Reclaimed Water for Cooling Make-up

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October 2015

ChemTreat

Agenda

- Why use Reclaimed Water?
- Characteristics of Reclaimed Water
- Pretreatment
- Treatment Requirements
  - Corrosion Issues & Control
  - Microbiological Issues & Control
  - Deposition Issues & Control

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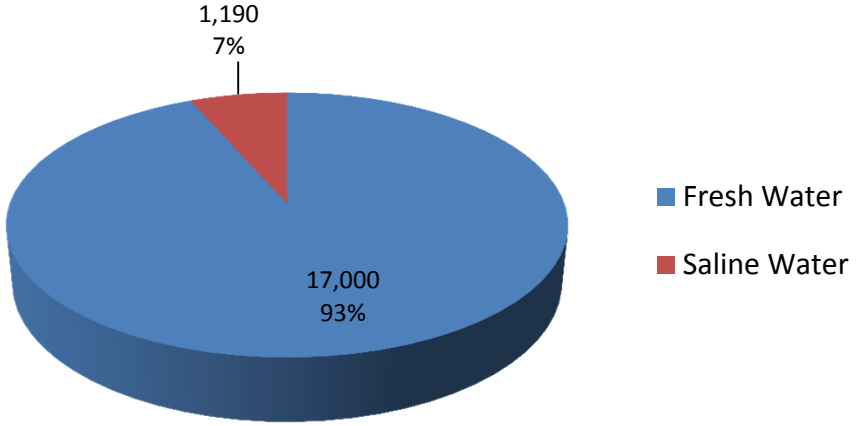
Industrial Water Consumption

Industrial self-supplied water withdrawals, by source and type, for the United States in 2005 (Data are in million gallons per day Mgal/d)

Source	Fresh Water	Saline Water	Total
Surface Water	13,900	1,150	15,050
Groundwater	3,070	37	3,110
Total	17,000	1,190	18,200

Industrial Water Withdrawals, 2005



http://ga.water.usgs.gov/edu/wuin.html

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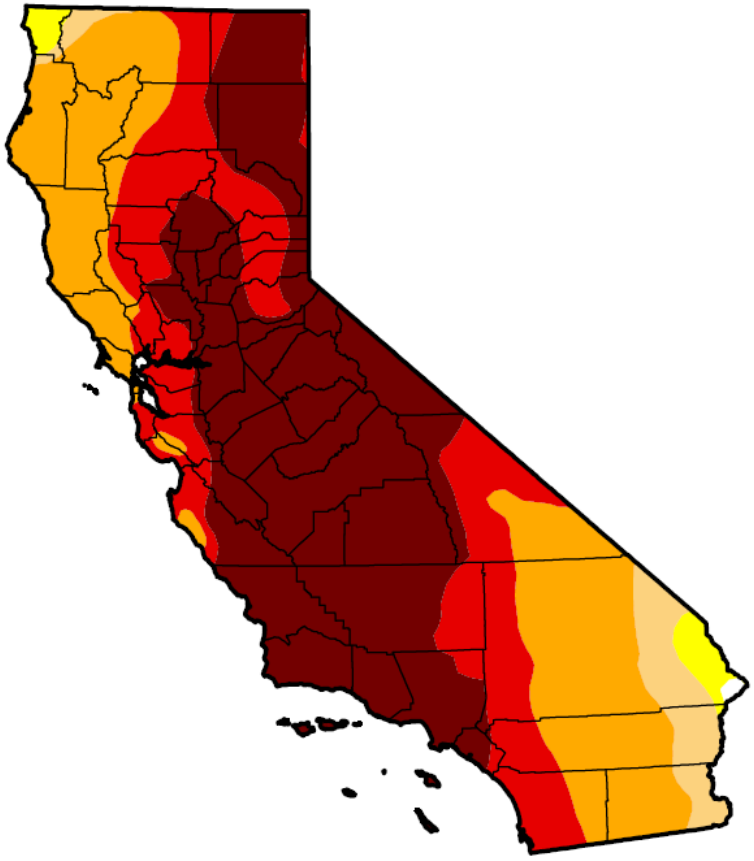
Why Use Reclaimed Water?

U.S. Drought Monitor

California



April 7, 2015

(Released Thursday, Apr. 9, 2015)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.15	99.85	98.11	93.44	66.60	44.32
Last Week *3/31/2015*	0.15	99.85	98.11	93.44	66.60	41.41
3 Months Ago *1/6/2015*	0.00	100.00	98.12	94.34	77.94	32.21
Start of Calendar Year *12/30/2014*	0.00	100.00	98.12	94.34	77.94	32.21
Start of Water Year *9/30/2014*	0.00	100.00	100.00	95.04	81.92	58.41
One Year Ago *4/8/2014*	0.00	100.00	99.81	95.21	68.76	23.49

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Michael Brewer
NCDC/NOAA

http://droughtmonitor.unl.edu/

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Reclaimed Water

General Characteristics

- High suspended solids
- Higher TOC
- High dissolved solids
- H_2S and NH_3
- High & variable phosphate

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Reclaimed Water Pretreatment Requirements

Excessive impurity levels in the reclaimed water may require pretreatment because:

- Consistency is critical
- Microbiological control is critical

Pretreatment Options

- Phosphate removal
- pH adjustment
- Bromine/chlorine addition
- API separator and/or DAF unit
- Ion exchange system
- Membrane filtration
- Nitrification
- Clarification or cold lime softening/filtration

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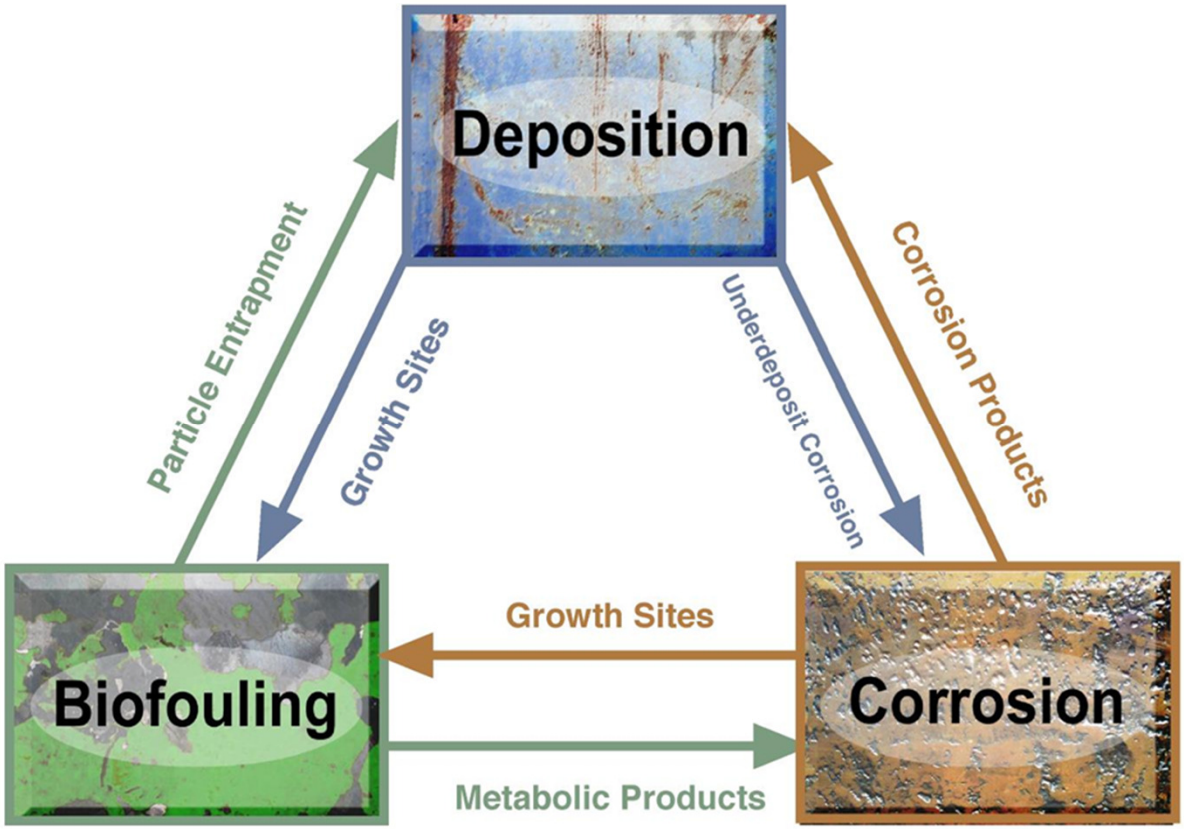
Chemistry Balance



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Corrosion Issues & Control

Understanding Corrosion Rates

Corrosion Rate or Pitting Rate	Life Span of ¼" wall thickness piping
1 mpy	125 years
2 mpy	62 years
4 mpy	31 years
8 mpy	15 years
10 mpy	12 years
12 mpy	10 years
25 mpy	5 years

Corrosion rates approximately double for each 18°F (10°C) increase in metal temperature.

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Impact of Reclaimed Water on Corrosion Control

Increased Potential for Corrosion with Reclaimed Water

- High TDS levels potentially increase corrosion rates for all metallurgies
- High levels of chloride can cause stress corrosion cracking of stainless steel
- Ammonia, even at very low levels, can cause elevated corrosion rates for copper bearing alloys and increase chlorine demand
- H_2S is very aggressive towards mild steel and copper bearing alloys
- Phosphate provides corrosion protection when stabilized with the polymer, but can increase corrosion potential with poor pH control – This can be a big issue!

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Introducing FlexPro® RZ

Flexible Control, Exceptional Protection, Maximum Efficiency

***Flex*Pro® RZ** is a breakthrough innovation in cooling water treatment that simplifies the management of water chemistry because it treats the metal, not the water.

- Reduces the building blocks for scale deposition
- Does not add the phosphate nutrient that promotes algae or biofouling
- Supports emerging environmental regulations
- Designed for the challenges associated with reclaimed water

ChemTreat's ***Flex*Pro® RZ** chemistry offers several key benefits:

- Forms a more persistent film, treating the surfaces rather than the bulk water
- Broad control band diminishes the need for precise system balance
- Reduces the potential for algae growth, often resulting in reduced biocide consumption
- Lower aquatic effects and a more favorable EH&S profile than current phosphorus and zinc based programs.
- Additional dispersion for TSS and scaling waters

Flexible Protection, Reclaim Water, Zero Liquid Discharge = FlexPro® RZ

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Microbiological Issues & Control

Impact of Reclaimed Water on Microbiological Control

Increased Potential for Biofouling with Reclaimed Water

- High levels of BOD and TOC may cause fouling and severe localized corrosion
  - Hydrophobic organics may directly foul cooling system surfaces
  - Hydrophobic organics and other organic contaminants may stimulate microbiological growth and cause the formation of biofilms on system surfaces causing microbiological induced corrosion (MIC)
- Microbiological control program may have to be modified to handle increased BOD, TOC, NH_3 and H_2S loading
  - Halogenation program may require modification (CLO_2, Br_2) due to high ammonia and TOC loading
  - Non-oxidizing microbiocides may be required to help prevent biofilms
  - Surfactants may be required to provide penetration of biofilms or oil dispersion

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Impact of Biofouling & Scale on Heat Transfer

Example:
Steel Thermal Conductivity = 35.6 BTU/(hr-ft-˚F)

Type of Deposit	Thermal Conductivity (BTU/hr-ft-˚F)
Calcium Carbonate	1.3 - 1.7
Calcium Sulfate	1.3
Calcium Phosphate	1.5
Magnesium Phosphate	1.3
Iron Oxide	1.5
Biofilm	**0.4**

Thermal conductivity, k, is the property of a material that indicates its ability to conduct heat.

Heat exchanger tube sheet: Heavy mineral and bio deposits

Lower section of bio-fouled heat exchanger tube sheet

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Why use Chlorine Dioxide?

- Does not react with most organics
- No carryover to wastewater plant
- Does not degrade treatment chemicals
- Effective at low doses and at sub-residual levels
- Highly effective on biofilms
- Active within a broad pH range 4-9
- Minimizes contribution to dissolved solids

ChemTreat's Solution: CD30

Chlorine dioxide is a highly reactive molecule with a natural tendency to come out of solution. Most safety incidents are primarily attributed to improper chemical handling , delivery and storage. To minimize these risks, ChemTreat has developed **CD30** - a cradle to grave hands-free program.

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Deposition Issues & Control

Impact Of Reclaimed Water Use On Deposit Control

Increased Potential for Deposition with Reclaimed Water

- High TSS levels will increase the potential for deposition throughout cooling system
- Elevated Ca, Mg, Al, SiO_2, SO_4, PO_4, Fe and Cu levels will also increase potential for deposition throughout cooling system
- Measurement and controllers may need to be added to the program to manage and control the impact of deposits
  - Turbidity is a useful indicator of TSS
  - Turbidity of the water is typically less than 0.4 NTU and TSS less than 1 ppm
  - This can be addressed by monitoring filtered vs. unfiltered ions and adjusting polymer accordingly
  - Target 10 – 12 ppm of active polymer while maintaining filtered vs. unfiltered phosphate at < 2 ppm

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Monitoring Program

Focus on critical key parameters

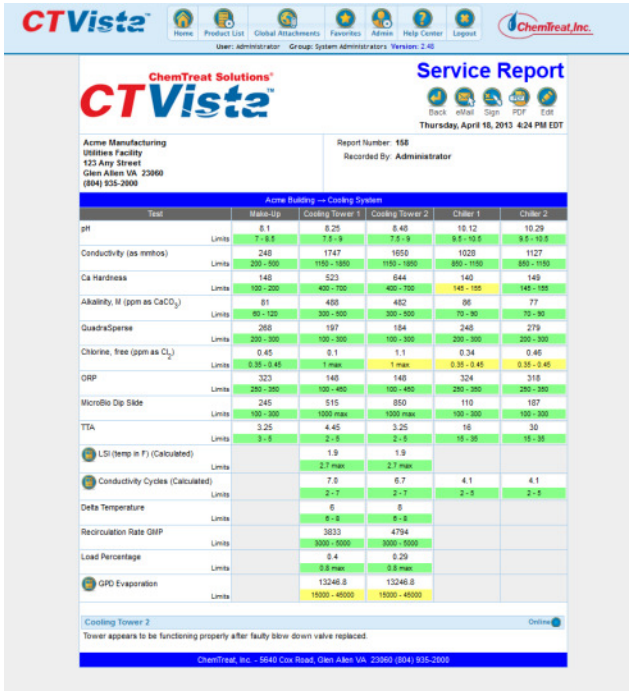
- pH, conductivity, oxidant, inhibitors
- Mass balance (flow, salts, and inventory)

Results-based monitoring

- Corrosion rates – either corrosion coupons or corrosion meters
- Temperatures and heat transfer
- Biological growth
- Appearance
- Water use and flow
- Chiller efficiency and condenser vacuum

Data management using CTVista®

- Trend graphs, statistics, reports to management



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Innovations that Support Reclaimed Water as Cooling Tower Make Up

Challenges

- Water is more corrosive due to high salinity
- Phosphate levels can be high and vary widely
- Higher levels of suspended solids can place a heavy demand on polymers
- Ammonia and organic matter create challenges for biological control with chlorine alone

ChemTreat Solutions

- Corrosion & Deposition
  - ***Flex*Pro® RZ** - Enhanced corrosion control and dispersant packages designed for difficult to treat waters
  - **P8200L** - Rare Earth Technology for phosphate removal
- Microbiological Corrosion & Fouling
  - **CD30** - Chlorine dioxide solutions or traditional bromine technology to handle biological control
- Automation and Control
  - **ChemTreat Solutions®** Data Management & Control
    - **CTVista®** - Data management
    - **CTControl™** - Controllers to maintain system performance

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Questions?

ThankYou

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Real Experts, Real Results

Contact our support staff

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