Surface Tension

(By Xinli Wu, xxw101@psu.edu, 863-1537)

1. The Phenomenon of Surface Tension

When a faucet with a narrow orifice is turned on slightly, a drop will be seen to form and hang for some time before it drops suddenly. The drop is supported before it falls by the vertical component of the surface tension. If a capillary tube is dipped into water, the liquid inside the tube rises higher than that outside. Here, the film of the liquid on the inside wall of the tube exerts an upward pull. It is commonly observed that water drops on a hot stove or on very dry dust assumes a spherical shape, which is the form assumed by a balloon surrounded by a uniform membrane. This suggests that every liquid is surrounded by a film, the tension of which causes the surface to contract to the smallest possible area for the volume of the liquid, provided other forces (such as gravitational) do not act to change the form.

2. The Definition of Surface Tension

The surface tension (also called surface stress sometimes), of a liquid is expressed as a force per unit length (dynes/cm). Surface tension of a liquid is numerically equal to the free energy of its surface per unit area. The surface tension of water at 20^{o} C is 72.80 dynes/cm.

3. Discussion

It will be easier to remove the water from the surface of the polyethylene jacket in the 2^{nd} design project if the surface tension is lowered. Here are some factors that can lower the surface tension. ***(1). Surface tension lowering by heating:*** The surface tension, and therefore the free surface energy, of a liquid decreases as the temperature rises, and very nearly as a linear function of the temperature. According to the rule of Le Chatelier, if the state of a system is changed, the system alters in such a way as to resist that change. Thus, if the solubility of a salt increases with the temperature, the last amount of salt which dissolves to saturate the solution has a cooling effect. This cooling lowers the solubility and thus retards the solution of the salt. Since the surface tension decreases with increasing temperature, a surface must cool if it is expanded, because by cooling the surface tension is increased, and this opposes an extra resistance to further extension. ***(2). Surface tension lowering by dissolution,*** and ***(3). Surface tension lowering by other factors.***

References

Burdon, R.S., (1940), Surface Tension and the Spreading of Liquids, Cambridge University Press, London.

Eustathopoulos, E., Nicholas, M.G., and Drevet, B., (1999), Wettability at High Temperatures, Pergamon, Amsterdam.

Harkins, W.D., (1952), The Physical Chemistry of Surface Films, Reinhold Publishing Corporation, New York.

Schrader, M.E., and Loeb, G.I., (1992), Modern Approaches to Wettability, Theory and Applications. Plenum Press, New York.