Water Technologies & Solutions
application note

boron monitoring to protect turbines and minimize costly repairs and downtime

introduction

Ultrapure water is an important component in power generation systems. Water treatment from source water and its use in steam generation is critical to overall plant efficiency and power production. The series and steps in water treatment depend on source water conditions, nature of any recycled stream, demand for power, and eventual power production mechanism. Frequently, water is heated in a boiler to steam using a fuel source (solar, coal, natural gas, nuclear, etc.) which is used to drive a turbine to generate electricity. Effective water treatment minimizes harmful contamination and protects equipment and maintains plant productivity. Further process control with improved monitoring can detect early leaks and optimize physical and chemical treatment systems.

problem

Silica is one of the most common and detrimental steam impurities. Silica is present in source water as silicates and can enter process streams through lubricants/oils, contaminated chemicals/reagents, or other mechanisms. Silica contamination can cause scale in boilers and cooling water systems and deposits on turbine blades. Even with good chemical and physical treatment, steam in the boiler selectively carries silica through the boiler to the turbine. As the temperature and pressure drop towards the outer edges of the turbine, silica can deposit on turbine blades. In addition, high purity is important for plants that operate intermittently with start/stop cycles due to frequent temperature fluctuations and high pressure/high temperature boilers where contaminant carryover is increased.

Silica deposits reduce turbine efficiency and often deposit randomly at varying thickness resulting in a pressure drop and restricted flow. Pressure drops cause vibrational problems that reduce power generation, lower efficiency, and damage the turbine often to the point where plant productions need to be shut down for maintenance and repairs as silica deposits are difficult to remove. Thus, there is a strong need to minimize silica in feedwater.

solution

Often demineralization systems are used to remove contaminants, including silica. A demineralization system usually consists of two specific ion exchange units (cation, anion) followed by a mixed bed exchange unit as a final safeguard to prevent ionic leakage and produce high purity feedwater. Monitoring these units helps prevent leaks, maintain purity, and control regeneration of the units.

Online silica analyzers are used to determine mixed bed breakthrough and when to regenerate demineralization systems. These analyzers detect reactive silica but cannot monitor colloidal silica. Often once the alarm point is reached (10-20ppb) too much silica has slowly eluted off the resin and has already caused damage. Boron elutes off resin beds before silica so online monitoring of boron in ultrapure water can be used as a control tool for early leak detection as shown in **Figure 1**. This will prevent deposits on the turbine, save time, minimize downtime, and prevent equipment failure.

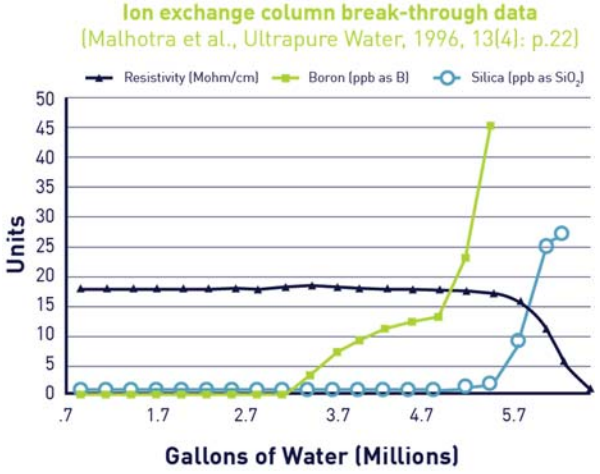

Figure 1. Correlation of boron, silica, and resistivity

conclusions

Boron is considered an important process variable as well as a water quality control parameter. Boron is the first contaminant released from a bed nearing exhaustion. Online monitoring of boron in ultrapure water provides a cost-effective, low-risk solution for resin management, leak detection, and protection of equipment assets.

References

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