

Waste Heat Boiler Failure Analysis

A Midwest refinery experienced two premature failures of a 450 psig waste heat boiler. The first failure occurred near the end of the expected service life of five years. The second unit failed after two years of service, far short of the five-year interval between turnarounds. Some refineries have reported ten to twelve years of service for units with this specific design. The locations of perforated tubes in each failure event did not correlate to heat transfer profiles or boiler water flow patterns.

Examination of the failed tubes showed extensive under-deposit corrosion damage on the waterside of the tubes. Chemical analysis of the deposits showed high concentrations of caustic. A review of the historical boiler water quality (Figure 1) showed poor conformance to the specification limits for conductivity of 1500 – 1800 $\mu\text{S}/\text{cm}$ (red lines).

Our investigation identified poor water sampling methods and improperly cooled samples compromising the accuracy of the conductivity measurements. In addition, the method of adjusting the existing manual blowdown valves was imprecise and undocumented. Investigation of

monitoring and control methods for other waste heat boilers showed similar deficiencies.

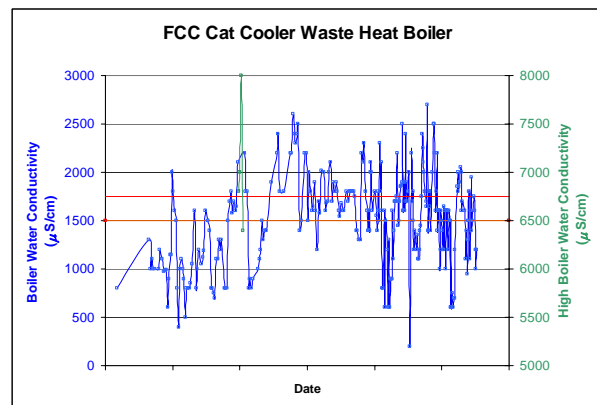


Figure 1 – Cat Cooler Boiler Water Quality

To reduce the risk of additional failures in this unit and other waste heat boilers, MarTech recommended that refinery personnel install sample coolers and improve sample handling procedures to ensure accurate water analyses and improve the precision of blowdown adjustments to control the boiler water quality to ASME¹ specification limits for conductivity. We recommended automation of blowdown control using on-line conductivity meters as part of a future system upgrade.

¹ "Consensus on Operating Practices for the Control of Feedwater and Boiler Water Chemistry in Modern Industrial Boilers," CRTD-Vol. 34, ©The American Society of Mechanical Engineers, New York, New York