CROWN SOLUTIONS
CUSTOMER NEWSLETTER

Biodetergents for Cooling Water

By Dave Christophersen, Vice President/Technical Manager

Before applying a coat of paint to a car, the surface should be clean to allow the paint to spread evenly and adhere properly. In a cooling system, for corrosion inhibitors to react properly with the metal and form a corrosion barrier, the surface needs to be clean and free of biofilm, suspended solids, or scale.

Biodetergents (Also called Biodispersants or Biopenetrants or Organic Dispersants)

Chemicals that can penetrate and loosen the complex matrix of biofilms allow biocides to reach the organisms for more effective kill and control. These chemicals are typically shot fed at dosages that break down polysaccharides, emulsify oils, release minerals and foulants, or disperse the biopolymers. Sometimes they are fed continuously.

The biofilms are often the glue that allows suspended solids found in recirculating water to be bound to the surface of the cooling system components including heat exchangers, piping, and the cooling tower structure. Mineral deposits are also commonly found within this matrix. Calcium and magnesium offer bridging mechanisms to strengthen the polysaccharide polymer chains. Corrosion occurs underneath the biofilms, releasing corrosion byproducts that become part of the matrix also.

Because accumulations of dirt and the formation of biofilms can lead to corrosion and scaling, their prevention through the use of filtration, biocides, and biodetergents can be extremely important for a successful water management program.

Biodetergents help keep cooling systems clean or help clean up fouled systems by dispersing the extracellular material created by bacteria, algae, and fungus. They help biocides to penetrate and kill the biological growth. By keeping the surfaces clean, they allow scale and corrosion inhibitors to perform better.

Some biodetergents can create foaming conditions especially at high dosages, so care must be taken in product selection and applying the product. Also, the compatibility with other treatment chemistry, especially oxidizing biocides, should be considered.

Some biodetergents include:

- DTEA II (2-Decylthio ethanamine)
- DMAD (Fatty acid amide)
- Dodecylamine acetate
- Polyquaternary amines
- DOSS (Dioctylsulfosuccinate)
- Polyoxyalkylenes
- Enzymes

Figure 1: Dirt and biofilm on a cooling tower distribution deck is shown sloughing off after an application of a biodetergent.

Applications

A. **Routine Treatment**: Apply biodetergents regularly as a part of any cooling water treatment chemistry to

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enhance the other chemicals and minimize scale, corrosion, fouling, and biofouling.

B. **Cleanup After Contamination**: Some cooling systems may experience unusual process contamination, loss of control, temporary poor quality makeup water, or other short-term contamination where the application of a biodetergent can help with recovery and cleanup.
C. **Wastewater Recycle**: Where treated wastewater is used as a cooling makeup source that provides consistent stress on the system or contaminants such as fats, oil, or greases, or other organics, incorporating a biodetergent as part of the ongoing treatment strategy may be advisable.
D. **Cooling Efficiency Optimization**: Where the load on heat exchangers or cooling towers are at their peak, the use of biodetergents can aid in achieving the maximum available cooling.
E. **Biocide Sensitive Discharges**: It is often necessary or desirable to limit as much as possible the application of oxidizing and non-oxidizing biocides because of their toxicities. In these cases, biodetergents can be a great aid in allowing minimal biocide dosages while still maintaining effective control of bacteria, fungus, and algae.

Case Studies

A. An aluminum die cast plant needed to recycle treated wastewater for use as cooling tower makeup because they were quantitatively limited by the city regulator on the amount of discharge water from their plant. Although the wastewater was treated onsite for oil and metal removals, the treated wastewater still contained residual amounts of oils and a relatively high BOD. Efforts to recycle in the past prior to their discharge flow limitations had created severe fouling in their cooling towers consisting of microbiological slime, oils, and suspended solids.

   This time around a biodetergent product containing DOSS and DMAD were applied and fed continuously to emulsify oils and to penetrate biomasses. The improved results were obvious as the systems remained cleaned and corrosion rates were held very low.
B. An oilseed plant experienced a persistent leak of vegetable oil into the cooling system through a plate and frame heat exchanger and production demands did not allow down time to repair the leak. The cooling tower wood splash fill became loaded with biological slime and even with the addition of high residuals of bromine and chlorine, some of the fill eventually collapsed.
C. Shot feeding of DTEA II biocide was initiated and after several weeks the fouling on the fill was mostly eliminated.
D. An air separation plant using clarified river water as cooling tower makeup was experiencing high approach temperatures on some of their heat exchangers due to river mud making it past their clarifier, and because of algal and fungal mats. After one high dosage application of DTEA II, the approach temperature on one critical heat exchanger dropped by 10 °F.
E. An ethanol plant experienced an ethanol leak into the cooling tower, which created a rich food supply for biological growth. Applications of chlorine and non-oxidizing biocides did not allow the removal of biofilm persistently hanging from the cooling tower fill. Application of

biodetergent shot fed 2 – 3 days per week allowed the system to recover.

F. A greenfield ammonia plant treatment strategy was designed to provide optimal water system conditions, so as part of the program a biodetergent was included. The treatment included continuous chlorination, periodic non-oxidizing biocide addition, and a phosphate/zinc/phosphonate/polymer/azole program. Mild steel corrosion rates of <1 mpy and copper rates of <0.1 mpy have consistently been obtained along with clean heat exchanger and cooling tower surfaces.

Crown Solutions Co., LLC
945 South Brown School Road
Vandalia, OH 45377

(937) 890-4075

www.crownsolutions.com