

Corrosion Control Mitigation for Recycled Water – A Case Study

By Manuel Najjar, P.E.



Photo courtesy of CCCSD

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Contra Costa County Animal Services Facility

- 35 miles east of San Francisco
- 37,000 sq. ft. facility
- Spaces for 156 dogs and 184 cats
- Specialized areas for birds and livestock
- Mall-like browsing for a pet
- Open to the public since May 2005



Photo courtesy of CCCSD

CCCSD Recycled Water Program

- CCCSD treats 45 mgd of municipal wastewater from 435,000 residents and businesses
 - Produces ~1.5 mgd of tertiary-treated water (meets CA Title 22 Standards)
 - Recycled water uses: concrete recycling plant, soil farm, golf courses, and schools
 - Animal shelter provides opportunity for increasing public awareness and educating on recycled water uses
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Recycled Water Issues

- Recycled water used for washing down pet kennels and in public restrooms
- Internal corrosion of piping and kennel wash down system is of concern to CCCSD

Question Posed:

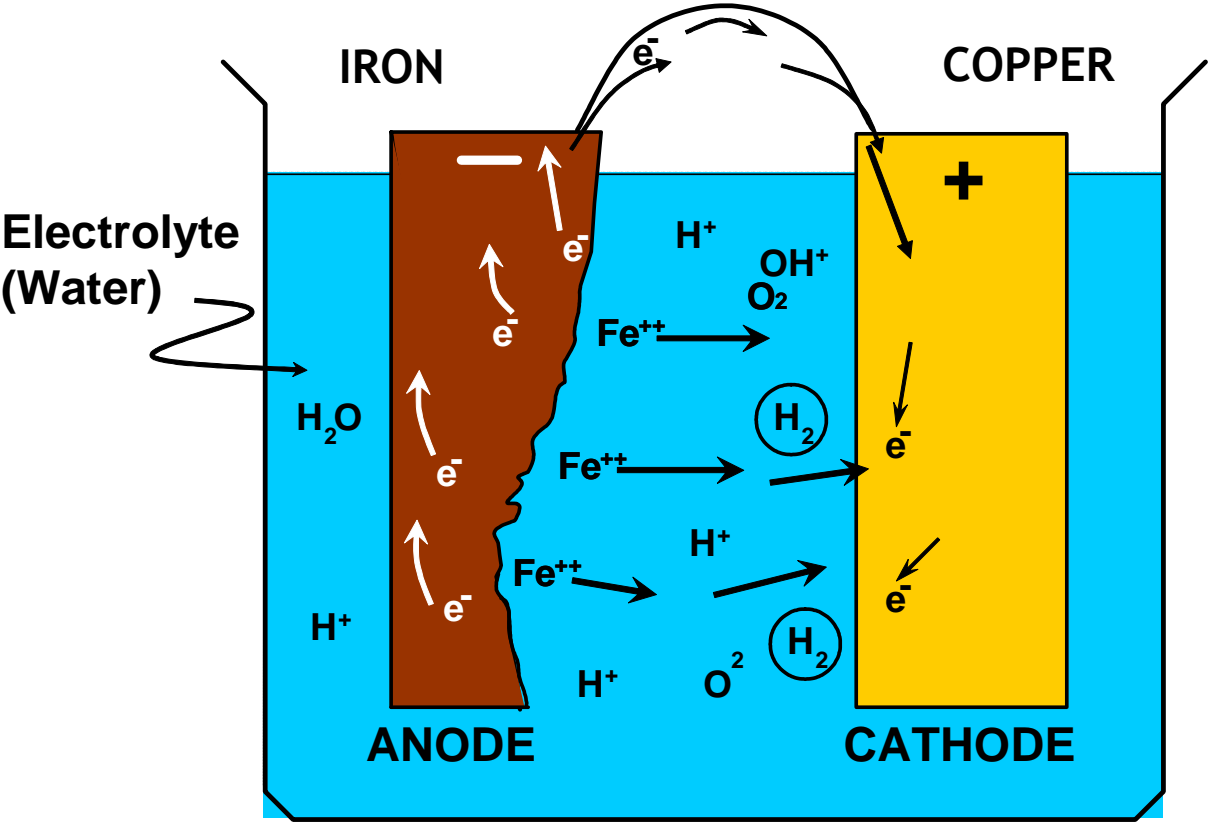
- If corrosion inhibitors are used, will they influence the effectiveness of cleaning agents?
 - What are the best piping materials to use for long term exposure to recycled water?
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Approach

- Water Data Analysis
- Review Architectural/Piping Drawings and Design
- Review MSDS for cleaning agents
- Review kennel wash down system materials of construction

Water Data Analysis

Corrosion Cell



Water Resistivity/Conductivity

- Primary indicator of corrosion potential
- Resistivity is inverse of conductivity
- The more conductive the water is, the more corrosive it can be

Resistivity (Ohm-cm)	Conductivity (μ mhos/cm)	Degree of Corrosivity
0 to 500	Above 2,000	Very High
500 to 1,000	1,000 to 2,000	High
1,000 to 2,000	500 to 1,000	Moderate
2,000 to 10,000	100 to 500	Mild
Above 10,000	Below 100	Negligible

Langelier Saturation Index

- Created in 1936 by Wilfred F. Langelier, UC Berkeley
 - $LSI = pH - pH_s$ (Ryzner Index = $2pH_s - pH$)
 - pH = measured pH in water
 - pH_s = saturation pH for $CaCO_3$
 - $LSI > 0$ = $CaCO_3$ deposits form on surfaces (Negligibly Corrosive)
 - $LSI = 0$ neutral water (**Neutral**)
 - $LSI < 0$ $CaCO_3$ does not form on surfaces (Moderately to Highly Corrosive)
 - LSI Calculation Factors Include:
 - pH
 - Calcium Hardness
 - Total Dissolved Solids
 - Total Alkalinity (Methyl Orange Alkalinity)
 - Temperature
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- Steel exposed to treated water with 1,400 $\mu\text{mhos/cm}$ (Highly Corrosive)



- Steel exposed to treated water with $LSI = +0.80$
(Negligibly Corrosive)

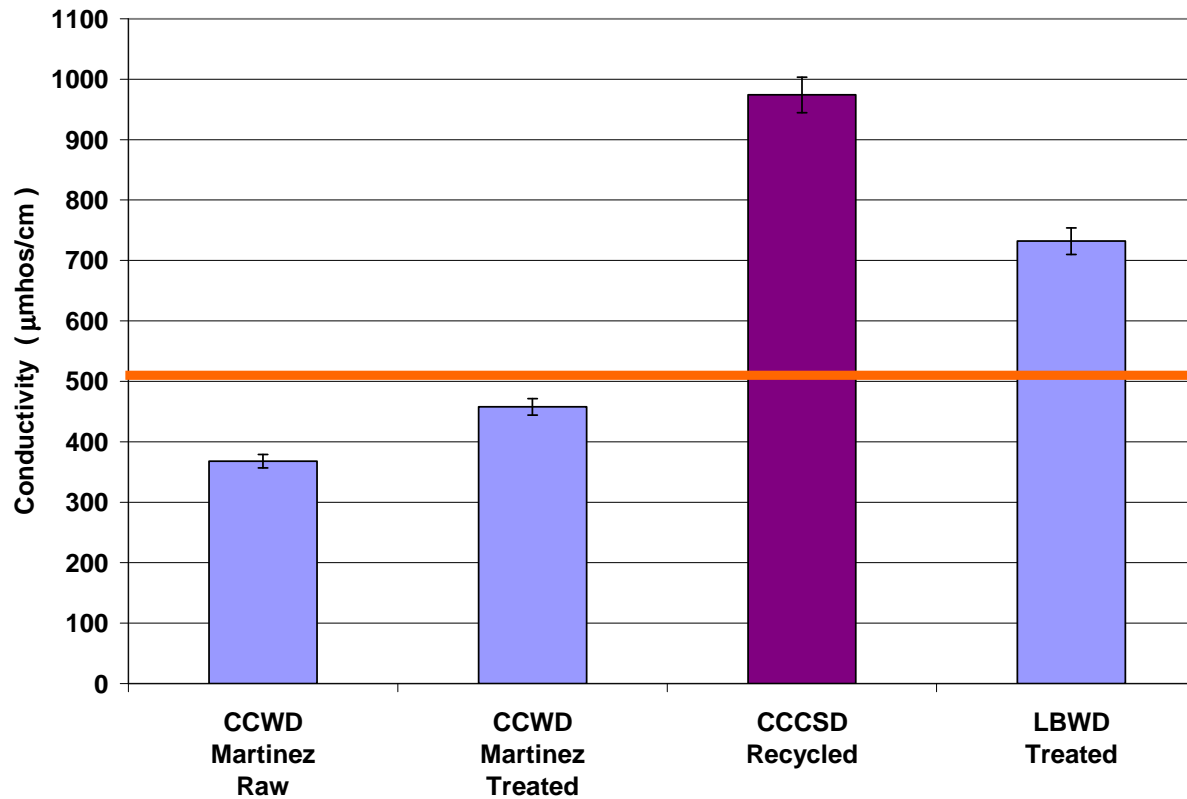


- Cement mortar lining exposed to secondary effluent
 - LSI = -1.36 (Highly Corrosive Conditions)
 - 529 $\mu\text{mhos/cm}$ (Moderately Corrosive)



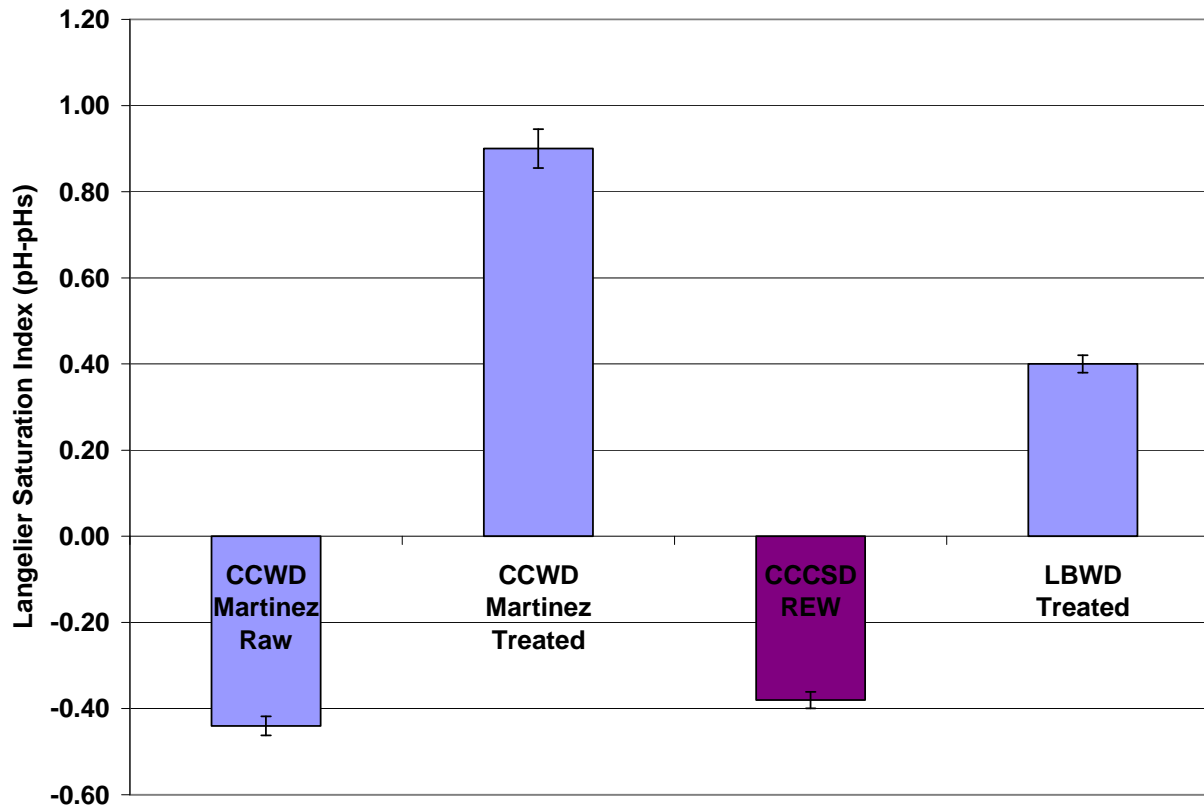
Comparing Water Quality Data

- CCCSD recycled water has the highest conductivity



Comparing Water Quality Data

- Recycled water has a negative LSI



Other Corrosive Constituents

- Average Concentration of Other Corrosive Constituents from June 2001 to October 2001
 - Chlorides = 121 ppm
 - Sulfates = 129 ppm
 - Nitrates = 0.50 ppm
 - Nitrites = 0.44 ppm
 - Ammonia Nitrogen = 20 ppm
 - Bicarbonate Alkalinity = 221 ppm
- All factors are negligibly corrosive

Kennel Wash Down System

- Uses recycled water to wash down kennels
- Disinfectants and deodorizers can be added to the rinse stream
- Manufactured with:
 - Brass
 - 304 Stainless Steel
 - Ceramic
 - Viton
 - Copper



Actions

Piping Modifications

- Installed Type K copper piping instead of Type L (86% more pipe wall thickness)
- County Approval
- Plumbing design same as a potable water system



Water Treatment System

- Installed a corrosion inhibitor system to apply a protective coating on the interior pipe walls
- Sodium silicate (pH = 7 – 9)



Photo courtesy of CCCSD

Review of Chemical Products

- Deodorizers, disinfectants, cleaning solutions, and granular absorbents used
- Reviewed MSDS sheets
 - Incompatibility
 - Active ingredients
 - pH
- Determined that sodium silicate inhibitor was **not** reactive with the chemicals

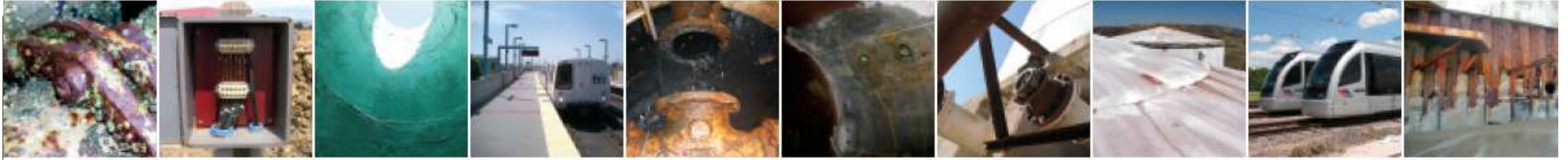
Conclusions

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- With proper corrosion control, recycled water has many uses and is cost effective
 - Open since May 2005 and no corrosion-related leaks reported to date
 - CCCSD exploring possibility of providing recycled water for industrial cooling towers at refineries

Acknowledgements:

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CCCSD Recycled Water Program**





Q & C