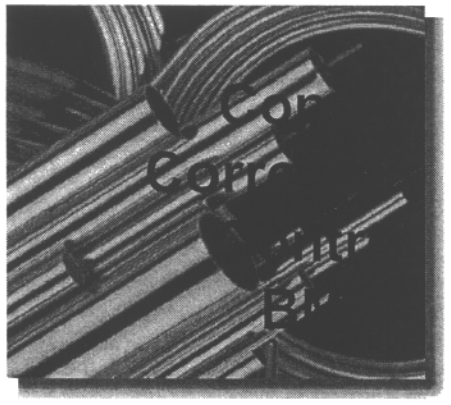


Palo Alto RWQCP
Copper Corrosion Control BMPs

Prepared by
Thomas Barron, PE
Civil Engineer
3351 Beechwood Drive
Lafayette, CA 94549
(925) 283-8121 • FAX 283-6746
tsbarron@attglobal.net

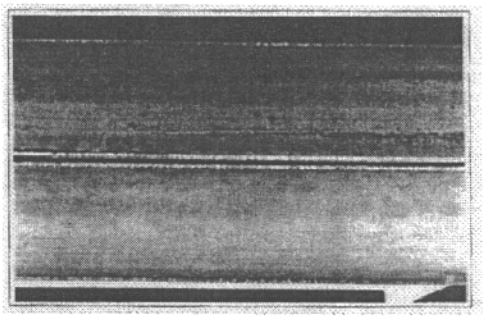
Acknowledgement is given to the many businesses, individuals, and organizations that provided technical information and photos for this presentation.

August 2001

Copper Pipe Corrosion

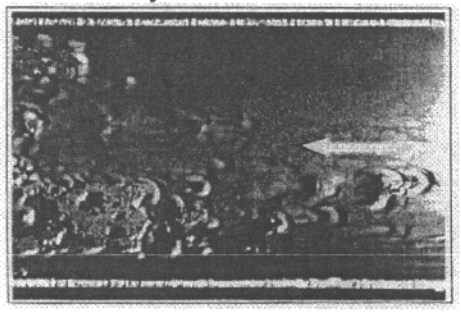
- Importance of the Issue
- Causes of Corrosion
- How To Control It
  - Manufacturing
  - Design
  - Installation
  - Operation
- RWQCP Corrosion Control Guidelines
- Where to get more info

Uniform Corrosion



Source: R. Lewis <http://www.wssc.dst.md.us>

Physical Erosion



http://www.wssc.dst.md.us/

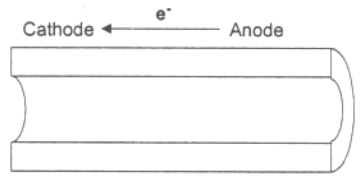
Importance

- **Plumbing System Life** = 30+ Years
  - Pipe Thickness = 0.032 to 0.065 inch
  - Corrosion = 0.0003 to 0.001 inch/year
- **Environmental Impacts** (RWQCP)
  - Pipe Corrosion = 355 lbs/yr of Copper
  - RWQCP Effluent = 600 lbs/yr
  - Total Including Creeks = 2,100 lbs/yr

Corrosion

- **How Corrosion Occurs**
  Physical & Chemical
- **Physical Factors**
  Flow Velocity & Temperature
- **Chemical Factors**
  pH / Alkalinity / Oxygen / Chlorine / TDS
  Hardness / Chloride Ions / Organics

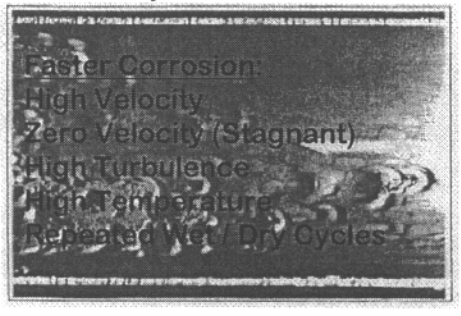
How Corrosion Occurs



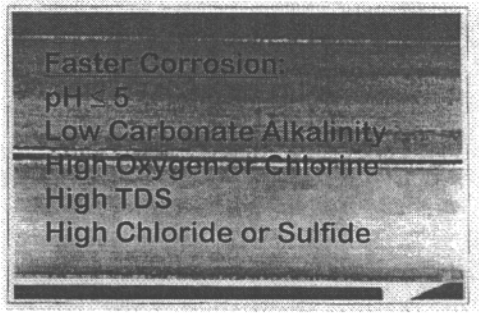
$2H^+ + 2e^- = H_2$

$Cu^0 - 2e^- = Cu^{++} + 2e^-$

Physical Factors



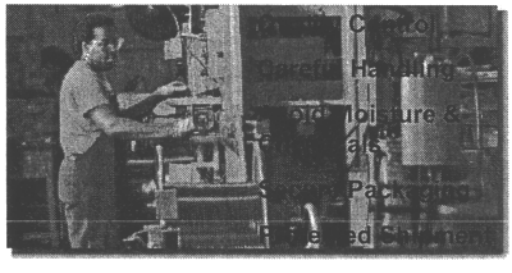
Chemical Factors



Corrosion Controls - Important At Every Step

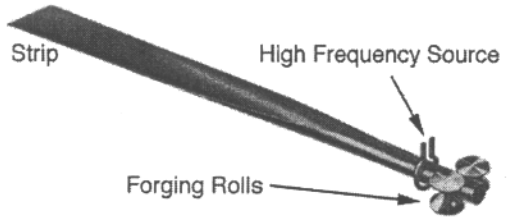
- **Manufacturing & Shipment**
- **Piping System Design**
- **Installation**
- **Operation**

Corrosion Controls - Manufacturing



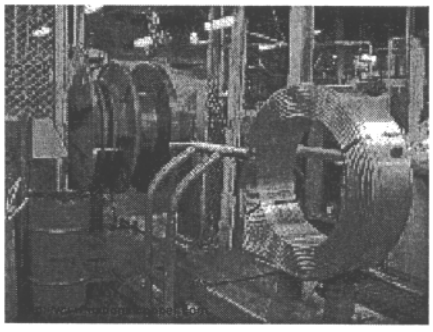
http://www.nationaltube.com

How Tubing Is Made



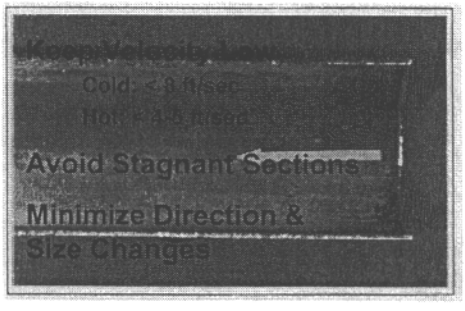
http://www.olinbrass.com

Careful Handling Is Important



Corrosion Controls - Design

Size & Orientation

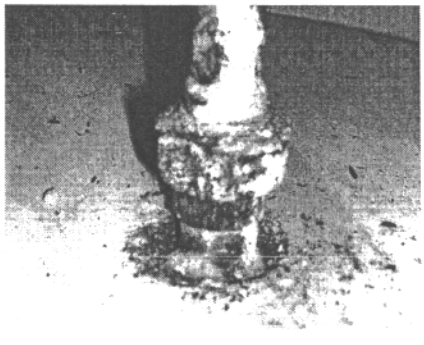


http://www.wssc.dst.md.us/

Fittings & Supports

- Use Compatible Materials
  - Specify Copper or Brass Straps
  - Specify Insulating Unions
- Avoid Induced Stresses
  - Provide Enough Support
  - Allow Thermal Expansion

Incompatible Materials



Maintainability

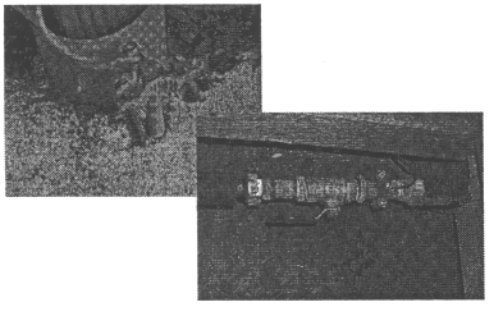
- Integrity vs. Ease of Disassembly
- BMP: Provide Pipe Union Joints
  - At Equipment
  - At End of Long Runs
- BMP: Specify Equipment That Can Be Repaired In Place

Stray Electrical Currents

- A/C Typically Not A Problem
- More D/C Devices Being Used Today
  - Hair Dryers
  - Computers
  - Battery Chargers
- Currents Affect Outside Of Pipe More

BMP: Use Grounding Rods

Good vs. Poor Grounding



Corrosion Controls - Installation

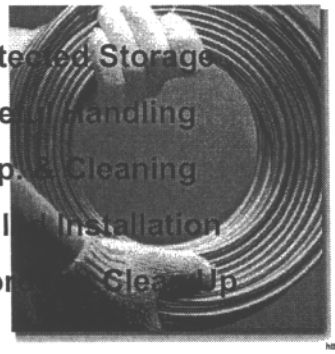
Protected Storage

Care[illegible]Handling

Prep[illegible]Cleaning

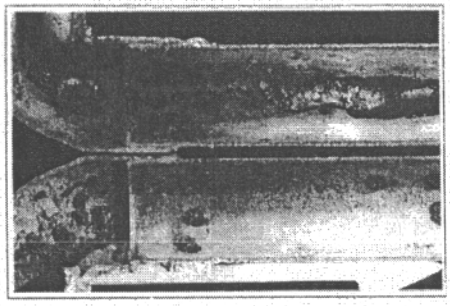
Skill[illegible]Installation

Thor[illegible]Clean Up



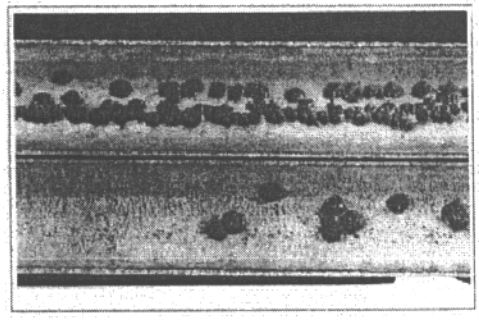
http://www.nationaltube.com

Excess Flux Deposits



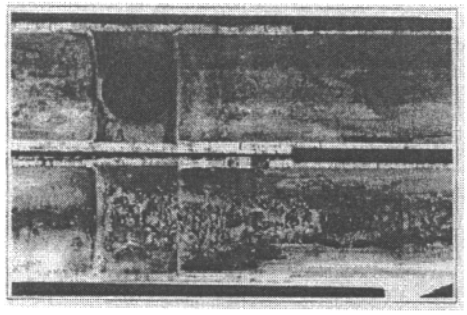
Source: R. Lewis <http://www.wsac.dat.md.us>

Downstream Corrosion



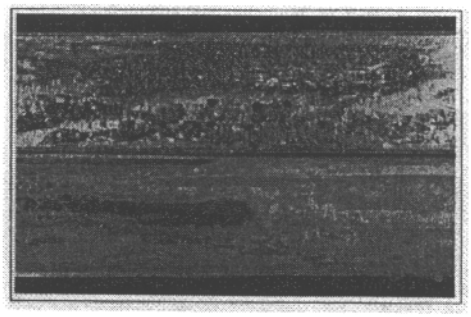
http://www.wsac.dat.md.us/

Solder Defects



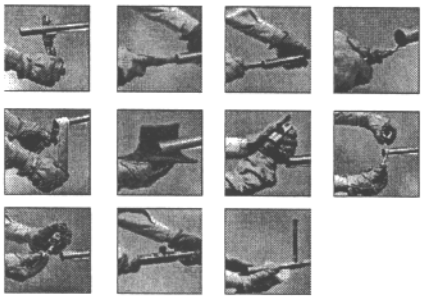
http://www.wssc.dst.md.us/

Pitting Under Flux



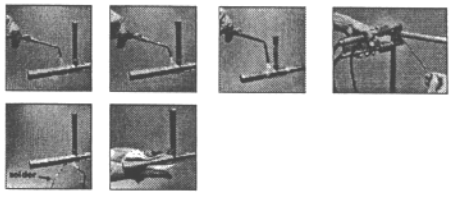
http://www.wssc.dst.md.us/

Skilled Prep. & Cleaning



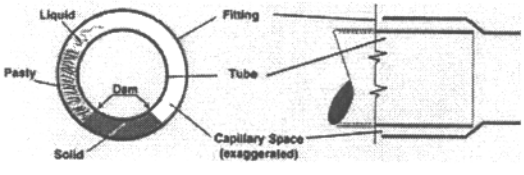
Source: CDA <http://tubebookcopper.org>

Skilled Installation & Clean-Up



http://tubebookcopper.org

Pipe Joint Details



http://tubebookcopper.org

Corrosion Control - Operations

- Flow & Temperature Management
- Line Flushing
- Corrosion Inhibitors
- Disinfectants (Chlorination)
- Corrosion Monitoring

Flow & Temp. Management

- Keep Flow Rates Within Design Limits
- Flush Stagnant Lines Monthly
- Set Temperatures 120 F

Corrosion Inhibitors

- Adjust pH to 6.5 - 7.5
- Add Orthophosphate to 1 - 3 mg/l
- Decrease TDS (Decrease Conductivity)

Disinfectants (Chlorination)

- Use Automated System
- Dose 2.0 mg/l of Chlorine Residual
- Operate Intermittently (4 hours/day)
- Have Vendor Inspect Regularly

Corrosion Monitoring

- Visual Inspections
- Water Sampling
- Corrosion Coupons
- Pipe Sectioning

RWQCP BMPs

- Contents
- Publication Plans
- Coordination With Other Agencies
- BAPPG Project in 2002-2003

More Information

- http://tubebook.copper.org
- http://www.sweets.com
- http://www.nace.org
- http://www.awwa.org
- http://www.wssc.dst.md.us

Acknowledgements

This effort started with the 1996 edition of "Guidelines for Plumbers", and then obtained recent technical reports, comments, and input from Robert Ryder (Kennedy/Jenks), Stephanie Hughes (Palo Alto), Richard Lewis (Consultant to MSSC), and the Copper Development Association. Photographs from these sources and various copper tube manufacturers are used here by permission.

August 2001