OPERATIONAL UPDATE ON INNOVATIVE COOLING TOWER PRETREATMENT TECHNOLOGY

Presented By:

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WATEREUSE ASSOCIATION

PRESENTATION OUTLINE:

- Subject Introduction
- Amylin Project Background
- Cooling Tower Basics
- Typical RW CT Implementation Challenges
- Alternate Pretreatment Technology
- Technology Benefits to RW Use

AMYLIN PHARMACEUTICALS BACKGROUND

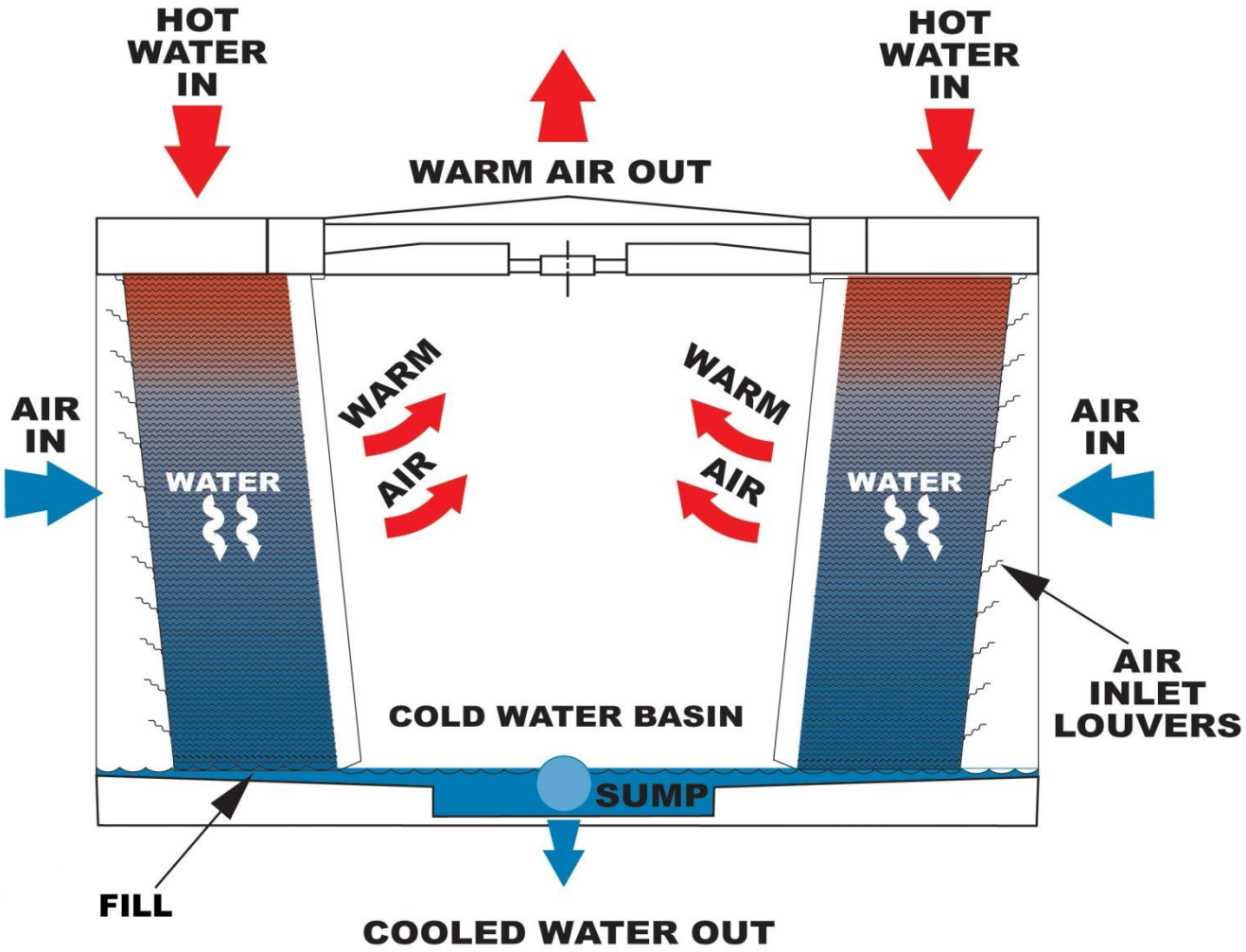
- Located in SD Golden Triangle
- Specializing in diabetes research and medicines production
- 104,000 ft^2 (9,662 m^2) office/ research building, reflecting pond, and irrigation areas
- Prior peak potable water makeup 25,100 gpd (95 m^3/d) for CT; 9,360 gpd (35.4 m^3/d) pond and irrigation
- Implemented RW retrofit at CT with Pretreatment Technology in 2012

AMYLIN PHARMACEUTICALS BACKGROUND

Project Goals

- Switch from potable to recycled water use
- Focus on feature pond, irrigation & cooling tower
- Reduce overall water use (implement conservation)
- Reduce overall O&M costs.

COOLING TOWER BASICS



COOLING TOWER BASICS

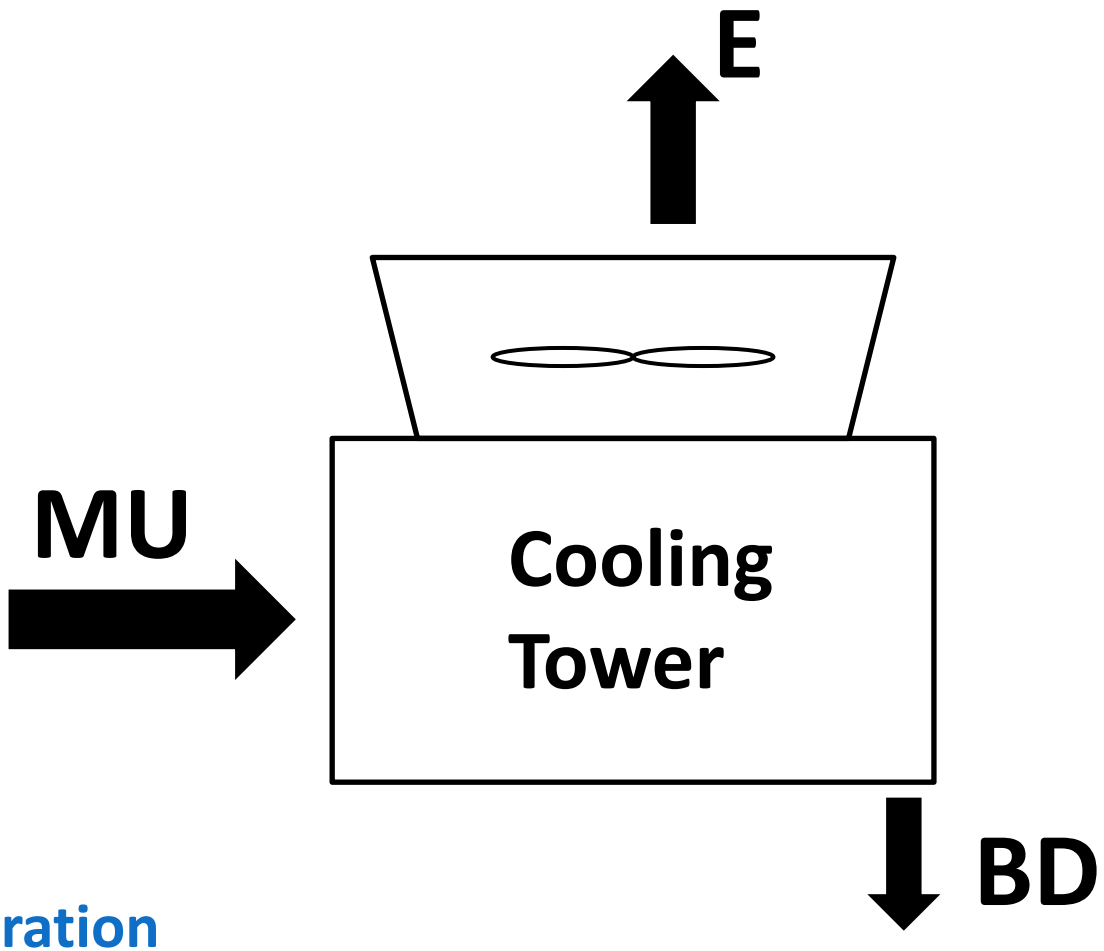
MU = E + BD

Where:

MU = Make-Up Water

E = Evaporation

BD = Blowdown



COC = MU / BD

Where:

COC = Cycles of Concentration

RW IMPLEMENTATION CHALLENGES:

- Water quality typically poorer than potable (TDS, PO4, nutrients, etc.)
- Maximum COC of RW < PW
- Increase in scaling potential
- Increase in corrosion potential
- Potential increase in bacteriological activity
- Condition of existing system
- Regulatory/permitting/inspection barriers & concerns

RW CT IMPLEMENTATION CHALLENGES

Constituents of Concern	Unit	City of SD RW Quality	Saturation Limits/Issues in Cooling Water
Total Dissolved Solids (TDS)	mg/L	914	Increases ionic strength & corrosion potential in cooling water
Calcium Hardness	mg/L as $CaCO_3$	162	Calcium carbonate scaling issues
Calcium Sulfate (Ca x SO_4)	mg/L	36,612	Max. 500,000 mg/L without scale inhibitor
Mag. Silicate (Mg X SiO_2)	mg/L	1,404	Max. 35,000 mg/L without scale inhibitor
Ortho-Phosphate	mg/L as PO_4	5.8	Calcium phosphate scaling
Ammonia	mg/L as N	0.3	Copper alloy corrosion issues
Chloride	mg/L	239	Corrosion issues
Total Org. Carbon (TOC)	mg/L	8.6	Fouling and biological issues

RW CT IMPLEMENTATION CHALLENGES

Constituents of Concern	Unit	City of SD RW Quality	Cooling Water Limits w/ Chemical Feed	Alternate Technology?
Total Dissolved Solids (TDS)	mg/L	914	< 5,000	
Calcium Hardness	mg/L as $CaCO_3$	162	<1,200	
Calcium Sulfate (Ca x SO_4)	mg/L	36,612	< 1,000,000	
Mag. Silicate (Mg X SiO_2)	mg/L	1,404	75,000	
Ortho-Phosphate	mg/L as PO_4	5.8	4 - 9	
Ammonia	mg/L as N	0.3	< 1.5	
Chloride	mg/L	239	< 1,500	
Total Org. Carbon (TOC)	mg/L	8.6	Fouling/Biological	

PRETREATMENT TECHNOLOGY

- Patented Alternative Pretreatment Technology (WCTI)
  - ✓ Media filtration to lower TSS and prevent IX resin fouling
  - ✓ Softening to remove Ca and Mg
  - ✓ Operation at high COC (i.e., high TDS, pH alkalinity, phosphate and silica)
  - ✓ Non-common (diverse) ion effect
  - ✓ Scale & corrosion prevention
  - ✓ Biostatic

ALTERNATE PRETREATMENT TECHNOLOGY

Constituents of Concern	Unit	City of SD RW Quality	Cooling Water Limits w/ Chemical Feed	Alt. Pretreat. Technology
Total Dissolved Solids (TDS)	mg/L	914	< 5,000	< 100,000
Calcium Hardness	mg/L as $CaCO_3$	162	<1,200	< 30 *
Calcium Sulfate (Ca x SO_4)	mg/L	36,612	< 1,000,000	N/A
Mag. Silicate (Mg X SiO_2)	mg/L	1,404	75,000	N/A
Ortho-Phosphate	mg/L as PO_4	5.8	4 - 9	N/A
Ammonia	mg/L as N	0.3	< 1.5	< 60,000
Chloride	mg/L	239	< 1,500	< 60,000
Total Org. Carbon (TOC)	mg/L	8.6	Fouling/Biological	Biostatic

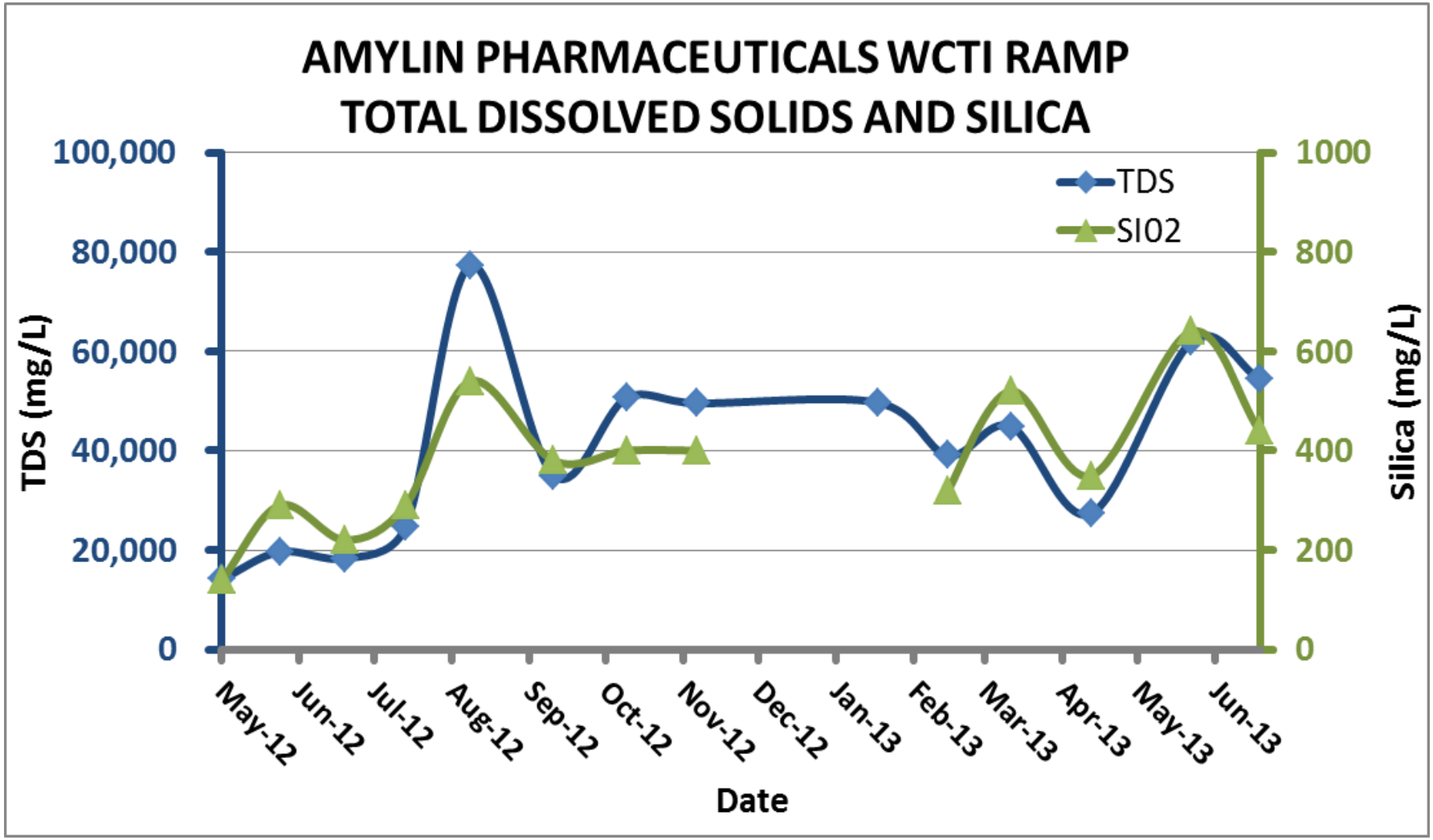
AMYLIN IMPLEMENTATION COOLING TOWER INFORMATION

Parameter	Value
Cooling Capacity	500 Tons
Delta T	10 Deg. F
Recirculation Rate	1500 gpm
Peak Evaporation Rate	12 gpm
Tower Materials	Galvanized with S.S Basin

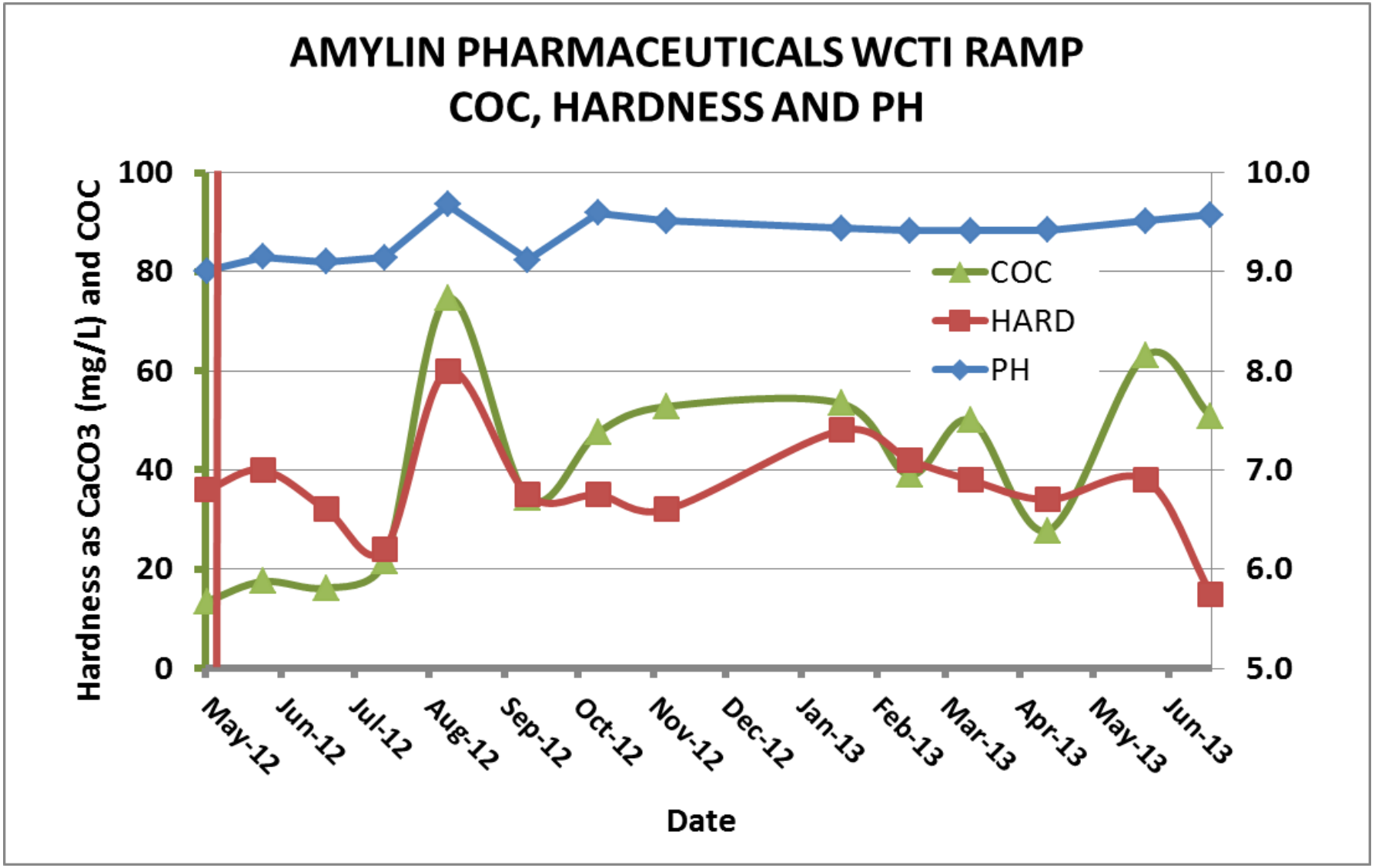
AMYLIN IMPLEMENTATION

- Pretreatment System Installed

OPERATIONAL UPDATE



OPERATIONAL UPDATE



OPERATIONAL UPDATE - INSPECTION

- Chiller inspection performed Jan. 2013
  - ✓ Electromagnetic induction (eddy-current) testing
  - ✓ Copper tube with epoxy-coated steel plate end
  - ✓ No tube damage, minor pitting noted
  - ✓ No or very minimal scale
  - ✓ Operator noted best inspection of chiller since installation.
- Cooling Tower Issues
  - ✓ White rust (i.e. zinc-carbonate) noted on galvanized upper.
  - ✓ No scale, no corrosion.

ECONOMIC ANALYSIS (ORIGINAL)

Description	Previous Chemical Treatment	Revised Chemical Treatment	Implemented WCTI Technology
Operational Data			
Make-up Water Source	100% Potable	100% Potable	100% RW
Annual Average Evaporation, gpd	17,280	17,280	17,280
Annual Average Blow-Down, gpd	7,855	4,320	353
Annual Average Make-Up Water, gpd	25,135	21,600	17,633
Cycle of Concentration	3.2	5.0	50
Annual O&M Cost Comparison			
Annual Make-up Water Cost	$44,650	$38,370	$6,880
Annual Blow-Down Cost	$28,750	$15,810	$1,290
Annual Chemical Cost	$8,000	$10,000	$0
Annual Salt & Patent Program Cost	$0	$0	$11,900
Total Annual O&M Costs	$81,400	$64,180	$20,070
Annual Cost Savings “Green” Tech	$61,330	$44,110	$0
Total WCTI Capital Cost			$21,350

ECONOMIC ANALYSIS (2012-2013)

Description	Previous Chemical Treatment	Revised Chemical Treatment	Implemented WCTI Technology
Operational Data			
Make-up Water Source	100% Potable	100% Potable	100% RW
Annual Average Evaporation, gpd	4,433	4,433	4,433
Annual Average Blow-Down, gpd	2,015	1,108	112
Annual Average Make-Up Water, gpd	6,448	5,541	4,545
Cycle of Concentration	3.2	5	40.7
Annual O&M Cost Comparison			
Annual Make-up Water Cost	$11,799	$10,140	$1,774
Annual Blow-Down Cost	$4,916	$2,704	$272
Annual Chemical Cost (Est.)	$2,052	$2,565	$0
Annual Salt & Patent Program Cost	$0	$0	$3,053
Total Annual O&M Costs	$18,768	$15,409	$5,099
Annual Cost Savings	$13,668	$10,310	$0
Total WCTI Capital Cost			$21,350

IMPLEMENTATION CHALLENGES - ALTERNATE TECHNOLOGY -

- Monitor operation on daily basis
- Verify proper functioning of existing open loop cooling system
- Consider removal of any existing scaling
- Allow for period of adjustment
- Requires regular monitoring same as chemical treatment
- Consider automatic blowdown control

OVERALL IMPLEMENTATION BENEFITS

- ✓ Potential for greater adoption of RW use in cooling towers
- ✓ Alternate technology adapts to challenging RW water quality
- ✓ Reduced water purchase cost (client benefit) and consumption (agency benefit)
- ✓ O&M costs minimized (typical ROI of 2 years or less)
- ✓ Qualifies for LEED credit

CONTACT INFORMATION

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QUESTIONS & ANSWERS

WATEREUSE ASSOCIATION