



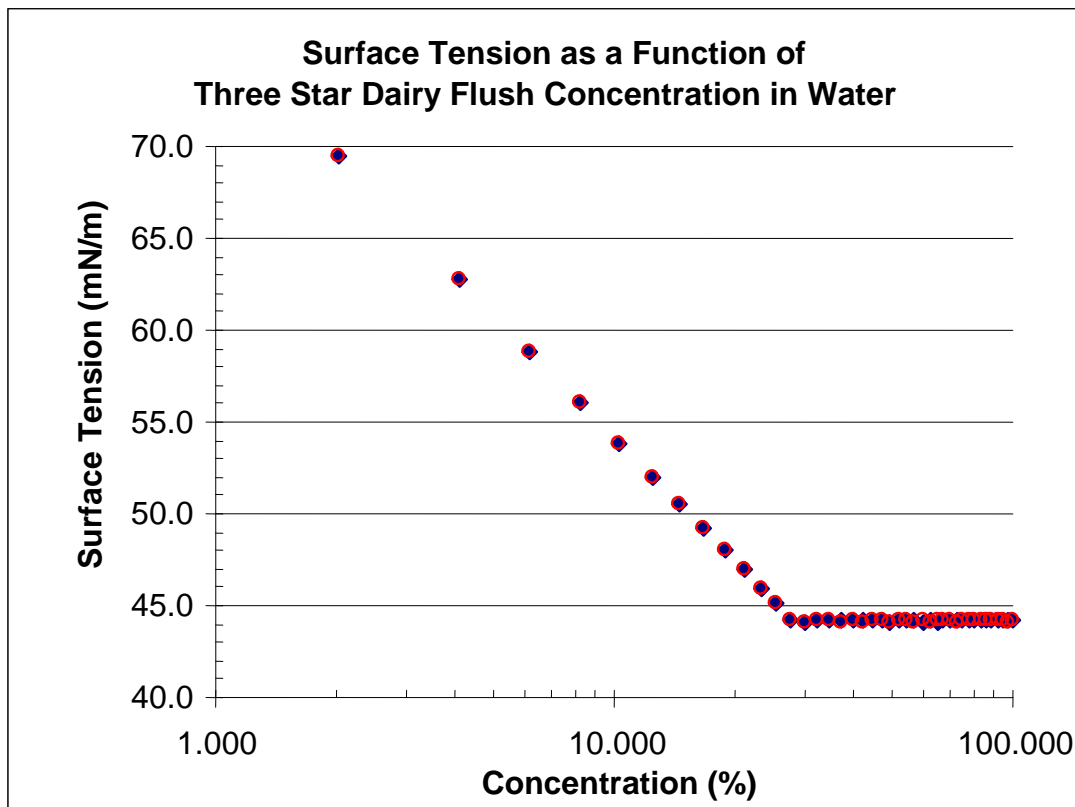
October 19, 2007

Rick Roberts
Three Star Dairy
PO Box 776
McCook, NE 69001-0776

Dear Rick,

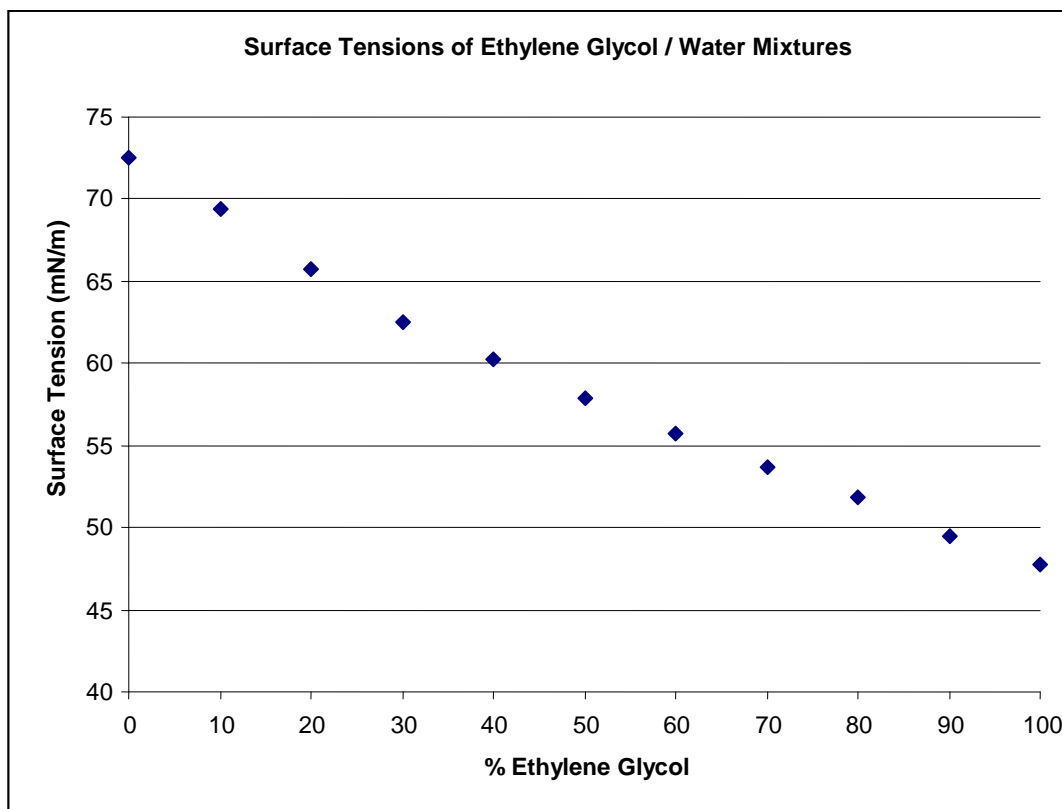
We have taken 5 ml of the Three Star Dairy Flush sample that you submitted and incrementally diluted it with pure water while measuring surface tension after each dilution until it was diluted back to a concentration of about 2% of its original. This was done twice (duplicate experiments) using a Kruss Processor Tensiometer K100 with automated dosing capability.

The resultant surface tension data – starting each time with a surface tension around 44.15 mN/m at 100% Flush – are shown on in the attached sample analysis report (Excel file in the electronic version of this report) and also in the graph below.



Based on these data I would conclude that the Three Star Dairy Flush contains materials that are acting as surfactants with a critical micelle concentration (CMC) around 28% of the total Flush. In other words, some type of surfactants are present at about 4 times the CMC in the as received Flush water.

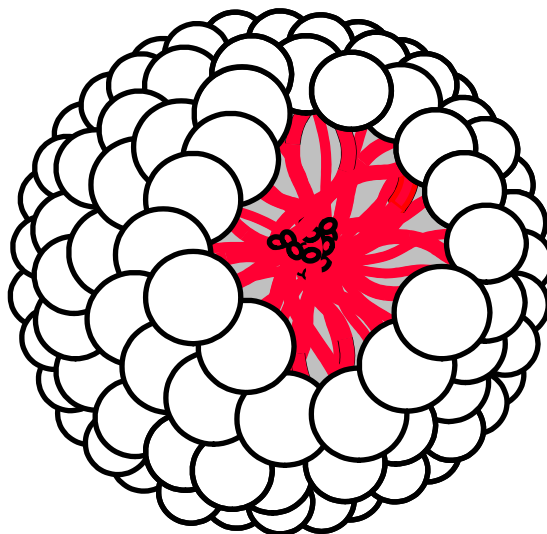
This conclusion comes from the distinctive shape of the surface tension versus concentration data. The surface tension of pure water is 72.5 mN/m at room temperature. If one dilutes a liquid with an initial surface tension around 44 mN/m with pure water and that liquid has a low surface tension not because of surfactant-like molecules forming a boundary layer at the surface and then micelles, but simply due to contamination by solvents or dirt, then the dilution commonly results in a linear to near-linear response of the surface tension with dilution. For example, the graph below shows the trend as a function of concentration for diluting ethylene glycol (surface tension = 47.7 mN/m) with water (surface tension = 72.5 mN/m).



If, however, there is surfactant activity, and the initial solution being diluted is above the CMC of the surfactant contained in it, then dilution will result in constant surface tension to be followed by increases in surface tension only below the critical micelle concentration. These increases in surface tension, are also logarithmically (rather than linearly) dependent on concentration – as you see with the Three Star Dairy Flush data.

A critical micelle concentration (CMC), by definition, is a concentration (below the solubility limit of a compound or group of compounds in solution) at which the compound begins to form soluble aggregates containing many (typically 20 to 100)

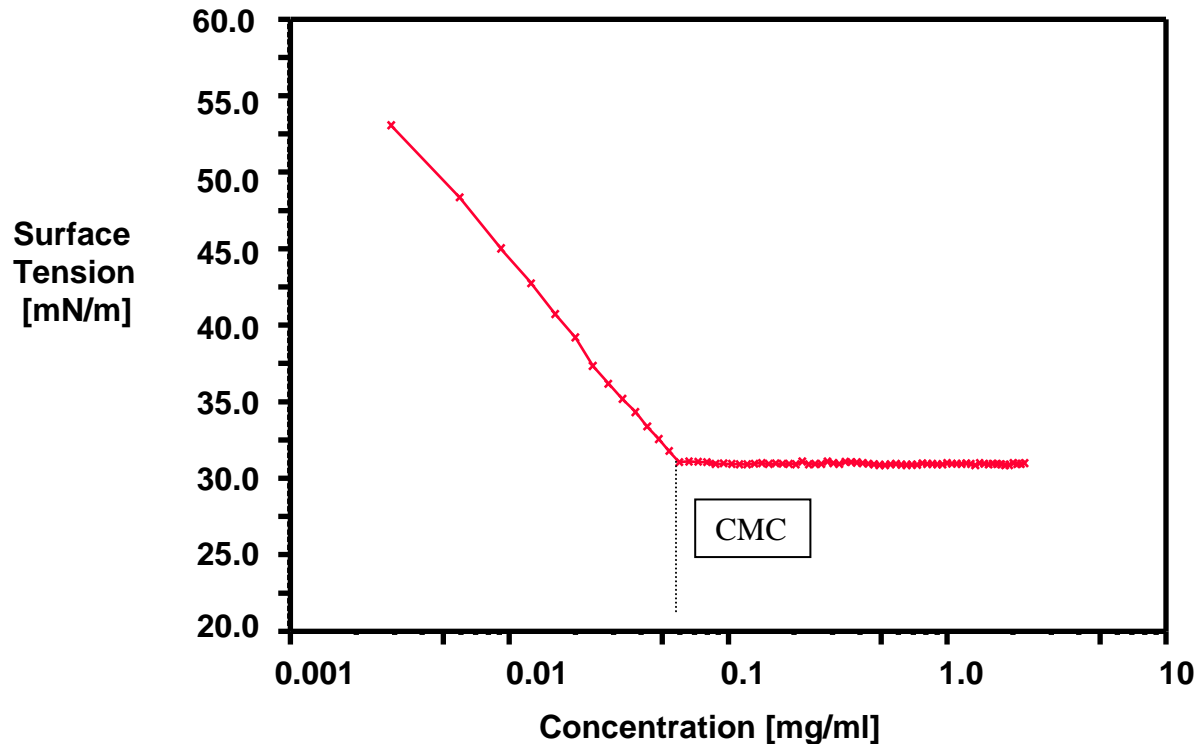
individual molecules. Such aggregates (micelles) are often formed in aqueous solutions by compounds which have significant hydrophobicity, despite their solubility. A schematic picture of a micelle is shown below:



wherein the external “spheres” represent the hydrophilic portions of the molecules of the compound, and the internal “tails” represent the hydrophobic portions of the molecules - which drive the aggregation to occur beyond a certain concentration (the CMC).

The critical micelle concentration for a compound in solution can be determined by studying the surface tension of the solution as a function of concentration of the compound. Micellar aggregation is linked to surface tension in the sense that compounds that will form micelles are also active toward the surface of solutions, and will form excess concentrations at the surface. This surface activity is favorable over the formation of micelles in terms of chemical potential – which is a logarithmic function of concentration.

Micellar aggregation only occurs after the surface excess concentration has reached the level of saturation. Therefore, if one takes a surface active compound, incrementally increases or decreases its concentration in solution, and measures surface tension, a plot of surface tension versus concentration, similar to the one shown below, emerges.



And, the critical micelle concentration can be identified as the point in concentration at which the surface tension no longer significantly decreases.

This is the common test for critical micelle concentrations (CMC) for surfactants. CMC's are important to surfactant makers and users because the concentration represents the concentration beyond which hydrophobic cores (micelle interiors) exist as a place to trap oil, dirt, and other hydrophobics and remove them from soiled bodies with a primarily water based cleaning solution.

The testing we have done with your Flush water is analogous and strongly suggests that the Flush water contains micelle forming surfactants with the following CMC's based on duplicate experiments.

Test #1 = 28.22%

Test #2 = 28.19%

I hope these data are useful for you. If you have any questions about them, or wish to discuss further analyses, please let me know. The charge for this work is \$500 (1 dilution type CMC experiment @ \$500). That sum will be charged to your credit card as you requested, and a paid invoice is enclosed.

Best regards,

Christopher Rulison, Ph.D.
Principal Scientist
Augustine Scientific