

April 14, 2004 by Jon Howarth

Stability-Demand Profile of PAA dosed to Colmac Power Station Cooling Water

Colmac Power Station cooling water that was sampled on 3/31/04 was received at the Enviro Tech laboratories on 4/12/04. The purpose was to obtain the PAA stability-demand profile, and then determine whether supplementing the water with a polymeric scale-corrosion inhibitor would prolong the half-life sufficient to improve the economics of treating this system with Perasan<sup>TM</sup>.

Before testing commenced, the water was determined to possess the following water quality parameters.

Parameter	
pH	8.15
Total Cl <sub>2</sub> /ppm	0.0
Conductivity / $\mu\text{Scm}^{-1}$	1920
NH <sub>3</sub> /ppm	0.5
Total hardness /ppm as CaCO <sub>3</sub>	120
p-alkalinity (ppm as CaCO <sub>3</sub> )	10
Total alkalinity (ppm as CaCO <sub>3</sub> )	60

The cooling water was dosed to a theoretical 5.0 ppm PAA using a freshly prepared stock solution of Perasan<sup>TM</sup>. The temperature of the sample was maintained at ambient (70 °F) as the PAA decay was monitored using the modified DPD colorimetric method.

As displayed in the figure, one minute after the initial dose, over 99% of the theoretical amount of PAA introduced to the cooling water was recovered analytically. Thereafter, the PAA decayed slowly over the following 8 hours. A plot of  $\ln(C_t/C_0)$  vs. time (where  $C_0$  is initial PAA concentration and  $C_t$  is the concentration at  $t$  hours afterwards) revealed a straight line. Regression analysis of the data revealed the plot was a good approximation to first order decay kinetics ( $r^2 = 0.9678$ ). The slope of the plot was used to calculate a half-life of 21.4 hours. This prediction is in good agreement with the experiment as 2.35 ppm of PAA was found to be present 22 hours after administering the first 5.0 ppm dose.

It is not fully understood why PAA should display such remarkable stability in this cooling water. In fact, PAA is more stable in Colmac cooling water than it is in model laboratory systems that have been dosed with 25 ppm of polymeric scale-corrosion inhibitors deliberately introduced to stabilize the product to chemical degradation. Thus, supplementing the cooling water with polymers does not appear to offer an effective means of prolonging the activity of PAA in practice.

Clearly this laboratory evaluation only models a first order degradation pattern for PAA in Colmac cooling water. In practice, other factors must be operating to explain the accelerated depletion of PAA. Physical losses due to flash-off would be expected at the higher bulk water temperatures, where the chemical degradation reaction would also be expedited. Chemical demand due to the presence of oxidizable organic contaminants that continuously inoculate the water will also consume the product at a faster rate than the laboratory experiment. Physical losses due to blowdown would be minimal because of the long Holding Time Index of the Colmac cooling water.

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