

# Best Practices for Heat Exchanger Cleaning Leak Detection

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# Importance of Cleaning Heat Exchangers

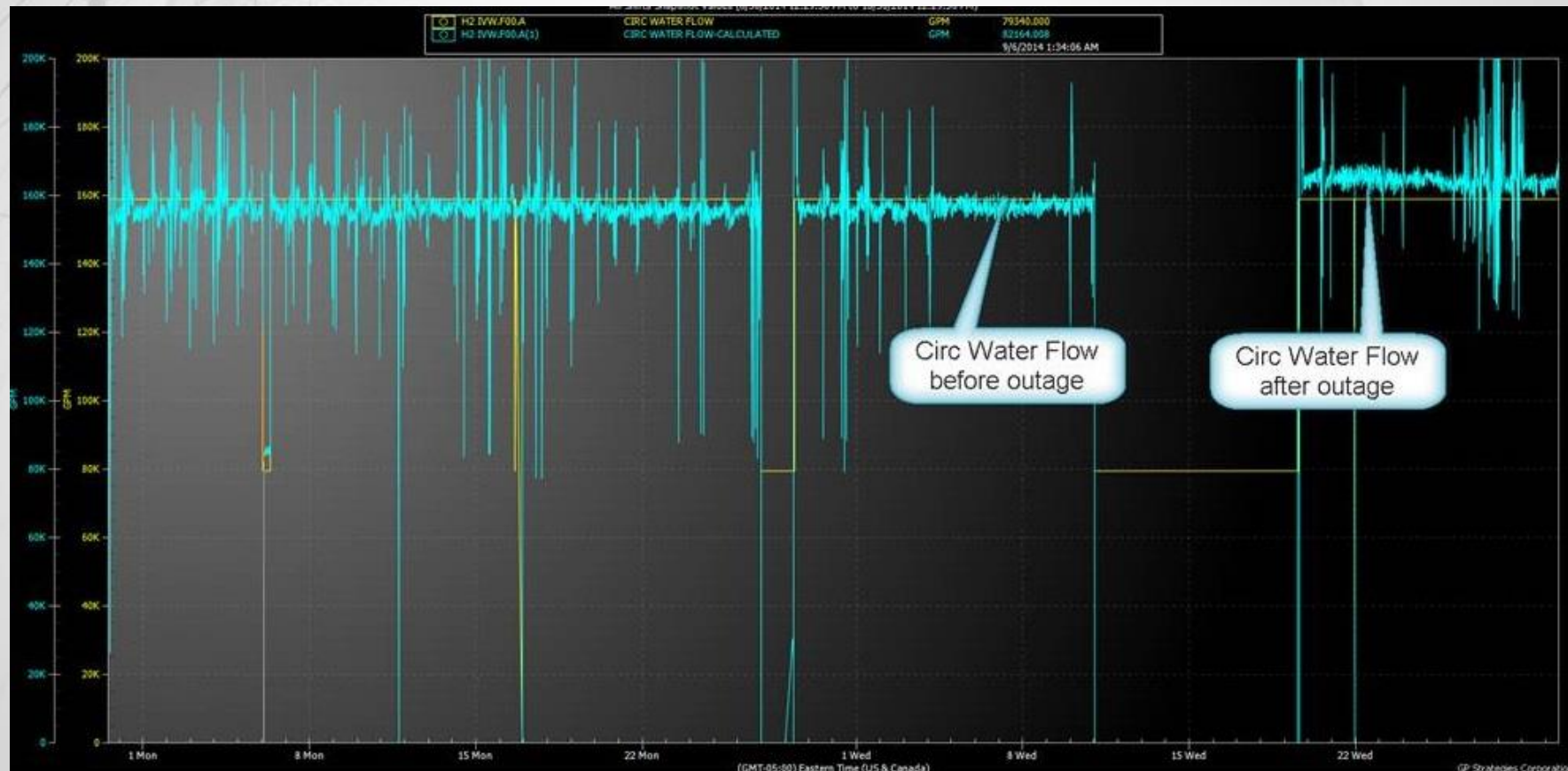
- Efficiency-heat transfer
- Equipment reliability
- Longevity of equipment



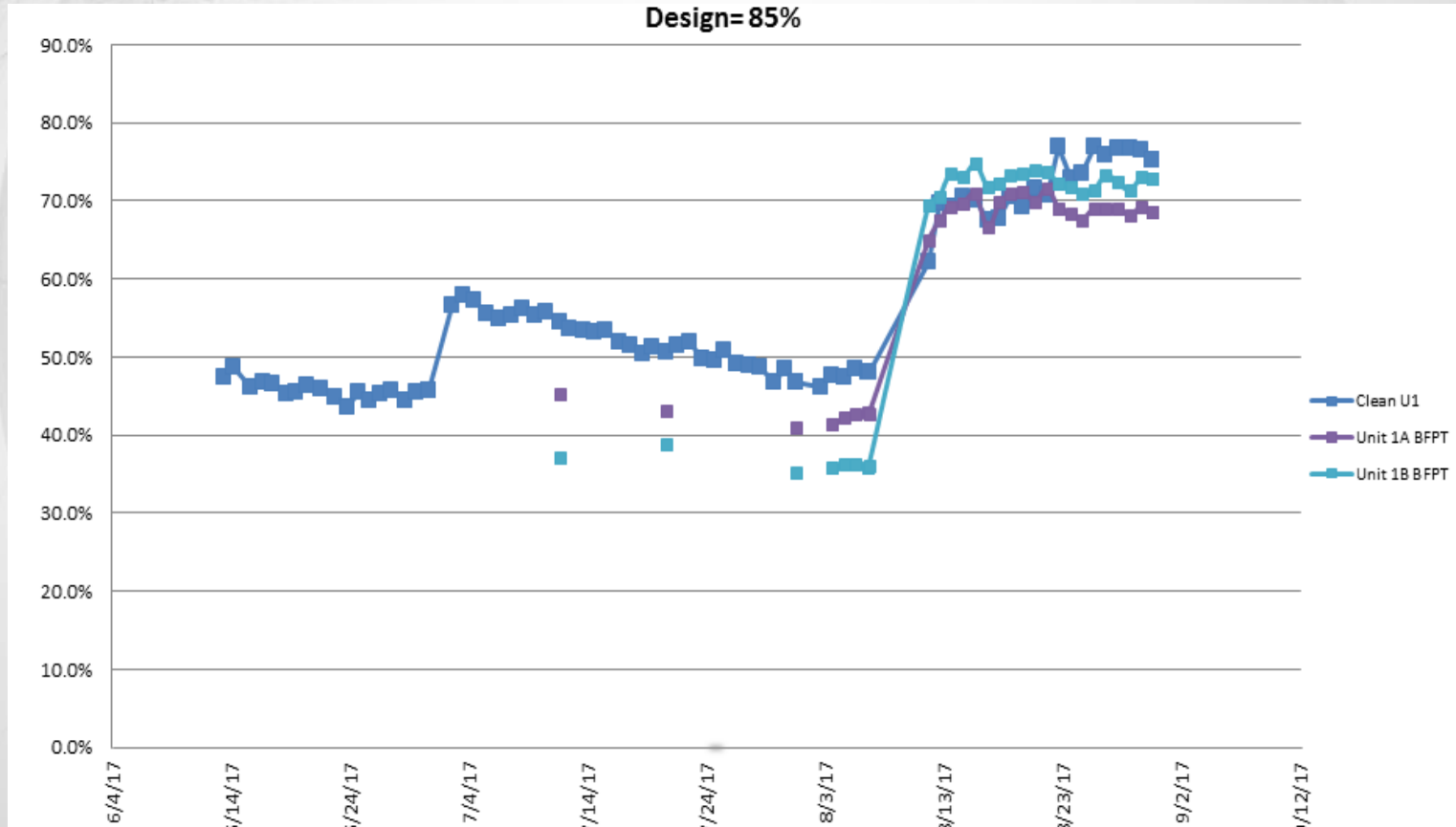
# Performance Metrics to Consider

- Temperature Changes (Delta T)
  - Measurement of cooling water temperature before passing through heat exchanger and after passing through heat exchanger
  - A larger change in temperature between inlet and outlet means a cleaner heat exchanger
- Flow Rates
  - Deposit in the tubes decreases the tube diameter
  - Reduces the flow across the unit
  - Cleaning heat exchanger increases flow rates
- Cleanliness Factor
  - Calculated by measuring a heat exchanger's current heat transfer coefficient as a percentage of the system's design specification.
  - The higher the percentage, the better the unit is operating

# Flow Rates Before and After



# Cleanliness Factor Before and After





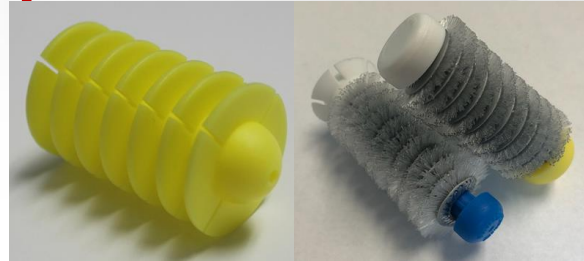
# Methods for Cleaning Heat Exchangers: Mechanical Tube Cleaning

- Utilizes specialized Mechanical devices called Projectiles to scrape deposit from tube walls
- Uses low pressure (350 psi) high volume (35 GPM) water to propel the Projectiles through the tubes, similar to pipeline pigging
- Various types of Projectiles based on the application:
  - Metal-Hard deposits
  - Nylon Brush- Soft deposits
  - U-tube Projectiles- for U-tube heat exchangers
- Pros:
  - Fast: can clean around 500 tubes per hour
  - Safe: no safety risks inherent with the process
  - Good quality of cleaning
  - Relatively low-cost method
- Cons:
  - Unable to be used on tubes that are severely fouled



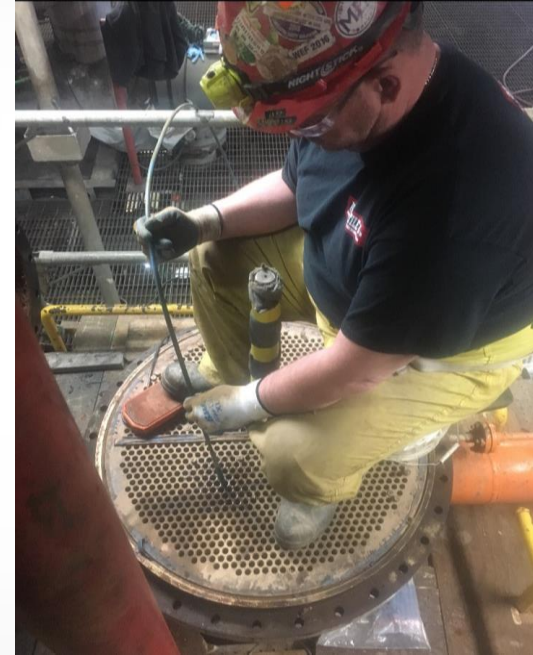
# Deposit Type and Projectile Selection

- Which Projectile Type should I choose?
- The projectile to use depends on the type of deposit in the tubes
- Soft Deposits
  - Scrubber
  - Nylon Brush
- Medium Deposits
  - Plastic Projectile
- Hard Deposits
  - Metal Projectiles
  - Stainless Steel Brush (Rifled Tubes)



# Methods for Cleaning Heat Exchangers: Rotary Tube Cleaning

- Uses a spinning lance with a brush or bit on the end. Utilizes water flush
- PROS:
  - Perfect for small tube bundles
  - Equipment is relatively low cost
  - Good starter set of equipment
- CONS:
  - Time consuming (less than 50 tubes per hour)
  - Cleaning effectiveness is below average





# Methods for Cleaning Heat Exchangers: High Pressure Water Blasting

- Water is mechanism removing the deposits
- Uses pressures as high as 40,000 psi
- Lances are pushed down each tube with spraying tips
  - Semi-automated systems are being used, but many people still push the lance by hand
- Pros:
  - Good quality of cleaning: the process can remove deposits that mechanical cleaning may not be able to
- Cons:
  - Relatively slower than mechanical and chemical cleaning
  - Expensive
  - Higher safety risk factor due to high pressure-specifically true with hand lancing



# Methods for Cleaning Heat Exchangers: Chemical Cleaning

- Mainly uses inhibited acids to remove mineral scaling that are called de-scalers
- Uses a water to de-scaler mixture: usually 15-50% de-scaler
- Most common scale to be removed is calcium-based compounds
- PROS:
  - Relatively quick process
  - Able to fully remove deposits and restore tubes to base metal
- CONS:
  - Expensive
  - Only works on certain deposit types
  - More planning and logistical work from the plant involved than other methods



# Plate and Frame Cleaning

- Two Cleaning Methods:
  - Circulate Chemicals
    - Pros
      - No need to disassemble
      - Lower Cost option
    - Cons
      - May not remove all deposition
  - Disassemble and clean with high pressure or individual dipping
    - Pros
      - More thorough cleaning method
    - Cons
      - Need to take apart unit
      - More expensive and time consuming





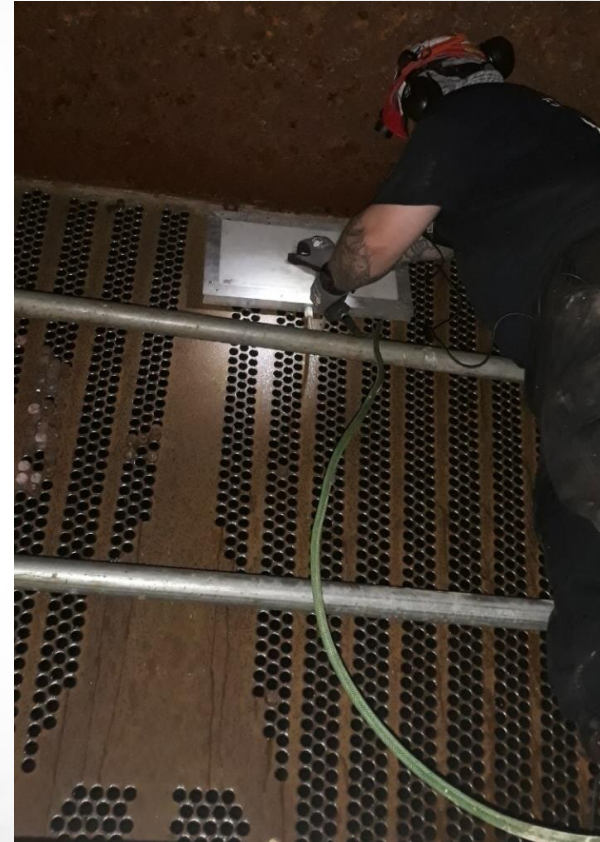
# Leak Detection Methods (Shell and tube)

- Helium Leak Detection
- Pressure/Vacuum Testing
- Shell side fill
- Plugging Tubes

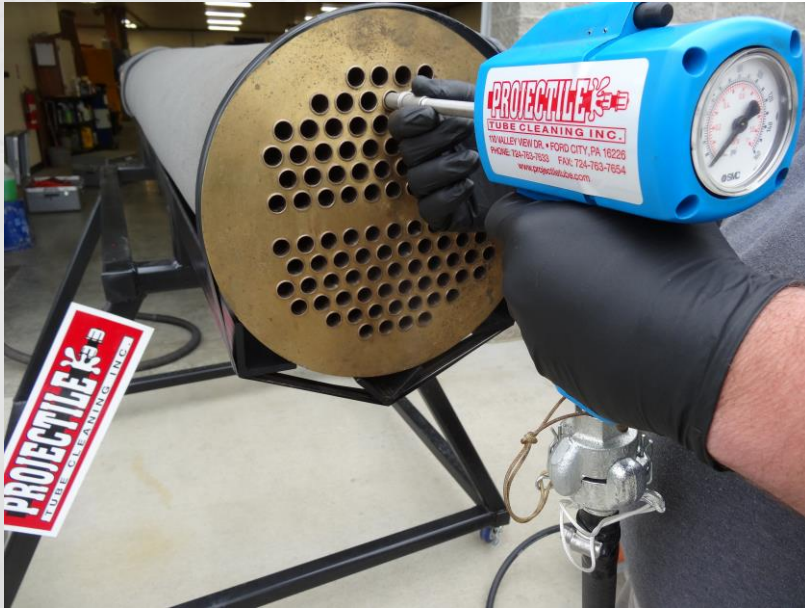


# Helium Leak Detection

- Pros:
  - Quick and Efficient
  - Most sensitive test: can find the smallest leaks
  - Good for finding tube to tube sheet leaks
- Cons:
  - Need an experienced contractor (technician)
  - Need shell side on
- Two Types of Tests:
  - Pressurize with helium
  - Vacuum test with helium



# Pressure/Vacuum Testing



- Specialized guns to either pressurize with air or pull vacuum
- Test each tube individually
- Pro:
  - Sometimes the only method available
  - Quick and easy if there are not a lot of tubes
- Cons:
  - Takes a long time (10 seconds per tube)
  - Potential for operator or equipment error
  - Does not test where the nozzle seals

# Shell Side Fill

- Fill shell side and watch tubes for leakage
- Dye to find smaller leaks
- Pros:
  - Quick, easy, low cost
  - Can find tube to tube sheet leakage
- Cons:
  - Not good for small leaks
  - Need the shell installed



# Plug Types

- Machined Poured in Plugs
  - Pin
  - Pin and Collar
- Expandable Rubber Plugs
- High Pressure Plugs
  - Explosive Plugs
  - Pop-A-Plugs
  - High pressure mechanical Plugs







# Questions?



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