



Canadian Boiler Society 2019 Education Days

Protecting Boilers Off-Line

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2019 Education Days

London, Burlington, Kingston, Montreal, Halifax

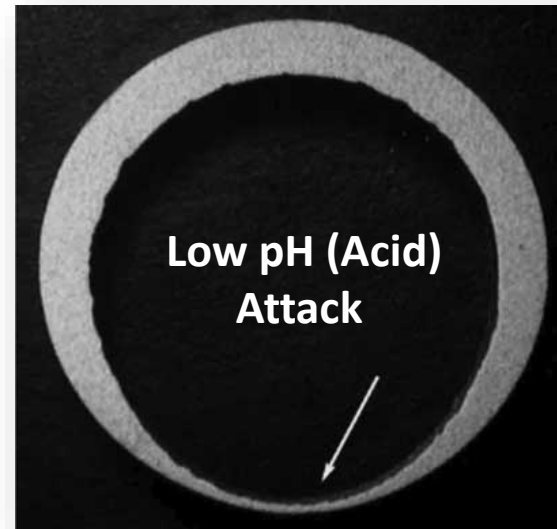
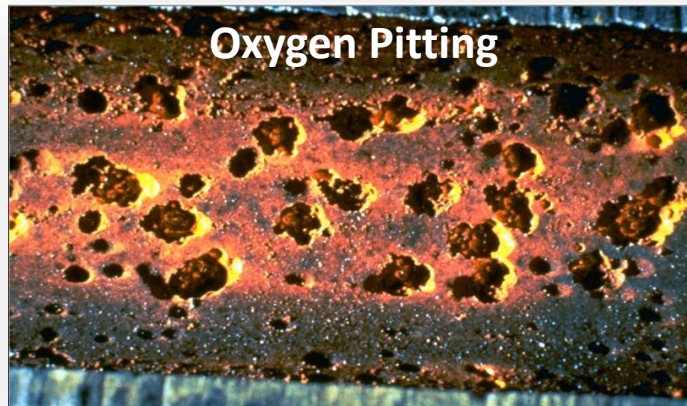
Content

- Impacts of improper layup...
- The recipes for corrosion
- Dry or wet layup?
- Best practices for wet / dry layup
- Vapor (Phase) Corrosion Inhibitors (VCI)



Impacts of improper layup

- Waterside Corrosion

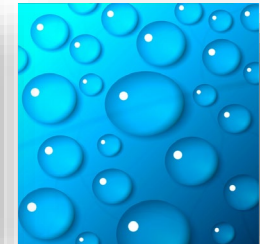
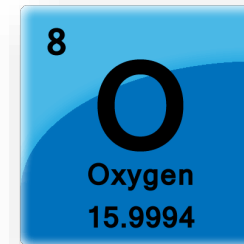
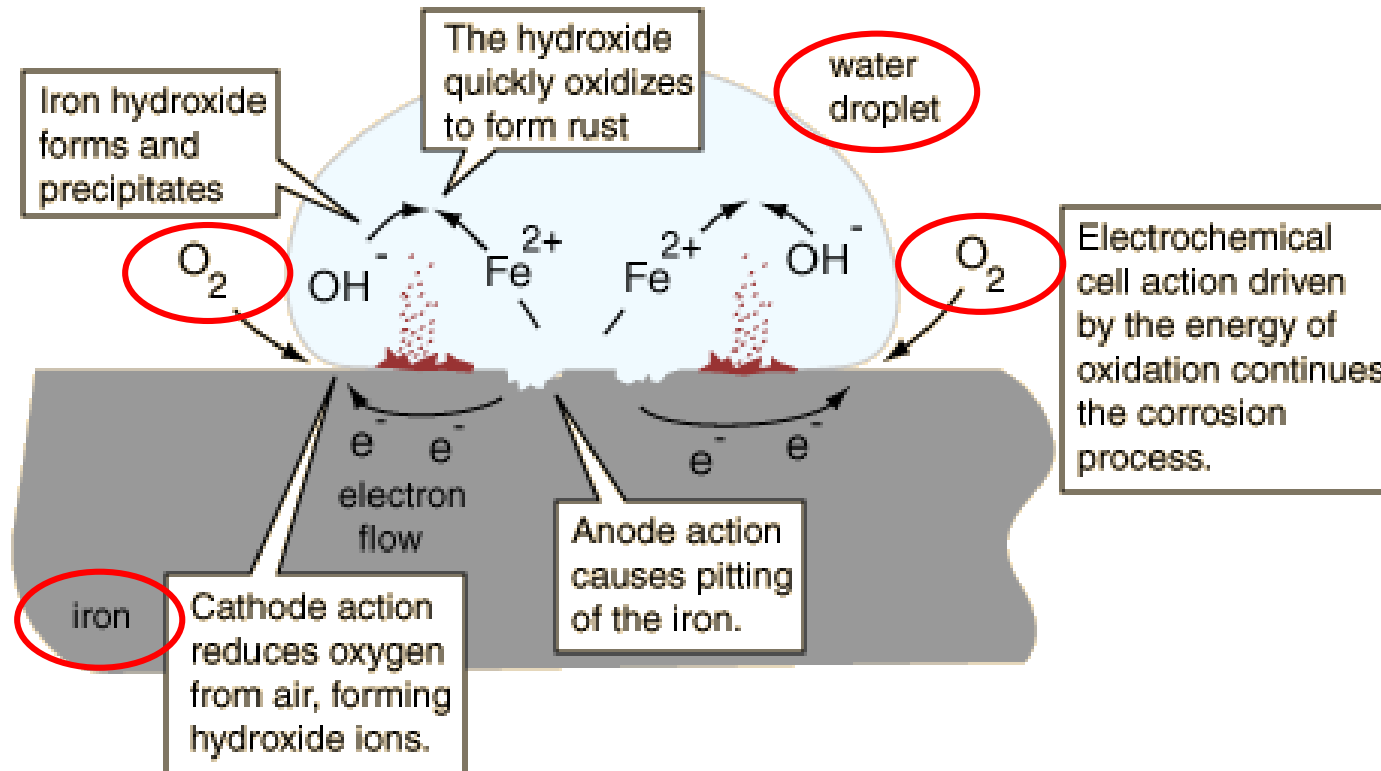


- Corrosion takes place within 1 week!
- Can escalate to cause serious damage within one 1 month!

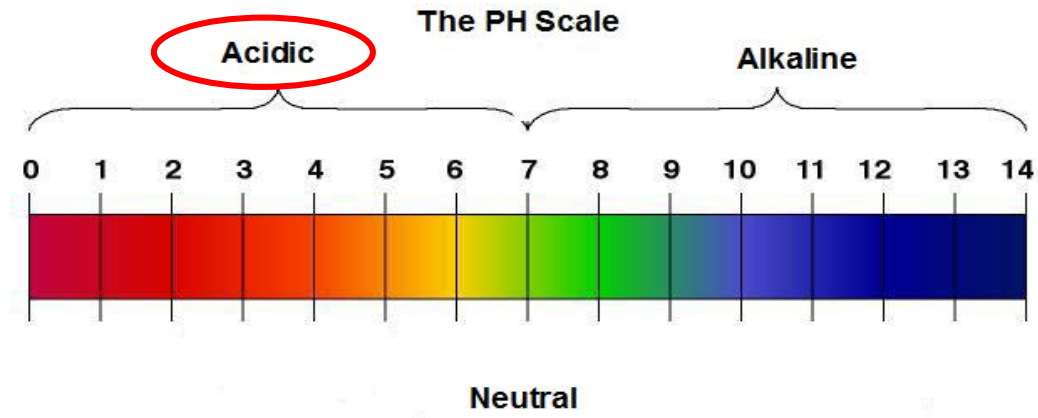
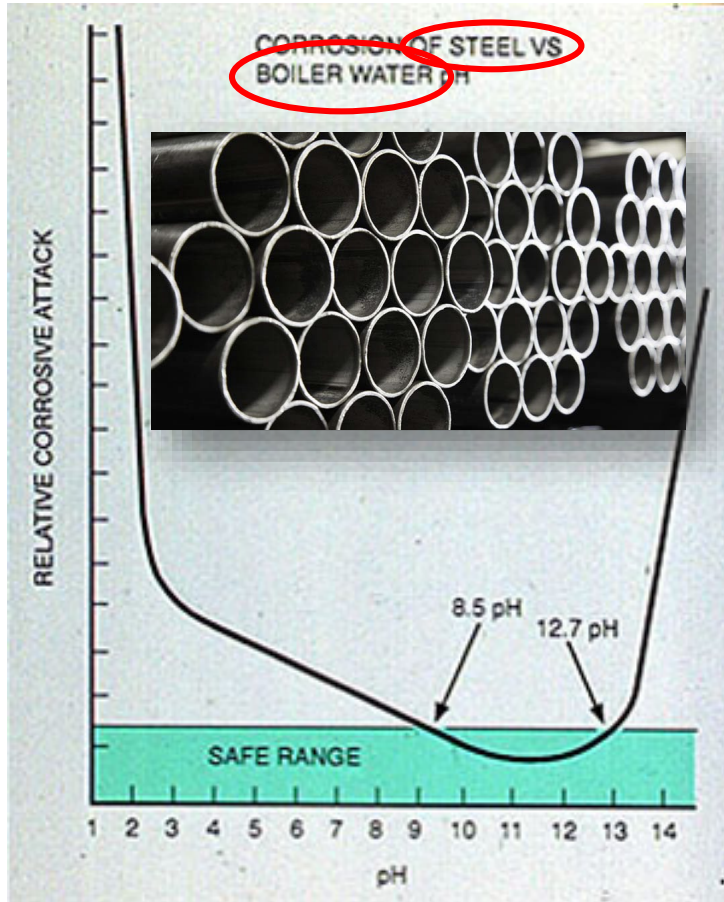
Impacts of improper layup



The 1st Recipe for Layup Corrosion



The 2nd Recipe for Layup Corrosion

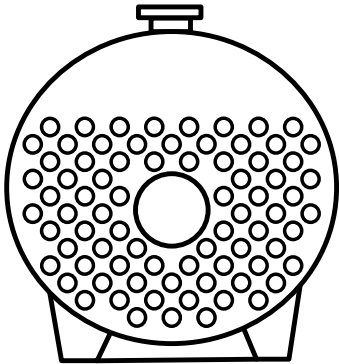


Dry or Wet Layup?

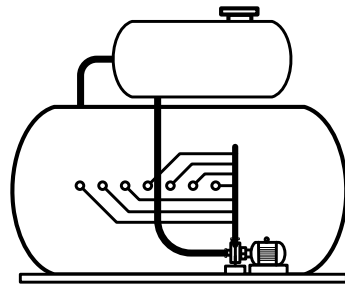
- Factors to consider:
 - What's the duration of downtime?
 - Need to provide immediate backup steam capacity?
 - Can the boiler be completely drained?
 - Does it have a superheater?
 - Is the superheater drainable?
 - Past history of layups, success, challenges?
 - What about proper chemistry and control?



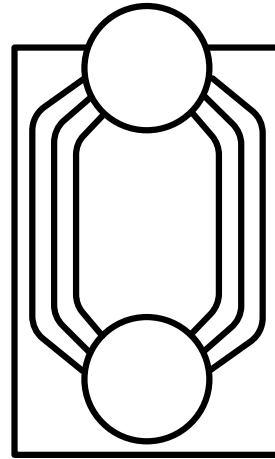
Boiler Types & Designs?



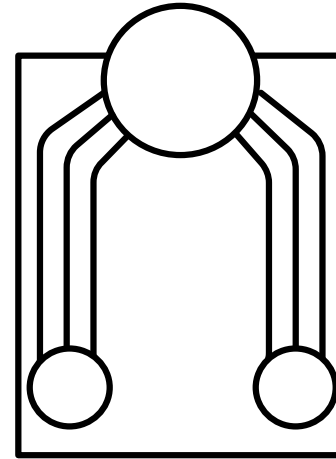
Firetube



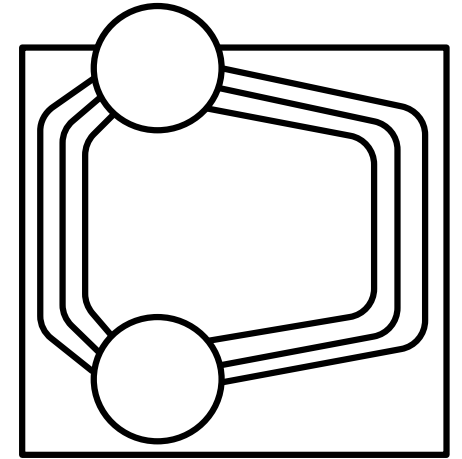
Watertube
Coil-type



Watertube
O-type

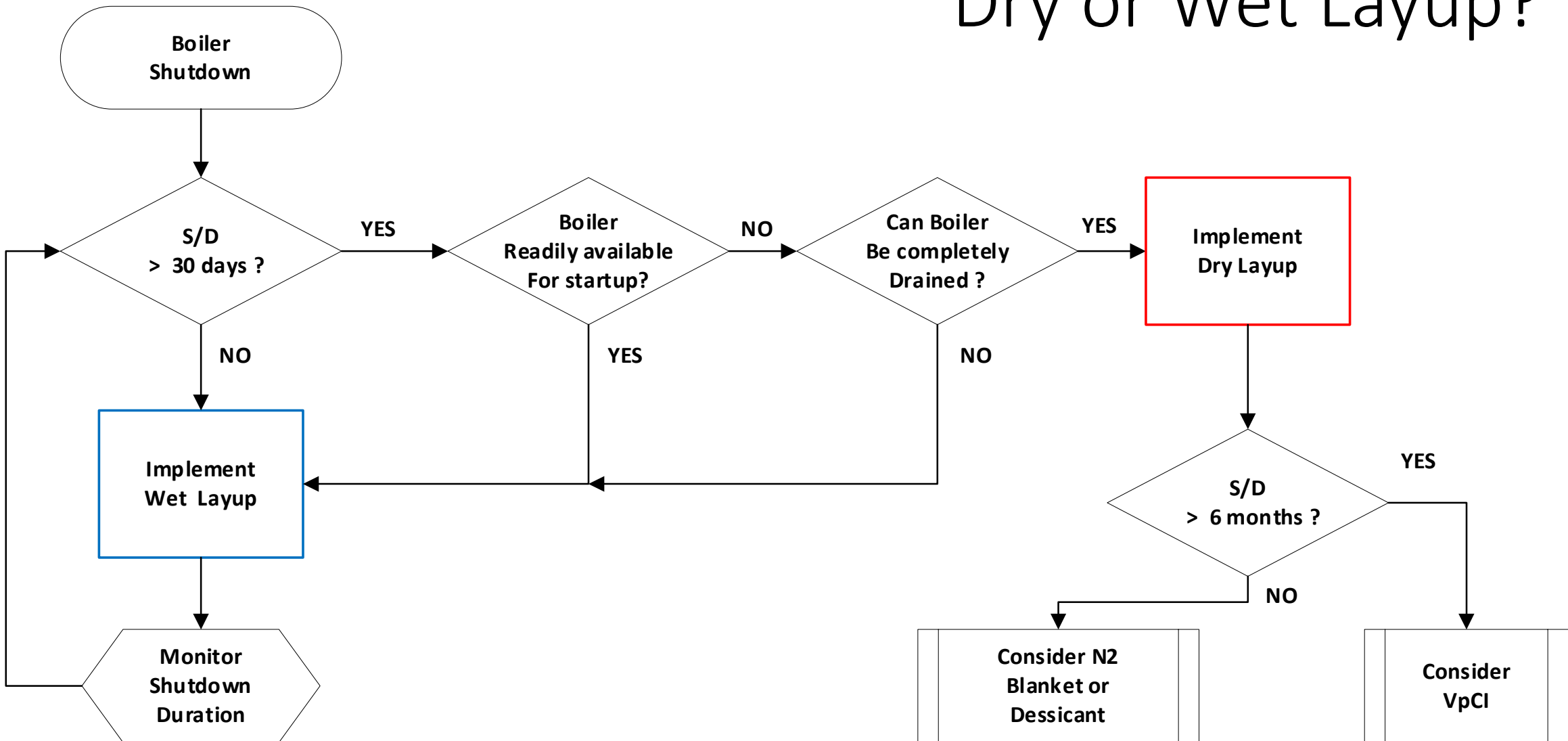


Watertube
A-type

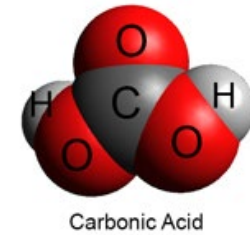


Watertube
D-type

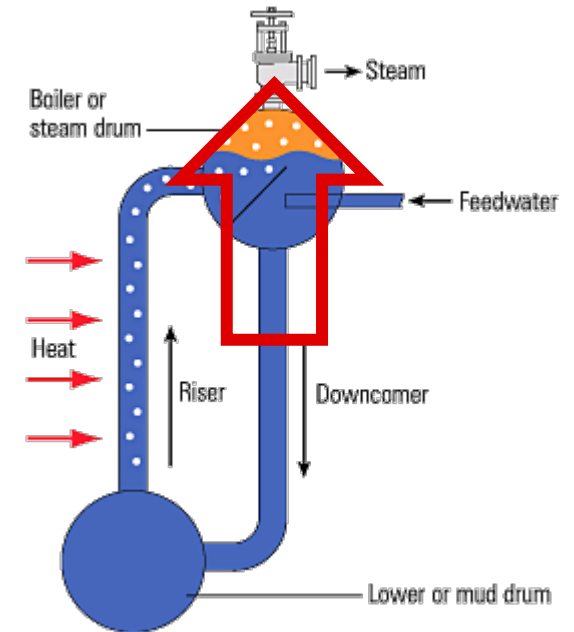
Dry or Wet Layup?



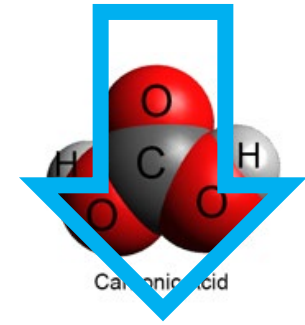
Wet Layup



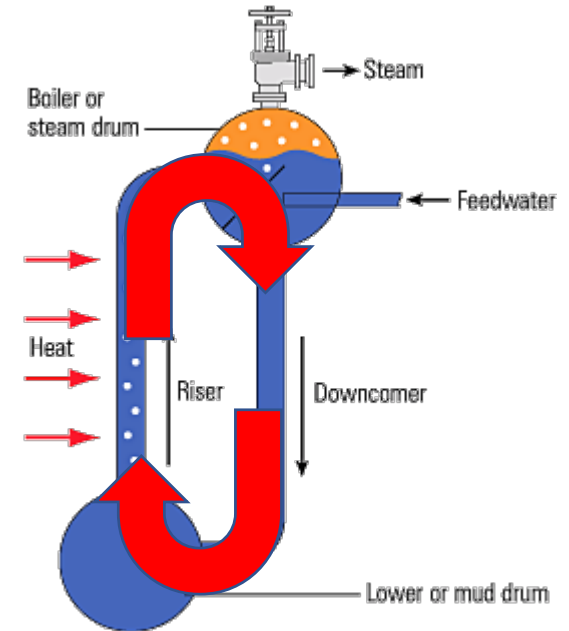
- Goal is to keep all surfaces wet and treated against corrosion
- Preparation:
 1. After the boiler has cooled but still above 180 °F, drain the unit completely;
 2. Thoroughly flush loose deposits from the water-side surfaces.
 3. Fill the boiler completely to the stop valve with treated feedwater while injecting sufficient layup products.
- Maintain oxygen scavenger with higher free residuals:
 - Sulfite: > 250 ppm (operating range 30 to 50 ppm)
 - Tannins: > 300 ppm (operating range 150 to 200 ppm)



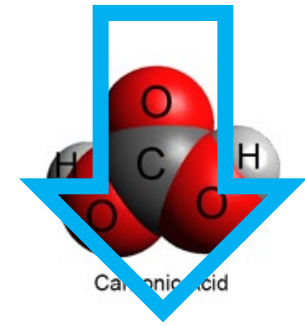
Wet Layup



- Maintain boiler water pH between 10,0 and 12,0:
 - Caustic: > 200 ppm as OH Alkalinity ($\text{OH} = 2\text{P} - \text{M}$)
or
 - Ammonia: +/- 11,0 pH (Combined with tannins)
- Fire-up the boiler or run a pumping loop to circulate water and test water parameters once per week.
- Circulate water when adding layup chemicals, protective chemistry needs to reach all areas of the boiler.
- Superheaters need special care (back-fill / pure water pH & AVT)

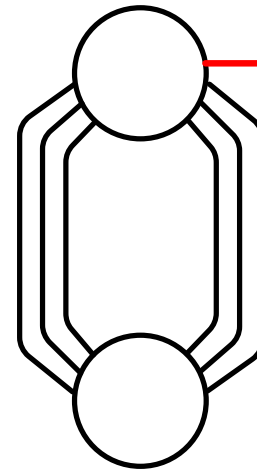


Wet Layup

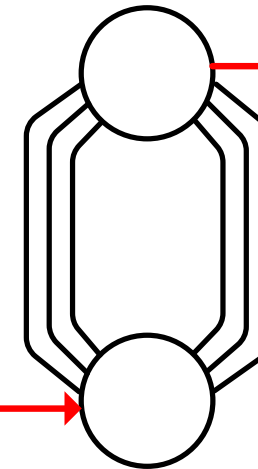


Cascading Layup Method

- Surface blowdown ONLY!
- Treated boiler water used to protect idle boiler
- Anti-syphon installation on laid-up boiler!



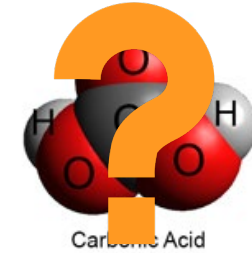
Operating Boiler



Standby Boiler

Flash Tank

Dry Layup



- Goal is to keep all surfaces as dry as possible
- No water = minimized risks (no electrolyte, no dissolved gases!)
- Preparation:
 1. Drain and thoroughly rinse out all boiler internals with clean water.
 2. Dry the watersides with warm air (might take several days).
 3. Blank all valves to ensure water cannot leak into the boiler.
- Dry Layup Methods:
 - Dehumidified Air: Atmospheric (open) conditions, constant heated airflow
 - Nitrogen: Pressurized gas
 - Desiccant: Silica gel, quick lime, alumina / moisture absorption
 - VCI: Vapor phase Corrosion Inhibitors

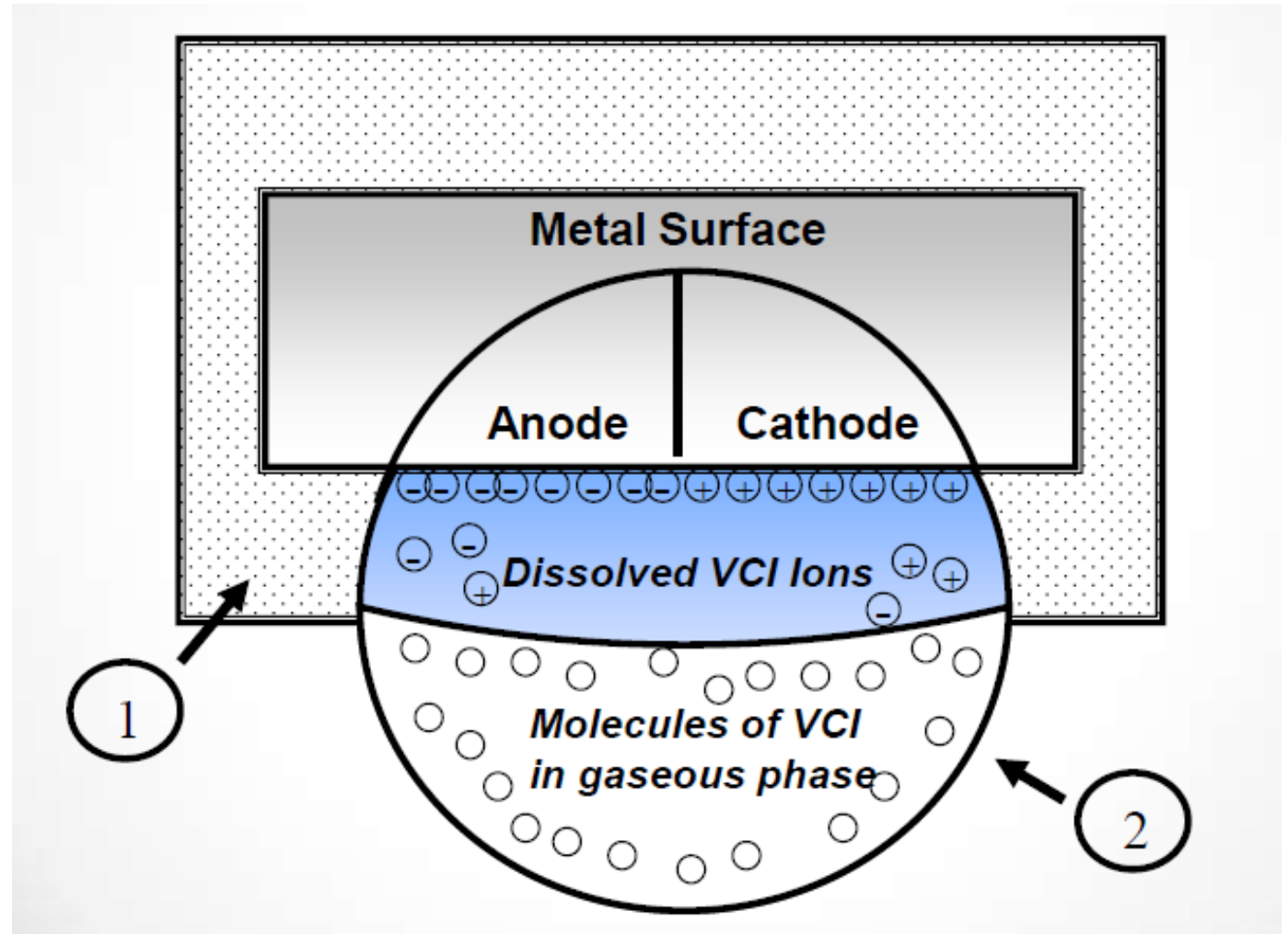
VCI: Vapor (Phase) Corrosion Inhibitors

- What: Powdered form ambiodic inhibitors, amine-like organics.
- How: Protection of all phases – liquid, vapor and interface.
Migrates to distant metallic surfaces (sublimation: solid to gas).
- Use: Dry layups, mainly.
- Form: Dry powder or in a water soluble PVA bag / 1,5 kg.
(each bag treats 130 ft³ or 1000 usg)
- Duration: Up to 12 months + of protection / boiler must remain well sealed.
- Monitoring: Good practice to inspect annually & use corrosion coupons.



How VCIs work?

1. VCI inhibitors sublime = change state from solid to gas.
2. VCI molecules reach equilibrium/saturation in the vapor space and form a protective layer.



Thank you

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Sources:

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Combined Cycle Journal, Layup strategies for maintenance outages, by A. Sieben and S. Wambeke, Fall 2008

The Analyst, Volatile Corrosion Inhibitors, unique water treatment applications, by A. Gandhi, Fall 2000

