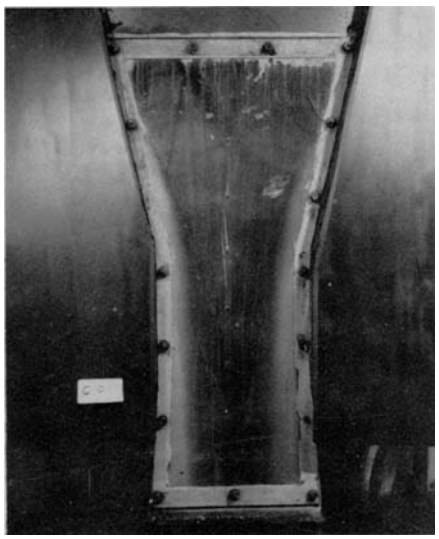
LETTERS TO THE EDITOR

TO THE EDITOR: MATHEMATICAL MODELING OF ATOMIZING SCRUBBERS

Commendably, Taheri and Sheih (1975) suggest that the task of modeling the performance of a venturi scrubber should be cast as a boundary value problem wherein one solves for the transverse as well as the axial distribution of liquor drops.

However, in carrying out this suggestion, these authors fail to consider the effects of initial transverse liquor momentum. That this effect is extremely important is evident from comparing previously published photographs (Figures 6 and 12 of Boll, 1973). These both pertain to the same throat velocity (300 ft/s) and the same point of liquor injection; only the initial liquor momentum is different (L/G of 4.5 gal/mft^3 vs. 9.0 through the same liquor nozzles). A large central void may be noted in the one case (4.5 gal/mft^3) vs. more-or-less uniform throat coverage in the other. Moreover, Figure 1, which is entirely new, was taken in the same venturi and at the same gas velocity as before, but with different liquor nozzles and a very low liquor flow (L/G $\simeq$ 1.7 gal/mft^3) so as to produce virtually zero initial liquor velocity. It will be seen that an actual line source produces only about 2 in. penetration at the bottom of the throat, or even less than the previous photographs would indicate. Surely, the mathematical treatment of the liquor injection as two line sources could not predict these substantial differences in liquor distribution nor the substantial differences in particle collection that they must engender.



To be sure, Taheri and Haines (1969) have shown that a large venturi can have quite poor liquor distribution at the bottom of the throat and still collect some 90% of the entering particulate. However, their particle size was not measured and, being produced by pneumatic atomization of a 1% dye solution, could easily have been about 5-microns mass-median diameter. Such coarse particles can be captured in the venturi diffuser as well as in the throat, explaining the 90% efficiency. On the other hand, particles of 0.5-micron size are captured primarily in the throat, and 50% throat coverage would necessarily mean less than 50% collection efficiency for these sizes.

In view of these considerations and the fact that Taheri and Sheih's calculations correctly predict Brink and Contant's (1958) particle-collection data even for the 0.5-micron size, it is suggested that their calculations contain not just one but two defects. The second defect might possibly be omission of the term $\left(-C_d \frac{\partial U_d}{\partial x} \right)$ in their Equation (2) since flow transport of liquor drops is correctly described by $\frac{\partial}{\partial x}(U_d C_d)$, not by $U_d \frac{\partial C_d}{\partial x}$ alone.

LITERATURE CITED

Boll, R. H., "Particle Collection and Pressure Drop in Venturi Scrubbers," *Ind. Eng. Chem. Fundamentals*, **12**, 40 (1973).

Brink, J. A. Jr., and C. E. Contant, "Experiments on an Industrial Venturi Scrubber," *Ind. Eng. Chem.*, **50**, 1157 (1958).

Taheri, M., and C. M. Sheih, "Mathematical Modeling of Atomizing Scrubbers," *AIChE J.*, **21**, 153 (1975).

Taheri, M., and G. F. Haines, "Optimization of Factors Affecting Scrubber Performance," *J. Air Pollut. Control Assoc.*, **19**, 427 (1969).

R. H. Boll
The Babcock & Wilcox Company
Research Center
Alliance, Ohio

TO THE EDITOR: ON MATHEMATICAL MODELING OF ATOMIZING SCRUBBERS

Dr. Boll's comments with regard to the consideration of initial liquid momentum in the y or z direction for a cross current atomizer have not been overlooked in our paper. We acknowledged and pointed out explicitly that the effects of initial transverse liquor momentum would be a contributory factor but since we found that the numerical solutions of the problem are much easier and convenient, as a first attempt we treated the source of liquid as a line or area source in the direction of water injection. Although this procedure may not have universal application, it was, however, found that the predicted results compared extremely well with data presented by Brink and Contant (1958) and showed clear superiority to prediction made by Boll (1973), based on his analysis assuming uniform water droplet concentration distribution.

Further, we are rather surprised to note that Dr. Boll presents an evidence of significance of effect of initial liquid momentum from a photograph which corresponds to utterly different liquid-to-gas ratios. Realizing that this ratio is the most important factor in the water distribution, he should have considered this fact in bringing forth the evidence. Finally, for the collecting zone which is of a relatively short length, the change of u_d with respect to (x) can be logically assumed insignificant compared to change of C_d with respect to (x).

LITERATURE CITED

Boll, R. H., "Particle Collection and Pressure Drop in Venturi Scrubbers," *Ind. Eng. Chem. Fundamentals*, **12**, 40 (1973).

Brink, J. A. Jr., and C. E. Contant, "Experiments on an Industrial Venturi Scrubbers," *Ind. Eng. Chem.*, **50**, 1157 (1958).

Taheri, M., and C. M. Sheih, "Mathematical Modeling of Atomizing Scrubbers," *AIChE J.*, **21**, 153 (1975).

M. Taheri
Dept. of Chemical Engineering
Pahlavi University
Shiraz, Iran