# AN ADJUSTABLE CAPILLARY METHOD FOR THE DETERMINATION OF SURFACE TENSIONS

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The best standard method for determining the surface tension of a liquid is the capillary rise method. This method is capable of very good accuracy when suitable precautions are taken, but in practice it suffers from the fact that the calibration of the capillary diameter is tedious and requires a traveling microscope.

The purpose of this paper is to describe a method of calibration which is simple, rapid, and gives excellent results. In its simplest application it gives results accurate within one-half percent, suitable for routine determinations or for physical chemistry laboratory, and with care should be useful as a highly accurate research method.

The capillary is given a permanent marking at some convenient height. The capillary is inserted into a pure liquid of known surface tension, and the equilibrium position of the capillary meniscus brought just to rest on the capillary marking. The meniscus is adjusted to this point by either of two ways: first, by getting an approximate adjustment just below the desired level by raising or lowering the capillary, and then adding liquid a drop at a time to the reservoir of liquid in the principal container or, second, by having the capillary mounted on a screw-driven trolley so that very fine vertical adjustments can be easily made by turning a knob. The height of the liquid column in the capillary can be accurately measured with a cathetometer.

From the capillary rise and the known value of the surface tension, the radius of the capillary is easily calculated. The capillary can then be used to determine the surface tensions of other liquids by adjusting the capillary to bring the meniscus to rest on the mark at which the capillary was calibrated with the reference liquid.

TABLE 1

*Surface tension values by the adjustable capillary method*

| Compound | Literature | Cap 1 | Cap 2 | Cap 3 | Cap 4 | Cap 5 |
|---|---|---|---|---|---|---|
| Benzene | 28.88 | 28.81 | 28.86 | 28.85 | 28.90 | 28.86 |
| Methanol | 22.61 | 22.55 | 22.57 | 22.62 | 22.64 | 22.60 |
| Toluene | 28.50 | 28.47 | 28.56 | 28.51 | 28.38 | 28.50 |
| Carbon Tetrachloride | 26.95 | 26.90 | 26.96 | 26.97 | 27.01 | 26.93 |
| Chloroform | 27.14 | 27.13 | 27.10 | 27.10 | 27.14 | 27.17 |

Table 1 shows the method applied to several liquids for five different capillaries. Each was calibrated with acetone at 20° C. The reservoir in each case was a 200 ml test tube in a 20° C water bath. The capillary height was adjusted by hand. Readings of the capillary rise were made with a cathetometer.

The agreements shown in the table are excellent; yet the materials are inexpensive and the procedure easy. It seems to us that this method could be made adequate for research determinations by using a properly made reservoir and a capillary tube rigidly mounted on a raising device with a micrometer adjustment screw.

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