# Canadian Boiler Society 2019 Education Days

# What's Wrong with my Deaerator?

Speaker(s):

Braden McKerlich

Industrial Project Applications Engineering

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# What is a Deaerator?

- Part of the boiler feed water treatment system
- Carbon steel pressure vessel
- A device that removes dissolved gases (oxygen & carbon dioxide) from water mechanically
- Typically mounted on top of a storage tank
- Reduces oxygen level to < 7 parts per billion (ppb) by weight or 0.005 cc/L
- Reduces carbon dioxide to a “zero” level

# Common Deaerator Parts

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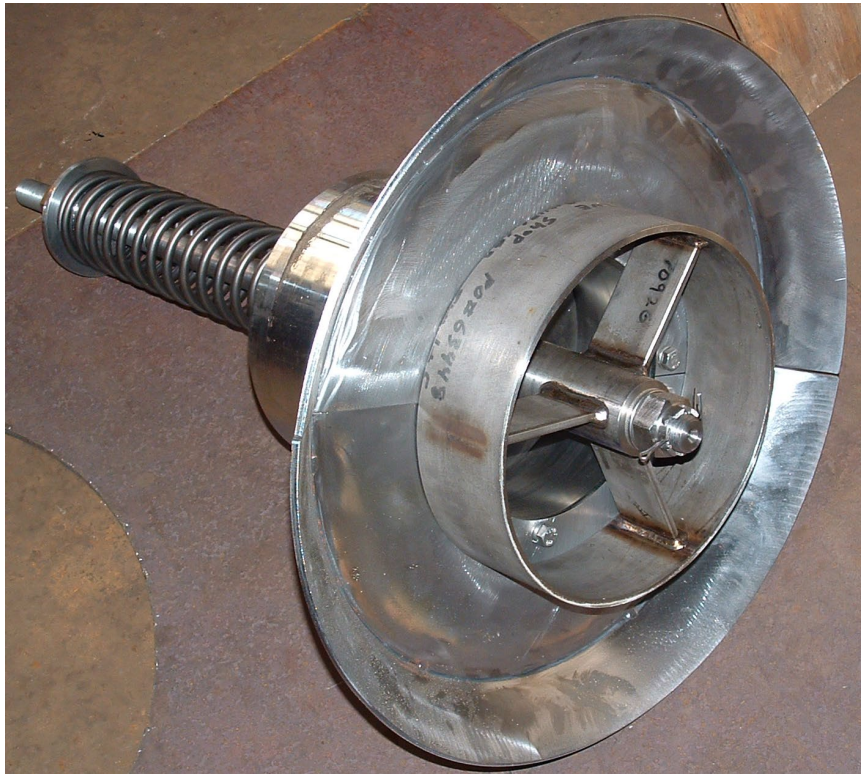
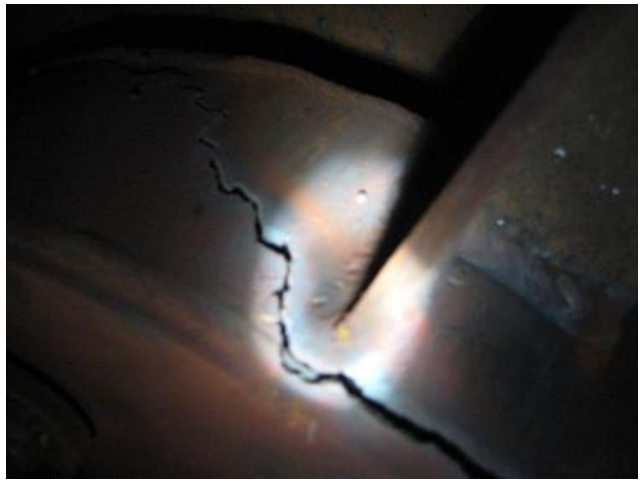


# Proper Operation, Maintenance, & Inspection

- Deaerators should be operated per the manufacturer's IOM Manual.
- During normal operation a deaerator vent should have an 18"-24" steam plume coming from the vent pipe.
- Pressure should stay as consistent as possible to create a stable pressure environment inside the deaerator. Steady State operation is key to deaerator operation.
- Must have enough steam volume to heat the incoming water to saturation temperature and carry out non-condensable gases.

# Proper Operation, Maintenance, & Inspection

- Deaerator maintenance and inspection is critical to life expectancy of the equipment and its process guarantee.
- Deaerators should be internally inspected at least once per year for damage to removeable parts (sprays, trays, atomizing valves) as well as damage to pressure vessel components and non-removeable internals.
- If removeable parts are damaged, it is suggested to work with the DA manufacturer to see if it was end of life or a process issue.  Damaged internals can drastically reduce the life of your DA.



# Common DA Issues: Improper Venting

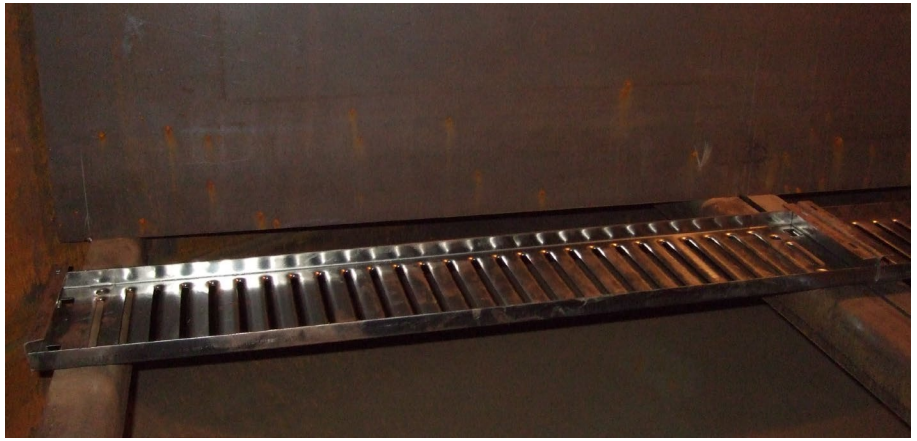
- Issue: High O2 in BFW Outlet (10-20 ppb O2)
- Common Causes:
  1. Excess vent rate caused by too large orifice creating wet vent.
  2. Too little vent flow creating air blanket inside deaerator.
  3. Improper vent piping arrangement.
- Solutions
  1. Calculate proper vent flow rate and create an orifice to control flow. Note in some cases two orifices might be required for seasonally differing loads.
  2. This is generally an issue found by exclusion. If high O2 is an issue, checking the vent is one of the easiest solutions without shutting unit down.
  3. Vent Piping should be as straight as possible limiting turns and valves that create pressure drop in line. Pressure drops cause steam condensing of highly corrosive water.

# Common DA Issues: Improper Venting

- Issue: Water out of the vent!
- Common Causes:
  1. Excess vent rate caused by too large orifice or no orifice at all
  2. Internal Damage to the vent condenser area inside the deaerator.
- Solutions
  1. Calculate proper vent flow rate and create an orifice to control flow. Note in some cases two orifices might be required for seasonally differing loads.
  2. Internal inspection of deaerator vent condenser for cracks, holes, defects. These are commonly identified visually. Contact DA manufacturer for repair options.

# Common DA Issues: Upset Trays

- Issue: High O2 in BFW Outlet (10-50 ppb O2)
- Common Causes:
  1. Trays installed incorrectly in the unit (commonly upside down).
  2. Trays dislodged or damaged
- Solutions
  1. Internal inspection and review tray installation vs. the IOM Manual to ensure compliance.
  2. Upon internal inspection, review and replace all damaged trays if not flat and square.



# Common DA Issues:  Upset Trays

- Issue:  Pressure Control & Storage Tank Level Issues
- Common Causes:
  1. Trays dislodged causing blockage of flow from DA Section to Storage Section.  This will cause pressure swings and level swings.
- Solutions
  1. Upon internal inspection, review and replace all damaged trays if not flat and square.
  2. If a common occurrence, a custom tray hold down device can be engineered and supplied.
  3. Note that rust is common on trays and doesn't always require replacement.

# Common DA Issues:  Broken Spray Nozzles

- Issue:  High O2 in BFW Outlet (100-300 ppb O2)
- Common Causes:
  1. Broken Spray nozzles caused by wear and tear.
  2. Broken spray nozzles caused by improper process conditions through spray nozzles
- Solutions
  1. Proper inspection of deaerator internals would show a broken spray nozzle which should be replaced.
  2. Replace broken nozzle and review process conditions with deaerator manufacturer.

# Common DA Issues:  Broken Spray Nozzles

- Issue:  Deaerator Hammering
- Common Causes:
  1. Flashing condensate entering through deaerator spray nozzles.
  2. Steam Expansion in incorrect area of deaerator
- Solutions
  1. Review process conditions with deaerator manufacturer to ensure entrance through correct nozzle.
  2. Replace all damaged spray nozzles as required.
  3. Note all spray nozzles should be the same design to ensure proper pressure drop and flow characteristics.

# Common DA Issues: Process Conditions

- Issue: High O2 in BFW Outlet (15-25 ppb O2)
- Common Causes:
  1. Preheating of makeup water without venting prior to entering DA.
  2. Makeup water entering through the wrong connection and not being heated.
  3. Excess O2 in a water stream from leaking valve, gasket, flange, pump seal, etc.
- Solutions
  1. Allow for preheated water to be first put through a vented condensate receiver to vent excess gas prior to going to DA.
  2. Cold water must be heated through spray nozzles/spray pipe. Confirm that this flow enters through that connection or contact DA manufacturer.
  3. This is an issue of exclusion. Check all connections for loose flanges, seals etc. one at a time to solve O2 issues. This is the most challenging O2 issue to solve and it is recommended a deaerator service engineer be on site to help troubleshoot.

# Common DA Issues: Process Conditions

- Issue: Deaerator Choked Flow
- Common Causes:
  1. Deaerator Trays are overloaded and flood which causes pressure fluctuations and heating issues.
  2. Deaerator atomizing valve is clogged and/or has a bent shaft/damaged
- Solutions
  1. If possible, reduce load temporarily and see if pressure/level fluctuations solve themselves. If not, contact manufacturer for options.
  2. Internal inspection would show any damage or clog in an atomizing valve.

# Replacing Removeable Parts

- Deaerator Trays
  - Deaerator trays are removed and inspected through the deaerator tray door.
  - Confined space entry generally required with all safety requirements for the site.
  - Trays are installed with the open or trough side upwards to catch water and spill over an edge.
  - No tools required and are installed in place.
  - Should be replaced in kind if possible to keep all trays of the same design to ensure proper pressure/flow profile through the stack.

# Replacing Removeable Parts

- Deaerator Spray Nozzles
  - Deaerator sprays are removed and inspected through the tray door or spray access panel.
  - Confined space entry generally required with all safety requirements for the site.
  - Deaerator spray nozzles should be replaced as direct replacements. If OEM replacement is not available, all nozzles should be replaced to keep same flow/pressure profile.
  - Generally 2 or 3 bolt installs with nuts required to fasten in place. Tools are required.

# Summary

- Issues can be identified by level of O2 in the Boiler Feed water with the following guidelines:
  - 10-20 ppb – Venting Issues
  - 10-50 ppb – Potential Tray Upset
  - 100-300 ppb – Potential Spray Nozzle Issues
  - 15-25 ppb – Process Condition Issues
- Many problems can be troubleshooted with the deaerator operating to avoid shutdown. Should exhaust those solutions before performing any internal inspections.
- Internal inspections are best completed by a deaerator service engineer who understands the equipment and designs of the internals.

# Thank you

Braden McKerlich

**Company:** Cochrane by newterra

**Email:** bmckerlich@newterra.com