

Troubleshooting: Condensate Contamination

By James McDonald, PE, CWT, Technical Resource Engineer

In a well maintained, properly operating boiler system, condensate is a relatively high purity water with low conductivity and minimal dissolved solids. Condensate contamination can be caused by heat exchanger leaks, boiler carryover, etc. and can be a perplexing problem. If approached logically, you will be able to find the source of the contamination.

Consider the analogy of a tree with the boiler being the trunk and the steam/condensate system being the branches. When condensate contamination occurs, you should start at the trunk and work your way out one branch at a time until the source is found.

A good boiler water management program should include regular condensate testing by both the boiler operators and the contracted water management specialist. When condensate contamination is found, the following steps will lead you to the source.

1. How is the boiler operating? Is the boiler operating within normal operational parameters? Is the steam load fluctuating significantly? If the boiler is overcycled, treatment chemicals are overfeed, or alkalinity is too high, carryover may occur. Fluctuating boiler water levels can be a cause too.

Boiler carryover is just as likely to have a mechanical cause as it is a chemical cause. Mechanical carryover causes include:

- Excessive movement of water in the steam drum.
 - Spray or mist carryover from fine water droplets. (This usually occurs when separation devices are missing or damaged.)
 - Steam production in excess of design rating.
 - Sudden swings in steam load.
 - High water level.
 - Changing boiler pressures.
2. What is the contaminant? Use the testing tools on-hand to determine the nature of the contaminant. Typical parameters you should be able to easily check are conductivity, pH, hardness, orthophosphate, molybdate, nitrite, chlorides, and iron.
 3. Are any of these contaminants unique to any of the steam uses in the plant? Hardness can come from a leaking hot water heat exchanger. Orthophosphate can come from a leaking heat exchanger in a phosphoric acid bath or boiler carryover. Nitrite can come from a leaking heat exchanger in a closed hot water loop. Elevated pH may be attributed to an overfeed of neutralizing amine, the inleakage of caustic from a heated bath, or boiler carryover. Increased conductivity can be caused by any of the above. If you are lucky, the uniqueness of the contaminant will lead you directly to the source.
 4. Check the condensate quality of the steam header as close to the boiler as possible and before any other possible contamination sources (including the neutralizing amine feed). You may be able to get a sample off the steam header's steam trap. If you find contamination here, you most likely have boiler carryover occurring. This boiler carryover may either be the **cause** of the

condensate contamination you see or be a **result** of it.

5. If you believe you have boiler carryover occurring, this must be corrected before you can further investigate the source of the contamination. Boiler carryover will contaminate the entire condensate system making any other condensate sampling a fruitless endeavor. Work with the boiler operators to correct the problem. Dump all incoming condensate, if possible, to clear the contamination from the system in the shortest period of time.

*Boiler carryover may either be the **cause** of the condensate contamination you see or be a **result** of it.*

6. After any carryover is under control and the condensate system has had time to clear itself of the carryover contamination, start testing the condensate return system for the contamination. Start first with the condensate receivers closest to the boilers. When you find one that's contaminated, work your way upstream from there. With

any luck, you may be able to quickly find the source of the contamination.

Finding contamination sources can be tough sometimes. The offending piece of equipment may only operate sporadically. By the time condensate contamination is seen back at the boiler, the leaking piece of equipment may already be offline and any contaminated condensate flushed from its nearest condensate receiver.

Heated baths are often temperature controlled. When the bath reaches the set temperature, steam flow through the heat exchanger is turned off. The steam remaining inside the heat exchanger condenses and can form a negative pressure. If the heat exchanger has a leak, the outside liquid is sucked into the heat exchanger. When steam flow is returned to the heat exchanger, a slug of contamination is sent back to the boiler system via the condensate. This can be an especially frustrating contamination source to find due to its intermittent nature, but can sometimes be easily spotted by a bubbling bath. If you see a heated bath bubbling near the heat exchanger, you most likely have steam leaking out of the heat exchanger. ❖



Crown Solutions Co., LLC

945 South Brown School Road
Vandalia, OH 45377

(937) 890-4075

www.crownsolutions.com