Water Treatment Chemistry

Cooling Water Treatment

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Introduction

- Charles Rohr
  - Education
    - B.S. in Biology from Oklahoma Christian University
    - M.B.A from Baker University (In progress)
  - Experience
    - Water Treatment Industry for 8+ years
      - ~5 years with GE Betz
      - ~4 years with City of Winfield “Water Treatment”

Cooling Water Treatment Questions

- Why do we need to treat cooling water?
- What are issues of untreated cooling water?
- What testing is imperative to run and why?
- What are modern issues in water treatment?
- What modern technologies are available on the market?

Why treat cooling water?

- Transfer heat from products or equipment to water, allowing increased or elevated production
- Protect plant equipment from corrosion by water
- Product plant equipment from deposition of solids (i.e. calcium & magnesium) which impedes heat transfer
- Prevent biofouling of product coolers
- Make cooling water safe for human exposure

Question #1???

- What are three major concerns which lead to the need for water treatment?

What lab testing should be run?

- It really depends on the chemistry being utilized in the system
- There are different programs depending on your chemical vendor
  - Alkaline vs. Non Alkaline Programs (pH)
  - Phosphate vs. Non-Phosphate Programs (Corrosion Inhibitor)
- Make-Up water source
  - Ground Water
  - Surface Water
  - River Water

What lab testing should be run?

- pH
- Conductivity
- ORP and or Chlorine (free or total)
- Hardness (calcium and/or total)
- Metals (iron/copper)
- Chemical Residuals
  - Phosphate (if phosphate program)
    - Filtered and Unfiltered
  - Zinc (if zinc program)
  - Dispersant
    - Polymer

pH of Cooling Water

- Consider pH to be one of, if not the most important, control parameter of a cooling tower
  - pH Scale ranges from 0-14 (units)
    - The lower the pH the more acidic it is
    - The higher the pH the more basic it is
      - 7.0 is considered to be neutral
- When the pH of water is <7.0 corrosion will occur in the system
  - This decreases the life of equipment and piping
- When the pH of water is >~8.6 deposition will begin to occur leading to deposition
  - This decreases heat transfer

Conductivity of Cooling Water

- Conductivity of a cooling tower is important to control because it is an easy way for operations to monitor cycles in a cooling tower
  - What is a cycle? https://www.youtube.com/watch?v=PcEFMbc3m3Y
- Cycles are important because of scale (aka deposition) which impedes heat transfer

ORP of Cooling Water

- What is ORP?
  - ORP stands for Oxidation Reduction Potential
  - It is essentially a way of measuring the presence of any oxidant in the system
- ORP can be used in conjunction with chlorine testing to prevent microbiological and fungal growth
  - Such growth can lead to fouling which also impeded heat transfer and can also lead to under deposit corrosion

Testing pH, ORP, & Conductivity

A Myron 6p Ultrameter is the most simplistic way of testing pH, conductivity, and ORP all in one tool. These can be used in conjunction with automated controls which lead to optimal water treatment.

Question #2?

- What are three easy tests that can be run, which can lead to quick assumptions on the cooling tower operations?

Chlorine in Cooling Water

- Chlorine is the actual oxidant in the water which is put in place to inhibit any growth
  - This growth includes but is not limited to microbiological, fungi, algae, and yeast
  - A microbiological growth that has come to light recently is Legionella (causes legionnaire's disease)
- Chlorine residuals range from 0.2-1.0 ppm depending on your chemical vendor
  - Recent studies show that due to legionella you should run between 0.5 and 1.0 ppm chlorine

Hardness in Cooling Water

- Testing hardness in water is imperative because elevated amounts of hardness in the water can drive the LSI up, leading to deposition throughout the cooling system
  - Elevated deposition = decreased heat transfer
- Hardness in Cooling Systems depend heavily on the type of make-up water supplies the system
  - Ground water
  - Surface water
    - Lake water
    - River water

Deposition in Exchangers

Metals in Cooling Water

- Monitoring of metals in the system is a way of monitoring corrosion in the system
  - Elevated amounts of iron or copper (greater than the average cycles of other constituents) is indicative of corrosion in the system
    - ***Elevated copper in the discharge or blowdown of the system can lead to violations within KDHE***

Monitoring Corrosion

- Any water treatment consultant should monitor corrosion in a cooling tower system
- This is typically done with corrosion coupons which should match the metallurgy of the system
  - Admiralty corrosion rates should be <0.2 mpy
  - Carbon Steel corrosion rates should be <2.0 mpy

Corrosion Coupons

THE GOOD

After Photo Coupon

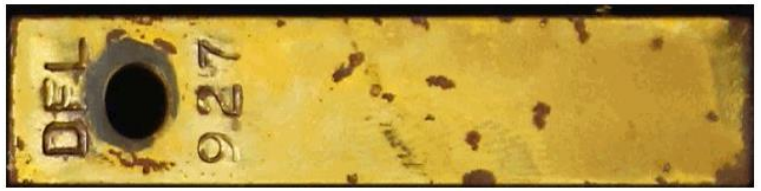
Before Photo Coupon

After Photo Coupon

Before Photo Coupon

THE BAD

After Photo Coupon



Before Photo Coupon

After Photo Coupon

Before Photo Coupon

Corrosion Coupons

THE UGLY

After Photo Coupon

Before Photo Coupon

After Photo Coupon

Before Photo Coupon

Chemical Residuals in Cooling Water

- Depending on your treatment program and your supplier your chemical residuals will vary
- Be sure to check with your water treatment consultant to ensure what your residuals should be and why
  - Understanding what chemistry is for is critical for both knowledge and costs

Typical Corrosion Inhibitors

- Over the years corrosion inhibitors have changed
- Today many chemical suppliers are utilizing some sort of phosphate program while others are still using an older zinc technology
  - If running a phosphate program both filtered an unfiltered phosphate testing should occur periodically
    - By running both you can monitor a delta
      - Elevated delta's (>3.0 ppm) increased the potential of deposition

Dispersants in Cooling Water

- Dispersants are used in cooling water to help keep any solids (calcium, magnesium, etc.) soluble in water
- There are multiple types of dispersants in the market, some are more effective than others
  - Speak with your local chemical vendor to get the latest on modern technologies

Modern Technologies

- Automation!!!!
  - Automation is one of the biggest things in the market today
    - Controllers allow for continuous monitoring of Cooling systems
      - Majority of them control pH, ORP, and Conductivity
      - Other systems can read the actual chemical residuals in the system (or tracers)
        - This will allow for chemical pumps and valves to operate without the need for manual action to occur

Modern Technologies Continued…

- Information at your finger tips
- Information from the controls can be sent to a DCS, Scada System, or even to the Internet
  - This allows for information to be seen from work computers, personal computers or even your phone

Challenge!

Challenge your current water treatment consultant as to what you use, why you use it, and to present you with information on the newest applications on the market!

Growth requires CHANGE!

QUESTIONS???

Differentiators GE Offers

- Halogen Resistant Chemistry
  - We have patented chemistry that none of our competitors have that is halogen resistant
    - Yellow Metal Corrosion Inhibitors
    - Stress Tolerant Polymers (STP)
  - These allow us to run the higher chlorine residuals (desired for legionella) without degrading our chemistry, allowing us to protect the system at lower treatment rates

Differentiators GE Offers

- Instantaneous Microbio Testing
  - BioScan
    - Allows for instant results of MB without an incubation period

Differentiators GE Offers

- Online Chemical Monitoring
  - Our TrueSense Two will read the actual chemical residual in a cooling system (free chlorine, STP, and phosphate)
    - When used in conjunction with the proper controller it can speed up, speed down, or turn chemical pumps on and off
  - InSight
    - Data from the controller can be sent near real time to our SRC Team allowing continuous monitoring and trending capabilities of data
      - Accessible from any computer or phone with proper login credentials

Differentiators GE Offers

- Service and Technological Support
  - GE prides itself in service
    - We have reps who can be reached nearly any time day or night for consultation
  - Technical Group
    - We have a group of experts in every division of water (Cooling, Boiler, Waste Water, RO etc.) who have decades of experience
  - Our own Lab
    - We have our own labs that process water samples, coupons, etc. and we can even perform metallurgy testing to determine the cause of any failure

Additional Questions

Please feel free to contact me at anytime!

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