Corrected values for static menisci on the outside of cylinders

By M. A. HILDEBRAND† AND J. A. TALLMADGE

Drexel University, Department of Chemical Engineering,
Philadelphia, Pennsylvania 19104

The meniscus profiles determined numerically by White & Tallmadge (1965) have been found to be in error. Accordingly, the reported values of meniscus height and curvature at the top of the meniscus are also in error. These errors were initially suspected by observing that top curvatures calculated from the reported values of height fell below the minimum possible (flat plate) value at large radii.

This error has now been explained and removed. Corrected values of meniscus height b as a function of radius R are given in table 1, using capillary length a to obtain non-dimensional parameters. These values are suitable for zero contact angle, as described previously. Corrected values for top curvatures can be calculated from table 1 using the theoretical expression

$$C = 2B + (1/G_0). \tag{1}$$

Table 1 indicates the magnitude of errors in the previously reported meniscus height, as a function of cylinder radius. The errors were about $7 \pm 1 \%$. The corrected numerical values are also of interest to those who wish to either (*a*) calculate meniscus heights for specific radii not shown in table 1 or (*b*) calculate meniscus profiles for any specific radii.

The error was found (Hildebrand 1968) to be due to a typographical error in the computer program of White (1965, p. 167, computer statement 56). Specifically, the first number (which appears correctly as one) on the right side of equation (9) in White & Tallmadge (1965) was found to be programmed as two. Thus no error appears in the equations given in White & Tallmadge (1965).

Once found, the error was easily corrected. The results reported in table 1 were obtained, however, only after a detailed search for the possible explanation. During the diagnostic study, a new variable was introduced ($S^* \equiv S - G_0$) in an attempt to reduce truncation errors, but no effect on meniscus height was noted within the range studied. Use of the new variable, which was felt to be unnecessary and was discontinued, is therefore not recommended. Subsequent calculations, including those for table 1, were made with the 14 place arithmetic of double precision in place of the single precision of earlier work. However, no effect of double precision on meniscus height was noted within the range studied (Hildebrand 1968).

† Present address: Department of Chemical Engineering, University of Texas, Austin, Texas.

The explanation reported here was developed and tested in 1968. Since then, the authors have been informed of another method of determining meniscus heights (Scriven, private communication; Huh & Scriven 1969). However, the Huh & Scriven method does not provide for evaluation at given values of radius (i.e at given G_0).

The results given in table 1 present accurate values of the maximum heights at given wire radii, for liquids which wet the surface completely and have a zero contact angle. David Marshall assisted in the preliminary calculations.

Wire radius $G_0 \equiv R/a$	Maximum height $B \equiv b/a$	
	Reported earlier, White & Tallmadge (1965)	Corrected values, this work
0·03	0·110	0·1191
0·06	0·180	0·1965
0·1	0·252	0·2766
0·2	0·381	0·4171
0·3	0·468	0·5111
0·4	0·532	0·5790
0·6	0·618	0·6706
1·0	0·713	0·7705
3·0	0·847	0·9087
6·0	0·889	0·9519
10·0	0·907	0·9705
30·0	0·926	0·9900
∞ (flat plate)	1·000	1·000

$a \equiv$ capillary length $\qquad a \equiv (2\sigma/\rho g)^{\frac{1}{2}}$

TABLE 1. Effect of wire radius on meniscus height

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