

# **SilcoTek's Corrosion Resistant CVD Coatings**

## **Performance Data**

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# Quick Reference - Contents

- The challenge of corrosion
- Salt spray
- Corrosive immersions (HCl, H<sub>2</sub>SO<sub>4</sub>, bleach, etc.)
- Pitting and crevice corrosion
- Evaluation on carbon steel substrates
- Galvanic corrosion
- Case study

# The Challenge of Corrosion

- Aggressive process and sample media
- Harsh external environments
- Expensive maintenance and replacement
- Little room for failure

# SilcoTek's Solutions

**Dursan**®



Ceramic-like with full pH range resistance and mechanical durability

**Silcolloy**®



Excellent protection from acids, high temperatures, and oxidation



# Salt Spray (ASTM G85)

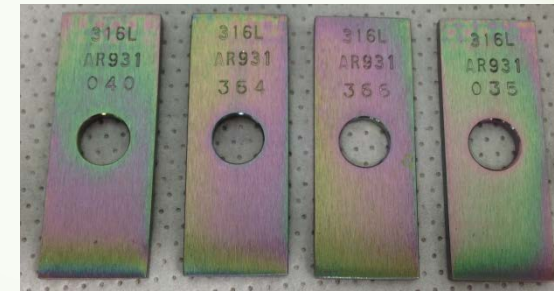
- 4,032 hours of acidified salt spray per ASTM G85-A2
  - Dursan and Silcolloy coatings are unaffected and provide excellent protection on stainless steel in a salt spray environment



Uncoated 316L



Silcolloy-coated 316L

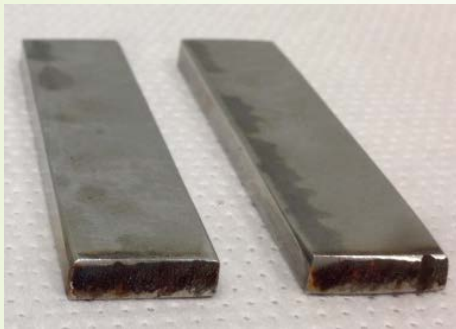


Dursan-coated 316L

# Salt Spray (ASTM G85)

(continued from previous slide)

- Dursan-coated 316L SS is completely unaffected by 168 days of acidified salt spray
  - Even corrosion resistant duplex alloy 2205 showed moderate corrosion under these conditions



Uncoated Duplex Alloy 2205



Dursan-coated 316L

# Salt Spray (ASTM G85)

- 672 hours of pH-neutral salt spray (NaCl), then 4,032 hours of acidified salt spray per ASTM G85-A2
  - Total exposure time: 4,704 hours



Uncoated 316L



Silcolloy-coated 316L



Dursan-coated 316L



# Salt Spray (ASTM G85)

(continued from previous slide)

- Dursan coating provides complete protection even after 4,704 hours of cyclic salt spray exposure
  - Silcolloy shows minimal corrosion at coupon edges



Uncoated 316L



Silcolloy-coated 316L

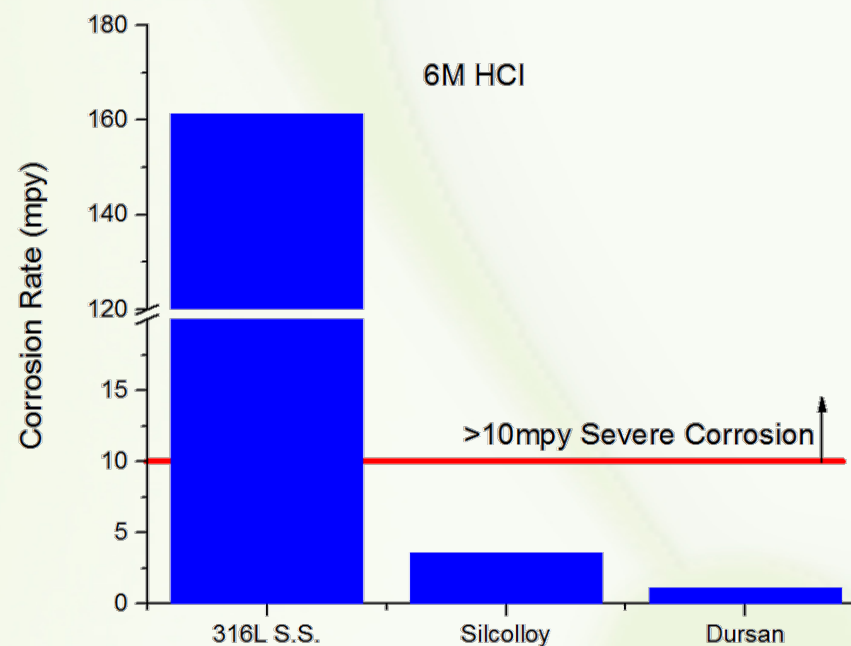


Dursan-coated 316L



# HCl

- ASTM G31 Guidelines
- 6M HCl Acid Exposure
- 24 hrs at Room Temperature

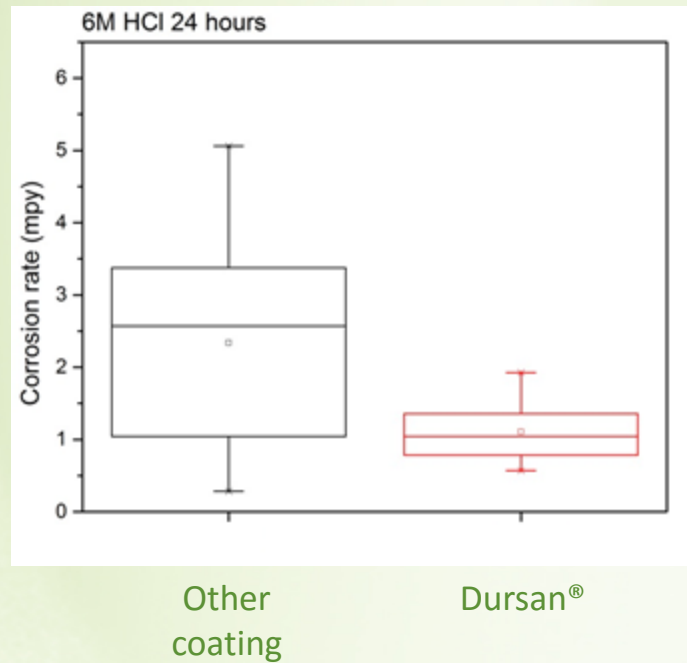


Both Dursan and Silcolloy coatings provide an excellent barrier to corrosion from HCl.

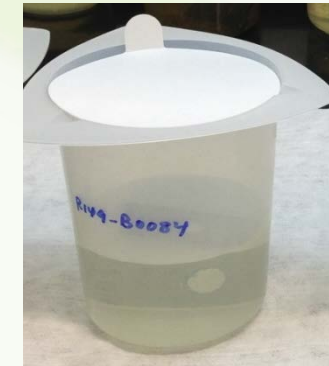
The coatings add considerable lifetime to parts in refinery and chemical manufacturing service, amongst others.

# HCl

## HCl Corrosion



Other  
Coating

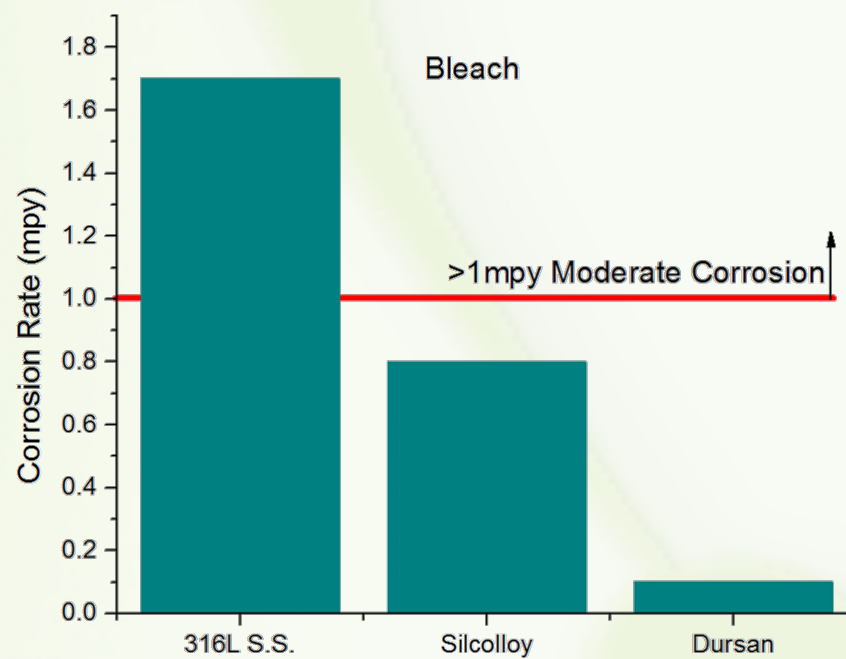


Dursan®

The solution containing Dursan-coated 316L SS shows no discoloration (corrosion) after the 24hr immersion test.

# 15% Bleach

- ASTM G31 Guidelines
- 15% NaClO Exposure
- 72 hrs at Room Temperature

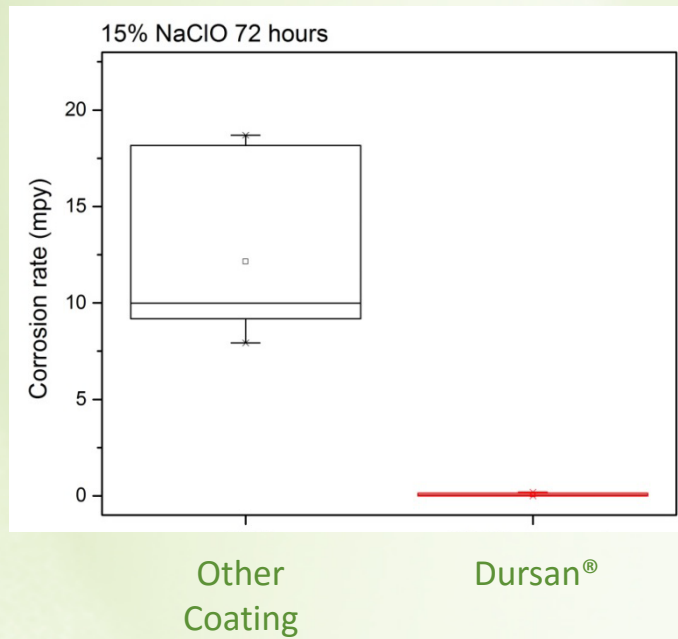


Bleach is very aggressive to stainless steel and other surface treatment, but Dursan provides stable protection.

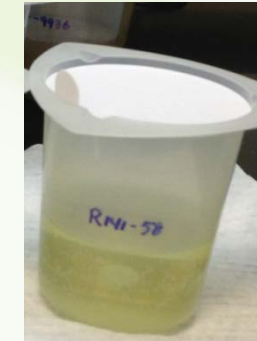
This is especially useful in biomedical and pharma applications where bleach is commonly used.

# 15% Bleach

## Bleach Corrosion



Other  
Coating

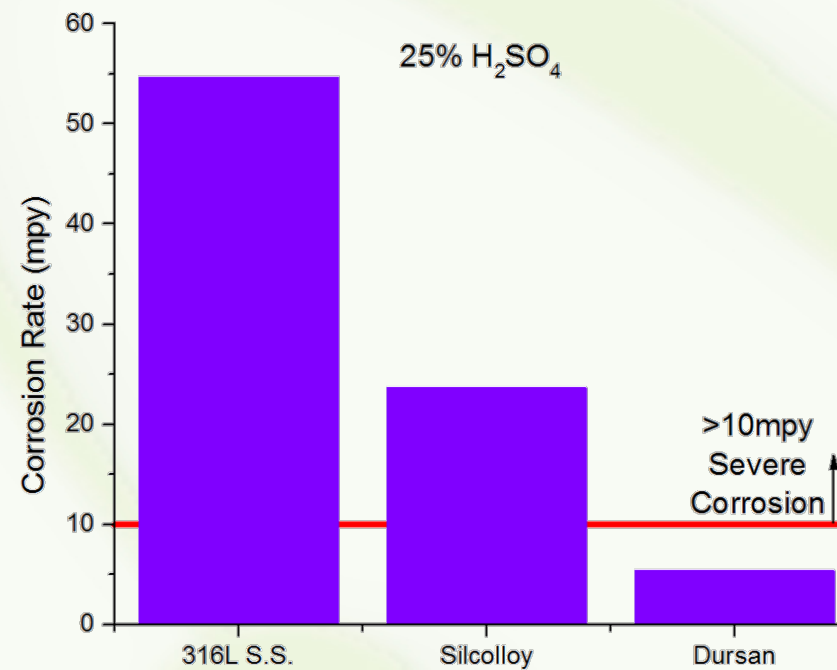
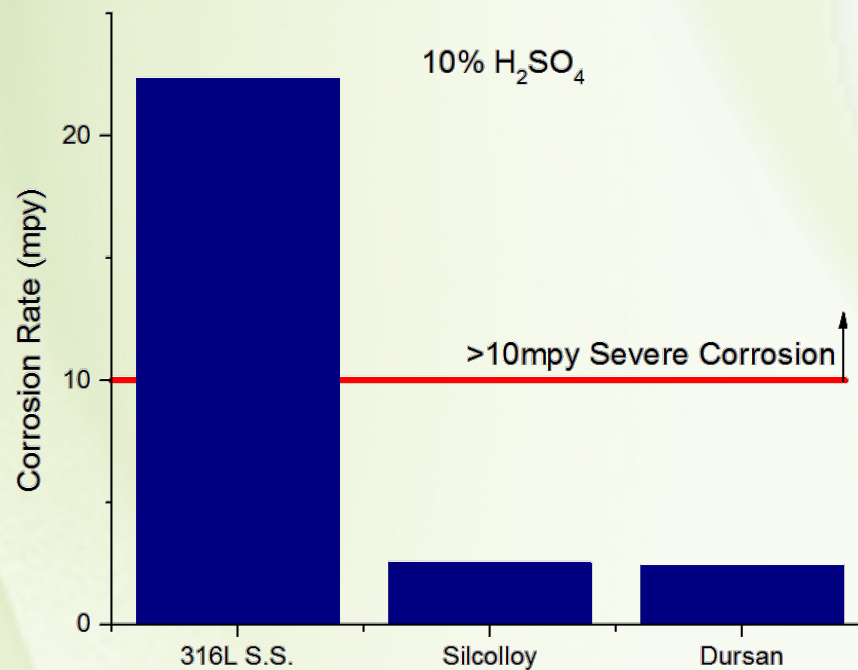


Dursan®

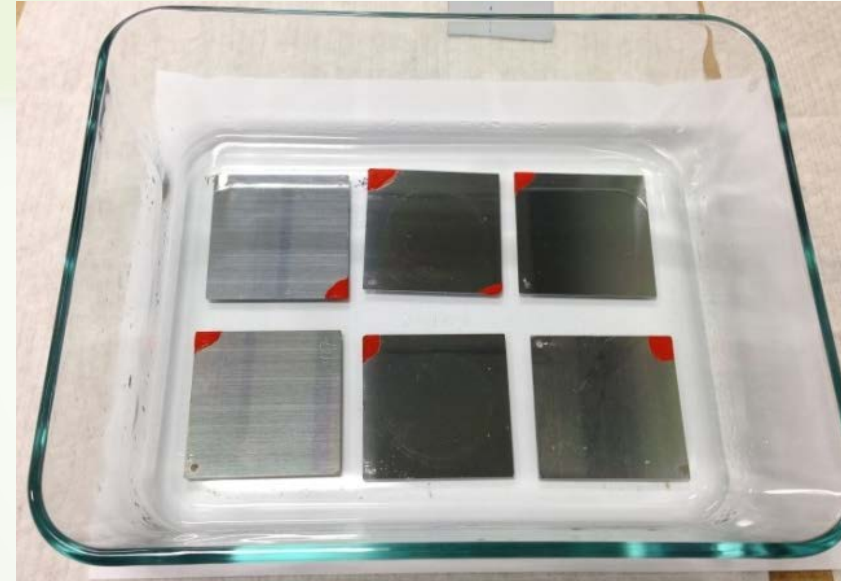
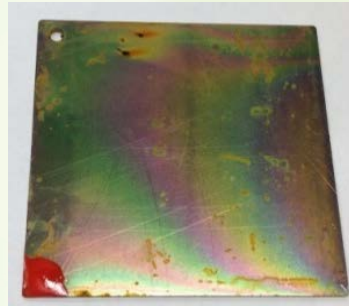
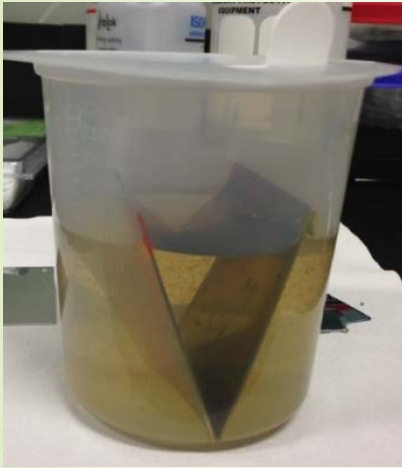


# Sulfuric Acid

- ASTM G31 Guidelines
- Sulfuric Acid Exposure
- 24 hrs at Room Temperature



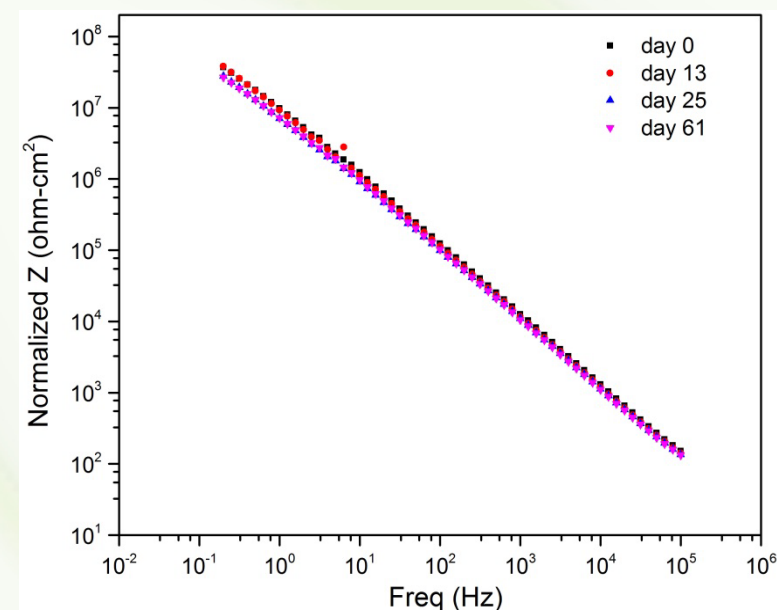
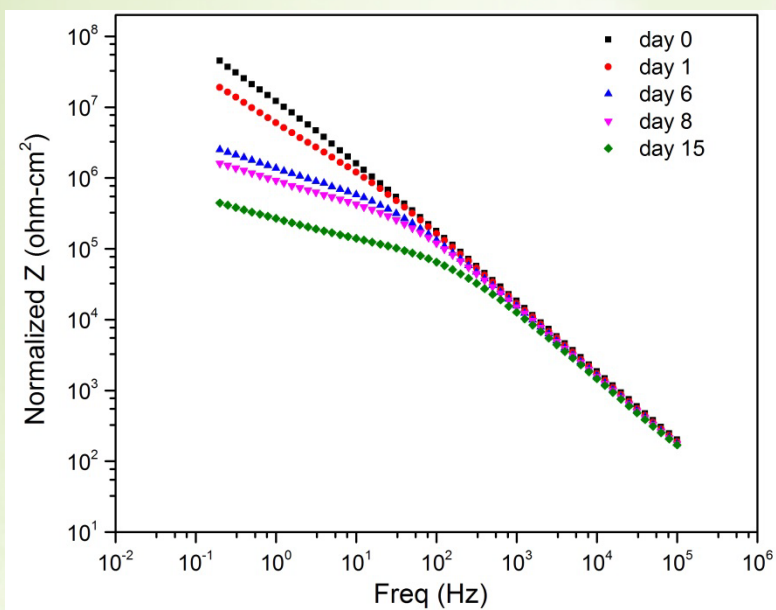
# Salt Water Immersion



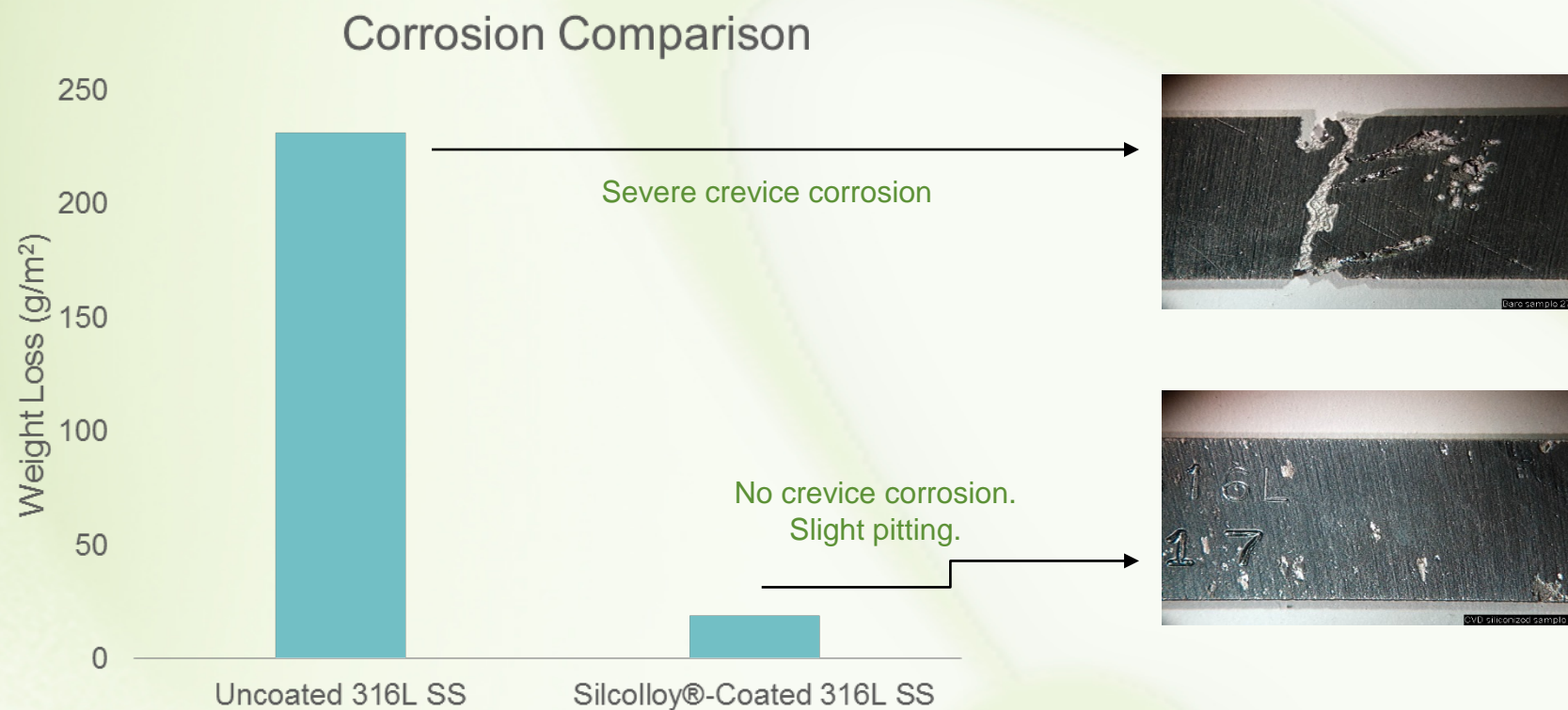
Dursan<sup>®</sup> Coating (right) shows no degradation in salt water after 60 days of exposure

# Salt Water

Dursan® Coating (right) shows excellent dielectric stability in salt water after 60 days, providing an effective corrosion barrier on the substrate.



# ASTM G48 B: Pitting and Crevice Corrosion





# Corrosion Resistance on Carbon Steel

# Carbon Steel

- SilcoTek's coating processes are optimized for stainless steel, titanium, and other performance alloys
- Carbon steel can still be coated successfully
- Coatings perform well on carbon steel for barrier/general chemical resistance applications. They do not provide corrosion resistance comparable to SilcoTek coatings on stainless steel substrates

# Material

- Three types of carbon steel corrosion coupons were tested, with increasing amount of carbon content
  - C1018 is the most commonly available of the cold-rolled steels
  - A36 is the most commonly available of the hot-rolled steels
  - C1045 is generally supplied in the hot-rolled condition

Type of steel	C1018	A36	C1045
Carbon content	0.18%	0.26%	0.45%



uncoated



SL1000-coated



Dursan-coated

# Carbon Steel –Salt Spray



# Salt spray: ASTM G85-A2

- Carbon steel type: C1018

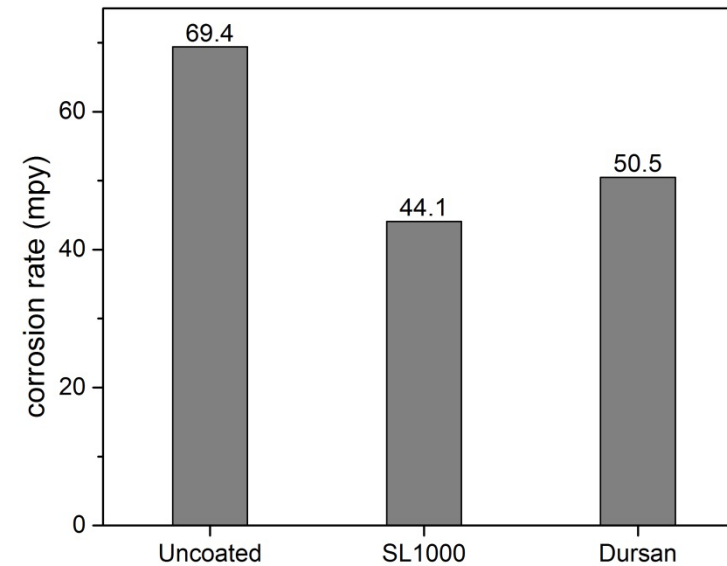
uncoated



SL1000-coated



Dursan-coated



# Salt spray: ASTM G85-A2

- Carbon steel type: A36

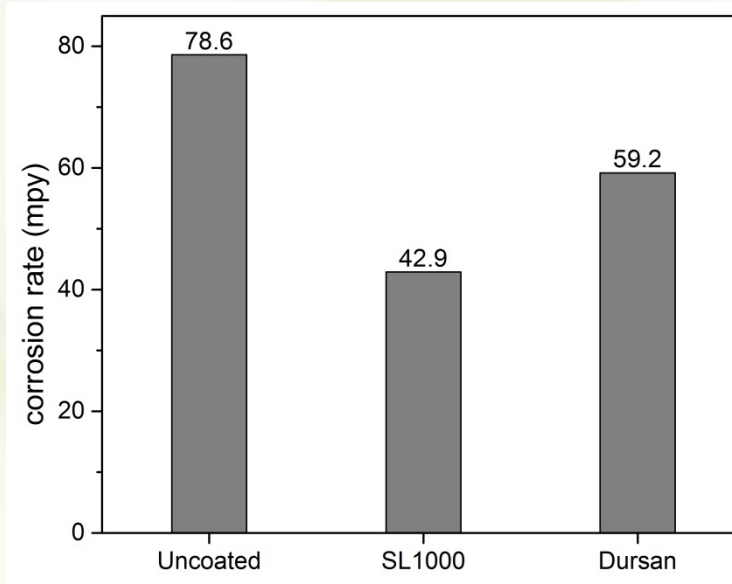
uncoated



SL1000-coated



Dursan-coated



# Salt spray: ASTM G85-A2

- Carbon steel type: C1045

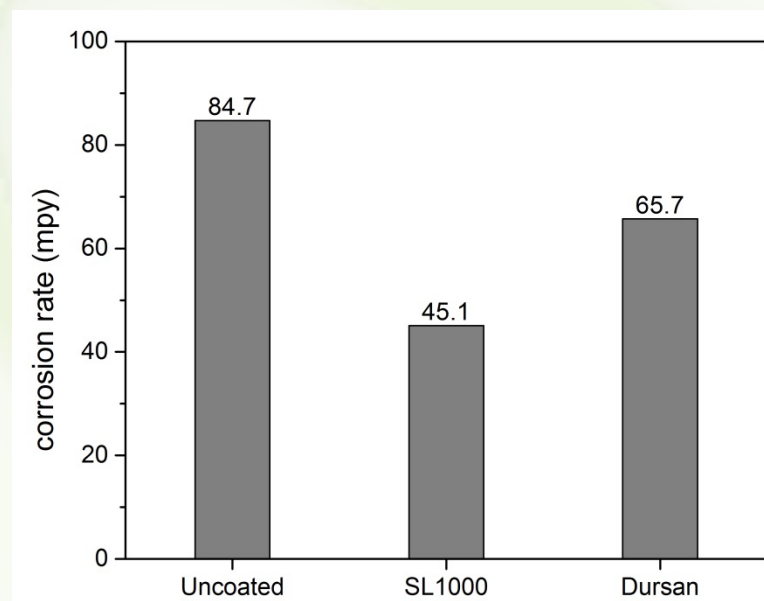
uncoated



SL1000-coated



Dursan-coated





# Carbon Steel – Salt Spray Testing

- Both coated and uncoated carbon steel coupons were severely rusted after 264 hours of exposure
- Still, SilcoTek coatings helped to reduce the corrosion rate
- Consult SilcoTek tech. service to select both the best coating and substrate for your application



# Carbon Steel - Hydrochloric Acid

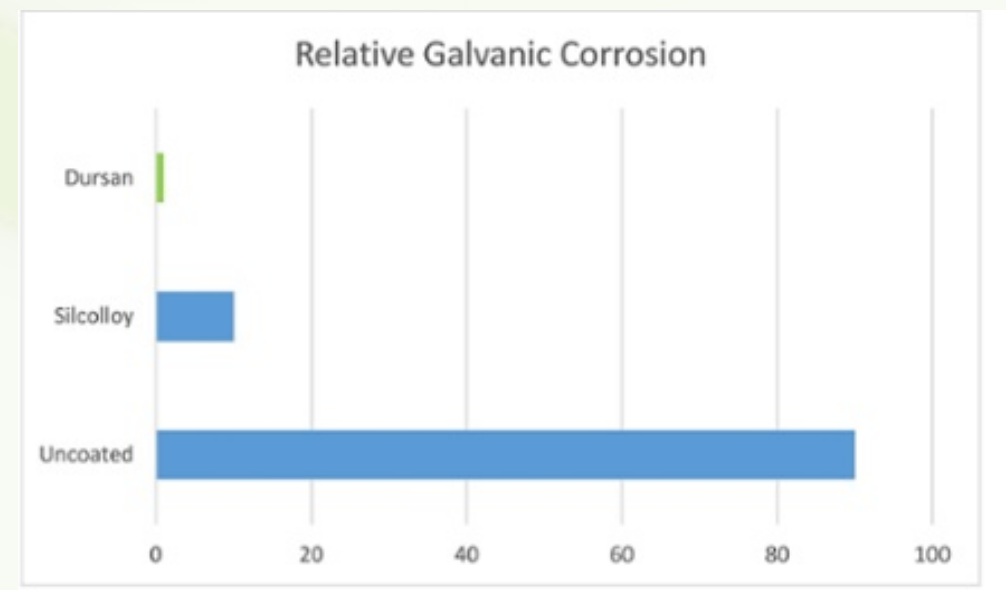
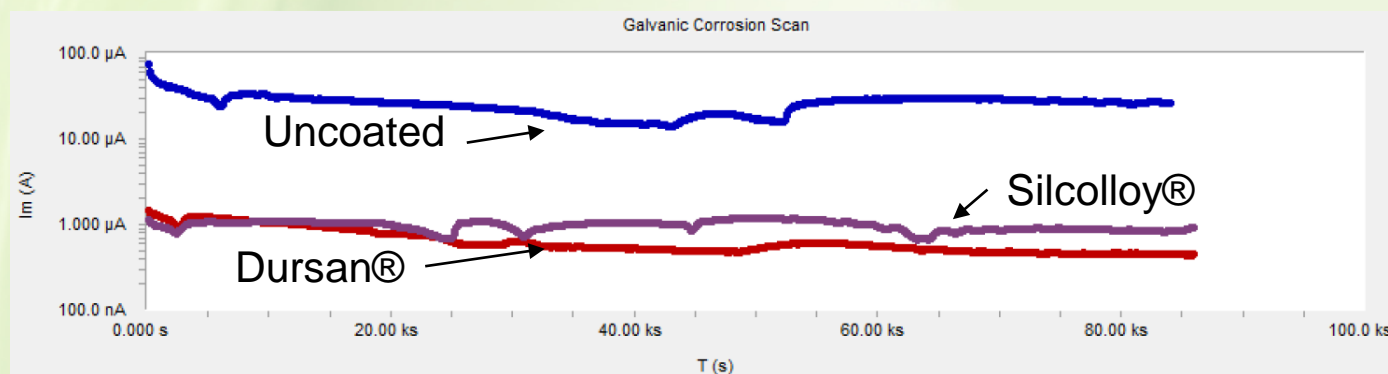
# Carbon Steel – HCl Corrosion Resistance

- SilcoTek coatings on stainless steel provide excellent protection to HCl exposure (see previous slides)
- However, the coating did not provide much benefit on carbon steel in the same tests
- **Optimizing coating and substrate selection to deliver best performance for the right cost is key**

# **Galvanic Corrosion**

## **304 SS coupled to 6061 Al**

# Galvanic Corrosion



- Both Dursan and Silcolloy noticeably minimize the effect of galvanic corrosion when coated 304SS is coupled to 6061 aluminum.
- Dursan offers drastically improved protection from galvanic corrosion over uncoated 304 SS (up to 2 orders of magnitude).



# SilcoTek Coatings as a Solution

- Cost-effective alternative to exotic metals
- Upgrade current components or easily install new, coated parts
- Advantages of CVD process: easily coats complex geometries; doesn't affect tolerances; environmentally benign

# Case Study: Turner Designs Hydrocarbon Instruments

See how [Turner Designs Hydrocarbon Instruments](#) cut costs and increased performance of their oil in water monitors by using stainless steel coated by SilcoTek's corrosion resistant surface technology instead of exotic metals.

Download the case study →



Download Now

# Contact SilcoTek

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