The Impact of Oxidizers on Corrosion

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After this Discussion

- Identify Oxidizers
- Measure Oxidizers
  - DPD
  - ORP
- Understand methods for controlling corrosion
“Oxidizer: element or compound in an oxidation-reduction (redox) reaction that accepts an electron from another species”

–www.Wikipedia.org
Oxidizers Used in Industrial Waters

- Biocides
  - Drinking Water Disinfection
  - Biofilm Prevention
  - Preservation
- Bleaching Agents
- Manganese and Iron Scavengers
- Odor Control Agents
The Perfect Biocide

Effective
Cheap
Compatible w Process
Compatible w Metals
Safe

No
1
2
3
4
5
Yes
The Perfect Biocide – Oxidizers?

- Effective: Yes
- Cheap: Yes
- Compatible w Process: Yes
- Compatible w Metals: No
- Safe: No
Quite Popular
Identifying Oxidizers
# What’s in a Name?

<table>
<thead>
<tr>
<th>“Chloro”</th>
<th>“Bromo”</th>
<th>“Per”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine Gas</td>
<td>Bromine</td>
<td>Hydrogen Peroxide</td>
</tr>
<tr>
<td>Sodium</td>
<td>Hypobromous Acid</td>
<td>Per Acids</td>
</tr>
<tr>
<td>Hypochlorite</td>
<td>Bromohydantoin</td>
<td></td>
</tr>
<tr>
<td>Hypochlorous Acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorine Dioxide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloramine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorohydantoin</td>
<td></td>
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</tr>
</tbody>
</table>
... but how do you differentiate?
The DPD Test

- DPD Turns Pink in Presence of Oxidizer
- “Free” and “Total”
DPD Reaction with Time

0.0 ppm  0.5 ppm  1.0 ppm  1.5 ppm
Free and Total DPD

Concentration

Time

“Free”

“Combined”

“Total”

?
“Free Chlorine” and “Total Chlorine” are misnamed

Many Interferences
- Turbidity
- Metals
- Air
Oxidation Reduction Potential

- “ORP” or “Redox”
- Reads mV
- More + = More Ox
- Be Aware
  - Influence of pH
  - Ability to detect peroxide
Impact of Peroxide Level on Corrosion

The graph shows the impact of peroxide level on corrosion (mpy cast iron). The x-axis represents different points, and the y-axis shows peroxide levels (ppm) and ORP (mV). The graph illustrates how peroxide levels correlate with corrosion rates at various points.
ORP

ORP (mV) vs. Biocide Residual (ppm as Total Chlorine)

- Free Chlorine
- Dichloramine
- Monochloramine
Recommended Oxidizer Levels

- Strong Oxidizers (Free DPD test)
- Combined Oxidizers (Total DPD test)
- Peroxide
Controlling Corrosion from Oxidizers

- Follow Best Practices and Do Not Overfeed
- Measure Corrosion
- Be Aware of Changing Process Conditions
- Avoid “Mixing” Oxidizers
- Quench If Needed
Final Thoughts

- Oxidizers are used for their efficiency and cost
- Biofilm is quite corrosive
- Reductive environments can also be quite corrosive
- Proper monitoring and control of oxidizer feed is critical
- Which oxidizer is most corrosive?