EVOLUTION OF WATER TREATMENT TECHNOLOGY

SUSTAINABLE NATURAL GREEN CHEMISTRY FOR COOLING WATER CONSERVATION

Presented by

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RADIAN
Engineering Solutions with Unique Technologies

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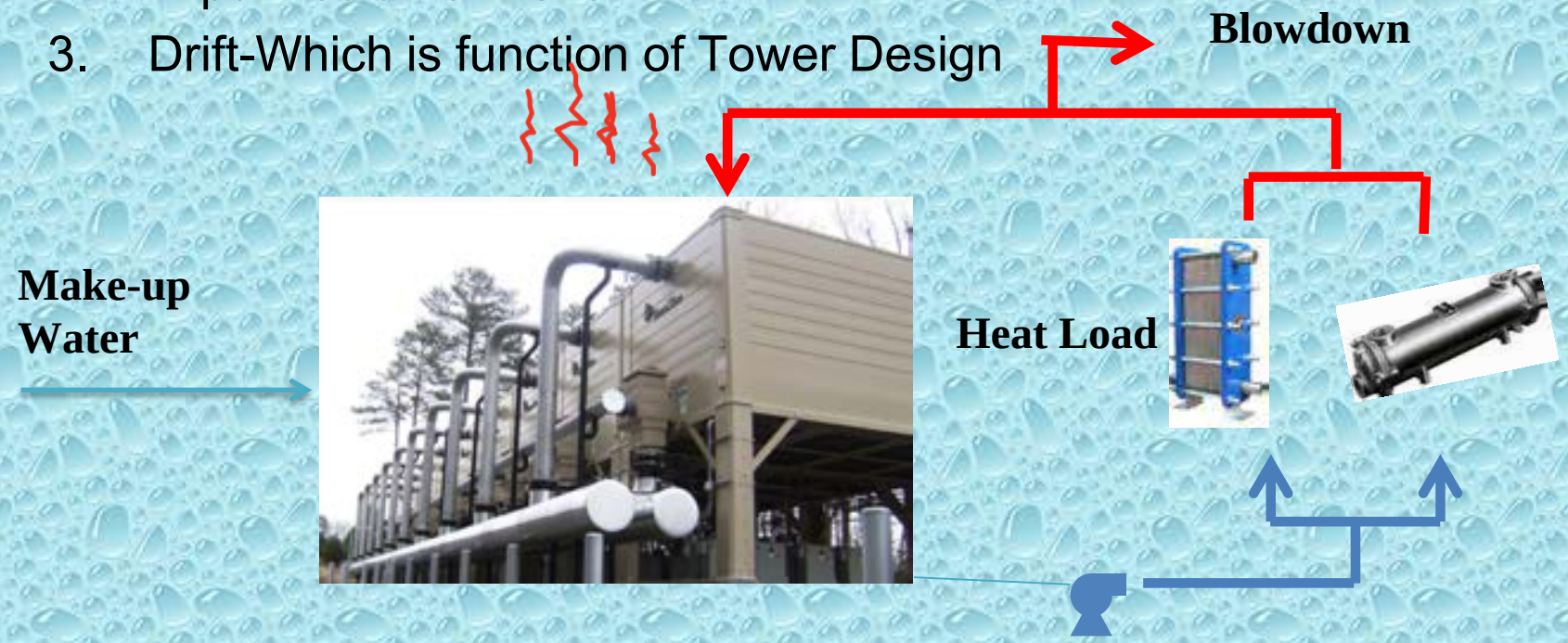
Cooling Tower Water Consumption

Cooling towers use water in three ways.

1. Evaporation- which is a function of cooling load
2. Blow-down –The portion of the circulating water flow that is removed in order to maintain the amount of TDS and other impurities at low level.
3. Drift-Which is function of Tower Design



Make-up water = Evaporation + Blowdown

A little Chemistry for Cooling Water

- Cycles of Concentration (COC): This is a ratio of concentration of dissolved solids (or conductivity) in the blowdown water compared to the **make-up water**.

  Water Use in GPH for a 100 TR Cooling Tower at different COC

COC	EVAPORATION (gph)	BLOWDOWN (gph)	Make- up (gph)
Once Through		18,000	
1.2	180	900	1080
1.5	180	360	540
2	180	180	360
2.5	180	120	300
3	180	90	270
4	180	60	240
5	180	45	225
6	180	36	216
7	180	30	210
8	180	26	206
10	180	20	200

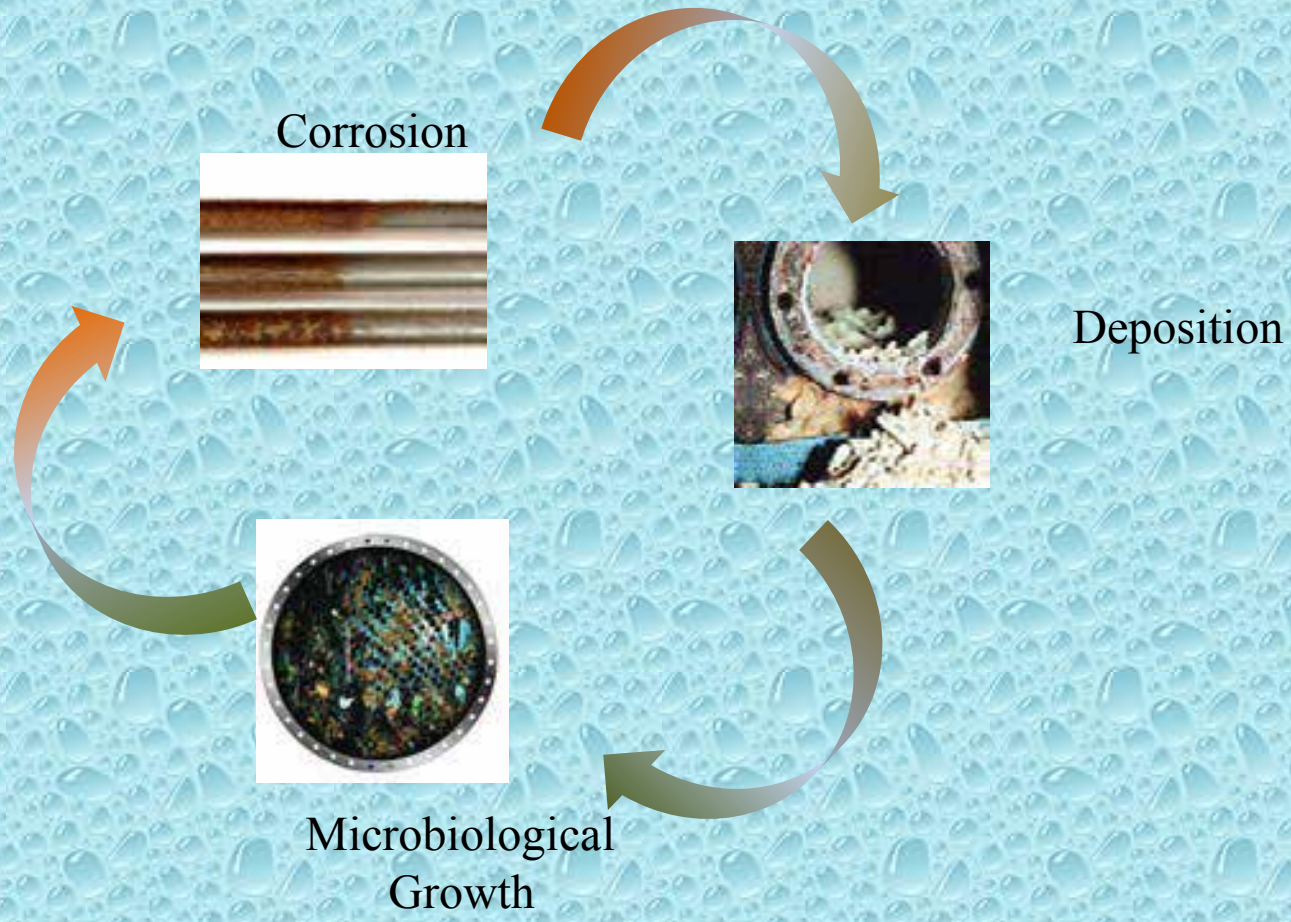
- Typically, chemically treated towers add chemicals to prevent scaling, corrosion, and biological fouling.

Cooling Water Chemistry

Cooling Water has minerals which keep on increasing when water concentrates during evaporation process,
which leads to:

- **Hardness to form Scale & Deposits In The Tower**
- **Silica Forms Deposits That Are Difficult To Remove**
- **Alkalinity which React with Hardness to Form Scale**
- **TDS corrodes Metal Components**
- **Bacteria Forms Slime And Causes Corrosion**
- **Dirt & Debris: Gives Slime A Place To Stick**

Traditional Cooling Water Treatment Issues



All require chemical treatment and blowdown to manage

Evolution of Water Treatment Technology

To overcome these issues, *New Green Chemistry* (NGC) technology evolved:

WCTI

(Water Conservation Technology International)

- *Minimum Blow Down*
- *Minimum Chemicals*
- *Minimum Biocide*
- *COC 50+*

What is WCTI Technology

WCTI Process involves:

HES (high efficiency softener) which removes scale forming ions, running high TDS and pH for biostatic conditions, while relying on natural silica corrosion control to treat metal surfaces

WCTI Water Chemistry

HOW DOES THE WCTI PROCESS WORK?

Traditional Chemical Treatment Is Based On

- Calcium Chemistry -

The WCTI Treatment Is Based On

- Sodium Chemistry –

WCTI Water Chemistry

HOW DOES THE WCTI PROCESS WORK?

- **Remove Scale Forming Ions From M-U Water**
  - ***HES-High Efficiency Softener***
- **Reduce Blow Down & Chemical Addition**
- ***Allow* Tower Water To Cycle Up**
- **WCTI *Sodium Based Chemistry* Takes Over**

WCTI Water Chemistry

Following Components React With *Sodium Ions*

Alkalinity: **Forms Sodium Carbonate**
- Buffers at a pH of 9-10

Sulfates, Chlorides: Forms Highly Soluble Salts

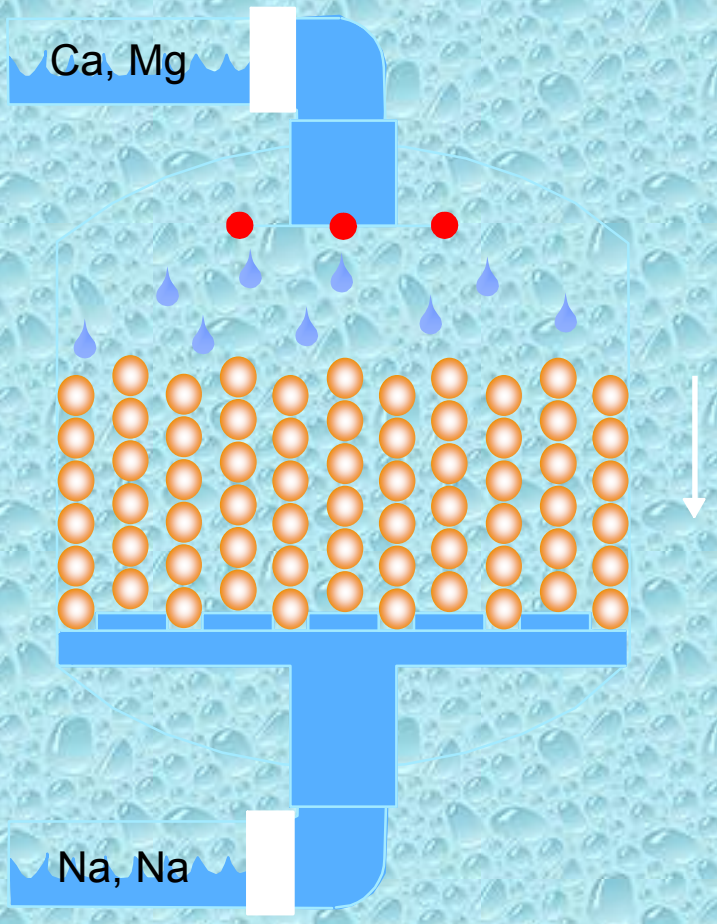
Silica: Reacts With Itself To Form Polymerized Silica
- Amorphous State, Will Not Scale
- Forms An Excellent Corrosion Inhibitor

Softening – Process

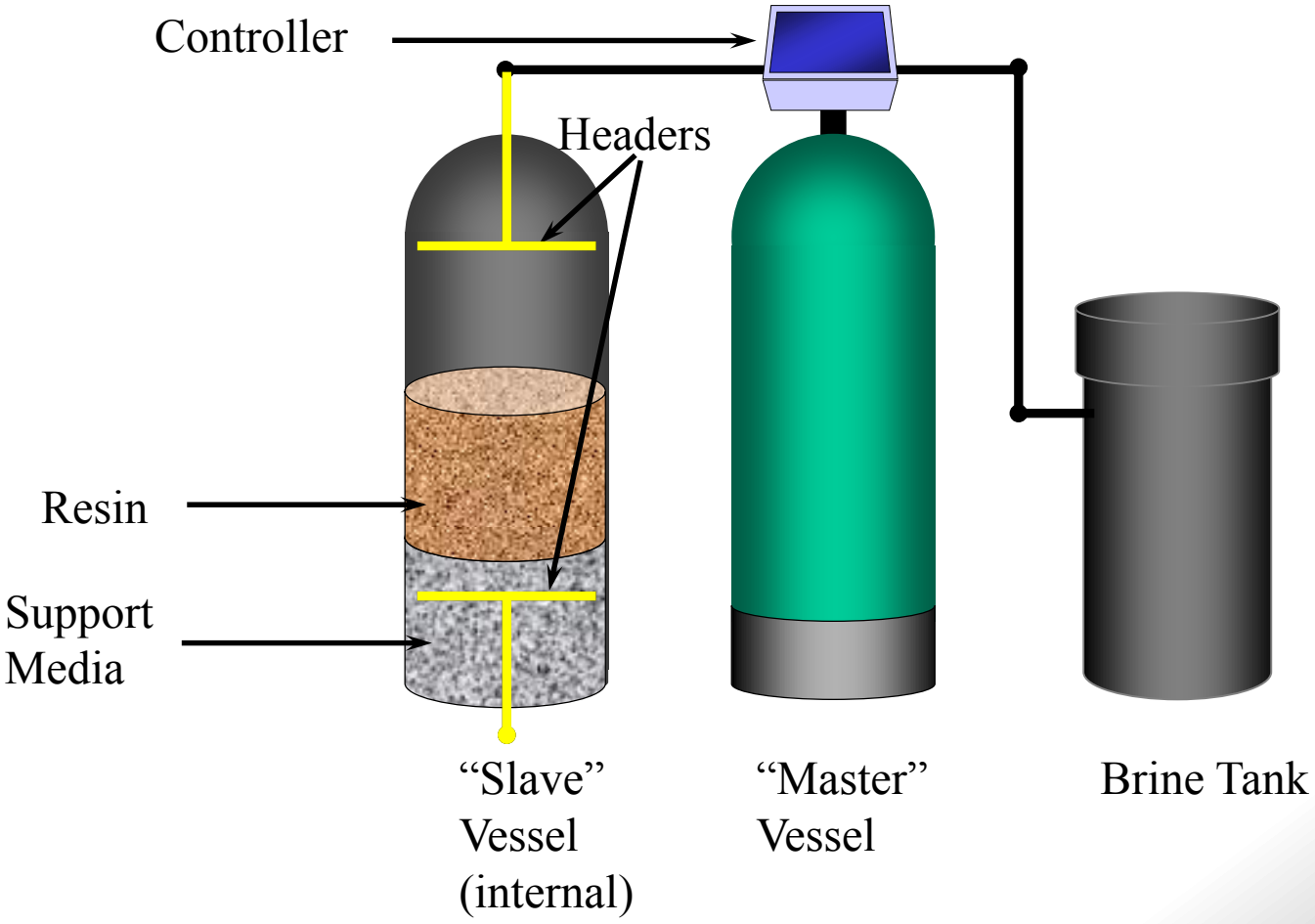
- "Ion" exchange, Ca^{++} and Mg^{++} ions exchanged for Na^{+} (Sodium) ions
- Exchange sites located on polystyrene zeolite resin beads
- Na^{+} ions can exchange for other positive charged ions such as Fe^{++}, Mn^{++}, Zn^{++}, Al^{+++}, Cu^{++}
- Resin attracts the hardness in the water and removes it and replaces it with sodium.
- Sodium comes from the salt (sodium chloride) used to 'regenerate' the resin

Sodium (Salt) Ion Exchange Softener

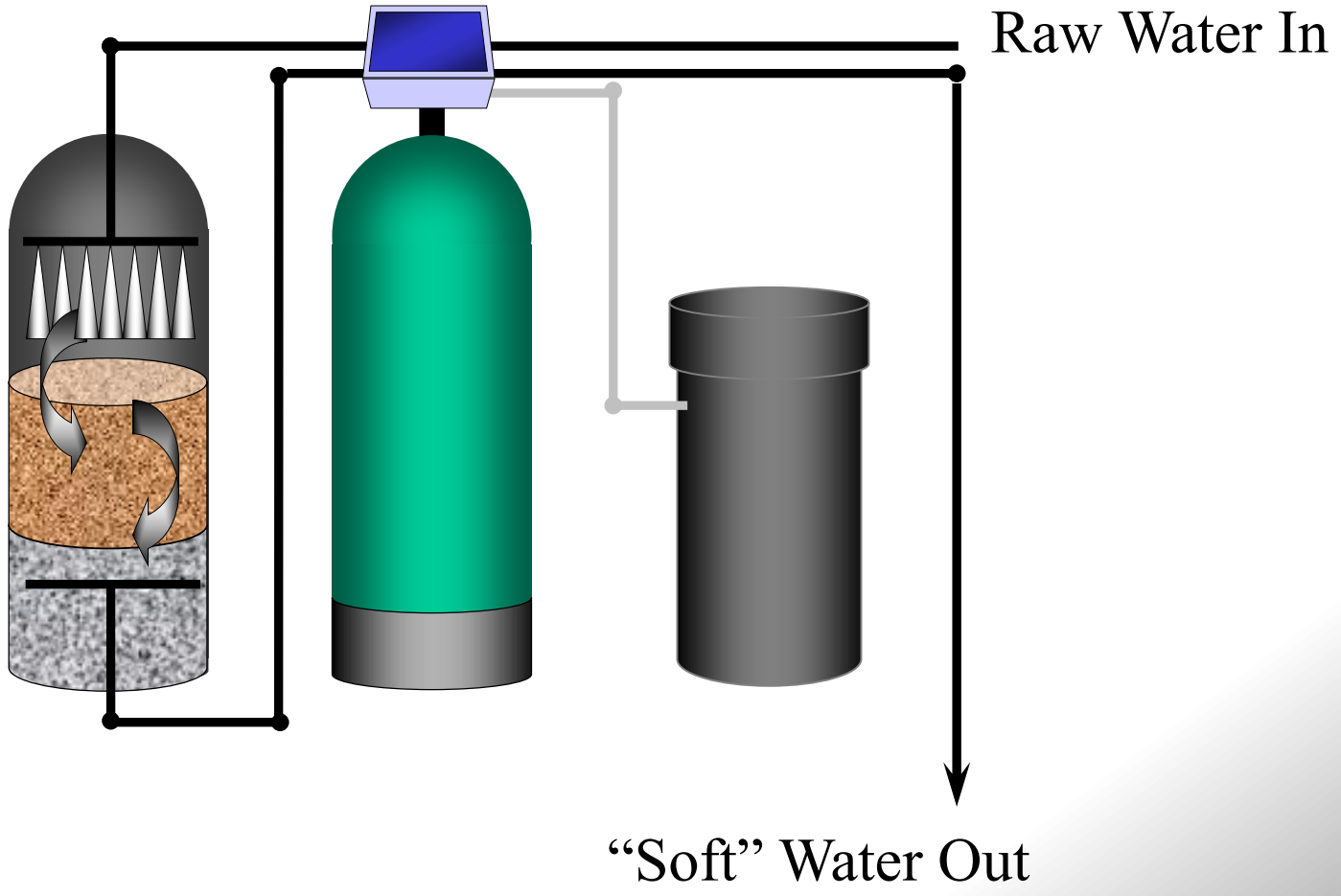
- ***Calcium and Magnesium Ions Are Exchanged For Sodium Ions***
- ***Sodium Ions Are Very Soluble***
- ***All Scale Forming Ions Are Removed***



Softener - Components



Softener - Service



Cooling Water Chemistry

Traditional Water Treatment:

ACCEPTED STANDARD FOR CONTROL LIMITS

- **Hardness** **500 PPM**
- **Silica** **150 PPM**
- **Alkalinity** **450 PPM**
- **TDS** **<1,800 PPM**

WCTI Water Chemistry

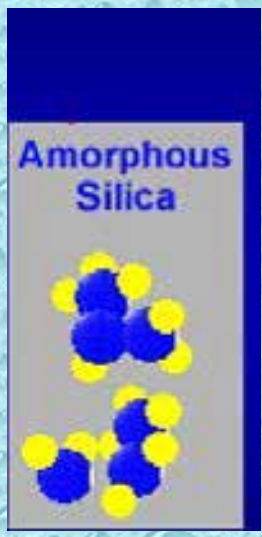
WCTI Tower Water Control Range

	Minimum	Preferred	Maximum
TDH	<30 PPM	<30 PPM	30 PPM
TDS	>5,000 PPM	>10,000 PPM	100,000 PPM
Silica	>200 PPM	>300 PPM	
pH	>9.0 pH	9-10 pH	<10.2 pH

Silica Is the Key

WCTI CHEMISTRY FOR CORROSION PROTECTION

Silica Has Excellent Corrosion Inhibition Properties



- **Silica Polymerizes at WCTI Conditions**
  pH >9.0, SiO2> 200

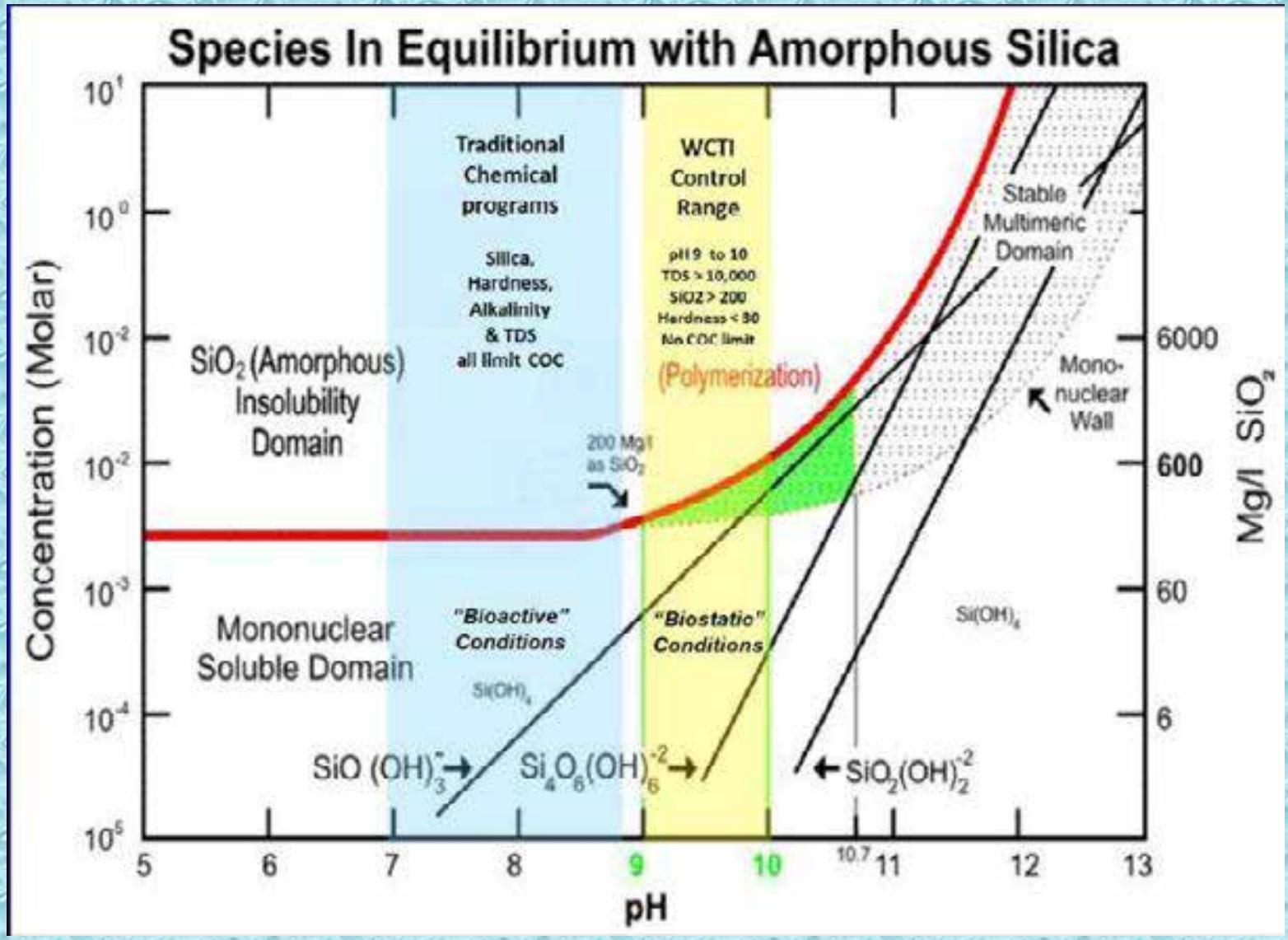
- **Silica Forms Amorphous Polymers (or Silicates)**

- **Polymerized Silica Is An *EXCELLENT* Corrosion Inhibitor**

- **Polymerized Silica Forms A Passive Coating, Seals & protects All Metal Surfaces**

- **Part of the patented process.**

Relationship Between Soluble, Insoluble & Polymerized silica species At Varying pH & concentration



WCTI Green Triangle

*The **green triangle** is the WCTI world*

1) total hardness less than 30

2) pH between 9.0 & 10.0

&

3) Silica > 200

WCTI Water Chemistry

WCTI CHEMISTRY CONTROLS BIO-GROWTH

Bio-static Water Conditions

High Cycles Creates Bio-Static Conditions

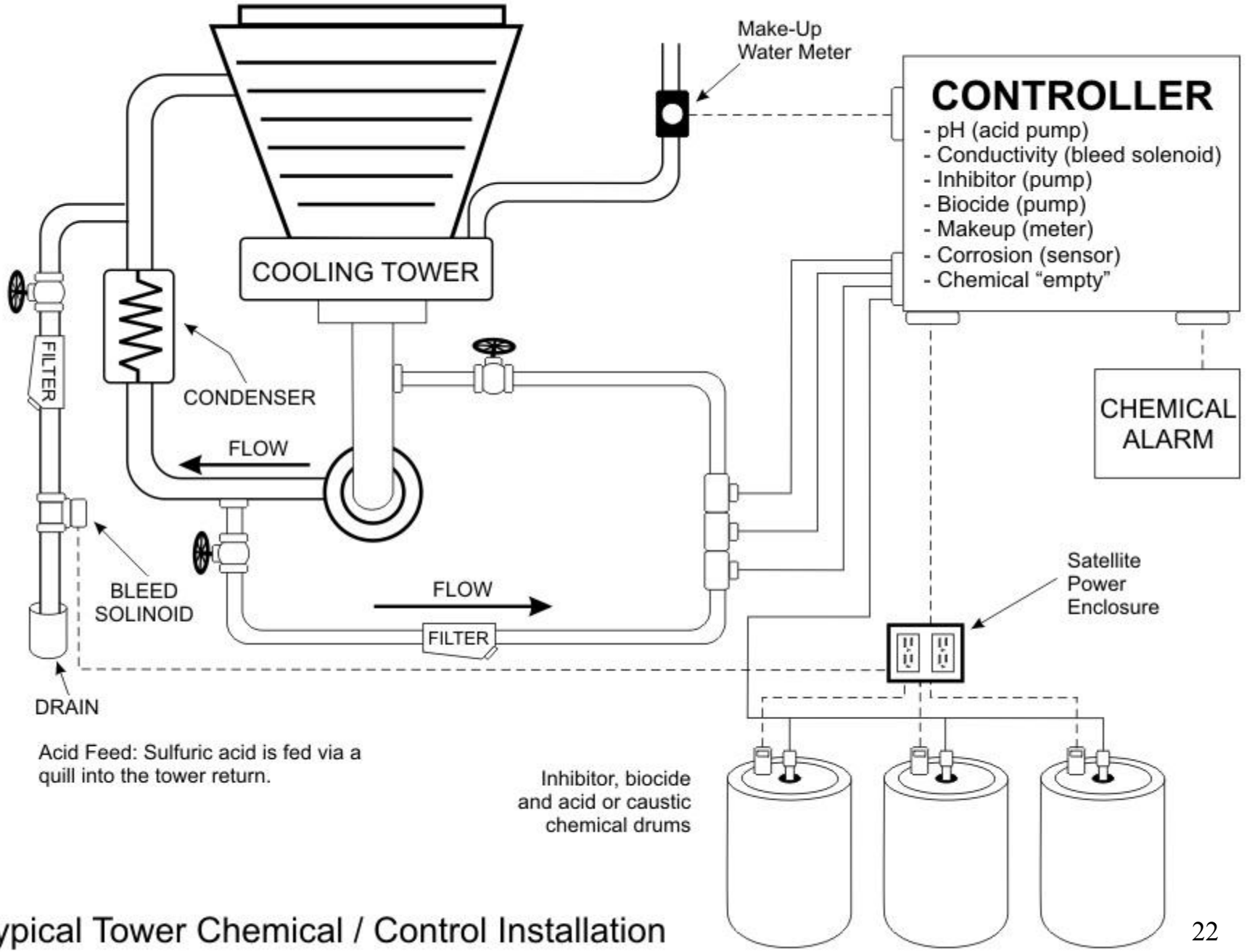
- **pH > 9.0 (Preferably 9.7 to 10.0)**

Bacteria and Pathogens Do Not Propagate (dormant)

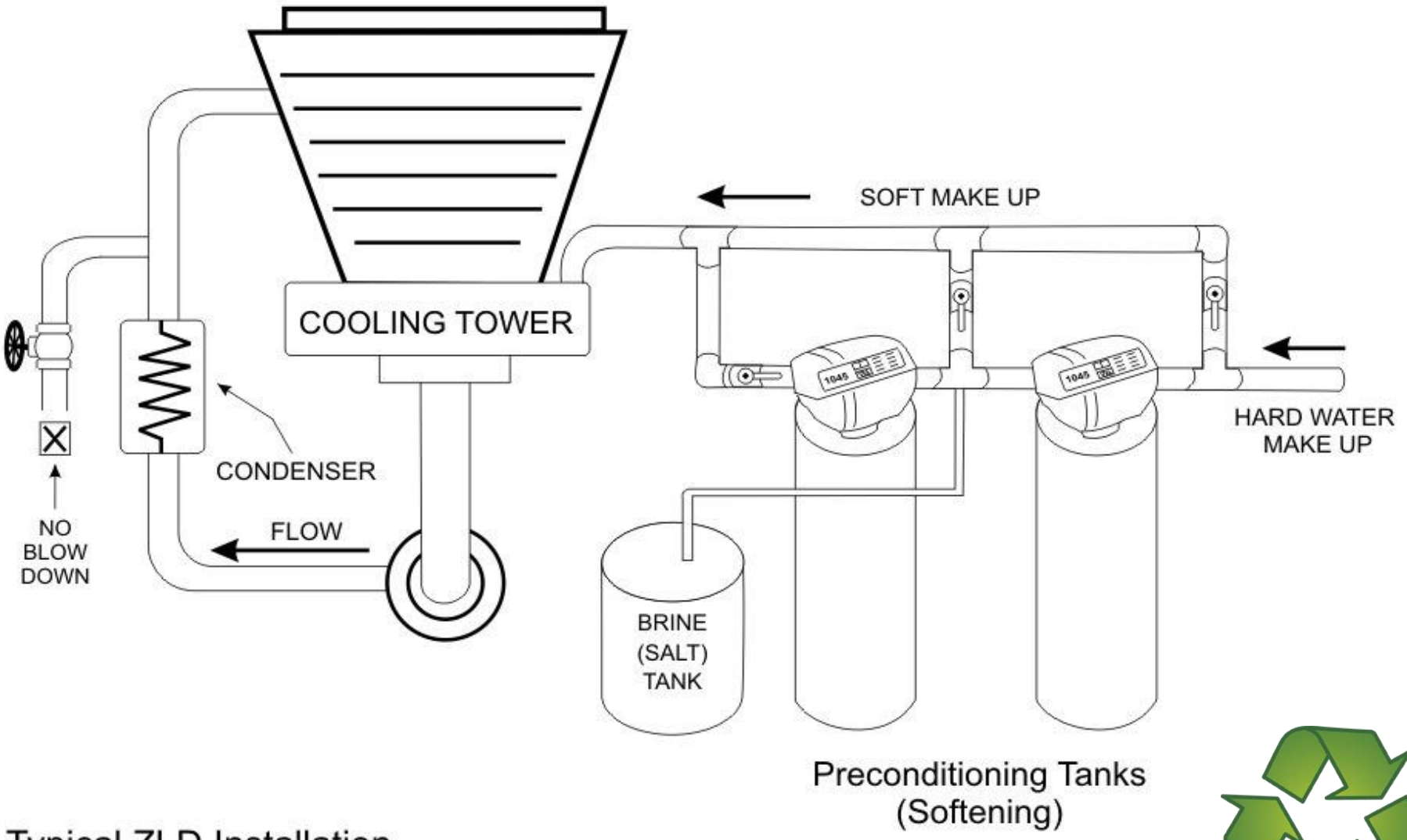
Reclaim or Recycle Water

Reclaim or Recycle Water Is :

- **Fully Compatible With WCTI Technology**
- **Not Affected By Organics, NH_3, Phosphorus, TDS**
- **Filtration Required To Remove Suspended Solids**



Typical Tower Chemical / Control Installation

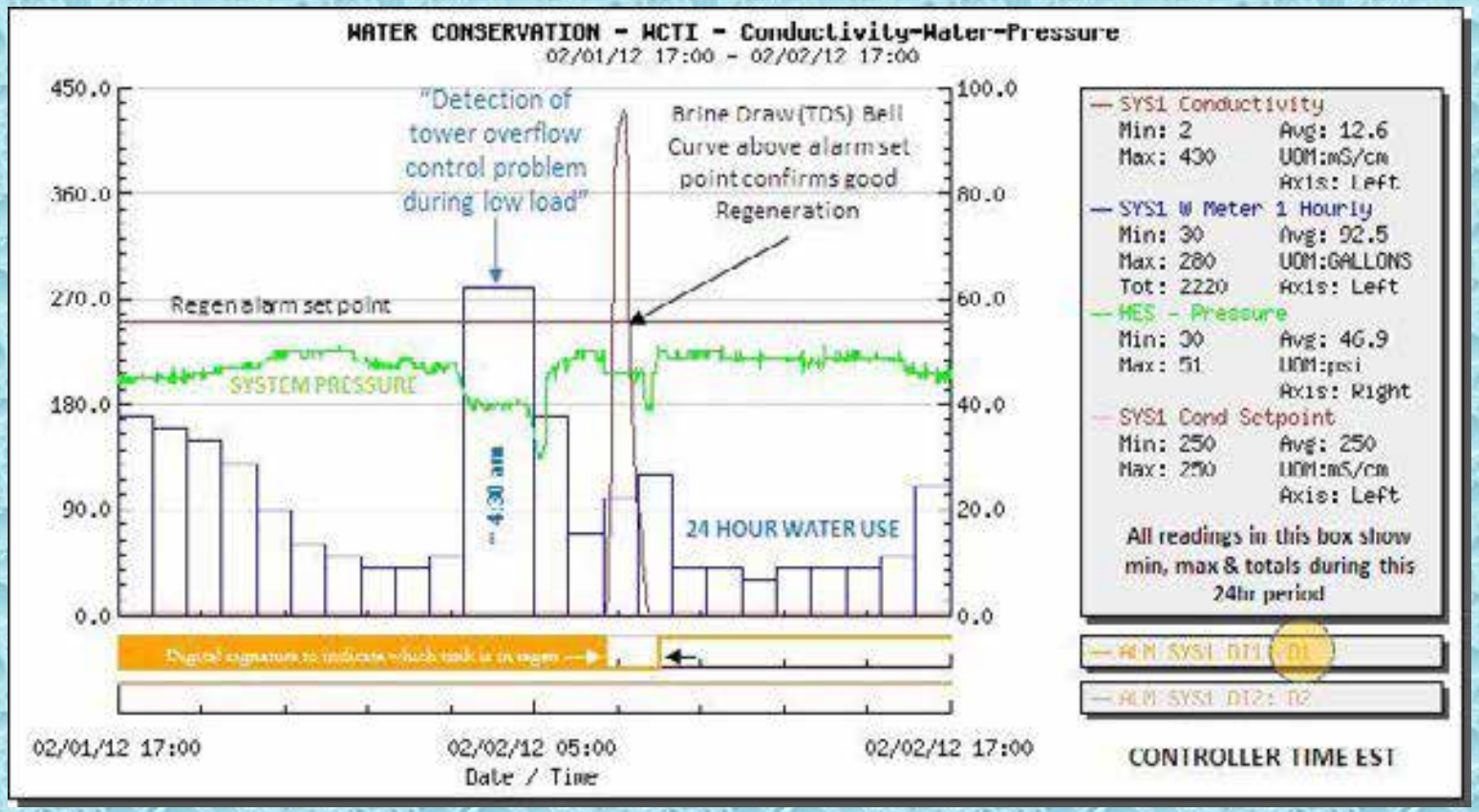


Typical ZLD Installation

On Line Remote Monitoring of High Efficiency Softening (HES) Program Assurance for Zero Blow Down Cooling Tower Operation

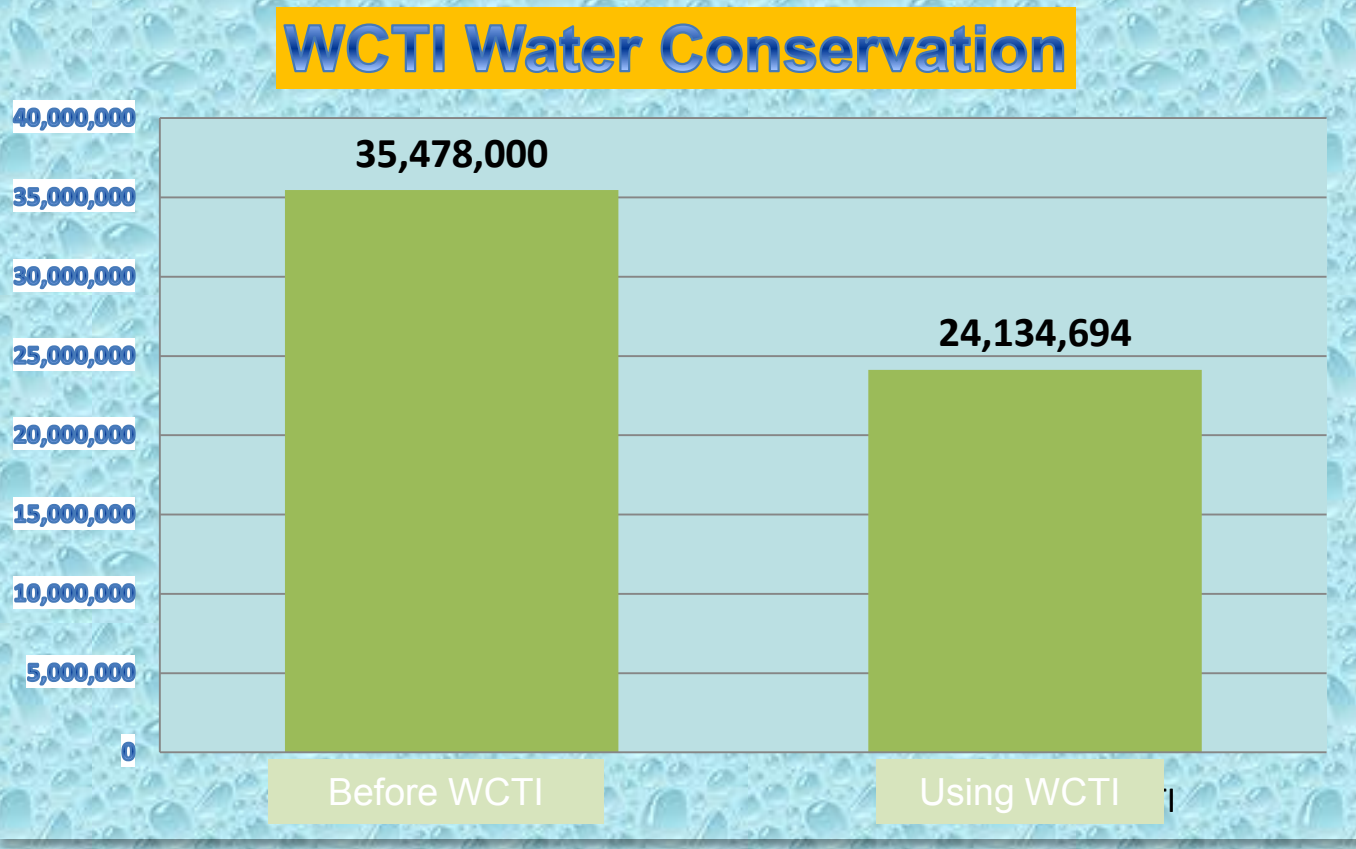
RPA

RPA (Remote Performance Assurance)
24/7 Remote Monitoring & Diagnostics



Water Conservation Resources

- Major Aerospace Company



11.6M Gallons Water Saved (2008 vs. 2009)

WCTI Performance & Sustainability

- Low operation cost (HES) removes scaling ions from makeup water
- 0-2% tower water wastage versus 20-40%
- Natural pH control, 9.7 to 10 range
- Concentrate silica to 200-800 mg/L
- Natural bio-static water – no toxic biocides
- Reduce total treatment costs 50-75%
- Prevent and remove energy loss deposits

Customer Benefits

- Green status, community relations
- LEED points attainment
- RPA (Remote Performance Assurance) links your operations to WCTI's equipment and support expertise, using global communications network.

Installations

DATA CENTER

AEROSPACE

National & Regional Customers

- Aerospace - Boeing, Northrop
- Data Centers – Microsoft, Apple, Yahoo, AT&T, Verizon, Info Cross
- Education - CSUDH, Cypress, KSU / JCI
- Power Generation, Industrial Gas
- Health & Bio Tech – Dignity, UCLA MC, Bristol Meyers, Fred Hutch, others

Thank You

Please contact:

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