

Control of cleaning solutions by surface tension measurements

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Device	Surface Tensiometer – DY-700 with a CMC kit
Point	Evaluation of cleanability by surface tension measurements
Keywords	Surface tension, surfactants, cleaning, permeation



Background

Compared with organic solvents, cleaning with aqueous surfactant solutions has less impact on objects and is safer for workers. Hence, it is widely used in households and industrial fields.

Even with the small amount of surfactant, the surface tension of water decreases significantly, increasing its permeability while enveloping and drawing oil away at the same time. However, the surface tension remains constant after a particular concentration (critical micelle concentration aka CMC), and the detergency stabilizes. Always using a cleaning solution in the best condition, it is crucial to manage the detergency quantitatively.

Problems to be solved

The surfactant of cleaning and plating solution is consumed over time, decreasing detergency and permeation. It is essential to periodically replenish the tank with a surfactant or replace the liquid. Since increasing the amount of the surfactant added does not improve the detergency, the amount used must be properly controlled. Therefore, we tested the possibility of controlling the concentration by measuring surface tension.

Measurements and results

We conducted the test using our surface tensiometer, model DY-700, with the optional automatic CMC measurement kit. We carried out the measurements using the Wilhelmy method, in which a platinum plate is brought into contact with a liquid sample placed in a petri dish, and the surface tension is calculated from the pulling force toward the liquid, detected by a weighing system (*Fig. 1*).

$$\gamma = F/L \cos\theta$$

- γ : Surface tension
- F : Pulling force on the plate
- L : Perimeter of the plate
- θ : Contact angle of the plate and the liquid

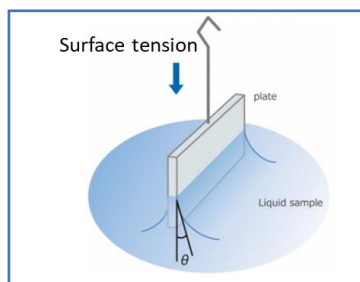


Fig. 1 - Illustration of the surface tension measurement

Firstly, a value of CMC was evaluated by plotting a graph of the surfactant’s concentration in the cleaning solution and its surface tension (Fig.2). It can be seen that the value of the surface tension tends to increase as the concentration decreases with surfactant consumption in the cleaning solution. By controlling the surface tension value of the cleaning solution around the CMC, it is possible to maintain the detergency and set the amount of surfactant used.

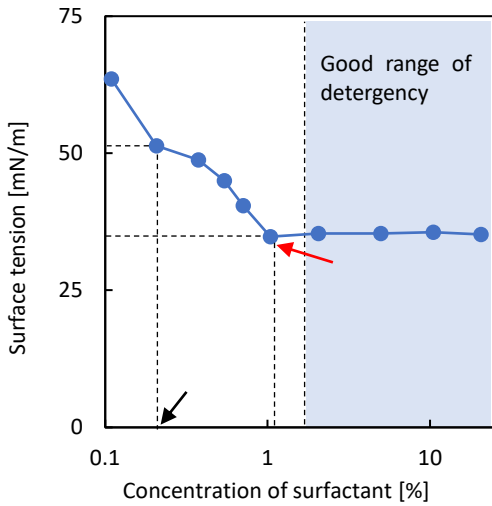


Fig. 2 - Image of data to show the relationship between cleaning solution concentration and surface tension. The red arrow indicates an example of CMC concentration, and the black arrow indicates 100 times diluted solution.

Conclusion

Our surface tensiometer series, DY-500, and DY-700, mounted with an automatic CMC measurement kit, is suitable for evaluating the detergency by surface tension measurements for economical use of surfactants, best reliability, and ensuring product quality.