Surface and Interfacial Tension of Liquids

The surface tension and interfacial tension are the result of imbalanced inter-molecular forces at the surface of a liquid or at the interface between liquids. Inside a liquid, any molecule has an equal number of neighboring molecules. Therefore, the net force acts on any inside molecule is zeroed out. On the other hand, the surface molecule has reduced number of neighboring molecules and this arrangement results in an inward cohesive force acting on the surface molecules. Liquid surface tension and solid surface free energy are from the same origin and could be used interchangeably in some situations. Existence of surface and interfacial tension may be evidenced by phenomena like a small part made of a denser material floating on a liquid surface or morning dew beading up on leaves. In general, low surface tension liquids have better surface wetting properties. High surface tension liquids have a higher tendency to form droplets. Surface and interfacial tension have infinite numbers of industrial applications where liquids, liquid to liquid interface, or liquid to solid interface are of interest. One of the most known applications could be in surfactant. Surfactant is a surface active agent to reduce surface tension of a liquid in order to increase the solution's wettability to surfaces or increase cleaning efficiency.

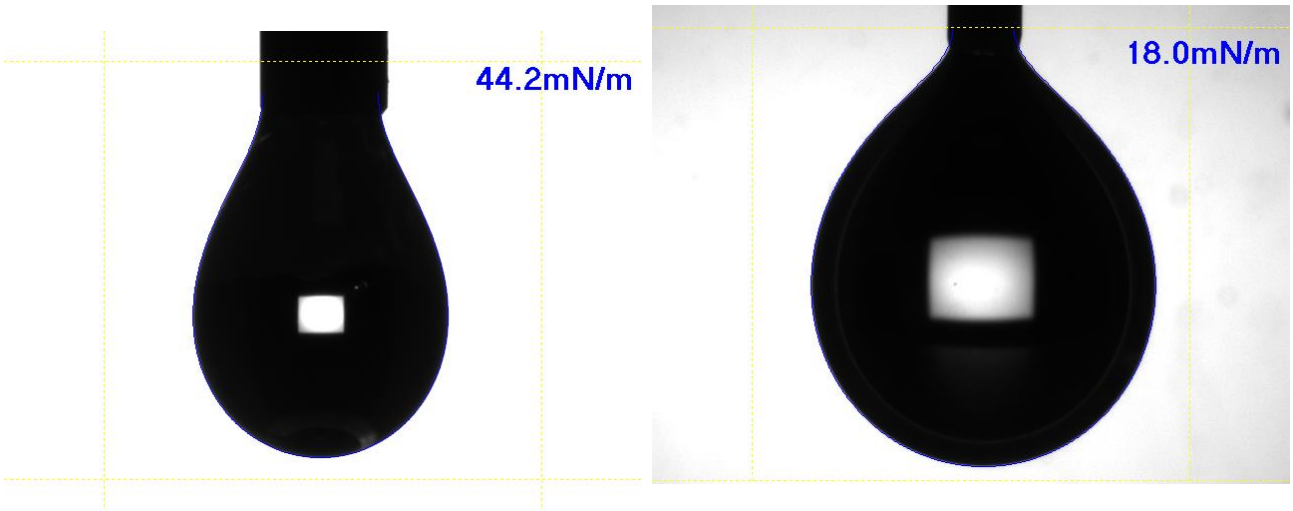

Figure 1. Image captures of a pure epoxy droplet suspended in air (left) and a water droplet suspended in toluene (right) and used for surface and interfacial analyses.

Kyowa's Contact Angle Meters all have the ability to measure the surface and interfacial tension of a liquid. For conducting the measurement, the largest possible droplet is created on the end of the needle of liquid dispenser. Using either the ds/de or the Young-Laplace analysis routine, the surface and interfacial tension of the liquid is found. Both analysis routines are part of the

FAMAS software available on the contact angle meters. This method is also referred to as the Pendant Drop method.

Any material that can be expelled through the dispenser tip can be measured by the Pendant Drop method. These materials include aqueous solutions, beverages, chemicals, cosmetic creams, food pastes, inks, oils, paints, surfactant solutions, tooth pastes, etc. To accurately measure the surface tension, the droplet has to reach equilibrium. Most liquids will reach an equilibrium point quickly. Thicker fluids may take a bit longer time to reach equilibrium. As demonstrated in Figure 1, the surface tension of a pure epoxy was found to be 44.2mN/m using the Young-Laplace routine.

The Pendant Drop method is not limited to surface tension measurements in air. A liquid can be used as the surrounding medium provided sufficient light is allowed to pass through. As shown in Figure 1, the interfacial tension of water in toluene could be easily determined. To ensure accurate measurement, the droplet was left suspended in toluene to reach equilibrium. Once equilibrium was reached, the interfacial tension of water in toluene was found to be 18.0mN/m using the Young-Laplace routine.