Ebatco Nano
A Bimonthly Newsletter

Vol. 2 | Issue 04
July/August 2012

Nano Brief

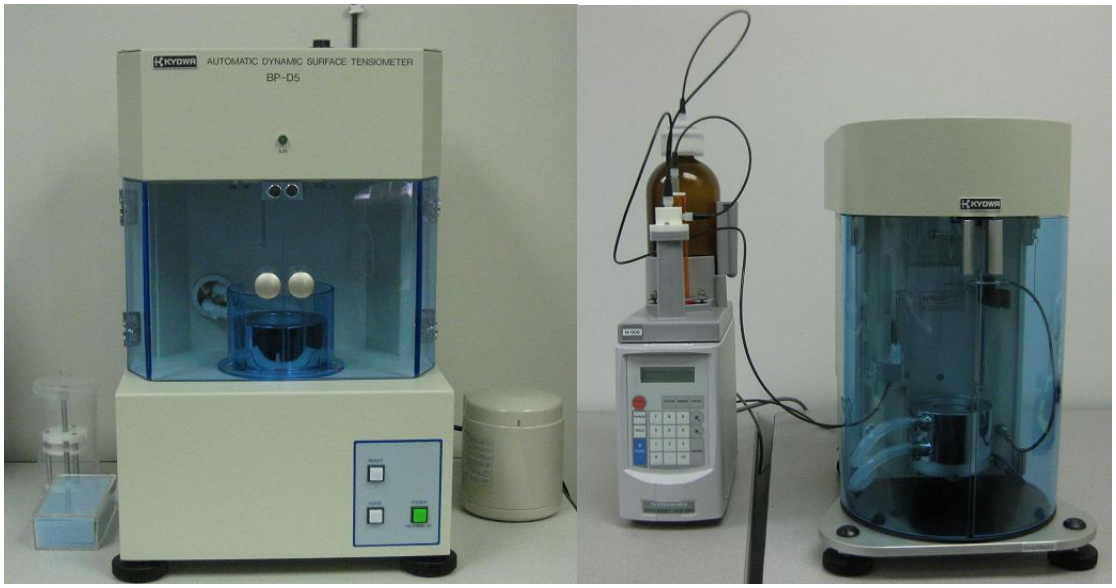
On September 11-12, representatives from Ebatco will be exhibiting at the Coating Tends & Technologies Conference in Oakbrook, IL. We hope to see you there!

Ebatco

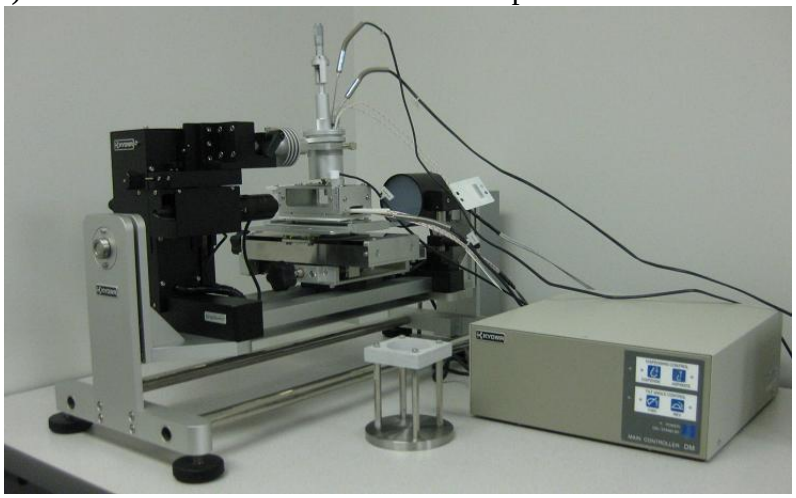
The NAT Lab has acquired new instrumentation from Kyowa Interface Science to expand our surface and interface characterization capabilities. The first of these instruments is the BP-D5 Automatic Dynamic Surface Tensiometer. The BP-D5 is a standalone instrument that measures the dynamic surface tension of a liquid. Instead of utilizing solid probes to determine the surface tension, such as the Wilhelmy Plate and du Noüy Ring, the BP-D5 employs a capillary probe with a known radius based on so called maximum bubble pressure technique. By applying a controlled gas stream through the capillary to generate series of bubbles with varying lifetimes to measure the maximum bubble pressure, the dynamic surface tension values of a solution can be determined.

Another instrument capable of analyzing surfactants in solution is the Automatic CMC (critical micelle concentration) Measurement Option. The Automatic CMC Measurement Option is an accessory for the DyneMaster series of surface tensiometers made by Kyowa Interface Science. With this option, a DY-500 or DY-700 surface tensiometer can determine the critical micelle concentration for a solution. With this option, the instrument automatically increases the concentration of the surfactant or other additive to a solution, and determines the surface tension after each increment of concentration. This will benefit our customers who have needs for determining the critical micelle concentration due to the improved capability to produce quicker measurement results.

The newly acquired Heater Type Stage and Heater Type Dispenser enhance thermal control capabilities of our contact angle meter. Normally, the DM-701 analyzes the contact angle of a liquid formed on a solid surface at room temperature. The addition of the Heater Type Stage and Dispenser allow for measurements under elevated temperatures of the sample, test liquid or both up to 380°C. These devices enable the characterization of materials that are not in liquid format at room temperature, such as polymers, waxes and solder materials. They are also great for studying effect of temperature on contact angle, wettability, and interactions of liquids with solids.



Kyowa BP-D5 (left) and Automatic CMC Measurement Option with a DY-700 Tensiometer (right)

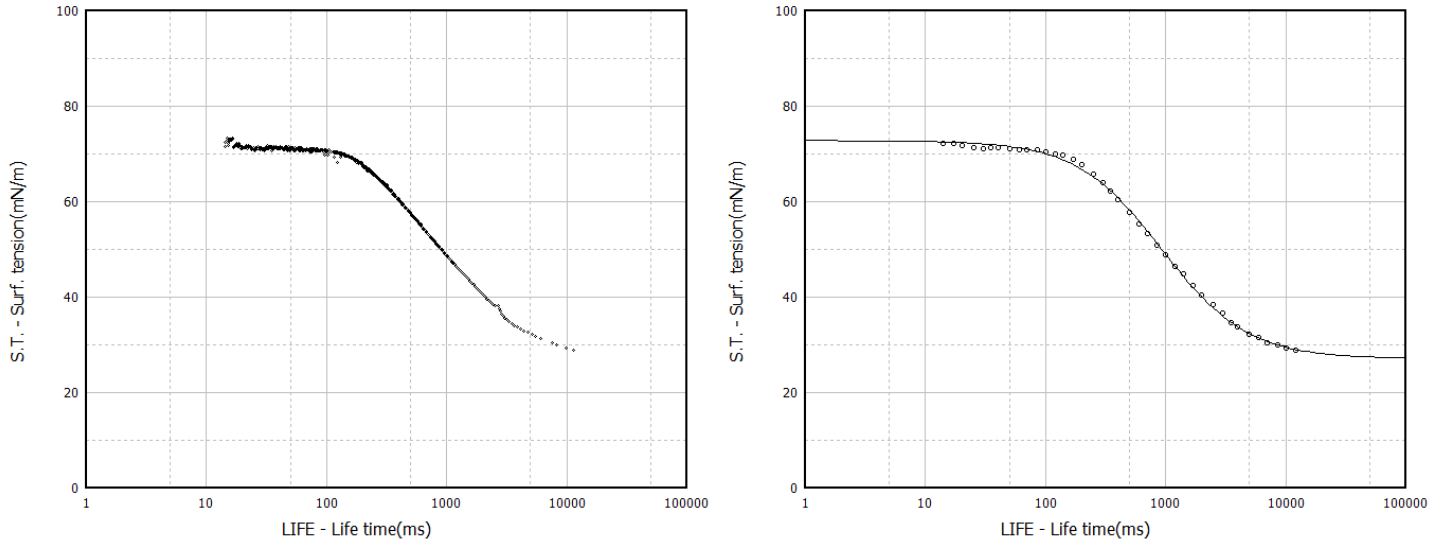

Heater Type Stage and Heater Type Dispenser with a DM-701 contact angle meter with rotation stage.

Case Study

Surfactants reduce surface tension and increase wettability of a liquid, but the effect is time dependent. In applications that require quick wetting, such as high-speed printing, some surfactants may not ideal for the inks to reach the desired surface tension in a timely manner. Dynamic surface tension measurements available on the BP-D5 type of instruments therefore become critical.

The BP-D5 Automatic Dynamic Surface Tensiometer is designed for measuring the dynamic surface tension of surfactant solutions through the maximum bubble pressure technique. The maximum bubble pressure technique works by controlling gas flow through a capillary with a fixed radius submerged in the testing solution while measuring the bubble pressure. As the gas flows through the capillary, the radius of the attached bubble decreases while the size of the attached bubble increases. Eventually, the radius of the bubble will equal the radius of the capillary, the minimum radius and maximum size for the bubble. At this time, the bubble reaches its maximum pressure and detaches from the capillary. With a known value for the capillary radius, the probe submerge depth, the liquid density and the maximum bubble pressure, the surface tension of the liquid is determined via the Laplace equation. The time needed for the bubble to reach its maximum pressure is called lifetime of the bubble and it can be varied through the control of the gas flow. As one can imagine, increasing the lifetime of the bubble allows more surfactants to reach the bubble-liquid interface and to reduce the surface tension of the liquid at that interface. Determining surface tension values at different bubble lifetimes thus provides an effective means to characterize the efficiency of the surfactants.

As an example of the measurement capabilities of the dynamic surface tensiometer, water with a small amount of dish soap was analyzed using the BP-D5. From the two graphs shown below, one can easily comprehend the usefulness of the dynamic surface tension measurement. When the bubble lifetime is very short, the detergent molecules do not have enough time to reach the bubble-liquid interface, the surface tension of the water-soap solution is approximately 72 mN/m, which is almost the same as that for pure water. When the bubble lifetimes are increased to more than 100 ms, the surface tension values begin to decrease as more time is allowed for the detergent molecules to reach the bubble interface. With more and more detergent particles amassing at the interface, the surface tension reduces until the detergent particles reach a saturation point. How efficient your detergent is working? It is time dependent!



Raw data (left) and average data with Rosen fit (right) for soap water.

To subscribe or unsubscribe to this newsletter, contact info@ebatco.com.

Ebatco, 7127 Shady Oak Road, Eden Prairie, MN 55344
+1 952 746 8086 | info@ebatco.com | www.ebatco.com