

## Water Treatment Basics

The **primary goal** of water treatment is to **maximize control** of the three inherent issues with cooling tower water: scale, corrosion and bacteria:

**Scale** - increases energy, maintenance and cleaning costs.

**Corrosion** - shortens equipment lifespan, increases capital expenses.

**Bacteria** - can be 6x more insulating the scale and introduces health/safety risks.

**Traditional water treatment** feeds scale and corrosion inhibitors, as well as biocides for bacteria, to control these issues. Once the tower water is concentrated to the point where these chemicals lose effectiveness (typically 2-4 cycles), the tower water is blown down and replenished with fresh make up water. **This is by far the most common method of cooling tower water treatment and control, and it requires significant water and chemical usage.**

## How is Capture H<sub>2</sub>O Different?

Capture H<sub>2</sub>O offers three programs that maximize control of these issues through different means, as there is not a "one size fits all" solution for water treatment. Our programs are designed to not only **maximize control**, but also address the **secondary goal** of water treatment – **maximize savings**:

**Water Savings** – maximize cycles of concentration to decrease water consumption.

**Energy Savings** – minimize scale and biofilm to increase heat transfer and minimize energy consumption.

**Reduce Chemicals** – optimize the program to eliminate or reduce chemical consumption.

Our programs are summarized in the table on the next page. The parameters of a traditional liquid chemical program are also provided for comparison.



Capture H <sub>2</sub> O Programs				
Solutions	Liquid Chemical	Solid Chemical	Hybrid	High Cycle
Cycles	2 - 4	2 - 4	6 - 10	25+
Water Savings	0%	0%	10 - 40%	25 - 50%
Chemicals	3 - 5, Most	3 - 5, Most	Less	Minimal
Value	Dangerous, Water Consumption = High	Increased Safety, More Sustainable	Increased Safety, Increased Water Savings	Optimal Water Savings, Increased Safety, Alternative Water Sources
Eligibility	Status Quo	Minimal CAPEX	250 - 750 tons, CAPEX	750+ Tons, Engaged Onsite Team, CAPEX

## The High Cycle Program

The patented **High Cycle Program** is our primary offering and best addresses the **primary and secondary goals** of water treatment:

**Scale** – high efficiency dual alternating softeners are installed on the makeup line to the cooling tower, removing Magnesium and Calcium ions, the "building blocks of scale". The 100% soft water supply to the tower also dissolves scale deposits in existing systems. This **eliminates the need to feed scale inhibitor chemicals** and allows the cooling tower to increase cycles to **25+** and **reduce water consumption** as it is no longer limited by scale. **Energy savings** are also realized from improved heat transfer due to lack of scale.

**Corrosion** – Cycling up the tower water to a pH above 9.0 will result in the naturally occurring silica concentrating in the water (200 ppm residual) to convert from a monomer to a polymer, and create a microscopic layer on all wetted equipment surfaces, **protecting metals and controlling corrosion**. This **eliminates the need to feed corrosion inhibitor chemicals** and **extends the lifespan** of equipment in the system.

**Bacteria** – Cycling up the tower to a pH above 9.5 and TDS greater than 5,000 microsiemens creates a **biostatic environment**. A change in pH inhibits normal metabolism and is a commonly used processes in fermenting food. A high conductivity environment results in an increased osmotic pressure that kills bacteria, for example when foods are salted for preservation purposes. Bacteria can survive and reproduce in either low or high pH environments or high conductivity environments, but not both. Neither aerobic or anaerobic bacteria can exist in these biostatic conditions, **removing the need to feed biocides**.



While the **High Cycle Program** offers the **best** savings, it also requires **more CAPEX** and **site engagement** to be a successful program.

## The Hybrid Program

The **Hybrid Program** uses **physical water treatment technology** to address the **primary** and **secondary** goals of water treatment:

**Scale** – a patented **water conditioning device** is installed on the riser pipe of a cooling tower's open loop. The device creates a harmless 150kHz signal that repetitively oscillates and decays at varying intervals throughout the condenser loop. This signal is transferred from the device to the ions and particles in the water passing through the pipe in the **same manner an electrical field is induced from the primary (device) to the secondary (pipe) coils in a transformer**. The design of this electrical field will cause the Magnesium and Calcium ions in the water to form crystals in the water with each other rather than on the pipes, **eliminating the need to feed scale inhibitor chemicals** and allowing the cooling tower to increase cycles to **6-10** and **reduce water consumption** as it is less limited by scale. **Energy savings** are also realized from improved heat transfer due to lack of scale.

**Corrosion** – using electrical phenomena known as “Back EMF” and “skin effect” – the high frequency varying signal from the device creates a magnetic field inside the material of the pipe, which induces an electric field in the water. The induced electric field always acts to oppose the current that causes it, and the field is strongest away from the surface of the pipe. **Near the surface of the pipe (within half a millimeter), the field drops to zero and is where current flows**. When corrosion tanks place, metal atoms in pipe material lose an electron to ions within the water and dissolve within the water themselves. When this occurs in the **hybrid program**, the electrons are forced to the outside of the pipe in the zero electric field region, preventing electrons from being available for the corrosion chemical reaction to continue. This **eliminates the need to feed corrosion inhibitor chemicals** and **extends the lifespan** of equipment in the system.

**Bacteria** – similar to how the program controls scale, the varying electric field will apply charges to any particles or bacteria passing through the device. This process is known as **electroporation** and will disrupt the bacteria cells' ability to regulate the flow of minerals, water and proteins across the membrane, causing it to become permeable and ultimately **killing the bacteria**. The signal will also cause **existing biofilm to detach from pipe**, sometimes causing a sudden rise in bacteria level testing before dropping down to low levels. A solid biocide feeder is recommended for the Hybrid program to supplement bacteria control on an as-needed basis.



The **Hybrid Program** offers **better** savings and requires **less CAPEX** and **site engagement** than the **High Cycle Program**, thus it is typically best suited for smaller applications.

## The Solid Chemical Program

For customers that do not have the CAPEX available or ROI benefits realized from the **High Cycle or Hybrid Programs**, we recommend a **Solid Chemical Program**. This is simply removing the existing chemical feed equipment and controls and installing solid chemical feed equipment and controls.

The **Solid Chemical Program** offers **minimal** savings, mainly from decreased chemical costs (i.e., more **economical** and **environmental** to ship solid chemicals than liquid chemicals), but provides **increased safety controls** to site personnel.

## Recurring Service Scope

Capture H<sub>2</sub>O not only sells the equipment for these programs, but also services our systems for every customer. Our service scope includes:

- Monthly or bi-monthly service visits by Capture H<sub>2</sub>O technicians that include wet testing, controller calibration and equipment inspections & maintenance.
- Digital service reports with inspection results, recommendations and corrective actions taken.
- Microbiological and corrosion coupon monitoring.
- Operator training and refresher training as needed.
- Digital and/or hard copy operator log sheets.
- Troubleshoot, as needed, and correct operation deficiencies.
- Review daily, auto generated 24 hour summary reports for performance anomalies.
- Respond to wireless control alarms with contact and instruction for site staff to ensure proactive corrective actions are taken to avert performance impact of water wastage.
- Provide recommendations to correct mechanical conditions causing tower overflow, tower leaks or excessive splash and drift that lead to excessive water loss and treatment control issues.
- Annual Business Reviews to review control metrics and savings, set goals, and prepare for the next calendar year.

