Bio-dispersant / Surfactant

SURFACTANTS

The name “surfactant” is an acronym for Surface Active Agent. Surfactants are organic chemicals, which because of their chemical structure are capable of wetting materials or hard surfaces, lowering surface tension, emulsifying oils, dispersing and suspending particulate soils, and breaking the adhesion of soils to surfaces. They can be used for a variety of applications in cooling tower systems, including bio-dispersants, oil dispersants, and cleaning applications. There are four basic types of surfactants. They are classified as the following:

1. Anionic (negative charge)
2. Cationic (positive charge)
3. Nonionic (no formal charge)
4. Amphoteric (both a negative and positive charge

Examples of anionic surfactants are soap (sodium stearate) and LAS (linear alkyl benzene sulfonate). Anionic surfactants are generally the least expensive and the oldest known surfactants. Both soap and LAS will combine with calcium to form insoluble calcium deposits (Soap scum). LAS is the most widely used surfactant for both industrial and household cleaning products. However, it is not biodegradable, so its use is limited in some areas or countries for environmental reasons. Cationic and amphoteric surfactants are primarily used in fabric softeners, bacteriostats, cosmetics and personal care products, and other specialty applications. Finally, cationic surfactants are typically not used in cooling water applications. The positive charge on these surfactants would neutralize the anionic polymers that are widely used as dispersants. This charge neutralization can inactivate the polymer, as well as the surfactant and cause precipitation in the cooling water. Nonionic surfactants are widely used as dispersants or emulsifiers in many applications. All surfactants contain a non-charged, hydrocarbon tail as the hydrophobic group.

Examples of hydrophobic groups used as the starting point for both nonionic and anionic surfactants include alkylphenols, fatty acids or alcohols, sugars such as sorbitol, and various chain lengths of polypropylene glycol (polypropylene oxide).

FIGURE 19.4 Suspended particle adsorbs highly anionic polymer, greatly increasing surface charge

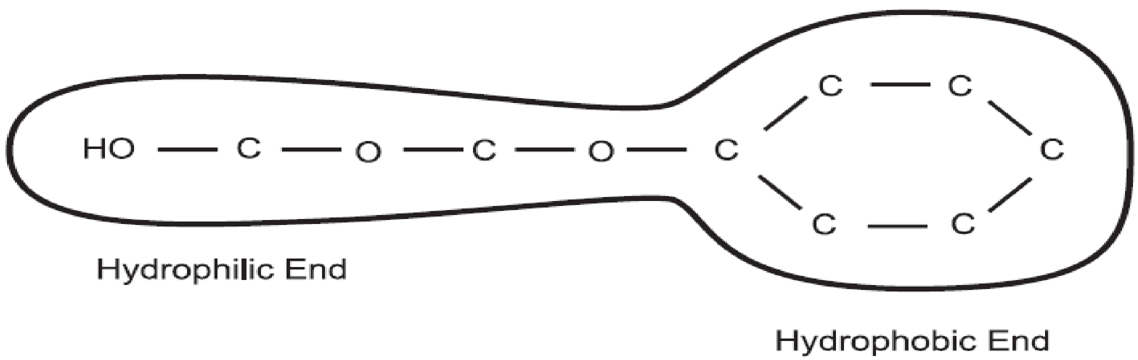

FIGURE 19.6 Typical surfactant molecule.

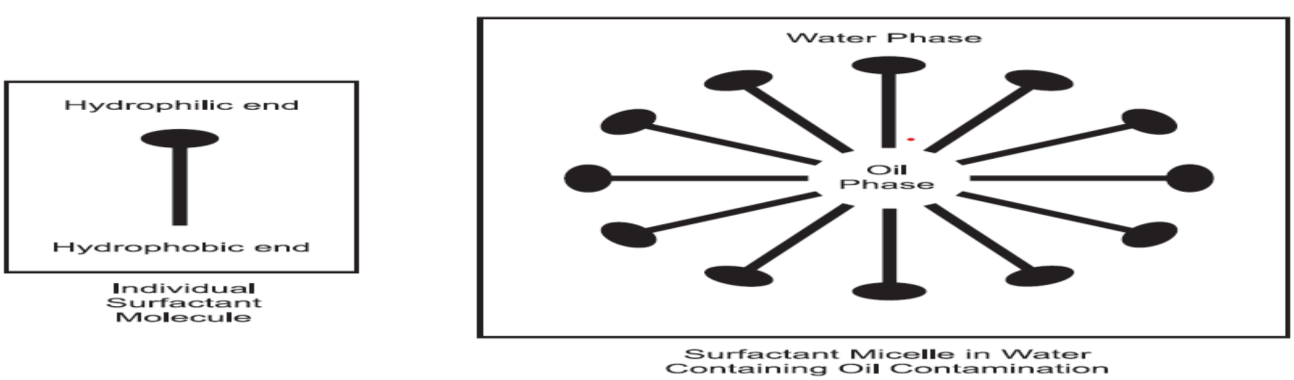

FIGURE 19.7 Micelles are organized clusters of surfactant molecules in solution. Oil can be emulsified and dispersed by the surfactant micelle.

For nonionic surfactants, the hydrophilic portion is almost always made only from ethylene oxide. In contrast, the hydrophilic portion of anionic surfactants can include sulfonates, sulfates, carboxylates, or other highly charged functional groups, sometimes even in combination with ethylene oxide. Nonionic surfactants have several advantages over anionic surfactants like soap or LAS. They are less sensitive to water hardness (less tendency to precipitate) and thus, provide better detergency under hard water conditions. Nonionic surfactants can be made to be lower foaming than anionic surfactants. As a result,foaming is less of a problem as compared to anionic-based detergents. Figure 3.9.31 represents drawings of typical examples of all categories of surfactants. Surfactants can be very beneficial in cooling water programs. Materials that reduce the interfacial tension between water and bacterial slime can help to remove these deposits. These bio-dispersants can remove the slime layer and make chlorination or bromination more effective. Surfactants be beneficial during process leaks of organic materials that may occur in refineries or chemical plants. If an organic process fluid that contaminates the cooling system is a liquid at normal temperatures, it may foul metal surfaces because it is “pushed” to the surface by the interfacial tension of water. Surfactants can impact this by Emulsifying the oils and keeping them dispersed in the water phase. Other types of surfactants can be useful in dispersing soils or suspended solids due to their detergency. These are not often used on a continuous basis, but may be part of aperiodic cleaning program. Most pretreatment programs also contain surfactants to help remove surface deposits and allow the metal surfaces to be better contacted by the passivating agent.

One caution when using surfactants in cooling towers is the foam that may result. As mentioned, nonionic surfactants can be made to be low foaming, and these are commonly used for cooling system applications. However, even low foaming materials can create undesirable foam, especially if overfed in the highly aerated environment of the cooling tower. Control of the dosage is important in all applications to minimize foaming. When a cleaning or pretreatment program is applied, it is valuable to have antifoam on hand in the event that undesirable foaming occurs.