CorrShield OR4407

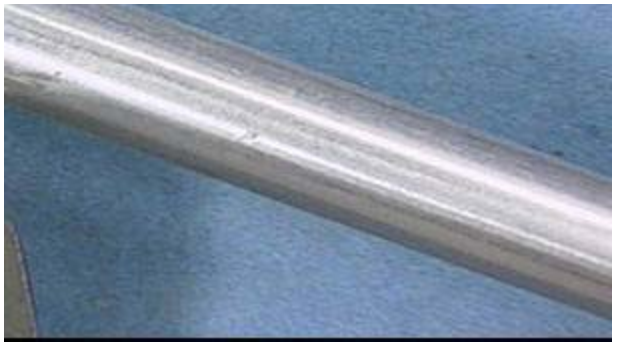
A Novel Organic Corrosion Inhibitor Program for Mixed Metallurgy Closed Systems

GE
Water & Process Technologies

imagination at work

Traditional Approaches

- Nitrite
- Molybdate
- Molybdate Nitrite blends
- Oxygen scavenger +/- polymer
- “Organic Inhibitors”



Molybdate Nitrite taken as the benchmark for performance / results

Molybdate – Nitrite Concerns

- Environmental – Restricted / banned in certain parts of the world / certain Local Authorities
- Cost – Molybdate
  - Demand for steel production
  - Closure of mines

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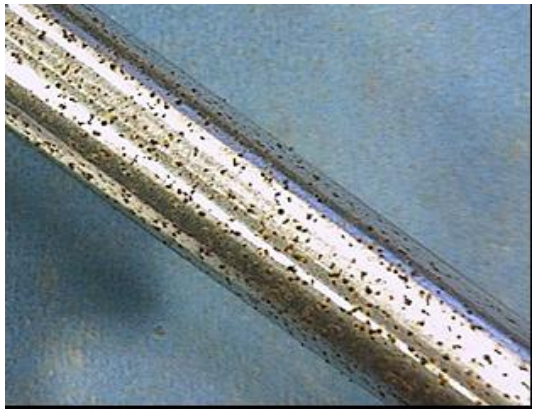
“Organic Inhibitors” Concerns

- Oxygen scavenger – Efficacy at < 60°C ?
- Phosphonates, Phosphonate / Triazine
  - Good results in “clean systems”
  - Loss of phosphonate in “dirty” (Fe_2O_3) systems
    - Loss of inhibitor
    - Production of acidic compounds



A New **ORGANIC** Closed System Inhibitor

New Technology **PDT**

Polyphosphonate

Dibasic acid

Tertiary amine

+

Polymer

Azole

How does the new technology work?

PDT creates a thin film on mild steel surfaces

- Film is less than 70 Å thick
- Stable metallic oxide film
- Passive and protective
- Formed by unique molecular interactions of the inhibitors and iron
- Maintained by dynamic equilibrium between the film and inhibitors in solution

Treatment Guidelines?

Inhibitor Concentration	3000 – 4000 ppm
pH	7.0 – 8.5
Calcium	< 250 ppm $CaCO_3$
Chloride	< 200 ppm Cl
Sulfate	< 500 ppm SO_4

pH 7.0 to 8.5

- **Formulation is strongly buffered**
- In demin water
  - 3000 ppm conductivity 430 pH 8.0
  - 4000 ppm conductivity 560 pH 8.0

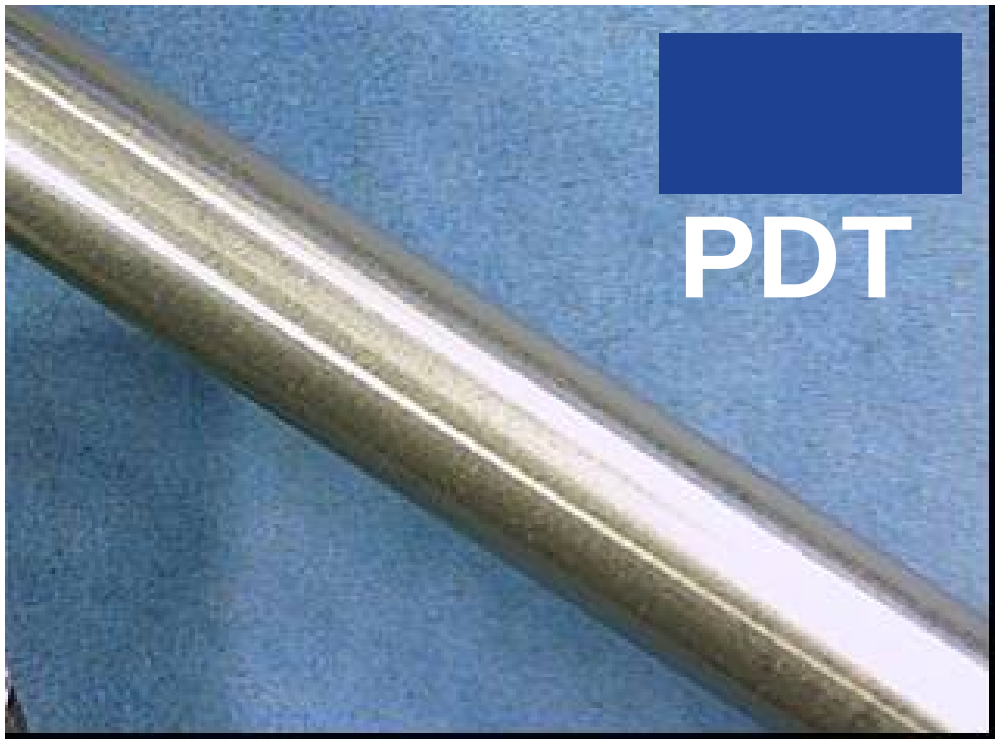
Ideal for corrosion inhibition of aluminum

Calcium

< 250 ppm $CaCO_3$

No deposition on heat transfer surfaces with 300 ppm $CaCO_3$ at 80˚C (176˚F)

Results?



Experimental Results

Waters tested

	ppm $CaCO_3$							
	Ca	Mg	M alk	SO_4	Cl	SiO_2	Soluble Fe	Iron Oxide ppm
A	60	20	35	24	42	4	0	0
B	60	20	35	**200**	42	4	0	0
C	**0**	20	35	**200**	51	4	0	0
D	60	20	35	**200**	42	4	**3**	0
E	60	20	35	24	42	4	**4**	**1050**

No Ca

Increased SO_4

Iron contamination

Experimental Results

Corrosion Rate on weight loss coupons

	Water A	Water B	Water C	Water D	Water E
No treatment	69.50 mpy	137.33 mpy	91.00 mpy	92.75 mpy	53.75 mpy
Molybdate Nitrite	0.05 mpy	0.20 mpy	0.05 mpy	0.13 mpy	0.07 mpy
Phosphonate Triazine	0.08 mpy	0.35 mpy	10.50 mpy	2.75 mpy	35.50 mpy
PDT	0.05 mpy	0.05 mpy	0.07 mpy	0.05 mpy	0.08 mpy

No Ca **Iron contamination**

Industrial Application Results?

Closed Cooling System (Chilled)

Steel

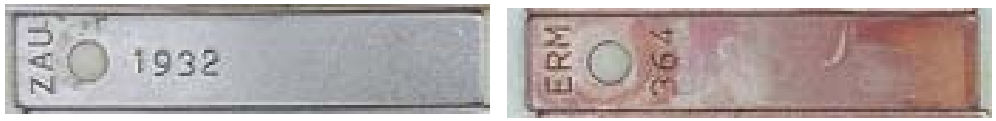
< 1 mpy
< 0.025 mm/y

Copper

< 0.1 mpy
< 0.0025 mm/y

Hot Water System (180°F)

< 1 mpy
< 0.025 mm/y



< 0.1 mpy
< 0.0025 mm/y

New Closed System Inhibitor

- No Molybdate
  - Cost benefits
  - Environmental benefits
- No Nitrite
  - Environmental benefits
- Controlled by a simple potassium test
  - Field test method available

New Closed System Inhibitor

- Does not suffer in dirty (Fe_2O_3) systems
- Mixed metallurgy inhibition – Carbon Steel, Copper Alloys, Aluminum
- Organic Closed Cooling Water treatment
- Organic Hot Water System treatment