BWT-PG-CH-N460-02.14

Power Generation

FAC Mitigation at Combined Cycle Power Plant Reduces Iron Transport by 50 Percent

Amercor™ 8780 Corrosion Inhibitor

Customer Overview:

- Segment: Power Generation
- Product(s): Electricity
- Location: Southeast United States

Application Overview:

- Type: Boiler Water Treatment
- Equipment: 2 Multiple Drum Heat Recovery Steam Generators (HRSG)
- Capacity: 14,520,000 pounds per day
- Other: Large 550 MW standard 2 x 1 configuration, combined cycle power plant operated by a large independent power producer. The HP drum pressure is 1800 psig.

Existing Treatment:

The plant had been using a blend of aqua ammonia and monoethanolamine (MEA) in accordance with a corporate mandate. However since converting to this regime, the plant continued to experience two phase flow accelerated corrosion (FAC) in both LP drums. Principle variables affecting FAC were presented to plant management with the key focus on pH elevation (see Figure 1).

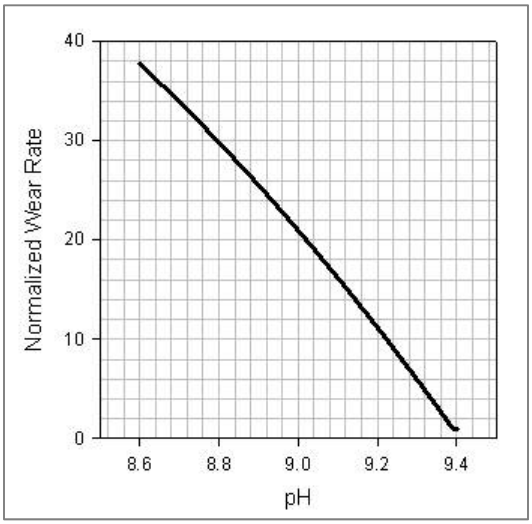

Figure 1 – pH versus metal wear rate

Problem Summary:

To achieve proper pH elevation of the HRSG feed water using the ammonia/MEA blend required twice the typical feed rate.

In order to evaluate any chemistry changes, Solenis offered to monitor iron transport with the Sentry* Corrosion Products Sampler. Two units were installed (one for each HRSG) and sampling began with the following results:

- Iron at steady operation showed 0.5 to 0.6 ppb
- Iron at cycling operation showed 1 to 3 ppb

It was determined that the ammonia/MEA blend was not adequate in raising the feedwater pH to desired pH ranges. As an alternative, a blended product of cyclohexylamine and Methoxypropylamine (MOPA) was selected and the trial was initiated with a strong rise in feed water pH. However, after a few days, the pH in both Intermediate Pressure (IP) drums fell to < 9.0.

Customer Objectives:

- FAC mitigation
- Elevated feedwater and drum pH
- Reduced iron transport
- Lower cation conductivity values
- Reduced chemical usage and cost

Solenis Solution:

Laboratory studies confirmed that MOPA yields a lower pH depression from thermal breakdown than cyclohexylamine and has a lower distribution ratio than cyclohexylamine.

By 500 psig MOPA had started breaking down to into organic acids resulting in a drop in IP drum pH values.

MOPA had now been evaluated and deemed unacceptable due to the IP drum pH depression while ammonia didn't have enough basicity to raise pH effectively. More discussion and review of technical data led Solenis to further evaluate the affect of cyclohexylamine.

Amine content data calculated during previous trials suggested that cyclohexylamine and MEA would yield the desired pH in feedwater without the organic acid buildup in the IP drums. Amercor 8780 corrosion inhibitor, a blend of cyclohexylamine and MEA was selected as the next trial chemistry which started very well with a strong rise in feedwater pH to 9.9.

Dosage was approximately 6 to 8 gpd initially and over the next several days, the required dosage to maintain the 9.8 pH was 10 to 12 gpd.

All drum pH values were stable and steady at 9.6 and the LP steam pH rose to 10.4 (see Figures 2 and 3).

Customer Benefits:

The Amercor 8780 corrosion inhibitor trial continued to run until the next outage. Iron transport data indicated approximately 50% reduction. Iron throw for steady operations was 0.18 to 0.3 ppb iron and iron throw for cycling operations was 0.5 to 1.0 ppb iron.

Conclusion:

During the outage, inspections revealed there had been some improvement to the metal surfaces in the LP drums. The visible areas of two-phase FAC had been reduced with surfaces appearing dull and not shiny as in previous inspections. The hotwell looked much better than the previous inspection and was no longer bright red as before.

Organic acids appeared to be concentrating in the kettle boilers and creating a higher demand for the Amercor 8780 corrosion inhibitor, so recommendations were made to increase the blowdown on the kettle boilers to reduce organic acid accumulation and reduce Amercor 8780 feedrates. The increased blowdown worked well and cation conductivity dropped to ~ 2 uS/cm (see Figure 4) while pH remained at 9.8 in the feedwater. The plant was able to reduce the chemical costs by 54% with annual savings of $75,000.

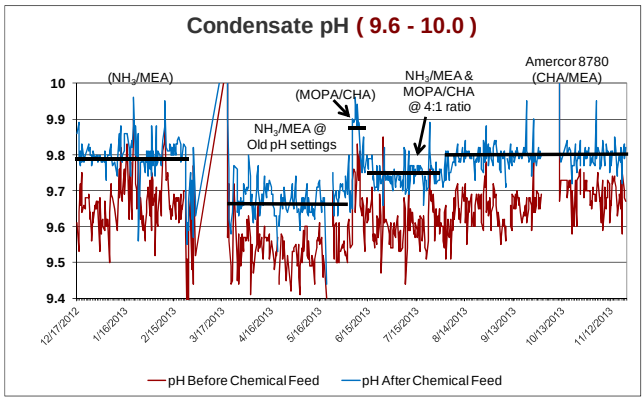

Figure 2 – Condensate pH before and after chemical feed

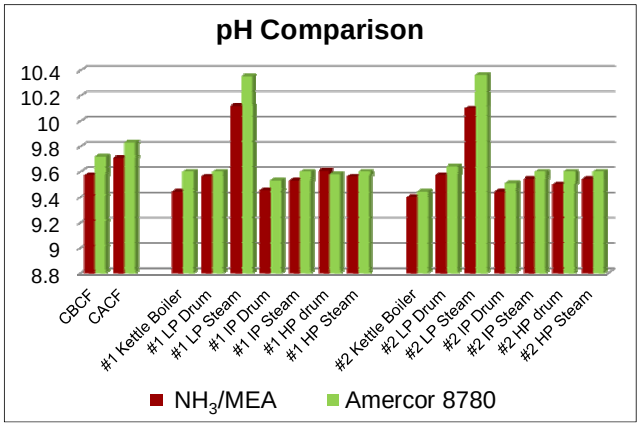

Figure 3 – Steam Cycle pH Comparison

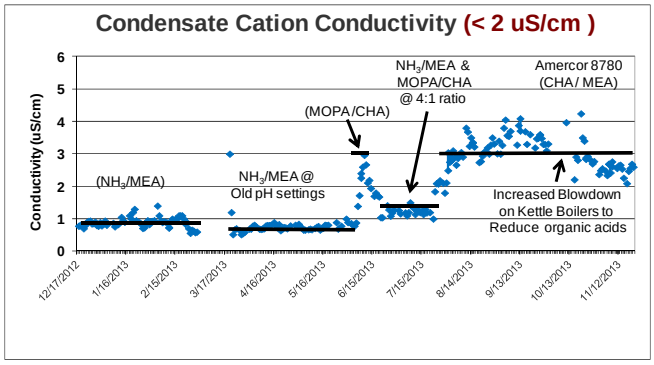

Figure 4 – Kettle Boiler Blowdown Reduces Cation Conductivity