

# Water System *Info Card*

## Water Saving Opportunities

### Manufacturing Processes

1. Install timers/sensors to automatically shut off water flow when water is not required
2. Set equipment to the minimum flow rates required by processes and recommended by manufacturers
3. Reuse water from other parts/processes of the facilities

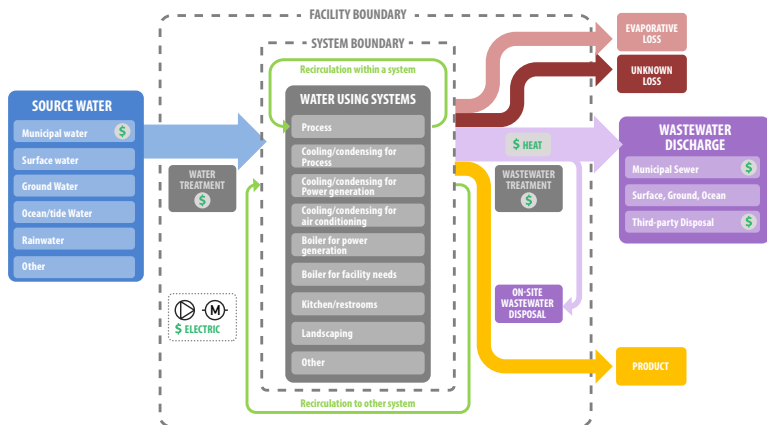
### Cooling Water Systems

1. Eliminate water overflowing from cooling tower basins
2. Set the ball float valves to the correct size
3. Install flowmeters and conductivity sensors on blowdown lines
4. Operate blowdown operated in continuous mode
5. Eliminate once-through water cooling by using closed loop chilled water

### Steam Systems

1. Check and replace steam traps regularly
2. Install boiler blowdown flash tank to recover flash steam
3. Install conductivity sensors on boilers to automatically control surface blowdown

## Water Flow Diagram with True Cost Components and System Water Balance



## Rules of Thumb

- In cooling towers, **1%** of the water recirculation rate must be evaporated for every  **$\Delta T$  of 10 °F**.
- A boiler making **10,000 lb/hr** of steam requires **20 GPM** of feedwater.
- Steam blowdown rates typically range from **4% to 8%** of boiler feedwater.
- **~15% to 30%** of steam traps may be failed in steam systems that are only maintained every **3 to 5 years**.

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## Formula and Unit Conversions

$$\text{Cooling tower blowdown water} = \frac{\text{Evaporation Loss}}{\text{Cycle of Concentration}-1}$$

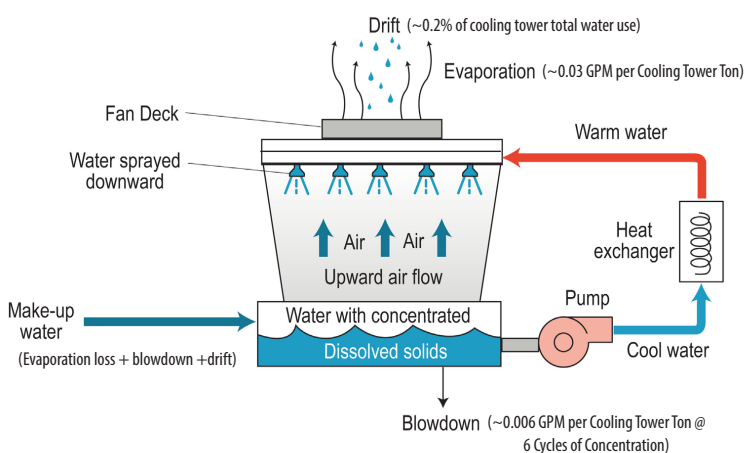
$$\text{Cycle of Concentration} = \frac{\text{Makeup Water}}{\text{Blowdown}}$$

$$1 \text{ gal} = 3.785 \text{ liter} = 0.134 \text{ ft}^3 = 0.00379 \text{ m}^3$$

$$1 \text{ gpm} = 0.063 \text{ l/s} = 0.23 \text{ m}^3/\text{hr}$$

$$1 \text{ gal water} = 8.35 \text{ lbs}$$

## Cooling Tower Water Loss



## Cooling Tower Annual Water Usage for Different Sized Chillers at Varying Cycles of Concentration

Cooling Tower Usage (Million Gallons/Year)						
Chiller Tonnage (Nameplate)	Cycles of Concentration					
	3	4	5	6	7	8
100	2	1.8	1.7	1.6	1.6	1.5
200	4	3.6	3.4	3.2	3.1	3.1
400	8	7.2	6.7	6.4	6.3	6.1
500	10	8.9	8.4	8	7.8	7.7
600	12.1	10.7	10	9.7	9.4	9.2
800	16.1	14.3	13.4	12.9	12.5	12.3
1000	20.1	17.9	16.8	16.1	15.6	15.3

\*Assuming that the annual operation is 8760 hours.

## Resources

1. DOE Plant Water Profiler (PWP) tool. <https://www.energy.gov/eere/amo/software-tools>
2. Guideline for Estimating Unmetered Industrial Water Use by US Department of Energy
3. Byers, William, Industrial Water Management: A Systems Approach, Wiley-AIChE, 2003