Interfacial Tension Measurement and Adsorption Isotherm Determination Using the Inverted Drop Weight Method

Teng-Jui Lin
Department of Chemical Engineering, University of Washington

Surface and Colloid Science

Surface tension calculation from the drop weight method

- Tate (1864)

$$W = 2\pi r\sigma$$

- Harkins and Brown (1919)

$$W = 2\pi r\sigma f = \frac{r\sigma}{F}$$

$$F \equiv \tfrac{1}{2}\pi f$$

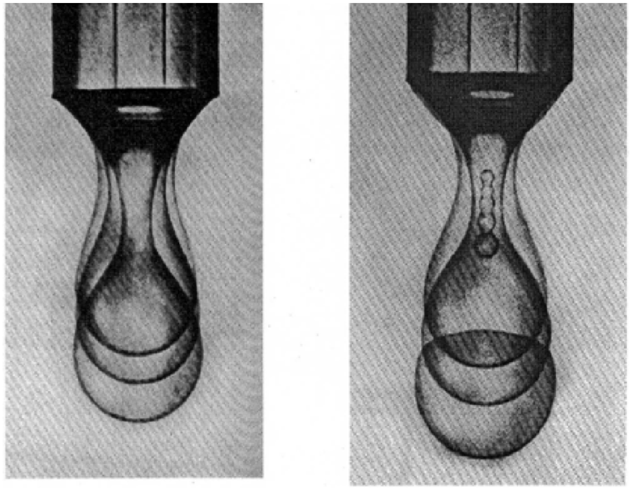
- Heertjes et al. (1971)

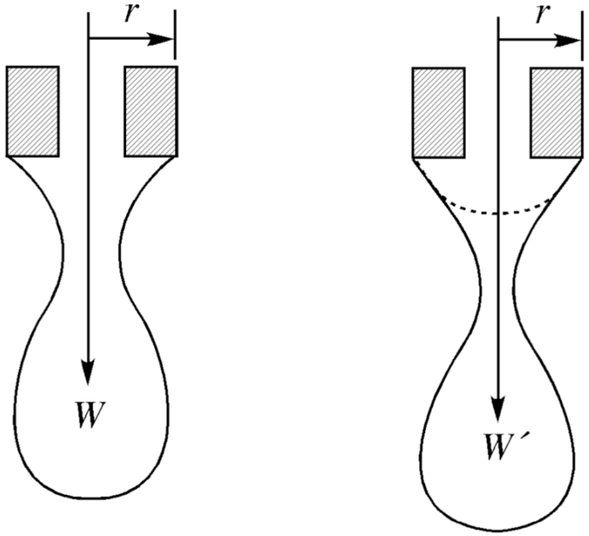
$$F = 0.14782 + 0.27896\left(\frac{r}{V^{1/3}}\right) - 0.1662\left(\frac{r}{V^{1/3}}\right)^2$$

Constraint: $\left(\frac{r}{V^{1/3}}\right) \in (0.3, 1.2)$

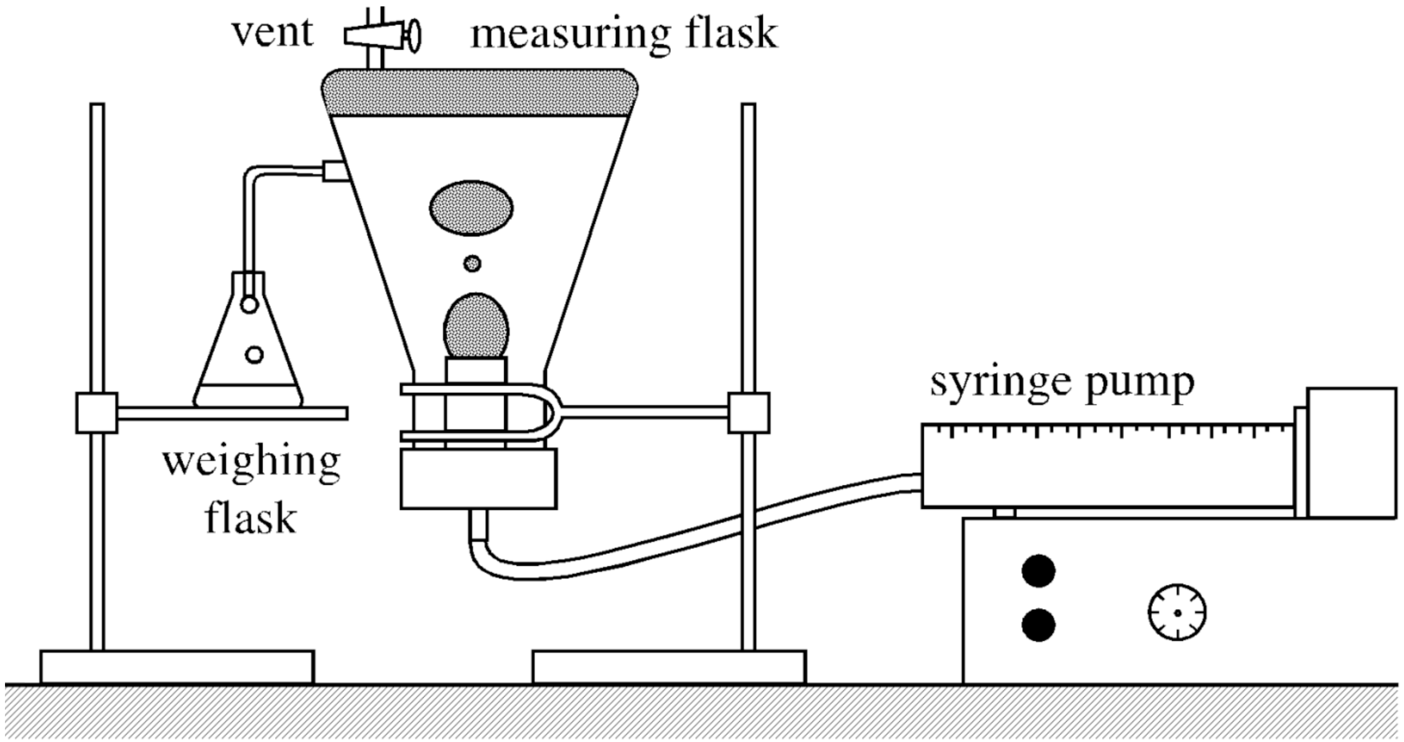
- Surface tension

$$\sigma = \frac{V|\rho_2 - \rho_1|gF}{r}$$





Interfacial tension between liquids is measured with inverted drop weight method



- Interfacial tension
  - $\sigma = \dfrac{V|\rho_2 - \rho_1|gF}{r}$
  - $F = 0.14782 + 0.27896\left(\dfrac{r}{V^{1/3}}\right) - 0.1662\left(\dfrac{r}{V^{1/3}}\right)^2$

Szyszkowski equation describes surface tension of binary aqueous solutions

- Szyszkowski equation

$$\sigma = \sigma_0 - RTB \ln\left(1 + \frac{C_2}{a}\right)$$

Adsorption isotherm is modeled by Gibbs adsorption equation

- Gibbs adsorption equation: ideal dilute solution

$$\Gamma_{2,1} = -\frac{C_2}{RT}\frac{d\sigma}{dC_2}$$

- Finite difference method

$$\frac{d\sigma}{dC_2} = \frac{\Delta\sigma}{\Delta C_2} = \frac{\sigma_2 - \sigma_1}{C_{2,2} - C_{2,1}}$$

- Szyszkowski equation

$$\sigma = \sigma_0 - RTB\ln\left(1 + \frac{C_2}{a}\right)$$