Quit Cooling Dirt!

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Executive Summary

Quit Cooling Dirt!

Particle contamination of water-cooled systems is a leading cause of efficiency losses in HVAC applications. In addition, the build-up of unwanted contaminants could be a health and safety risk both at the equipment and buildings served.

Removing airborne dirt and suspended solids from the chilled water will result in maintenance, energy and water savings.

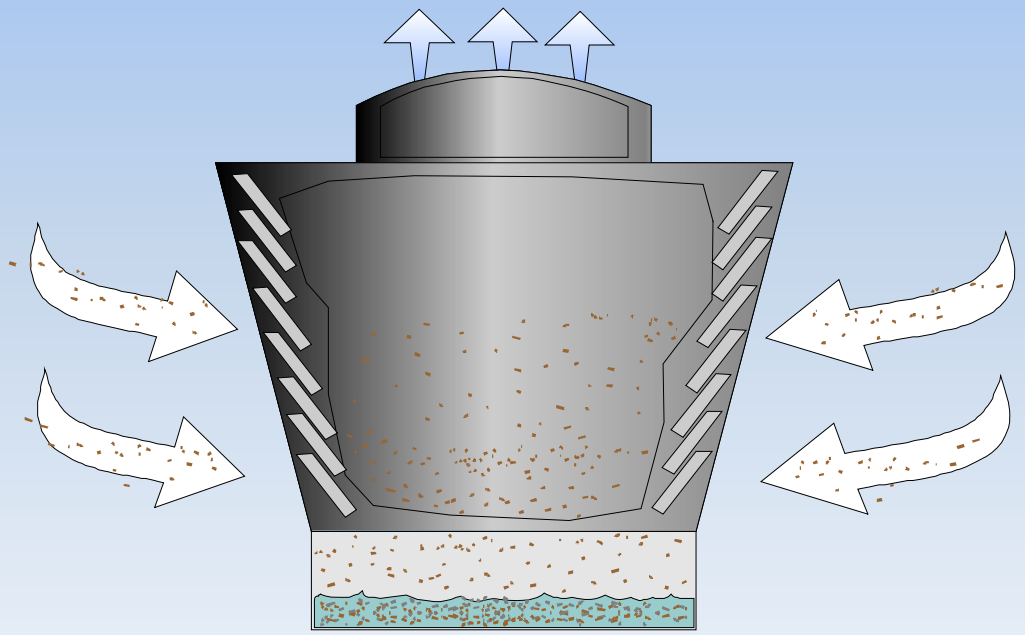
Proven filtration solutions used in district cooling include:

- Full flow filtration
- Side stream filtration
- Basin cleaning

Why is Filtration Needed in Heat Transfer Systems?

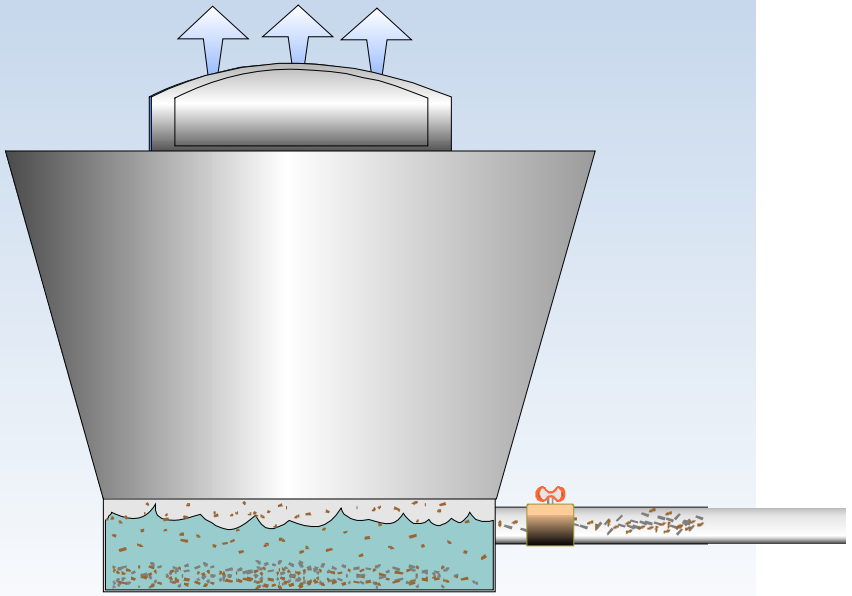
- What kind of particulates do Heat Transfer systems encounter?
- What are the different sources of these solids?
- How do these contaminants affect the Heat Transfer systems?
- Does particulate size and quantity matter?
- What are your filtration equipment options?

Sources of Particulates in HVAC Systems...



Particulate deposits through airborne entry

Particulate deposits through make-up water



…Sources of Particulates in HVAC Systems

"A typical 200 ton cooling tower operating 1000 hours may assimilate ***upwards of 600 lbs.*** *of particulate matter from airborne dust and the makeup water supply (Broadbent et al. 1992). Proximity to highways and construction sites, air pollution, and operating hours are all factors in tower soil loading."*

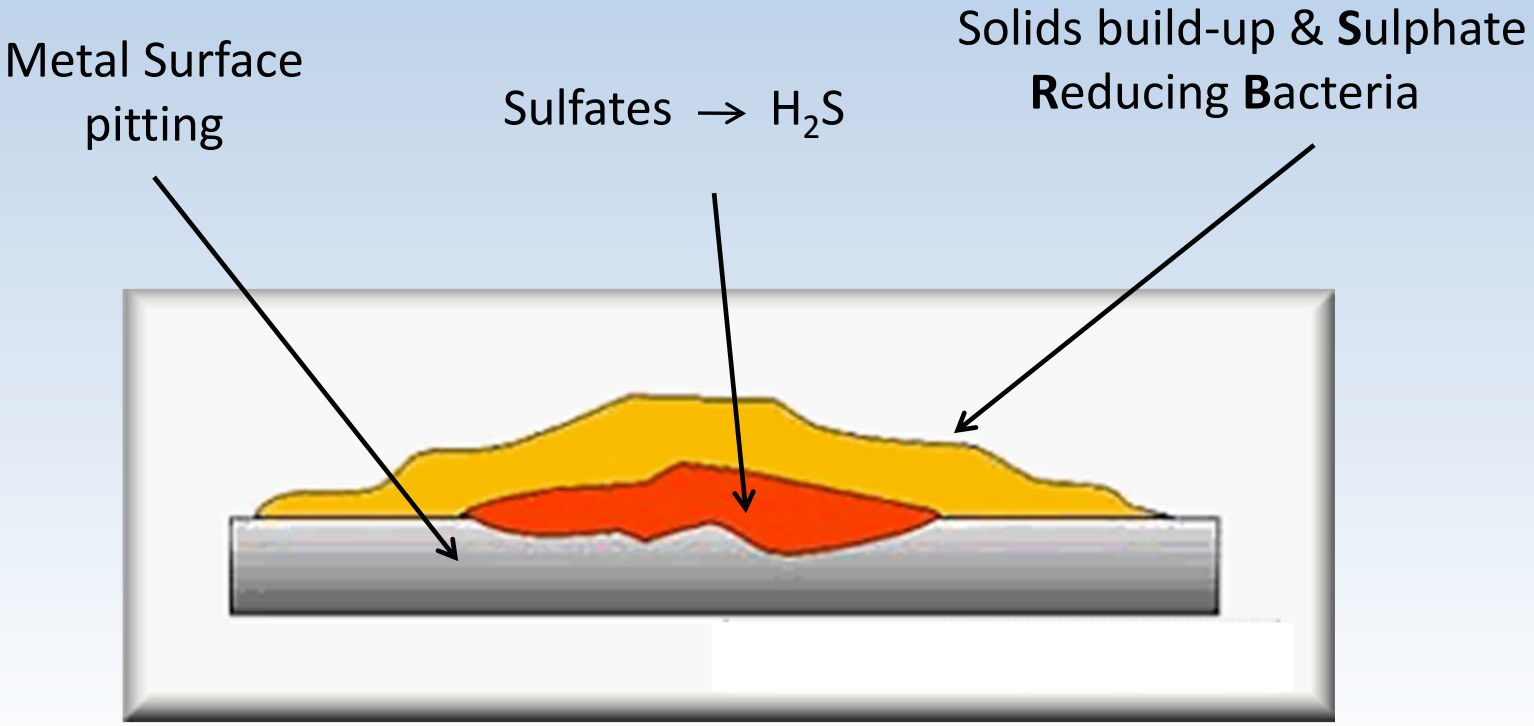
REF: 2008 ASHRAE Handbook – HVAC Systems and Equipment

Solids Accumulation in Cooling Towers

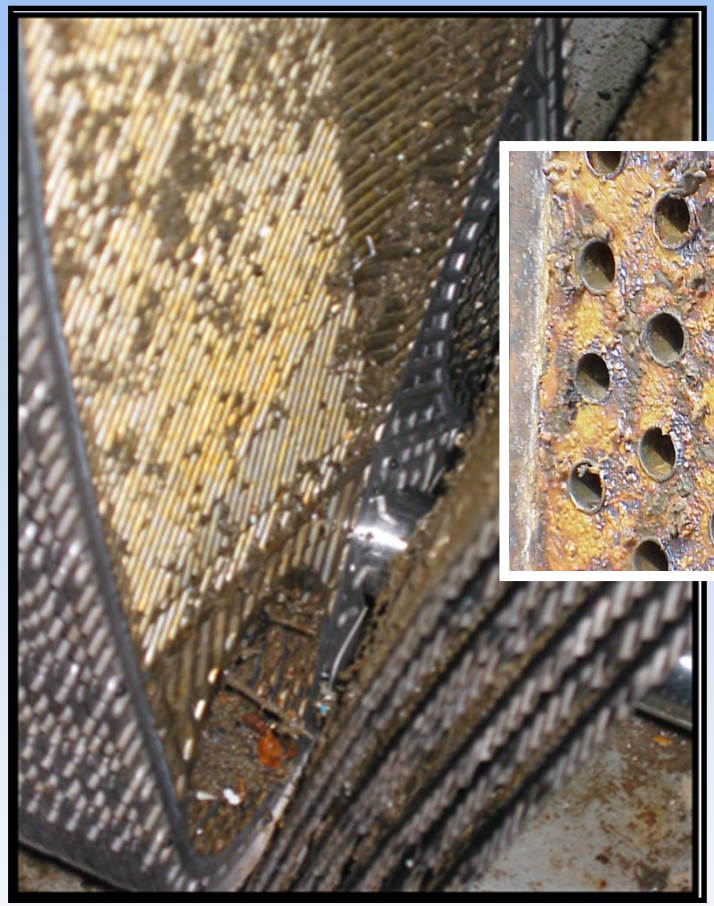
- Increased bacteria growth/contamination
  - ***Legionella***, other health risks
- Decreased heat transfer efficiency = Increased energy consumption
- More blowdown = more makeup water and chemicals usage
- Higher maintenance costs and down time

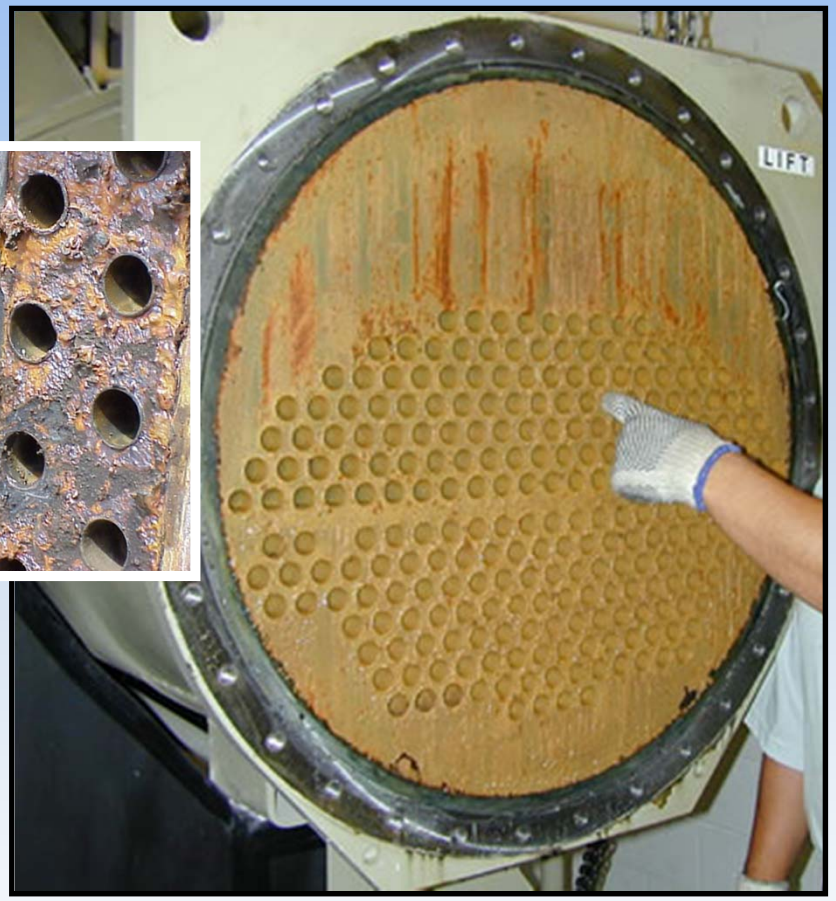
Is Basin Cleaning Really Necessary?

- 1/16” (1.6mm) of basin debris prevents chemicals from protecting basin
- Under-Deposit Corrosion Occurs



Heat Exchangers Fouling
= Decreased Heat Transfer Efficiency!



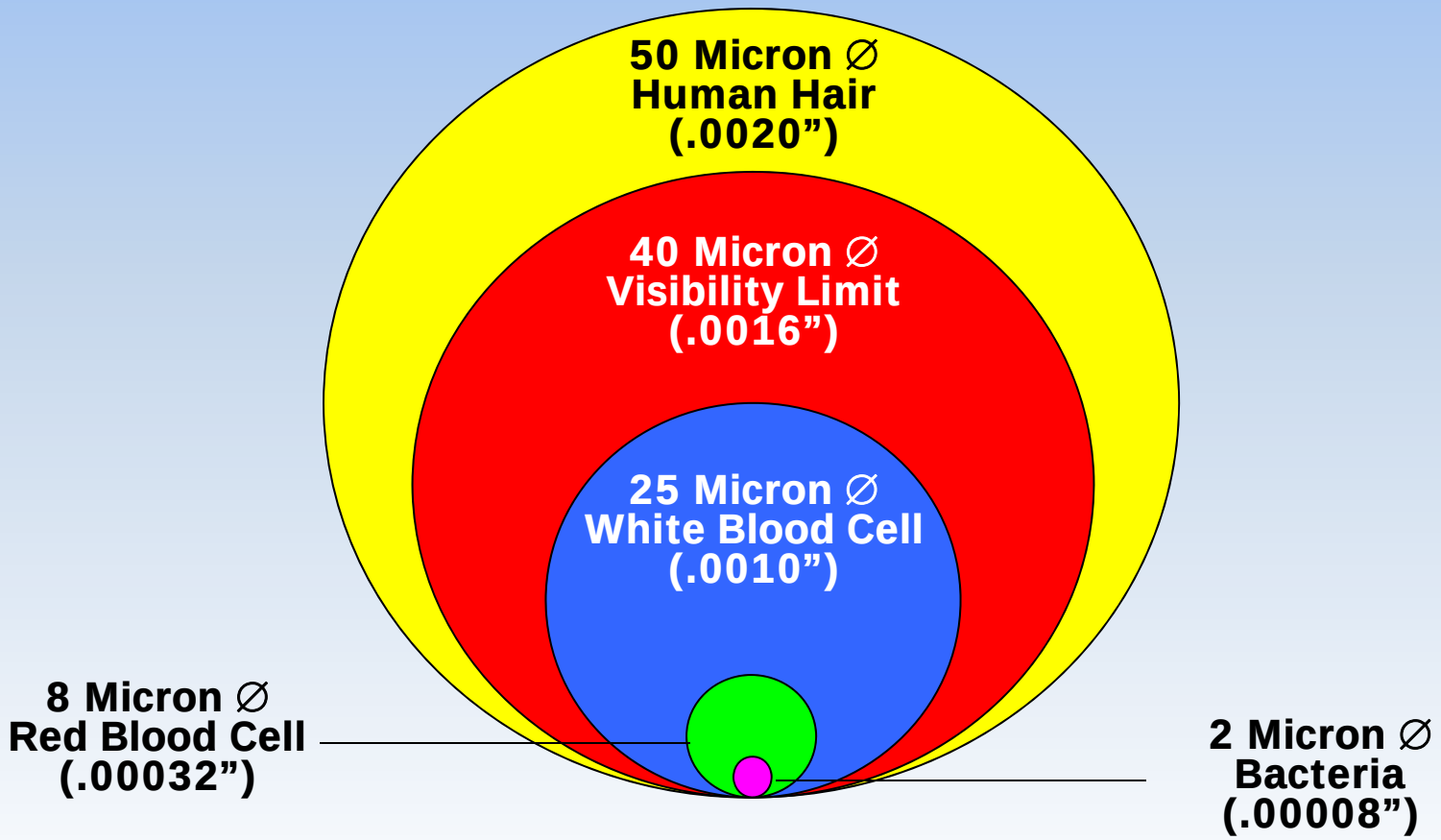


Typical Condenser Fouling Factors

CONDENSER FOULING FACTORS		
Fouling Factor	**Approx. Scale Thickness**	**Power Increase**
Clean System	0.000 inch	0.0 %
0.0001	0.001 inch	1.1 %
0.0005	0.006 inch	5.5 %
0.0010*	0.012 inch	11.0 %
0.0020*	0.024 inch	22.0 %
0.0030*	0.036 inch	33.0 %
0.0040*	0.048 inch	44.0 %
** Typical fouling occurs in this range*		

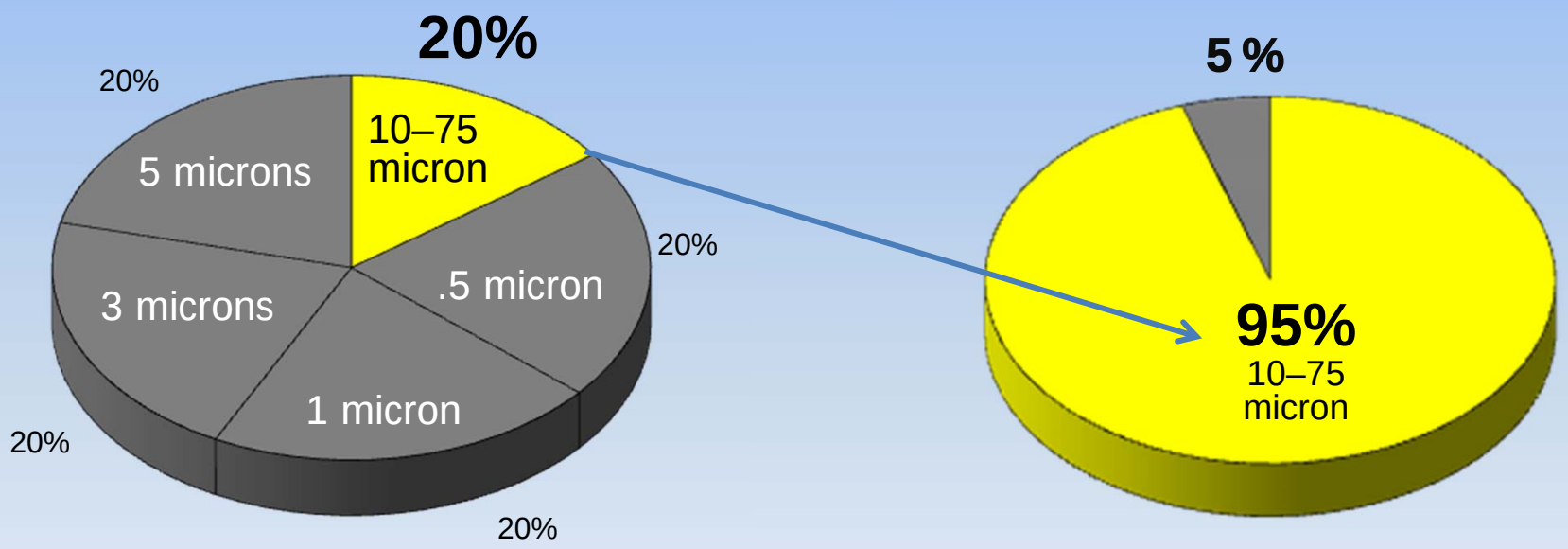
Applying a typical fouling factor of 0.002 to a 1000 ton condenser in California using a $.07 Kw/hr with "clean" operating cost of $170K/year would increase annual costs by as much as $37K (22%)!

How Fine is Fine?
Filtration vs. Disinfection



Particle Count vs. Particle Volume

Example: 1 trillion particles of different micron sizes



Particle COUNT

Assume there is the same number (quantity) of each of these different sizes among the 1 trillion particles (20% of the total).

Particle VOLUME

Even though there are the same number (quantity) of each size, the VOLUME they represent is NOT equal. The 20% that are larger particles account for 95% of the total volume.

Size Does Matter!

10-75 Micron Particles

95%

(by volume)

0.5-5 Micron Particles

5%

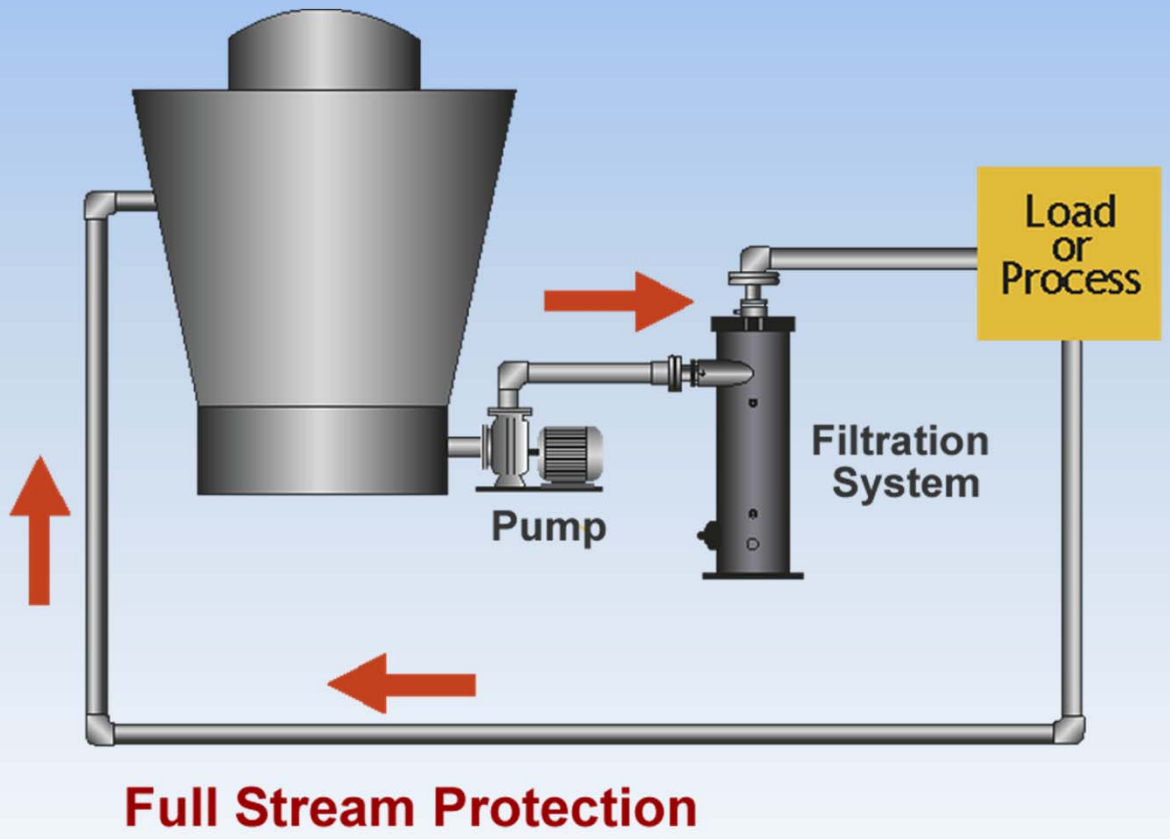
(by volume)

Basic Filtration Options

"A Filtration System -no matter what kind it is, or how good it claims to be- can only remove the particles that have a chance to pass through it."

- **Full Flow** – Filtering 100% of the system flow
- **Side Stream Flow** – Filtering a percentage of system flow (normally 3%-10%)
- **Basin Cleaning** – Filtering between 10% and 20% of system flow and utilizing nozzles installed in the cooling tower basin to "sweep" solids to filtration system

Full Flow Filtration

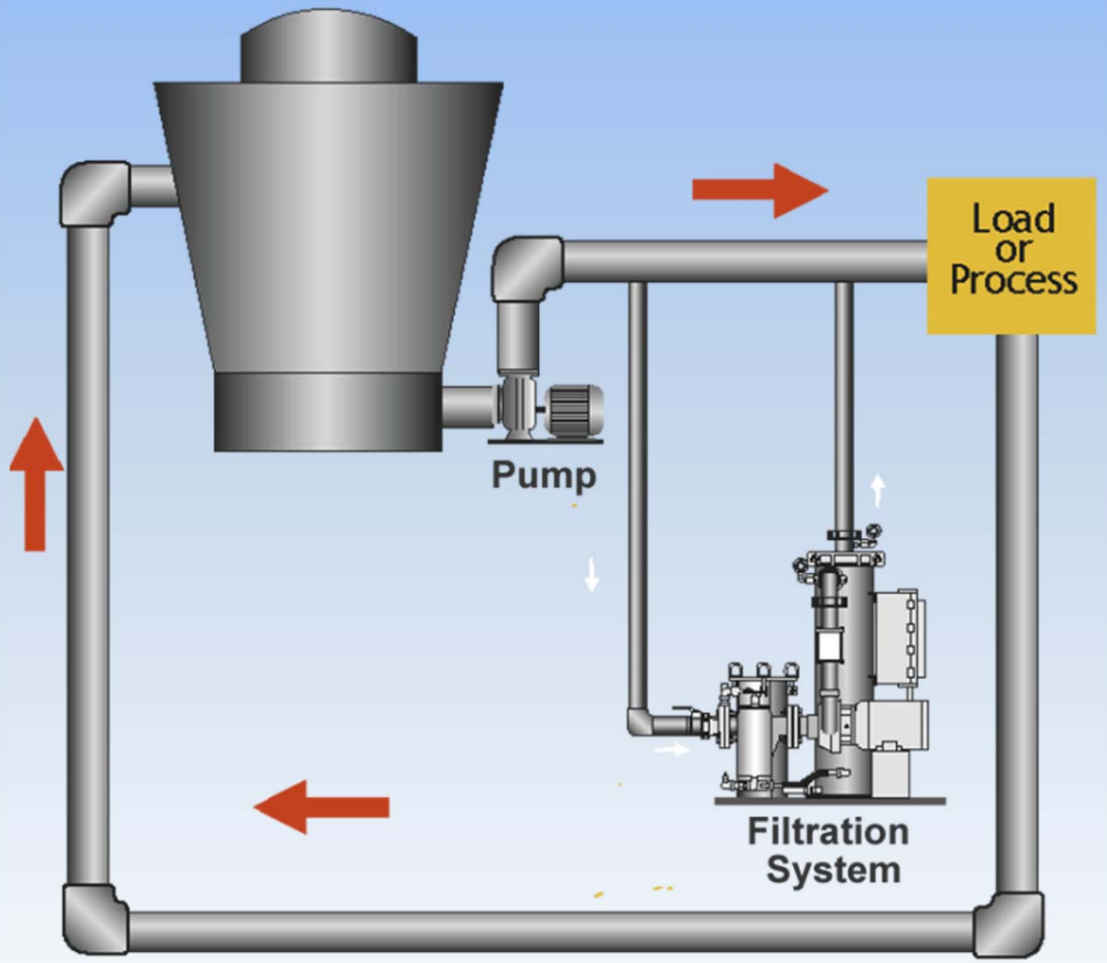


Full Stream Protection

Benefits:

- ✓Full protection downstream
- ✓Ease of sizing & installation
- ✓More common in plan & spec jobs

Side Stream Filtration

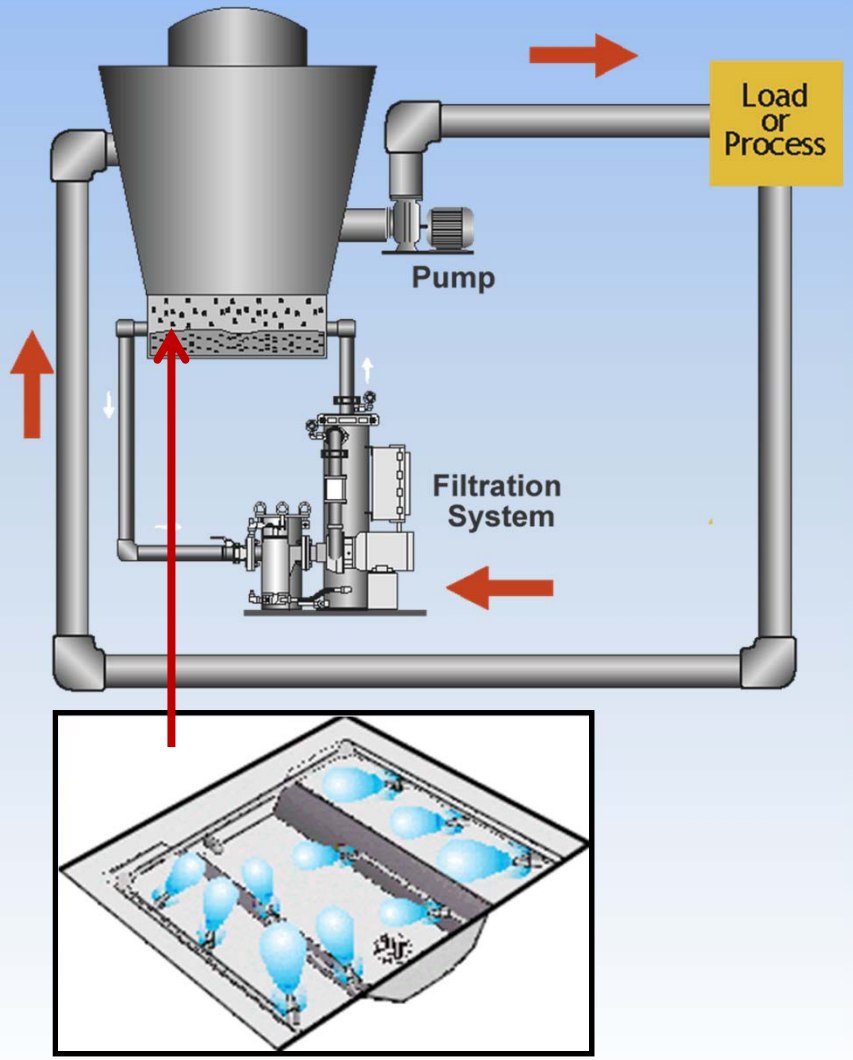


Side Stream Protection

Benefits:

- ✓Offers partial protection
- ✓Ease of sizing & installation
- ✓Applicable on large and variable flow rates

Basin Cleaning Filtration



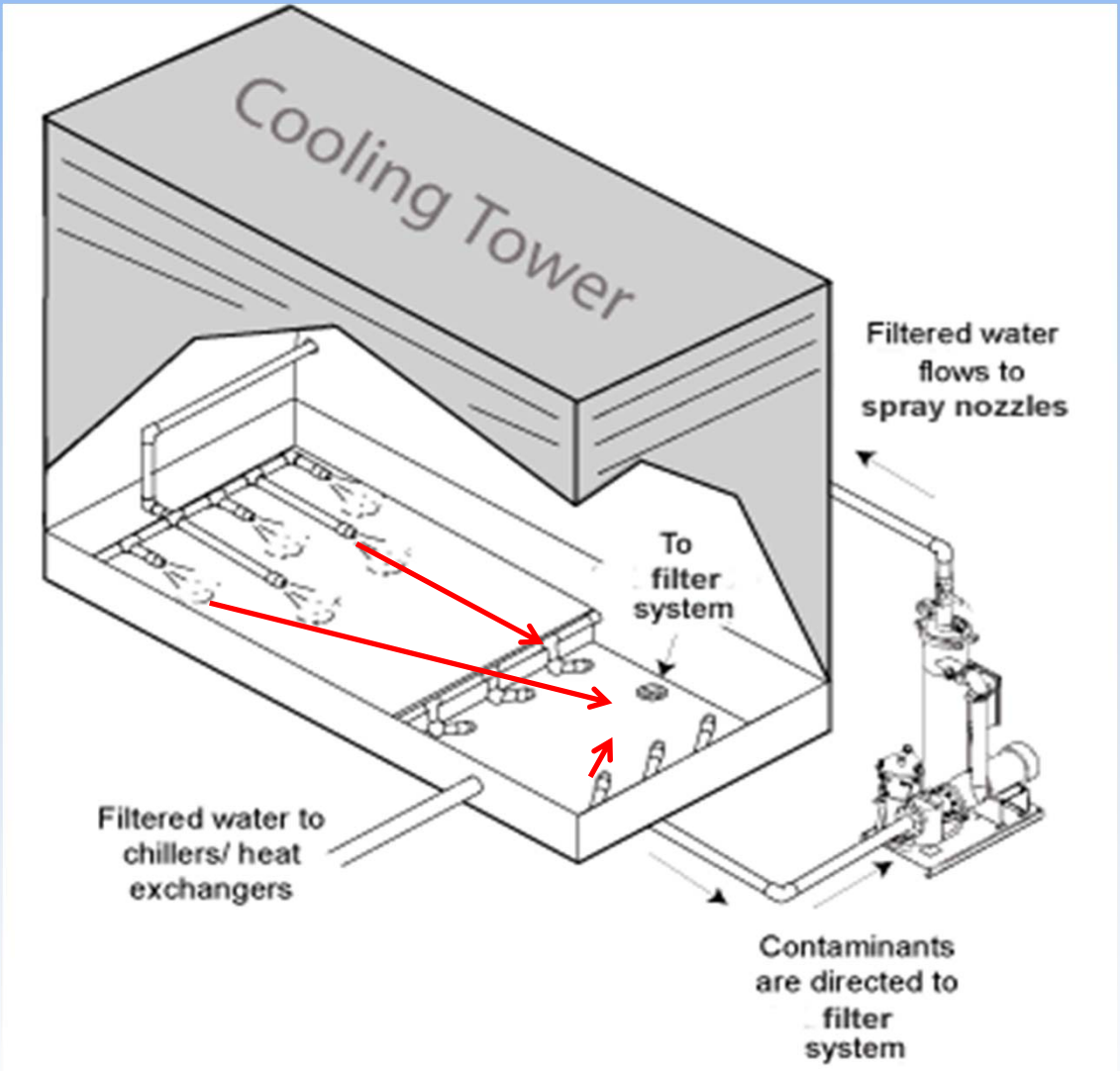
Benefits:

- ✓Attacks problem at the source
- ✓Comparable to full-flow filtration
- ✓Keeps basins clean
- ✓Reduced health & maintenance risks
- ✓Big energy savings potential

Manual Basin Cleaning

- At least once a year
- Requires tower shut-down
- Confined space regulations
- Labor intensive
- Can expose workers to safety/health hazards

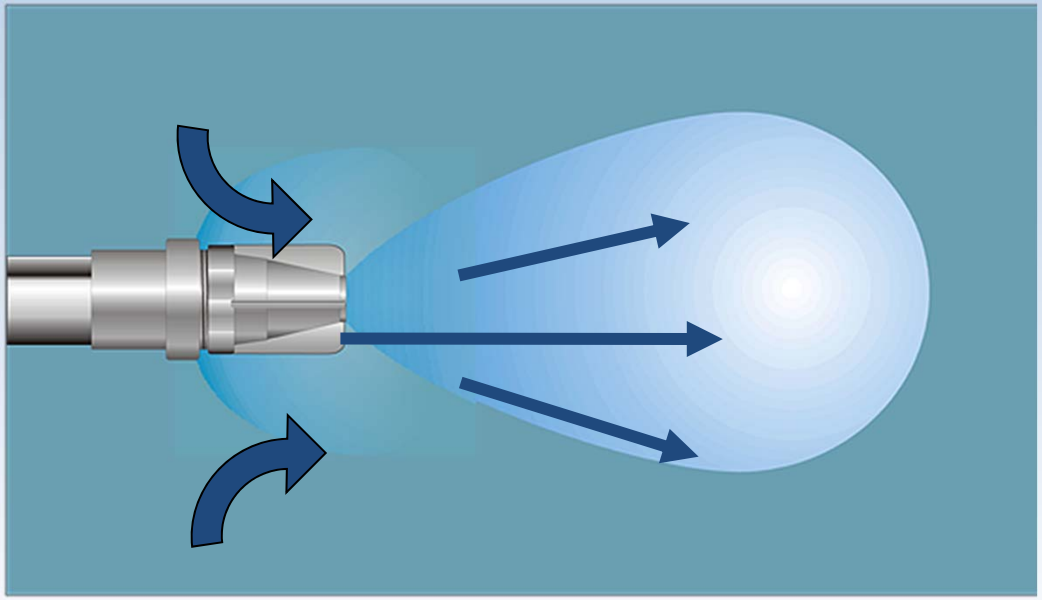
“Basin Sweeping”



"Basin Sweeping" Design Best Practices

- Move solids to the filter
- Continuous Cleaning
- 20psi (1.4bar) to nozzle header
- Required submergence: at least 2" (50mm)
- 1GPM per ft^2 of basin (2.5 m^3/h per m^2)

“Basin Sweeping” Directed Turbulence



- Venturi Effect
- Activity Rate 6:1
  - Strategically placed filter loop discharge
  - Sweeps solids toward filter loop suction

Cooling Tower Basin Sweepers

- Articulated nozzles
- Pipe clamps
- Extensions cover dead spots
- Factory installed or aftermarket

Filtration Equipment
Centrifugal Separators

- Removal of 40+ micron solids
- Small to large flow range
- No moving parts, little or no maintenance
- Small to medium carbon footprint
- Low volume of water required for purge
- Zero liquid loss options available

Filtration Equipment
Sand Media Filters

- Barrier filtration typically utilized for water clarity and removal of particulates down to 0.5 micron
- Small to medium flow range
- More moving parts
- Sand bed maintenance yearly
- Medium to large carbon footprint
- Medium to large volume of water required for backwash (purge)

Filtration Equipment
Bag/Cartridge Filters

- Barrier filtration intended for water clarity and removal of particulates down to sub-micron levels
- Small to medium flow range
- No moving parts
- Small to medium - Large carbon footprint
- No water required for purging
- Maintenance required for removal/replacement of filtration elements (bags or cartridges)
- Bag or Cartridge replacement cost

Major Benefits of Filtration…

- Energy savings due to increased thermal efficiency downstream
- Water savings thanks to less frequent purge
- Reduced health risks associated with solids build up
- Extended equipment life cycle
- Reduced maintenance, shutdown

How Clean is Clean?

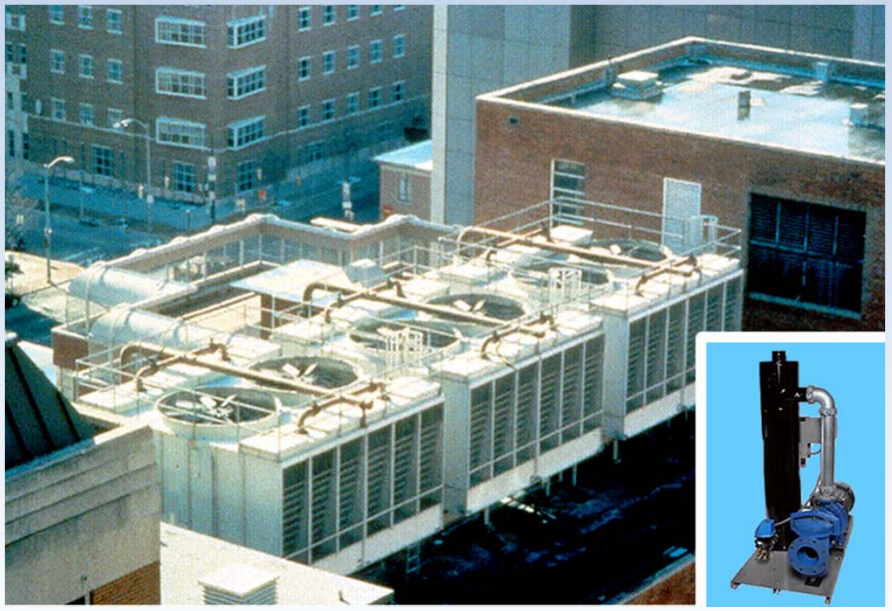
"*Some* level of Filtration is better than *No Filtration*"

Absolute Perfection vs. Affordable Protection

Why is Filtration in HVAC Necessary?

Think of the oil filter on your car…

Wouldn't you want filtration on your multi-million $$ HVAC System, too?



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Separators and Filtration Solutions