Buckman

WATER TECHNOLOGIES

CASE HISTORY

Buckman assists a Canadian power plant in eliminating scale and increase the cycles of concentration in the condensate cooling system

Background

The customer was having scale buildup problems and losing efficiency on their steam condenser, which was impacting their ability to generate the full rated capacity of the plant. The water source/quality changed a year previous to Buckman being involved, and the chemical program from the previous supplier was not able to cope with the changes.

The customer was using a 2 component all-organic cooling water treatment. Initially they were not using acid for pH control; but, as problems mounted (scaling), they began to use sulphuric acid to adjust the cooling water alkalinity, with a target pH level of 8.7. This was done in conjunction with feeding additional anti-scalant.

Microbiological treatment consisted of sodium hypochlorite (bleach).

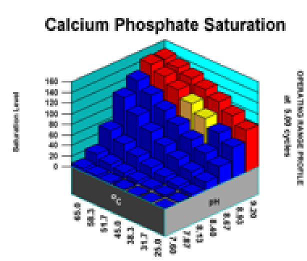
Action

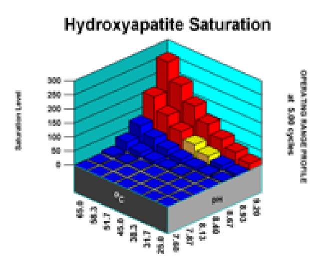
A number of steps were taken as part of the full plant audit and proposal development process:

I. A plant survey was conducted that involved log reviews and analysis of key plant parameters to determine root cause of the scaling problem that the plant was experiencing.

II. During the survey it was determined that one of the important changes in the make-up to the cooling tower was that there was a significant amount of orthophosphate now present. In addition the make-up water pH had risen to 8.3. Bleed-off from the cooling system was done based on conductivity and this had led to a harmful feedback loop. As hardness began to precipitate, it removed ions from the water which lowered the conductivity; this in turn meant that the controller decreased bleed-off to achieve the desired conductivity. The outcome was that the cooling water cycled up even more and this led to further hardness precipitation and fouling.

III. In order to assess what the correct cycles of concentration should have been, modeling was done to determine both this as well as the optimum cooling water pH.





IV. Based on the scaling models it was clear that lowering the cooling water pH to under 8.6 would eliminate the potential for calcium phosphate scales and their "seeding" effect on calcium carbonate.

V. This was confirmed by the cycles of concentration based upon Ca and Mg. The magnesium cycles were much higher than were measured for calcium, which confirmed that $CaCO_3$ was being lost on an ongoing basis.

Results

The audit revealed that the phosphate was critical in the scaling process and that the precipitation of calcium phosphate was occurring at their current operating conditions and was "seeding" calcium carbonate precipitation.

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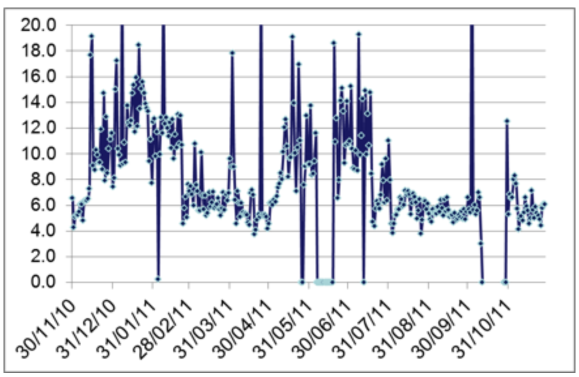
The table below illustrates the cycles of concentration using different parameters. Not surprisingly, the cycles based upon calcium (and the interconnected parameters, M alkalinity and conductivity) did not reflect the true cycles of concentration, as measured by using Mg and silica. Consistent loss of calcium like this would certainly lead to heat exchange problems.

Parameter	Cycles
Conductivity	4.3
Calcium	3.4
M alkalinity	4.5
Magnesium	6.8
Silica	7.8



While the target number of cycles of concentration was 5, the actual ones, based upon mass balance (not conductivity), were much higher and at times reached 20. The combination of phosphate to initiate precipitation, a poor control strategy (conductivity), a pH limit that was too high for the phosphate present and an ineffective anti-scalant led to the scaling seen in their turbine condenser and other heat exchangers.

Once it was concluded that the root cause of the fouling was related to the orthophosphate in the make-up to the cooling tower, the steps to stop scaling became evident:

I. The feed rate of sulphuric acid was increased to lower the cooling water pH to between 8.4–8.6, so that the phosphate saturation levels were more acceptable.

II. The chemical treatment program was modified so that a calcium phosphate specific anti-scalant was included (Bulab® 9174).

III. Another recommendation was to use water meters to control the cycles of concentration and not the conductivity. By doing this, the chance of the cycles increasing beyond our operating parameters is eliminated. We also recommended using feed verification on the chemical injection and a water meter on the bleed-off to control the chemical feed rate (mass balance) rather than relying upon a tracer.

Benefits

ROI:

The change to Buckman has resulted in an increase in chemical costs by approximately 10%, which was projected to occur. However, scaling has stopped and there has been no need to clean either the turbine condenser or plate and frame heat exchangers (on the compressors). Previously, they had to do both acid cleanings and in some instances send the plate and frame heat exchangers out for mechanical cleaning because they were completely blocked with scale. The most recent cleaning cost the plant $10,000, which is equivalent to the incremental cost of the Buckman treatment program.

Maintenance of the turbine vacuum and the elimination of heat exchanger cleanings offset the higher chemical costs and improved plant reliability.

ROE:

While the primary concern of the plant was scaling, there were ROE benefits associated with the changes that were made. Raising the cycles of concentration from 5 to 8 lowered water consumption by 52,779 M^3/year, which is equivalent to the water consumption of 366 households (family of four).

Another recommendation was that the plant changes from liquid bleach to solid Bulab 6058 which improved performance at the more alkaline cooling water pH and also lowered transportation emissions. At the same time it improved plant safety since the risk of spillage was eliminated. Product shipment went from 17,630 kg of bleach to 2,115 kg of BCDMH (per year), which lowered CO_2 emissions due to transportation by 422 kg/year.