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Exponential Business and Technologies Company

Are You Using Too Much Detergent to Wash Your Dishes?

Everyone enjoys a tasty and rich dinner with many courses from salads, main courses to deserts. However, the after-dinner cleaning might not always be everyone's favorite chore. If you have washed those greasy dishes, you may have experienced that just water can not do the trick to remove oily organic soiling. That is when the dishwashing detergents come in to save our days. Commercial dishwashing detergent products contain surfactants which are amphiphilic molecules and can interact with both hydrophobic and hydrophilic surfaces. During dishwashing, these surfactant molecules reduce the surface tension of the washing liquid so that it can get in between the dish and the oily soiling and thus makes the oily soiling be easily rinsed away. How much detergent do you need? Are you using too much or too little? One of the scientific ways to know how much you should use is to know the critical micelle concentration or CMC of that detergent. Using more than CMC in dishwashing may waste detergent, using less than CMC may reduce the cleaning efficiency.

CMC, the critical concentration at which micelles start to form, is an important characteristic of a surfactant. The lower the CMC is, the lower the maximum free surfactant monomer concentration is and the easier for the surfactant to form stable micelles. CMC value is also a guide to detergent hydrophobic binding strength. The higher the CMC is, the weaker the surfactant binding strength is. One common method to determine the CMC is surface tension measurements of the surfactant solution at variable concentrations. The surface tension of a solution decreases greatly when increasing the concentration of a surfactant before reaching its CMC. At the CMC, the surface tension remains relatively constant or reduces very slowly with further increases to the concentration.



Figure 1. Three commercial detergent brands used for CMC measurement.

Three commercially available dishwashing detergents: DAWN, Full Circle and Palmolive were analyzed in order to determine their CMC and corresponding surface tension values. The testing instrument used for performing the CMC tests is a Surface Tensiometer model DY-700 made by Kyowa Interface Science Co., Ltd. (Tokyo, Japan) with a Hiranuma UCB 2000 Auto Buret. The instrument allows for automatically controlled addition of surfactant solution to a test sample. The measurement process is run automatically after set up until the preset termination criteria are



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met. To shorten the test run time for the CMC measurement tests the original detergent samples were diluted with de-ionized water 100 to 1000 times beforehand.

Table 1 Measured CMC Values for Commercial Detergent Brands

Brand	Surface Tension at CMC (mN/m)	CMC (Vol. %)
DAWN	25.5	0.0046
Full Circle	26.6	0.0329
Palmolive	27.0	0.0346

The data presented in Table 1 and Figure 2 was obtained on the three commercially available detergent brands, DAWN, Full Circle and Palmolive. The concentration values, shown as volume concentration (Vol. %), were calculated based on the assumption that the original samples had been purely surfactants before they were diluted with de-ionized water. As can be seen from Table 1, the three dishwashing detergents have reduced water surface tension significantly from 72.8 mN/m for pure water at room temperature to 25.5-27.0 mN/m when CMC was reached. The CMC for DAWN was only one seventh that of Full Circle and Palmolive. Therefore, you should put much less detergent in when you use DAWN than you would when you use Full Circle or Palmolive.

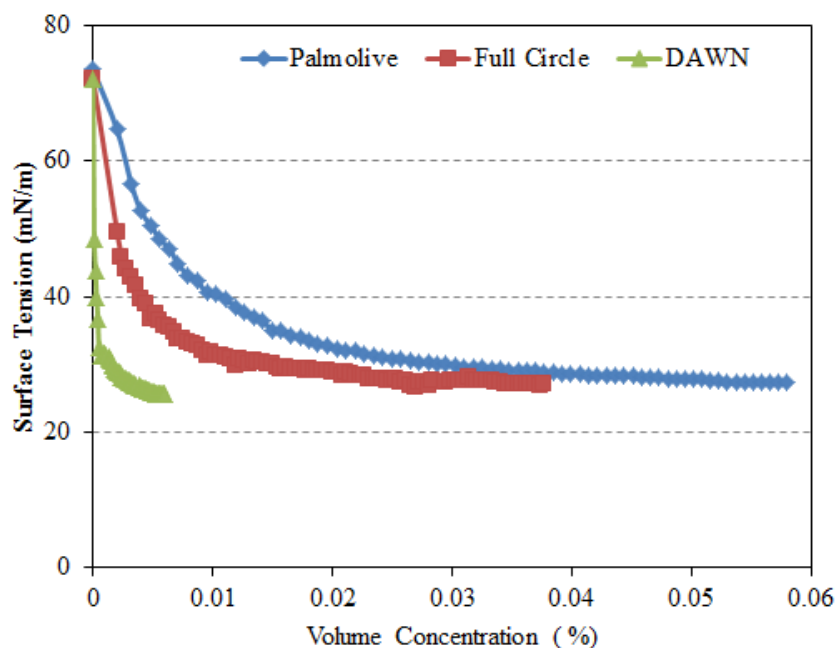


Figure 2. Surface tension values of dishwashing detergent water solution as a function of surfactant concentration.