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WEBINAR

Presenters

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Designing Your Water Treatment Program for Different Types of Heat Rejection Equipment

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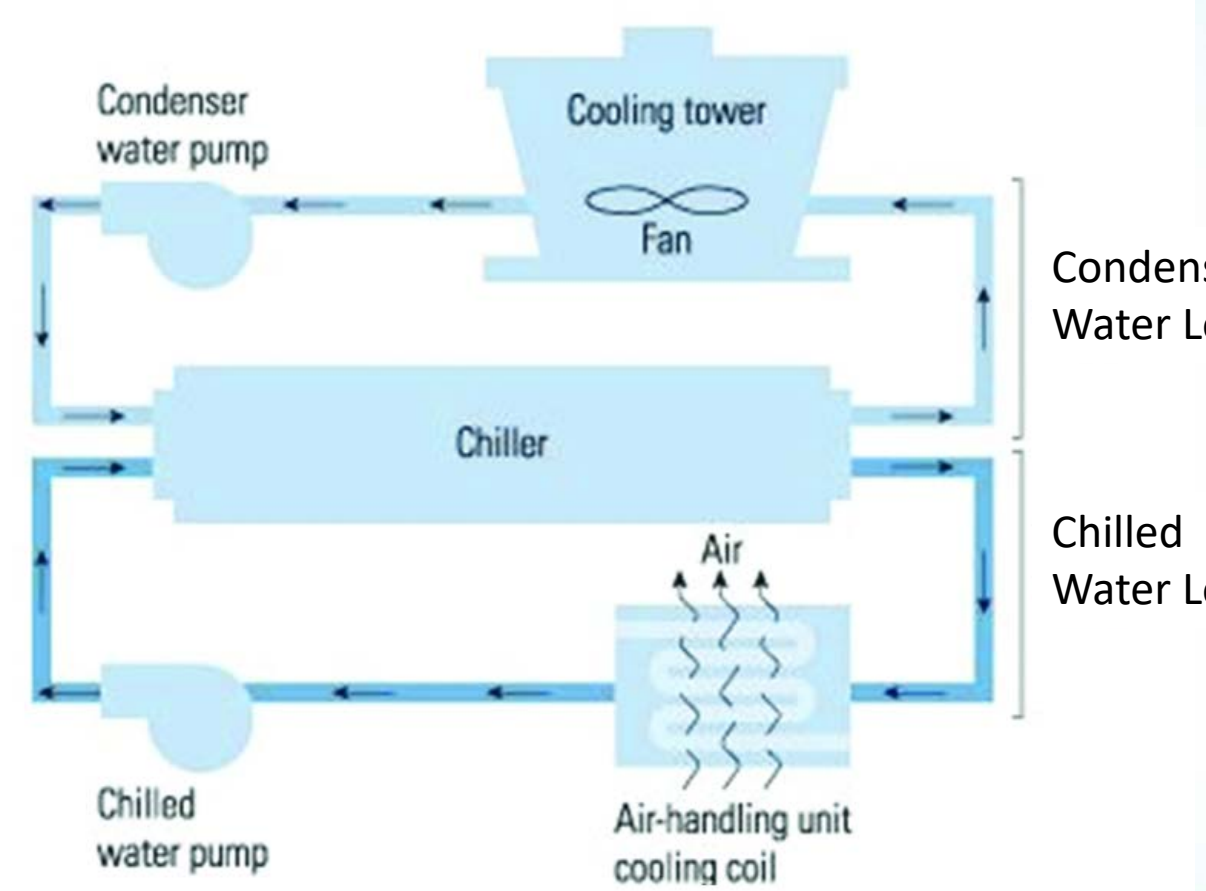
Types of Heat Rejection Equipment

- Open Cooling Tower
- Closed Circuit Cooler / Evaporative Condenser
- Hybrid System
- Adiabatic Cooler / Condenser
- Dry Cooler / Condenser

Typical HVAC System



Typical Materials of Construction

- Galvanized Steel
- Stainless Steel
  - Type 304/316 most common
  - Type 301 lower grade/less chloride resistant
- Fiberglass reinforced polymer (FRP)

Materials of Construction

- Manufacturer's equipment IOM provides water guidelines
- Chloride tolerance dependent on temperature

Property	G-235 Galvanized Steel	Type 304 Stainless Steel	Type 316 Stainless Steel
pH	7.0 – 8.8	6.0 – 9.5	6.0 – 9.5
pH During Passivation	7.0 – 8.0	N/A	N/A
Total Suspended Solids (ppm)*	< 25	< 25	< 25
Conductivity (Micro-mhos/cm) **	< 2,400	< 4,000	< 5,000
Alkalinity as CaCO3 (ppm)	75 - 400	< 600	< 600
Calcium Hardness CaCO3 (ppm)	50 - 500	< 600	< 600
Chlorides as Cl (ppm) ***	< 300	< 500	< 2,000
Silica (ppm)	< 150	< 150	< 150
Total Bacteria (cfu/ml)	< 10,000	< 10,000	< 10,000

Open Cooling Towers

- Different Designs & Types
- Components
- Principle of Operation

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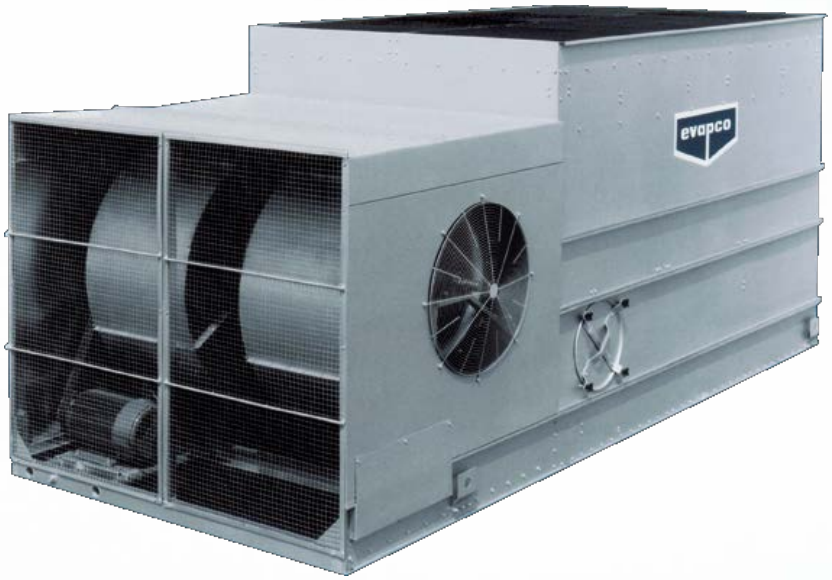
Different Types of Open Cooling Towers

- Forced Draft – fan towards the bottom pushing air through the unit
  - Usually Counterflow
- Induced Draft – fan on the top pulling air through the unit
  - Counterflow
  - Crossflow

Forced Draft Towers

- Fan pushes air into the tower
- Smaller Footprint
- Hard to inspect
- Minimal sunlight inside unit

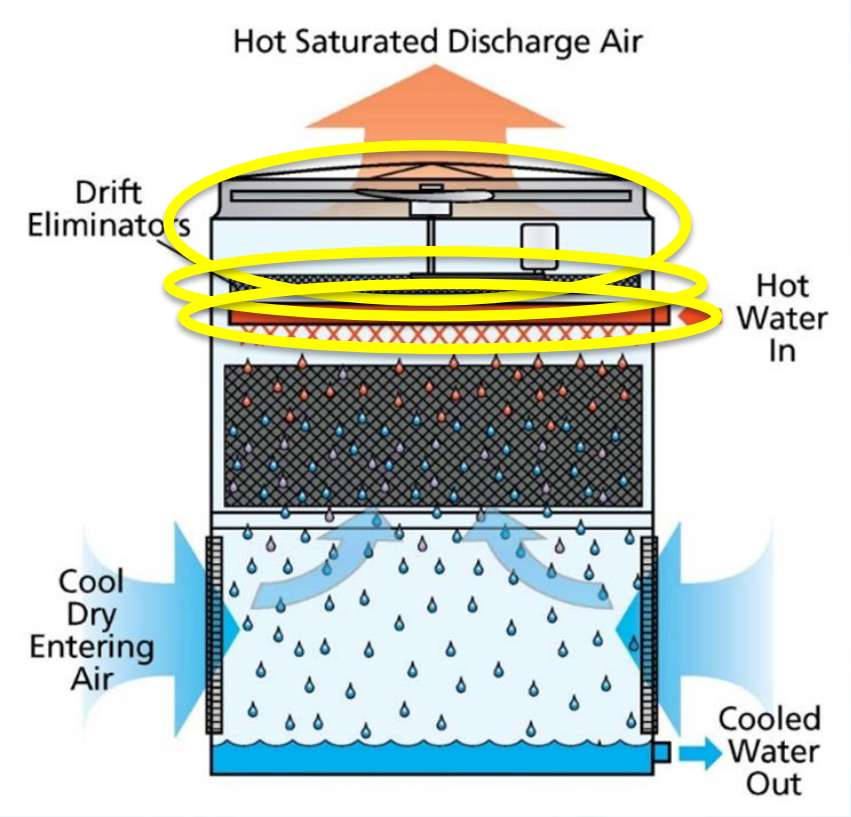


Induced Draft Towers

- More energy efficient
- Versatile layout options
- Simplified maintenance
- Generally used for larger installations

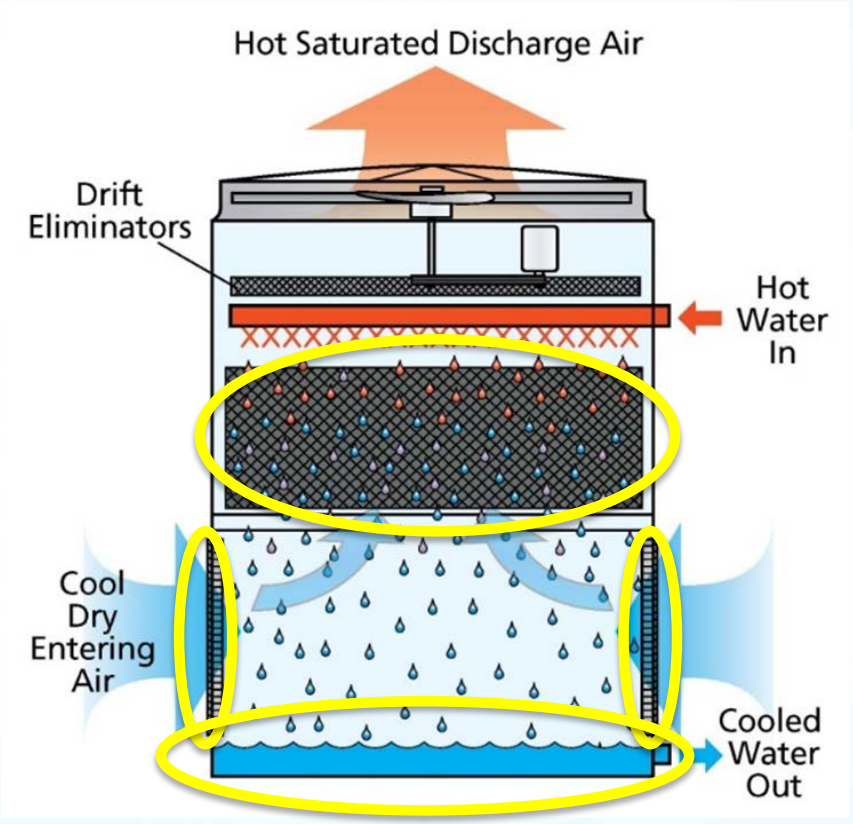
Induced Draft Counterflow Towers

- Fan and Motor
  - Lock out before inspection
- Drift Eliminators
  - 0.0005% drift rate
- Spray Nozzles
  - Different types



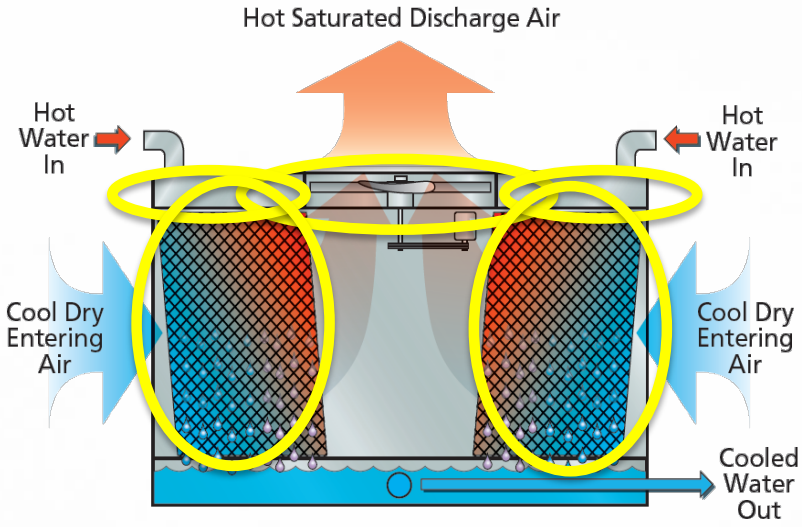
Induced Draft Counterflow Towers

- Fill
  - Where the heat transfer occurs
- Louvers
  - Blocks sunlight and large debris
- Basin
  - Typically lower water volume versus crossflow



Induced Draft Crossflow Towers

- Fan and Motor
  - Lock out before inspection
- Distribution Decks
  - Sunlight = Algae
- Louvers, Fill and Drift Eliminators
  - Higher drift rate (about 5x more)

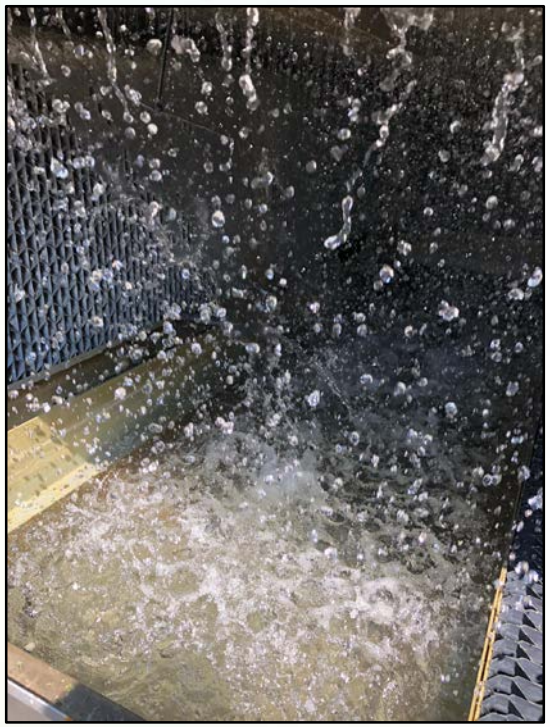


Induced Draft Crossflow Towers

- Larger water volume in basin = more biocide
- More debris and sunlight gets in the basin

Algae Growth

Counterflow



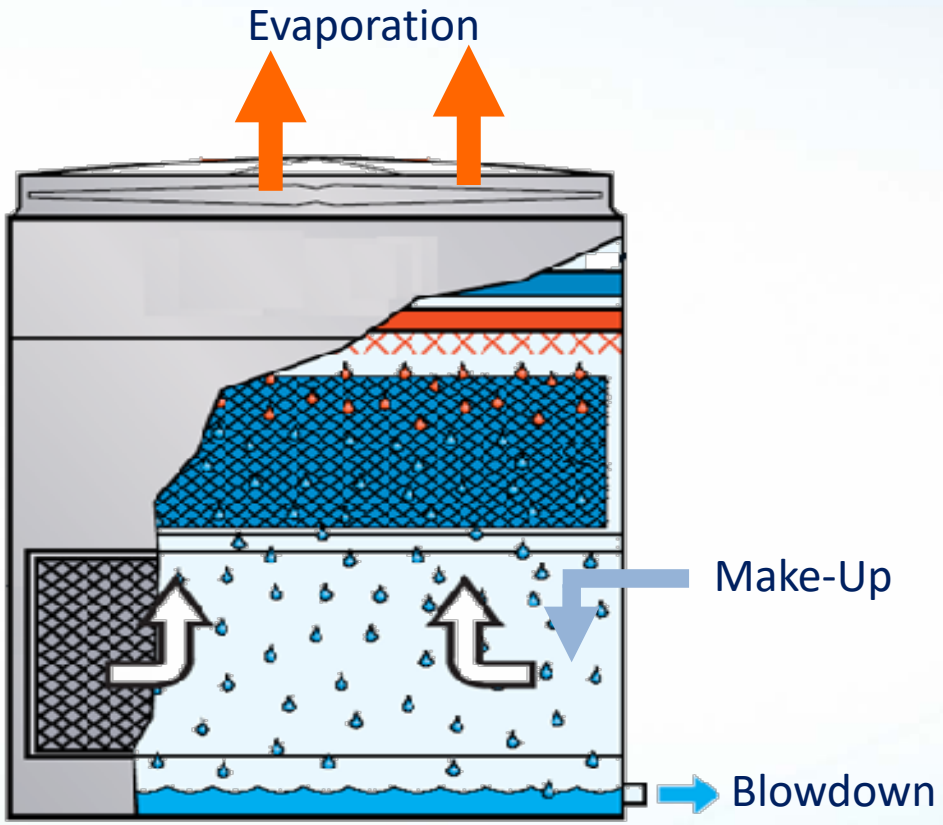
Louver removed for photo

Crossflow

Normal operation

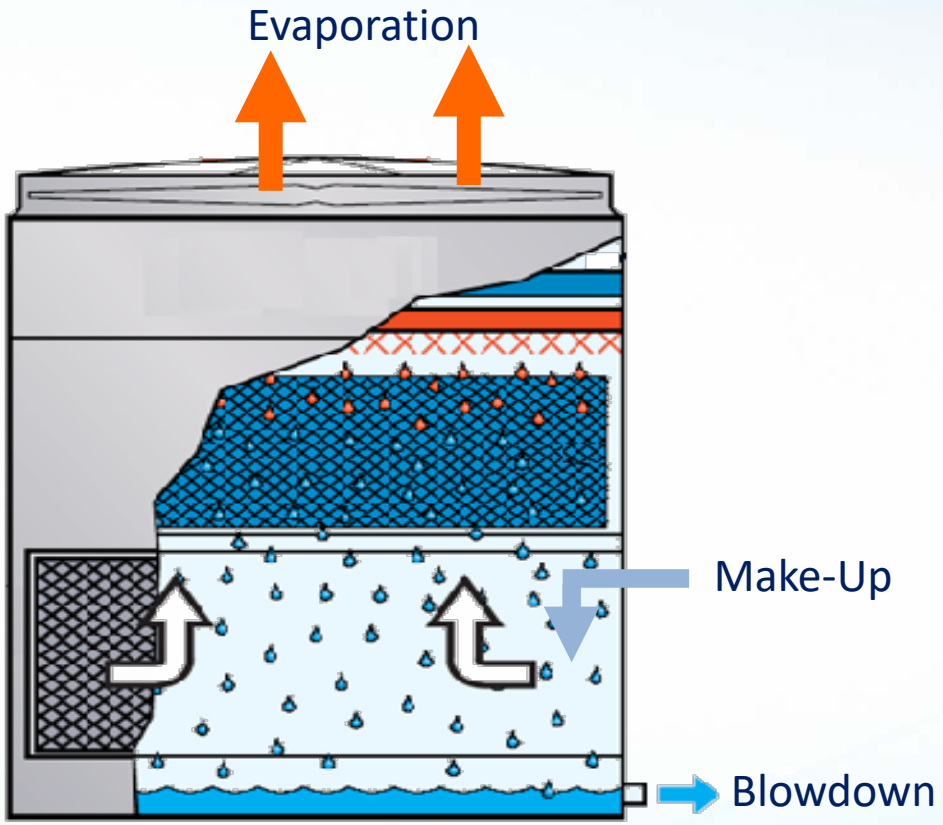
Principle of Operation

- Heat is rejected by the evaporation of pure H_2O
- Dissolved solids from the makeup water concentrate in the condenser water
- Great air scrubbers – adds suspended solids

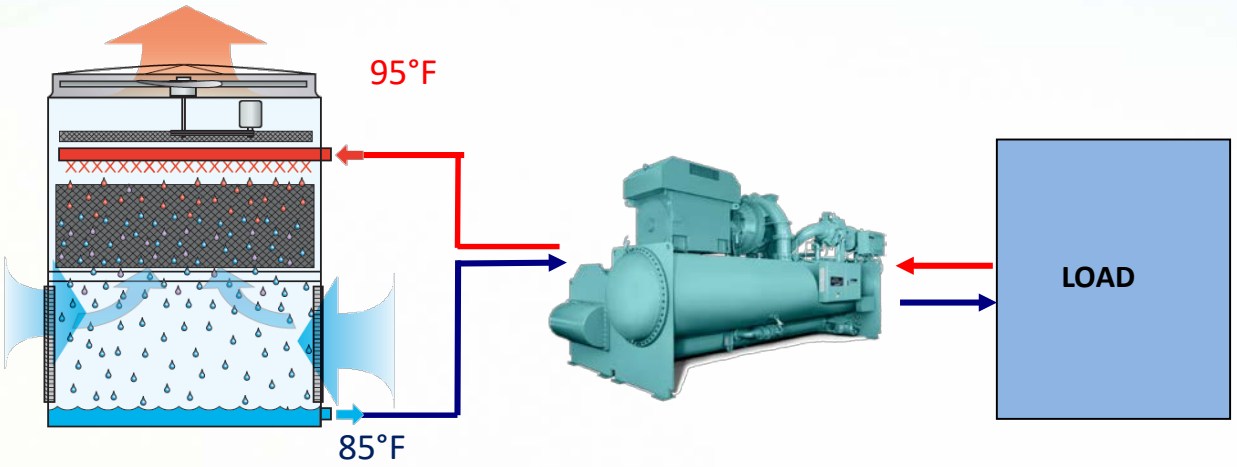


Principle of Operation

- Blowdown (or bleed) removes higher TDS in recirculating water from the tower
- Cycles of Concentration
  BD = Evap / (COC -1)

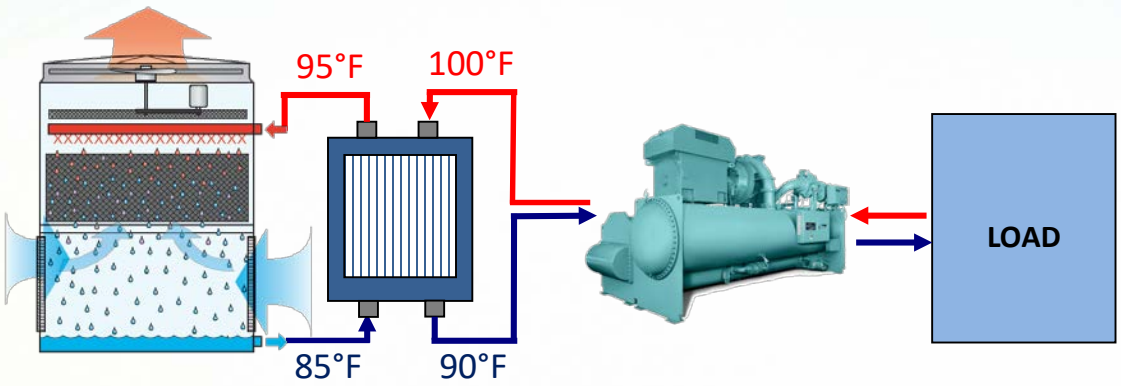


Tower + Chiller



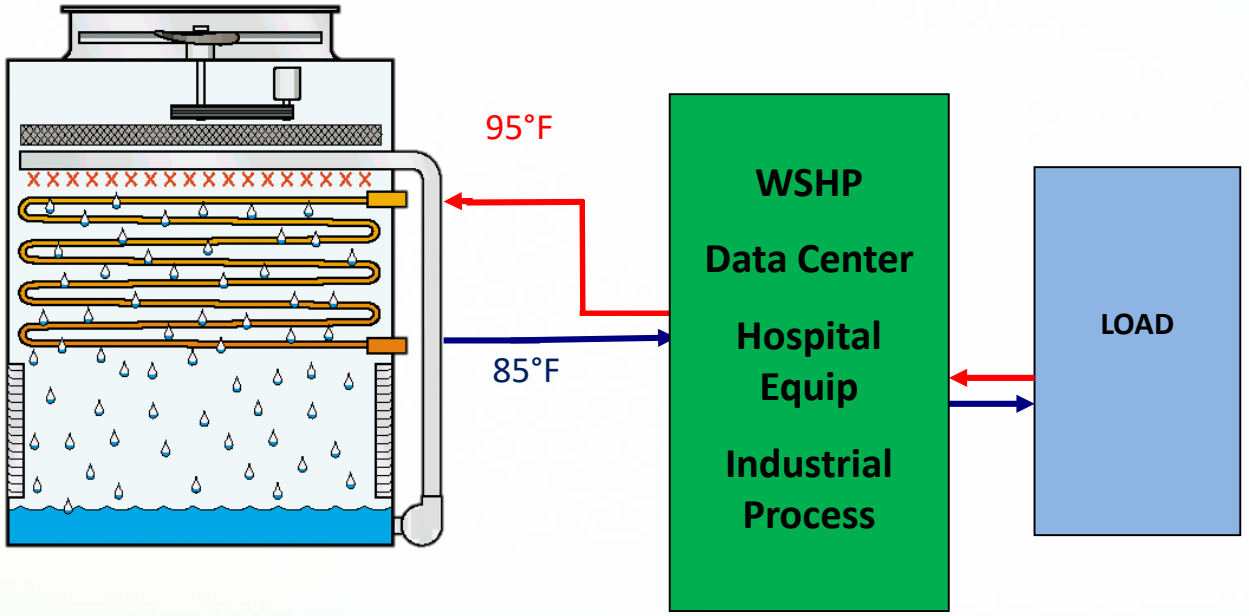
- Condenser water is exposed to the atmosphere via tower
- Can cause fouling in the chiller tube bundle

Tower + Heat Exchanger



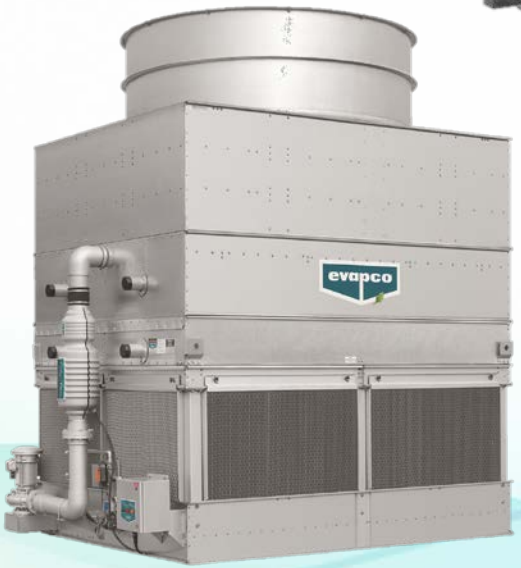
- Process water separated from cooling tower via heat exchanger
- Heat exchanger adds complexity to treatment and maintenance programs (small passes)

Closed Circuit Coolers



Closed Circuit Coolers

- Different Designs & Types
- Components
- Principle of Operation



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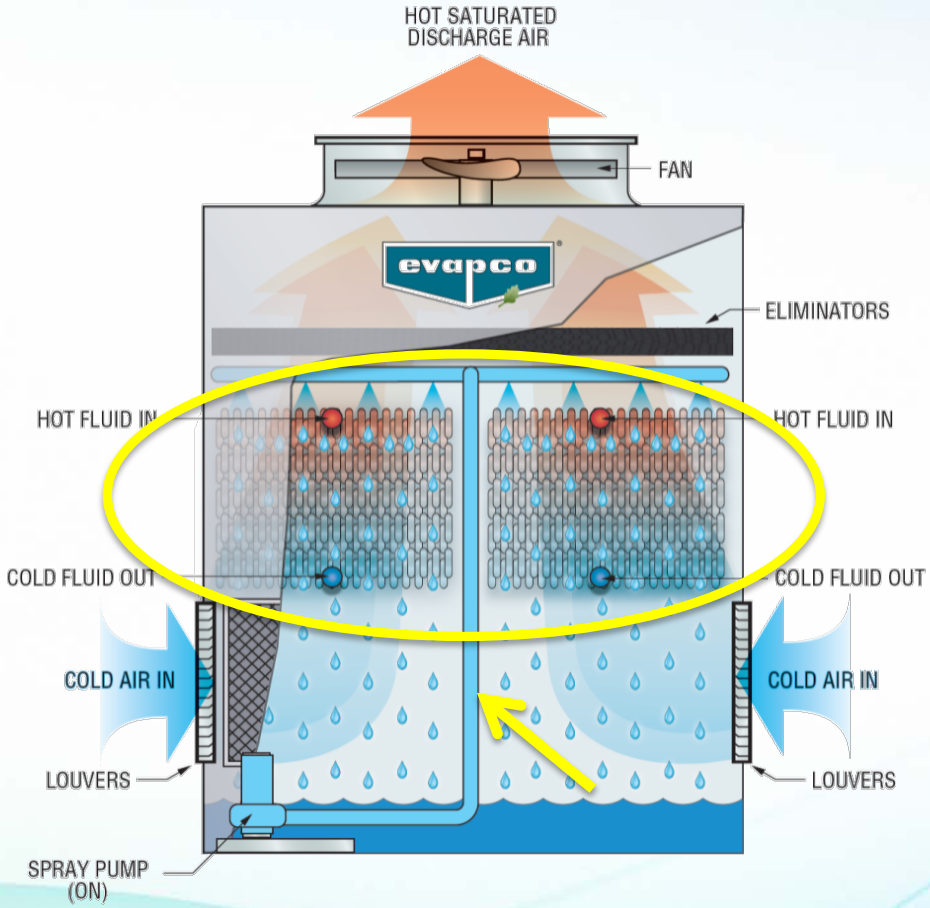
Closed Circuit Coolers

- Coils inside the unit

  Bare, elliptical, finned

- Recirculating water distribution system

  Pump, riser pipe

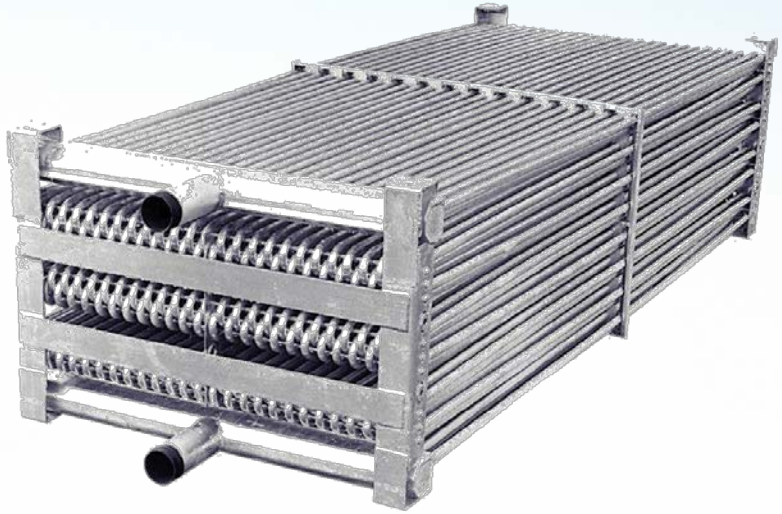


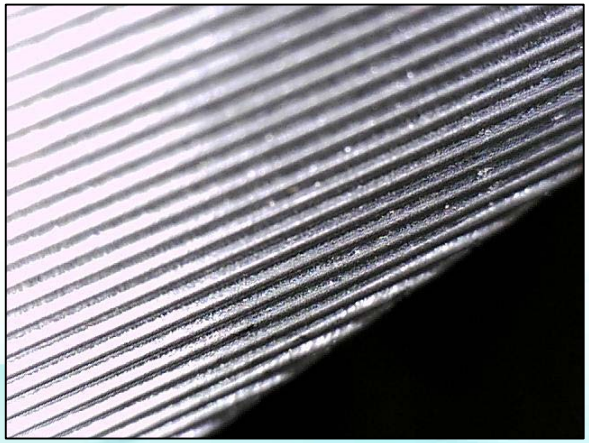
Evaporative Condensers

- Similar to closed circuit cooler
- Induced or Forced Draft
- Main difference what is in the coil
- Condenses the refrigerant
  - NH3
  - R-22

Coils for Coolers and Condensers

- Coils can be enhanced to improved efficiency
  - Internal rifling
  - External fins
- Hot Dipped Galvanized is the most common construction
- Galvanized: remember to offer a site-specific passivation plan
- Stainless Steel: no passivation, but test chlorides routinely





Water Treatment for Coolers and Condensers

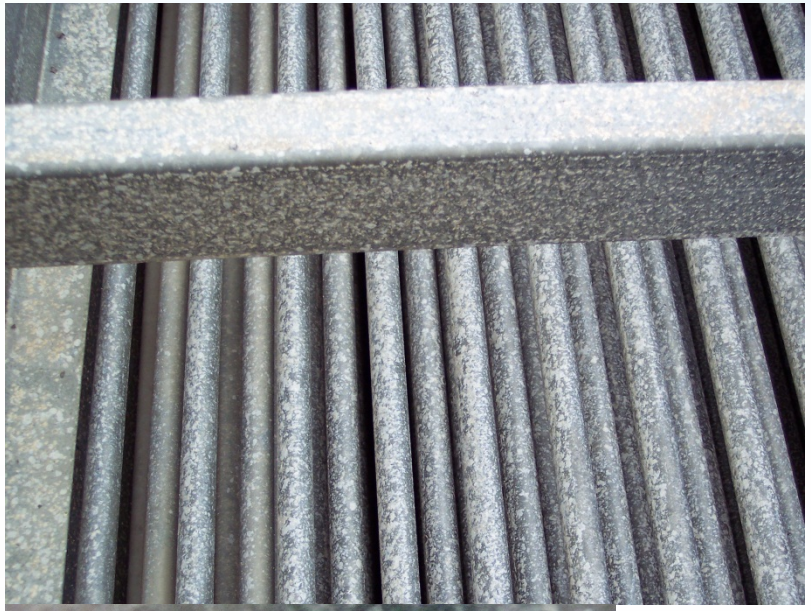
- Integral pump units (shown) typically have low spray water pressure (2 to 6 psi)
- Supplemental circulating pump may be required for liquid chemical feed systems
- Select biocides based on short retention time

Water Treatment on Coolers and Condensers

- Low water volume and high turnover rate compared to open cooling towers
- Ensure good mixing (dilution) of chemicals prior to returning to basin
- Return treated water below the coil

Passivate New Galvanized Steel

- To minimize White Rust & ensure service life
- What is White Rust?
  - Premature localized corrosion of the protective zinc layer
  - Read AWT's 2012 Guide Paper



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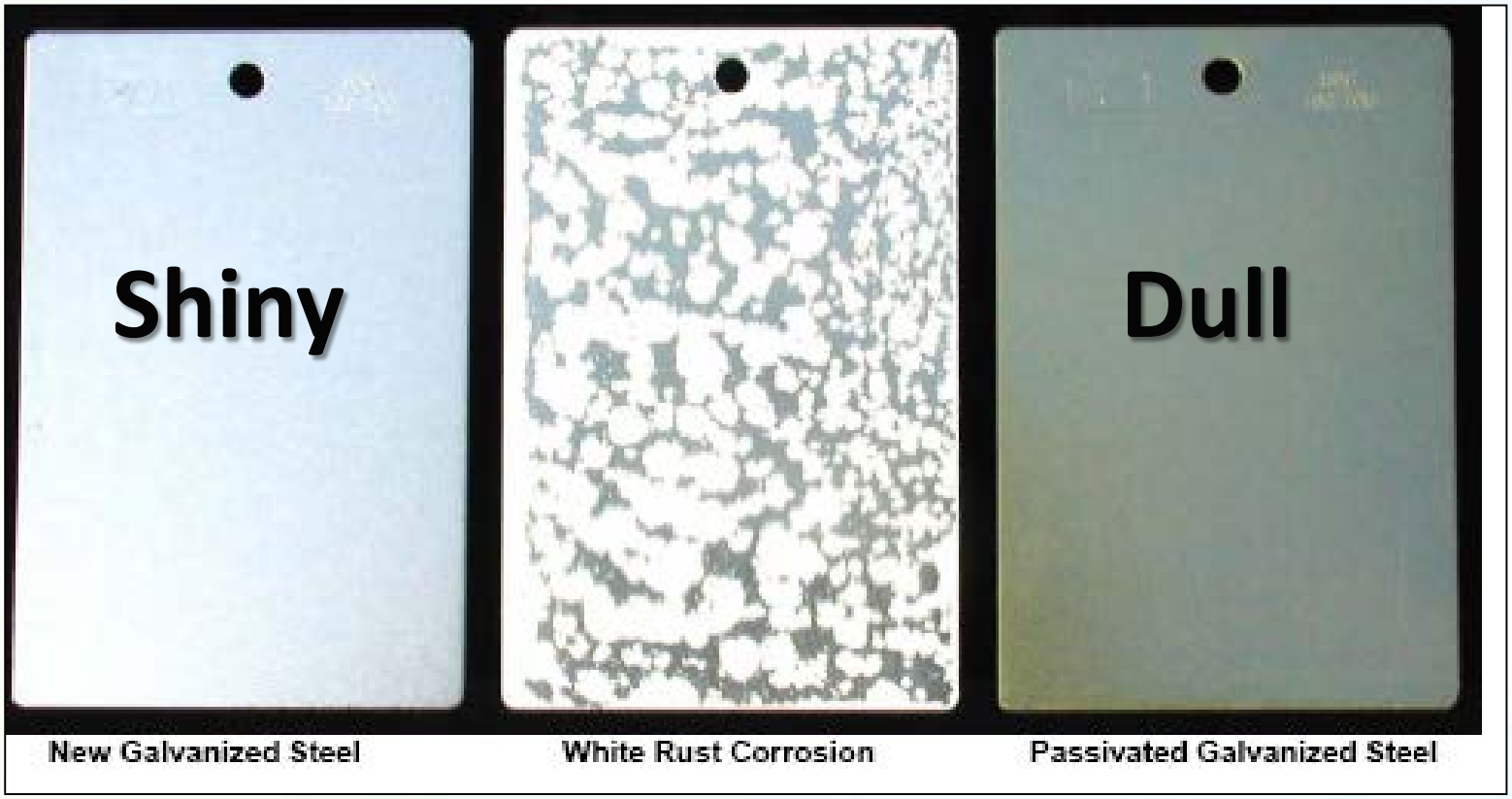
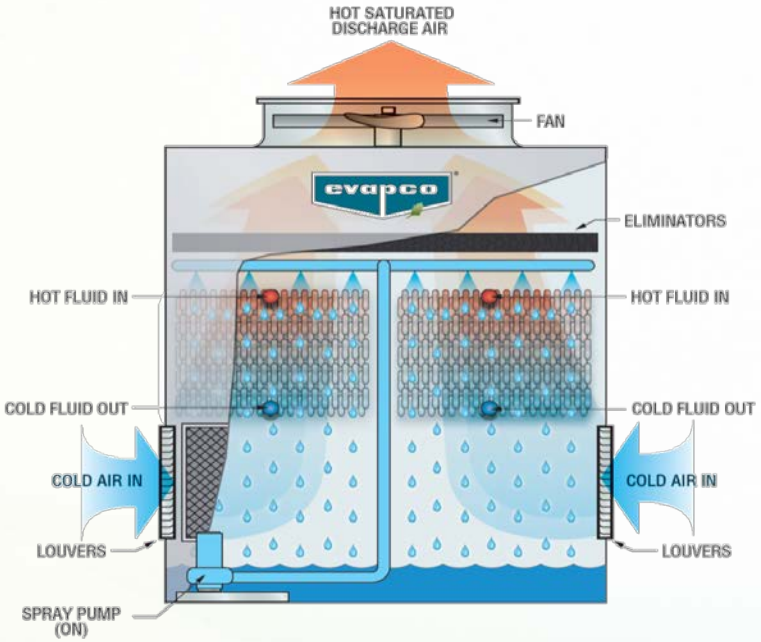
What does passivated zinc look like

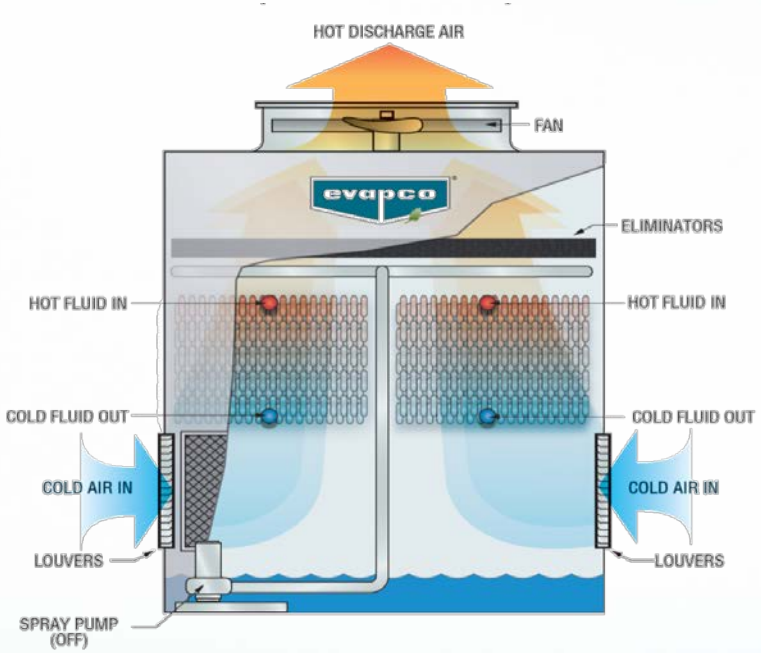


Hybrid System

Evaporative Mode



Dry Mode



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Dry Coolers and Condensers

V-Bank

Flat

- Process fluid inside coil requires glycol or treatment

Adiabatic Coolers and Condensers

- Adiabatic pads depress the dry bulb temperature of the entering air
- Water wets these pads
- May require pre-treatment
- Some equipment may have a basin and recirculating pump

Remember

- Understand the equipment you are treating
- Know the materials of construction
- Learn the operation of the cooling system
- Not all systems are the same
- BE SAFE