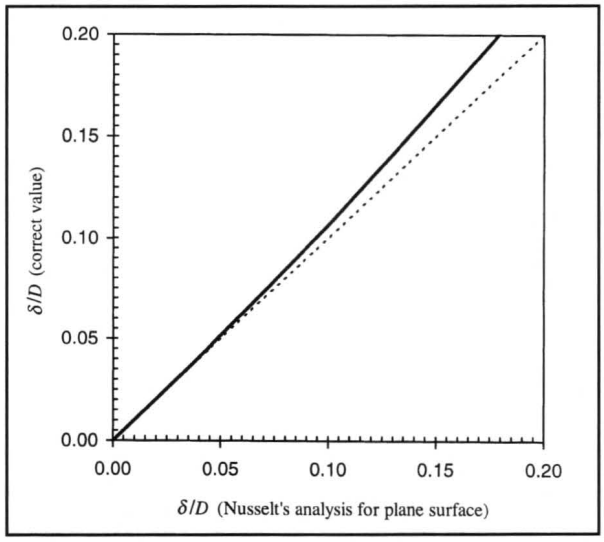

Figure 1- Correct versus approximate film thickness.

In order to minimize possible sources of error, it is suggested that columns with internal diameters in the range of 15-35 mm be used. With larger tube diameters it may be difficult to obtain laminar film flow, unless very viscous solutions are used. Also, one has to use longer columns due to greater velocities of the bubble, and the complexity of the instalation increases.

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