Corrosion Control Training Objectives

To gain an understanding of:

- Corrosion control vocabulary
- The factors affecting corrosion
- Methods used to control corrosion

Corrosion Control Vocabulary

**Alkalinity**

The capacity of water to neutralize acids. This is caused by carbonate, bicarbonate, hydroxide, borate, silicate and phosphate.
Corrosion Control Vocabulary

**Anode**
The positive pole or electrode of an electrolytic system, such as a battery. The anode attracts negatively charged particles or ions. (anions)

**Cathode**
The negative pole or electrode of an electrolytic cell or system. The cathode attracts positively charged particles or ions. (cations)

**Cathodic Protection**
An electrical system for the prevention of rust, corrosion and pitting of metal surfaces which are in contact with water or soil.
**Corrosion Control Vocabulary**

**Corrosion**
The gradual decomposition or destruction of a material by chemical action, often due to an electrochemical reaction.

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**Hardness**
A characteristic of water caused mainly by the salts of calcium and magnesium.

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**Langelier Index**
An index reflecting the equilibrium pH of a water sample with respect to calcium and alkalinity.
Corrosion Control Vocabulary

**Sacrificial Anode**
An easily corroded material, deliberately installed in a pipe or tank. The intent is to sacrifice this anode to corrosion, while the water supply facilities remain relatively corrosion free.

Corrosion Control Vocabulary

**Stray Current Corrosion**
A corrosion activity resulting from stray electrical current originating from some source outside the plumbing system.

Factors Affecting Corrosion

- Electrical
- Chemical
- Physical
- Biological
Factors Affecting Corrosion

**Electrical:**
Corrosion is an electrical process with the transfer of electrons.

Cathode Anode

The iron pipe will corrode

**Chemical:**
- Alkalinity
- pH
- Dissolved oxygen
- Dissolved solids
- Hardness
- Chloride and Sulfate
- Phosphate and Silicate

**Physical:**
- System construction
- System pressure
- Soil moisture
- Temperature
- Flow velocity (> 5 ft/sec erodes away calcium carbonate on pipe wall)
- Stray electrical current
Factors Affecting Corrosion

**Biological:**
- Iron Bacteria
- Sulfate-Reducing Bacteria

Galvanic Series Chart

<table>
<thead>
<tr>
<th>Most Active</th>
<th>Galvanic Series</th>
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<tbody>
<tr>
<td>Anode</td>
<td>Magnesium</td>
</tr>
<tr>
<td></td>
<td>Zinc</td>
</tr>
<tr>
<td></td>
<td>Aluminum</td>
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<td>Cast Iron</td>
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<td>Nickel</td>
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<td>Copper</td>
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<td></td>
<td>Stainless Steel</td>
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<td></td>
<td>Silver</td>
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<td></td>
<td>Graphite</td>
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<td>Gold</td>
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</tbody>
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Corrosion Control Tools

**Calcium Carbonate Saturation**
Water is considered stable when it is just saturated with calcium carbonate. In this condition, it will neither dissolve nor deposit calcium carbonate. There are two ways to determine calcium carbonate saturation. The **Marble Test** and the **Langelier Index**.

Langelier Index (L.I.)

\[
\text{Langelier Index} = \text{pH} - \text{pH}_s
\]

\[
\text{pH}_s = \text{pH at which water having the same alkalinity and calcium content is just saturated with calcium carbonate.}
\]
Corrosion Control Tools

Factors Affecting the L.I.

Langelier Index = pH - pH_s

- Temperature
- pH
- TDS
- Ca
- Alkalinity

Positive L.I. = Deposit
Negative L.I. = Dissolve
Zero L.I. = Neither

Chemical Treatment

Chemicals can be added to the system to inhibit corrosion. They form a protective layer over system surfaces.

Chemicals used:
- Orthophosphates – primarily used to control lead.
  - Optimal pH range is 7.2–7.8
  - Residual must be maintained in system.
- Silicates – used in small systems with iron and manganese problems.

Chemical Treatment

Corrosion inhibitor side effects:
- Phosphate-based inhibitors may encourage slime growth, creating a chlorine demand (reduce residual).
- Zinc Orthophosphate may cause problems for wastewater treatment plants with zinc or phosphate limits in their NPDES permits.
- Silicates may reduce the life of water heaters because of "glassification." (Silicates precipitate at higher temps.)
Review the lecture handout and then complete the quiz. This will help you remember the information we just covered.