COOLING TOWERS, BIOFILMS AND BOC

Remove and Prevent Biofilms in Cooling Towers

By Mike Platt

Case Study

ABSTRACT

Cooling towers are very active at rejecting process heat and therefore are still one of the most environmentally friendly ways to provide process cooling. However, there are still challenges for cooling tower operators to reduce costs and ensure compliance with local regulations for the control of Legionella bacteria.

Some of these challenges are increasing water costs, process efficiency challenges, process fouling and rising maintenance costs which all need consideration while ensuring regulatory compliance.

Most of these challenges are avoided with effective water treatment of the system. Typically, chemical and non-chemical programs use corrosion inhibitors, antiscalants, bio-dispersants and biocides to provide stable waterside conditions.

Conditions vary in cooling systems with process load changes, process contamination and breakdowns leading to challenges in water chemistry control. All of these factors increase the risk of biofilm formation in a system, and once accumulated, it is tough to remove and provide the ideal habitat for pathogens such as Legionella bacteria to reproduce. Biofilms act as insulating barriers for heat transfer, reducing the efficiency of a system significantly and provide conditions for microbiologically induced corrosion.

A trial, using Bio-organic catalyst (BOC) technology on a variety of industrial and commercial cooling towers. Typically, the BOC replaces secondary biocide dosing or traditional bio dispersant dosing and therefore is no extra cost to the overall program. It is, however, non-toxic and environmentally friendly and thus reduces the health and safety impact for employees handling chemicals on site.

THE SITE

The process cooling system consists of two linked cooling towers (3MW and 1.5MW) and two process water holding tanks (50m3 each) which collect hot water return from the factory and distribute cooled liquid back to the process after recirculating over the cooling tower. Before dosing BOC, the system accumulated organic solids (FOG and food particulates) from the process which typically settled in the cooling tower basins and the two process holding tanks.

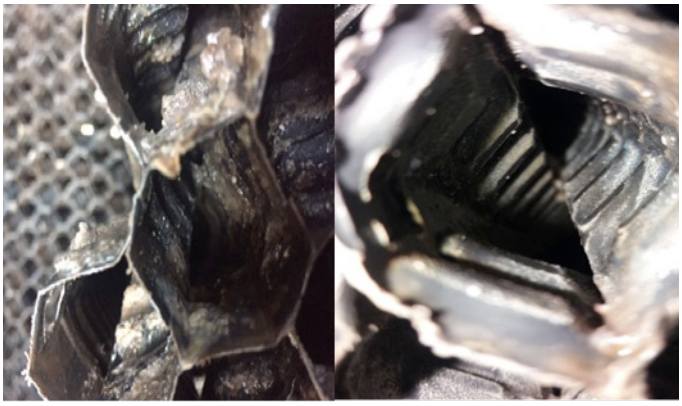

Figure 1 Fill pack before and after, notice the absence of biofilm on the after picture

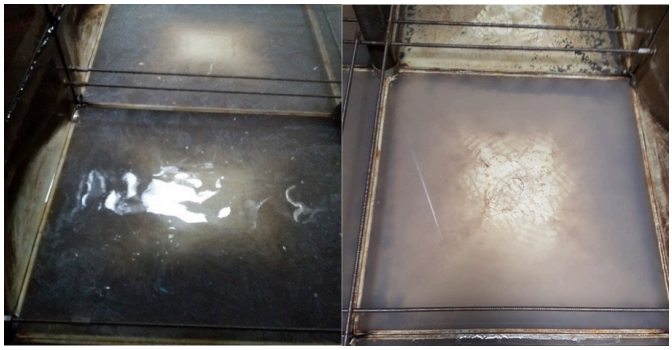

Figure 2 Before and after, prior to treatment is on the left, treated on the right.

The Challenge

Biofilm and FOG form on the visible surfaces in a cooling tower over time. Offline cleaning was necessary every three months to remove the organic contamination and biofilms by manual cleaning methods, e.g. jet washing and vacuuming. It was successful in removing most of the visible contamination. Still, the contamination in the hidden parts of the system like pipework and heat exchangers was more challenging. Microbiological control was difficult to control with bromine, and high levels (5-7ppm total bromine) were needed to keep sessile bacteria concentrations levels within parameters.

Method

BOC added proportionally to make up water after an initial shot dose to establish correct concentrations. Dosing concentrations are usually based on BOD, FOG and suspended solids data. On commencing dosing, COD levels rose after addition of the BOC, and this was attributed to the product dissolving the

insoluble organic material and in particular the FOG, which reduced dramatically. It made control of the bacterial loading more of a challenge. Still, a COD range of 200-250ppm found to be the limit whereby a balance between clean up and bacterial compliance achieved while a clean-up of the system was continuing.

INTRODUCING BOC

BOC acts on the process of water by the following actions

- BOC, through its surface modifying property (Colloidal Suspension), can dissolve the EPS matrix in most of its forms, into its monomeric constituents. These then become available to the planktonic bacteria as a food source (energy). As well as the dissolution of the EPS, the BOC can reduce the free energy required in cleaving the Organic material loading in the system.
- The BOC activates some enzymes, lipase as an example, which can dissolve lipoprotein EPS and prevent the secretion of the polysaccharide from FOG loading.

RESULTS AND DISCUSSION

After the first month inspection to the tanks which typically have considerable amounts of debris, the photos show the before and after conditions with an estimated 95% reduction on organic fouling. The surfaces felt less slimy, and the staining of the GRP surfaces was beginning to fade. Over successive inspections, conditions have continued to show immaculate conditions. Bacterial control is also much more stable due to less biofilm and sludge available for recontamination of the system.

The program has been running successfully for two years, maintenance and reduced water consumption has resulted in a financial saving of over 75%. The pictures below are recent (Easter 2020) and show clearly the effect in the use of the BOC.

Figure 3
Top: Typical Organic Sump contamination
Below: Contamination after BOC treatment