

Chlor\*Rid International, Inc. Soluble Salts Testing & Removal  
NACE Corpus Christi Chapter – Corpus Christi, Texas  
September 20, 2016

visualphotos.com



# Norman Petticrew

**GULF COAST MANAGER**

**CHLOR\*RID INTERNATIONAL, INC.**

- 48 years in the Marine, Petro-Chemical, & Offshore Coatings Industry
  - Application, Manufacturing, Inspection, Consulting & Sales
- **NACE CIP Level III Certification # 850**
- **SSPC: the Society for Protective Coatings**
  - Chairman Gulf Coast Chapter 2014 – 2015

That's all I've got to say about that!



DOES THIS LOOK FAMILIAR?

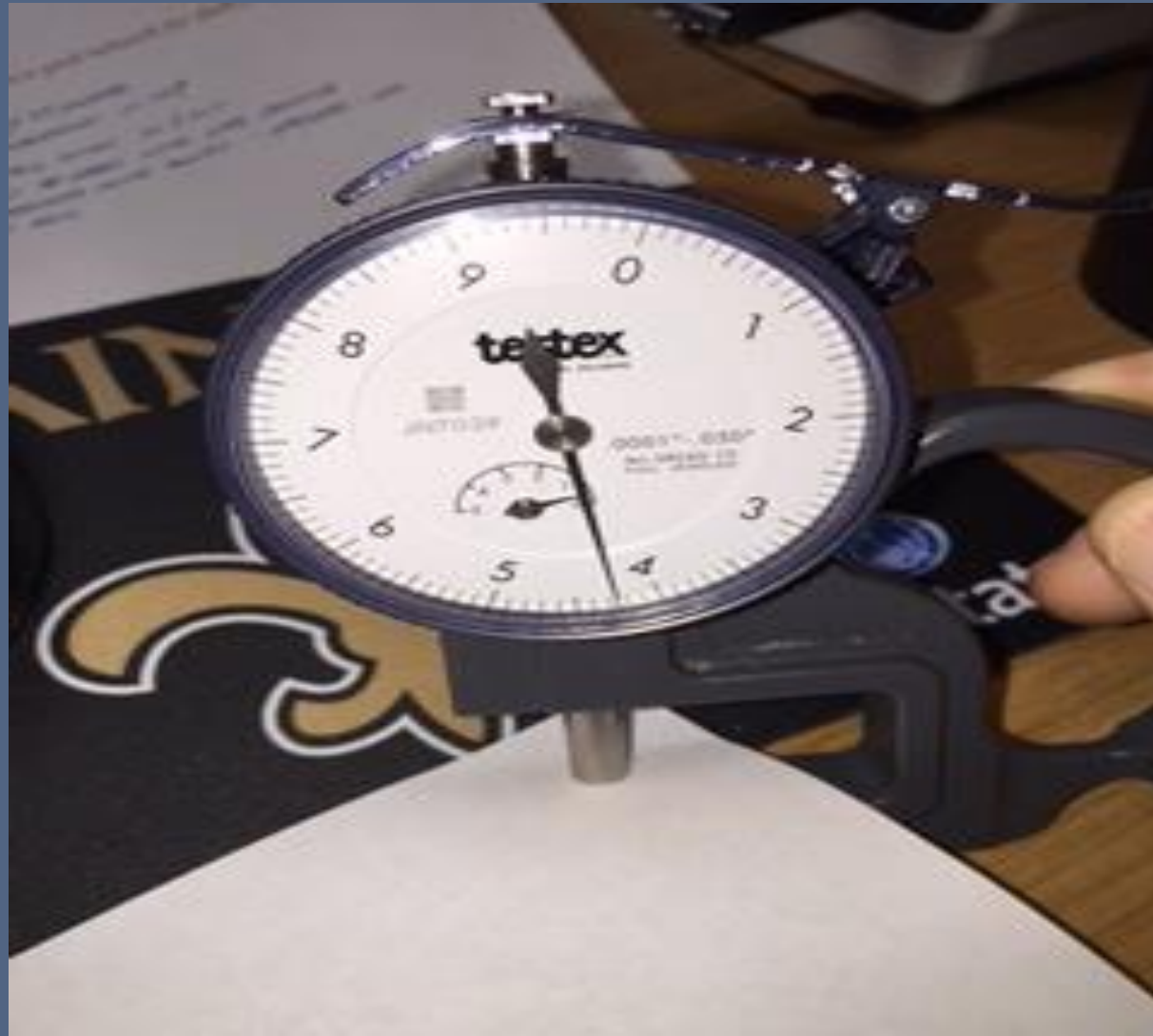


OR THIS?



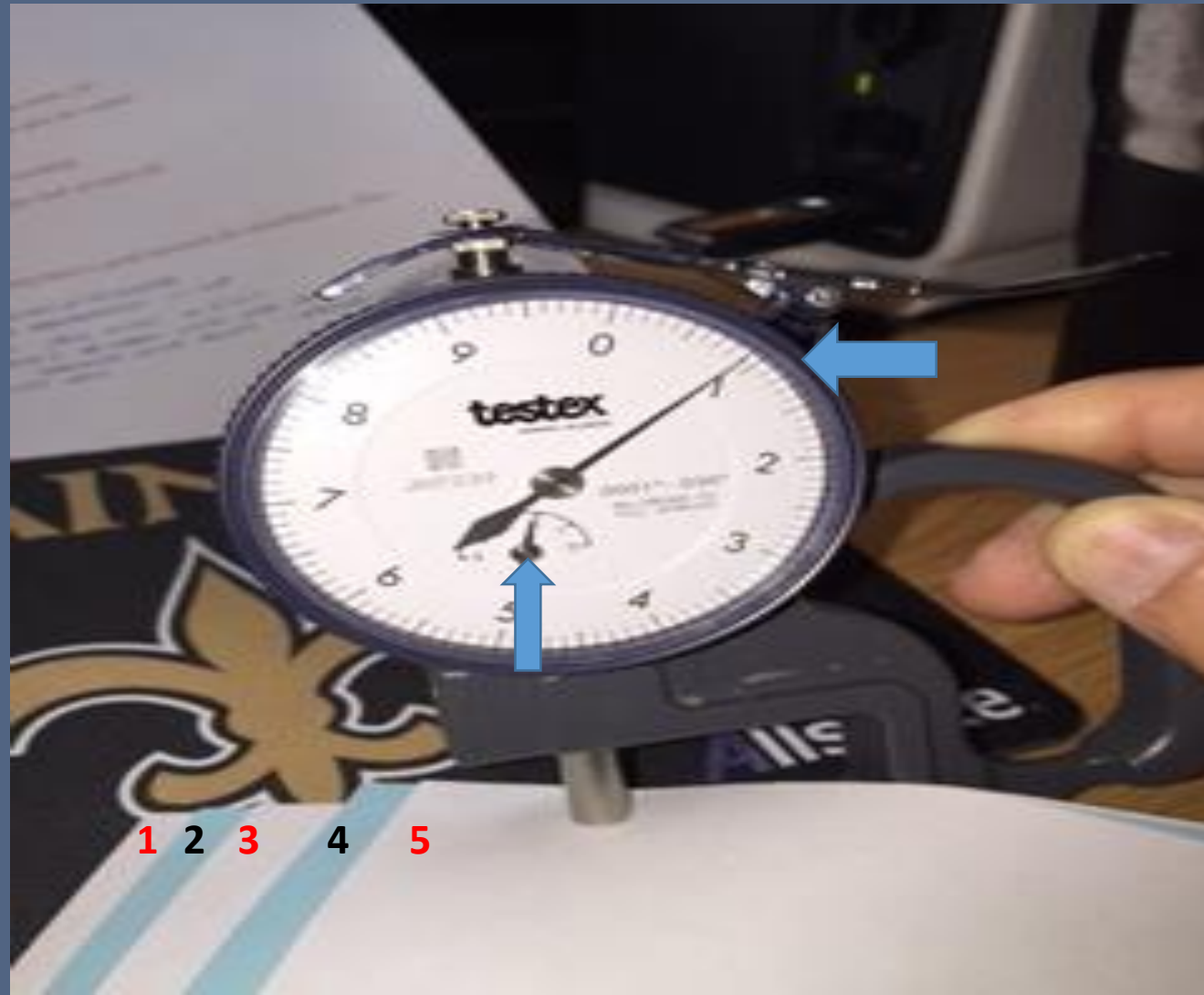
# COATINGS THICKNESS COMPARISON

**1 PAGE OF  
TYPING PAPER  
= 4.25 MILS  
THICKNESS**



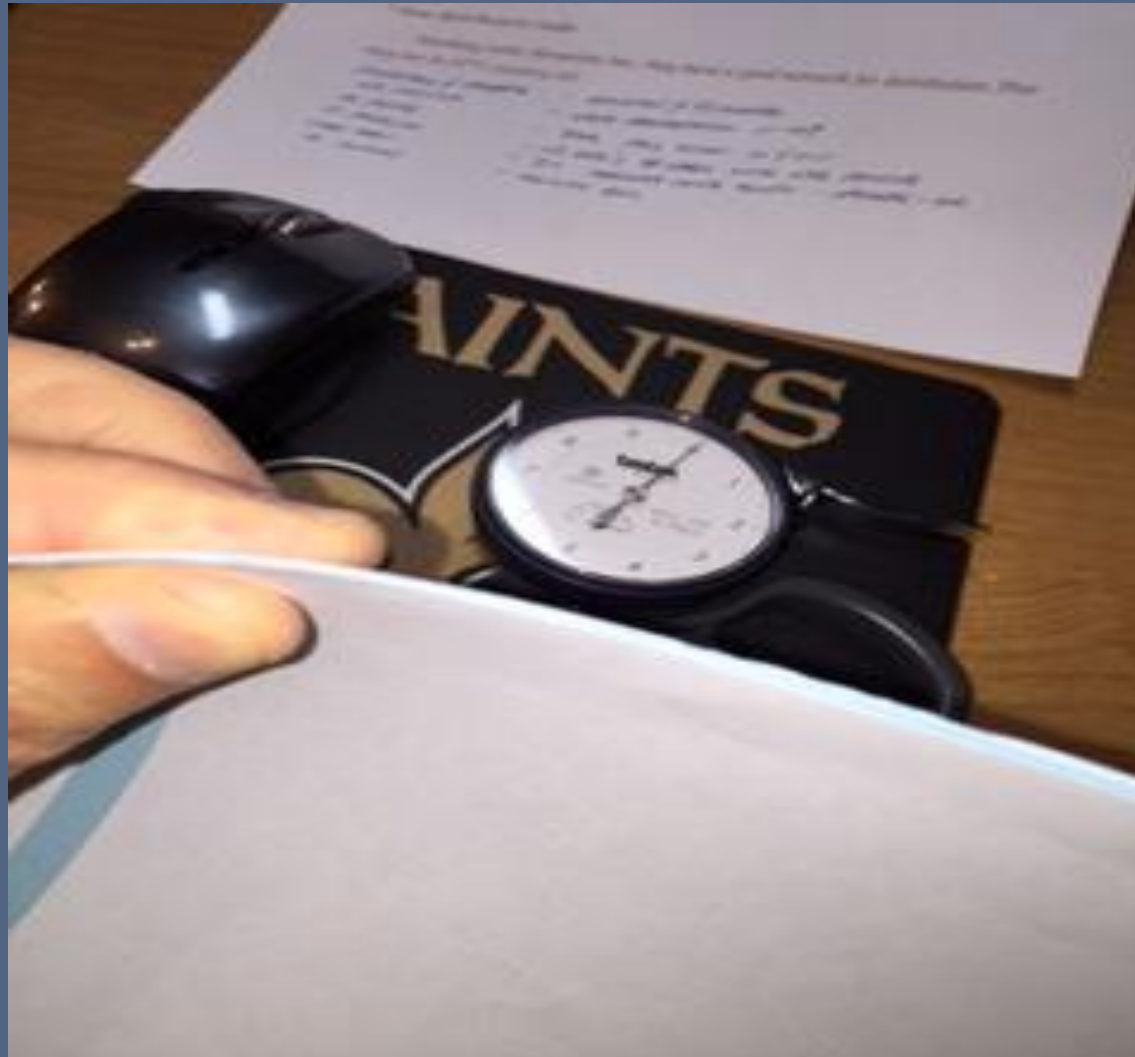
# COATINGS THICKNESS COMPARISON

5 PAGES OF  
TYPING PAPER =  
21 MILS  
THICKNESS



# COATINGS THICKNESS COMPARISON

5 PAGES OF  
TYPING PAPER  
POINT OF VIEW  
FROM THE  
EDGES





# CORROSION PREVENTION

- ❖ **ALL COATINGS ARE PERMEABLE TO MOISTURE**
- ❖ **EVEN 100% VOLUME SOLIDS COATINGS!**
- ❖ **WHEN MOISTURE PENETRATES A COATING & COMES INTO CONTACT WITH SOLUBLE SALT, THE CORROSION PROCESS HAS STARTED.**
- ❖ **IF NO SALTS ARE PRESENT, CORROSION DOES NOT TAKE PLACE!**

**UNDERSTANDING  
SOLUBLE SALTS  
CONTAMINATION**

# NON-NVISIBLE THINGS

1) GOD

2) HUMAN  
SPIRIT

3) AIR – OXYGEN

4) HUMAN  
THOUGHT

5) ATOMS

6) ENERGY

7) GERMS

8) SOLUBLE  
SALTS

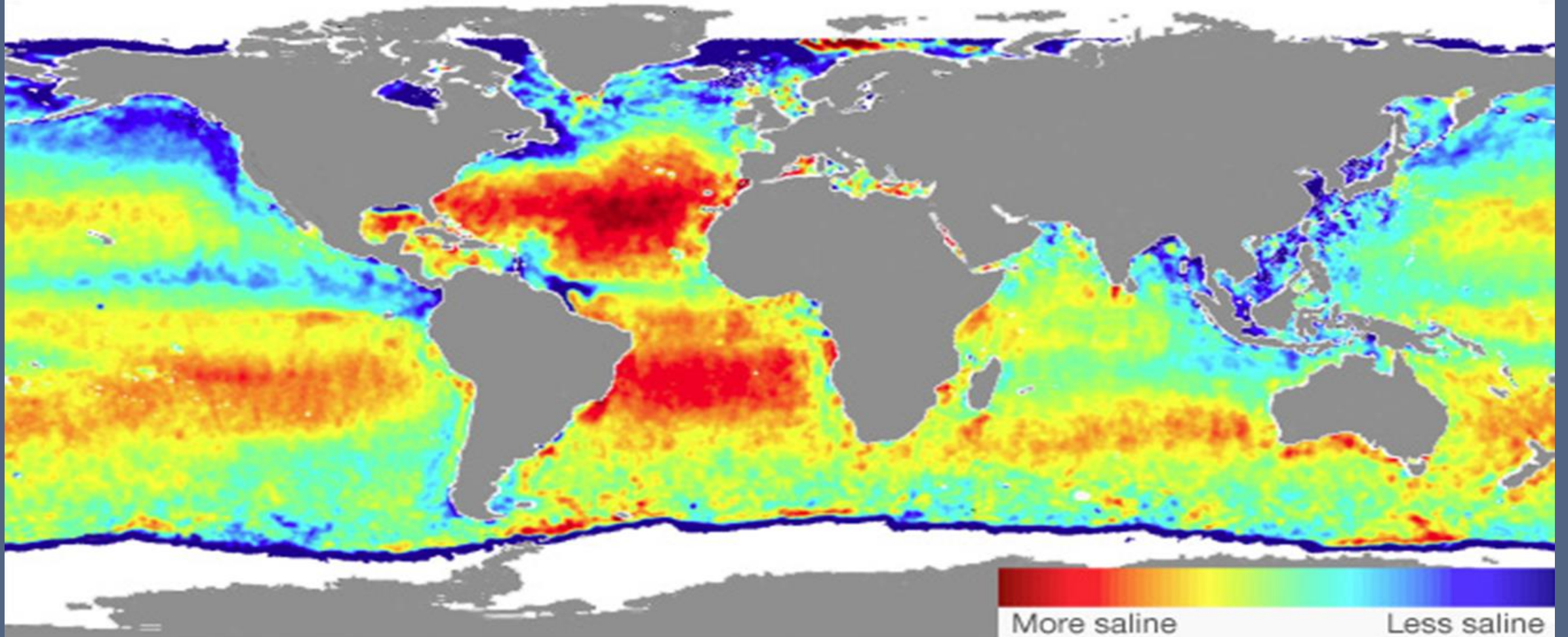
# CORROSION

## THE THREE MAIN SOURCES OF SOLUBLE SALTS CONTAMINATION OF STEEL STRUCTURES ARE:

- **CHLORIDES** – Seawater (contains 1.94% chlorides), Sodium Chlorides (found in carbon steel welding rod flux)
- **SULFATES** – Power Plants Burning Sulphur-Containing Coal
- **NITRATES** – Vehicular Emissions from Exhausts

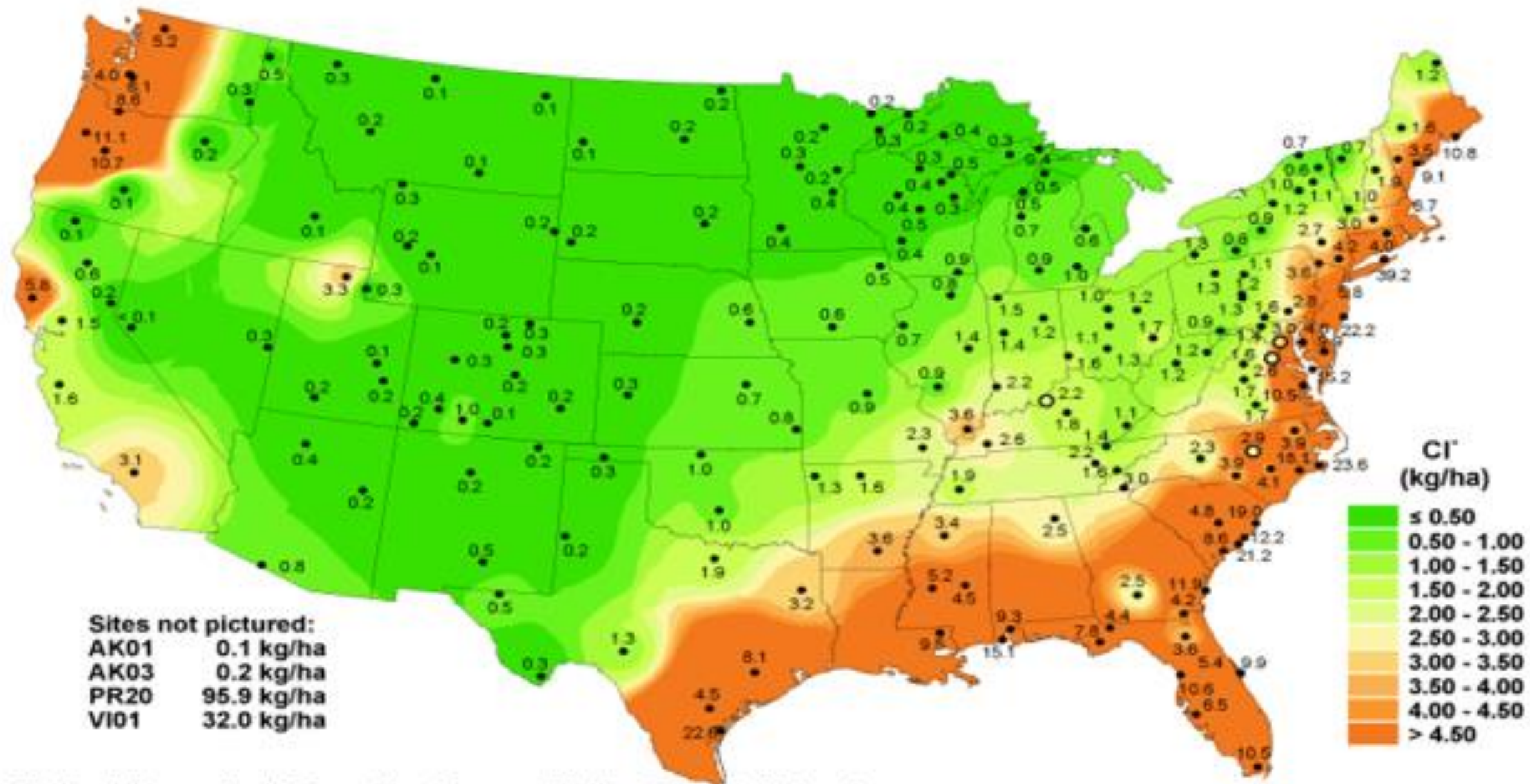
# SALINITY VALUES WORLDWIDE

Global ocean salinity as measured by Europe's Smos satellite



Source: ESA/SMOS

# Chloride ion wet deposition, 2006

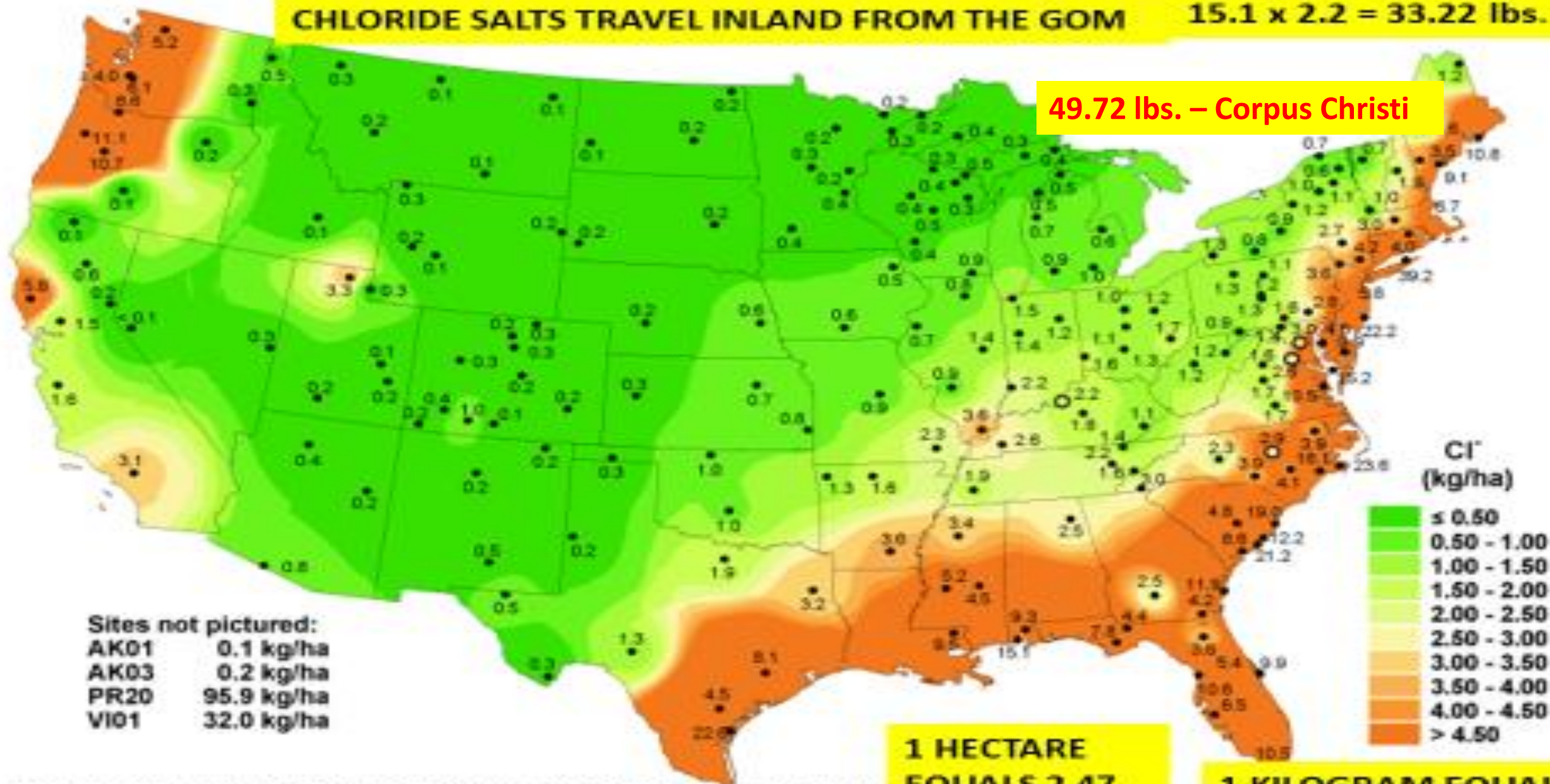


# Chloride ion wet deposition, 2006

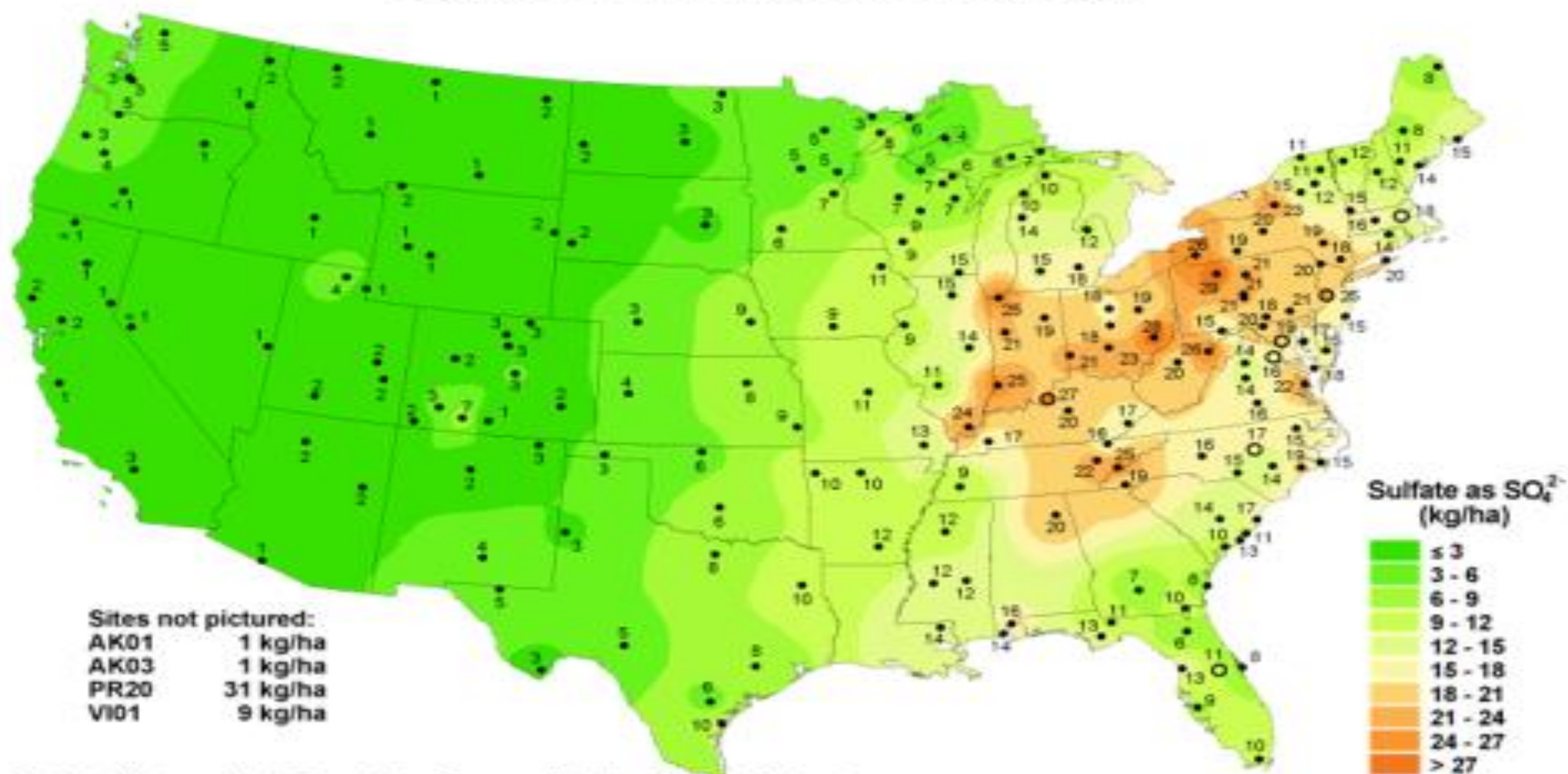
Mobile, AL

CHLORIDE SALTS TRAVEL INLAND FROM THE GOM

$15.1 \times 2.2 = 33.22$  lbs.

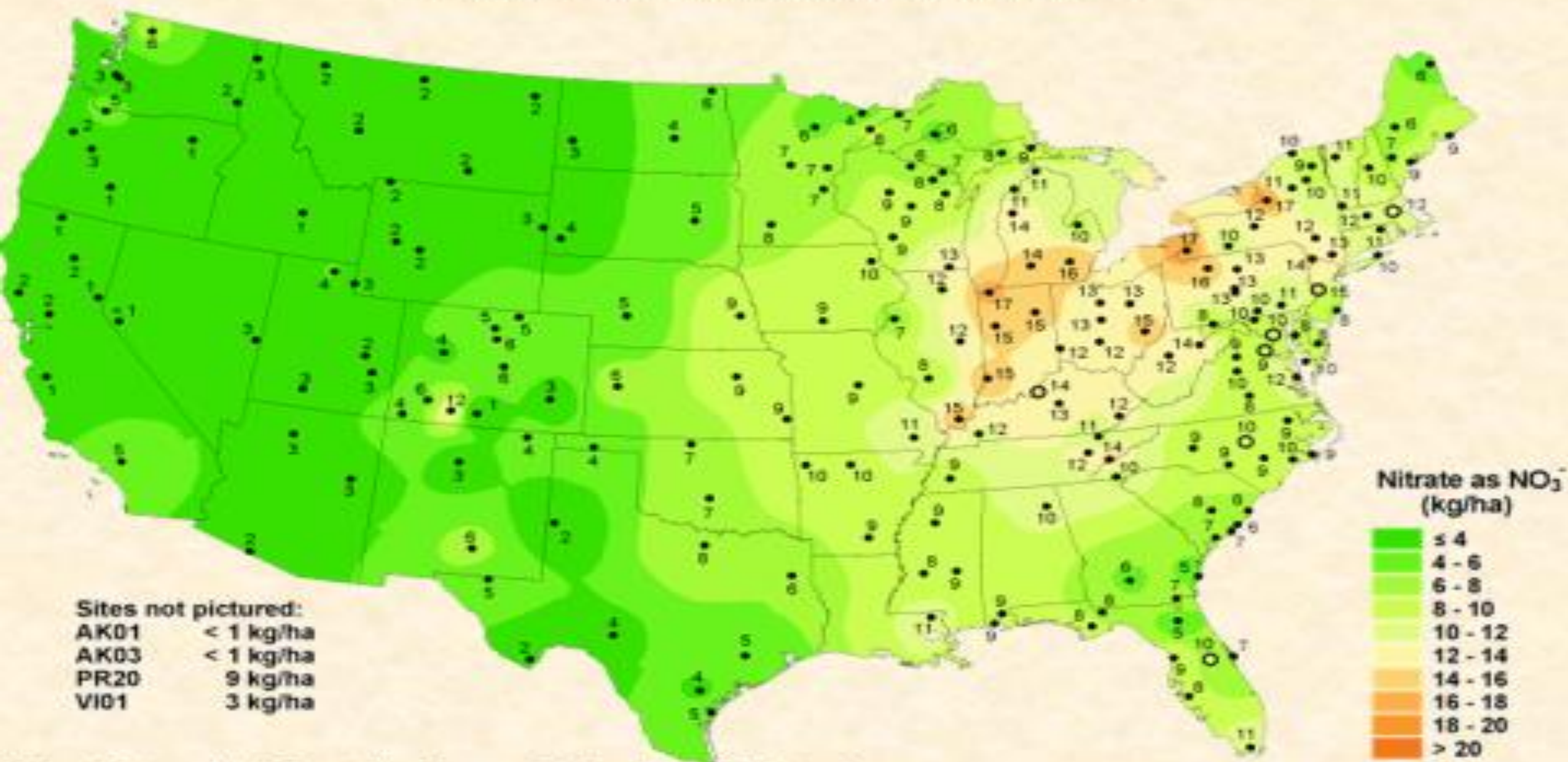


# Sulfate ion wet deposition, 2006





# Nitrate ion wet deposition, 2006



# ISO 8502-2

(INTERNATIONAL STANDARD ORGANIZATION)

Second Edition 2005-10-15

- **Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness**
- **Part 2: Laboratory determination of chloride on cleaned surfaces**

# ISO 8502-2

## (INTERNATIONAL STANDARD ORGANIZATION)

### Second Edition 2005-10-15

#### ➤ 1 Scope – Note 1

- The test method is not applicable to surfaces treated with chromate, nitrite or amine, which are commonly used as inhibitors in the water when wet blast cleaning. This is because a chromate concentration of 10 mg/l or greater or a nitrite concentration of 20 mg/l or greater in the wash water interferes with the determination of the chloride.
- Also, the amine inhibitors can form a hydroxide boundary (not water soluble) over the substrate and prevent the water from contacting the underlying salt for its removal.

NACE International Publication 6G186

Surface Preparation of Soluble  
Salt Contaminated Steel  
Substrates Prior to Coating

# NACE International Publication 6G186

- **Page 9: Wet Abrasive Blasting:**

- After wet abrasive blast cleaning and confirmation of acceptable levels of soluble salts, it is common practice to perform a final rinse to remove any particulate matter that may remain on the surface.
- **An inhibitor is sometimes added to the rinse water to deter flash rusting.**
- NOTE: Owners usually require any inhibitor to be approved by the coating manufacturer prior to use to insure that the inhibitor does not affect coating adhesion or performance.
- **Inhibitors often mask detection of soluble salts.**
- Consequently, soluble salt testing is usually performed prior to inhibitor application.

# WHY ARE SALTS A BIG ISSUE?

- **LEAD BASED COATINGS BANNED**
  - ( Lead formed Insoluble Salts )
- **VISUAL STANDARDS ARE INSUFFICIENT**
  - ( Soluble Salts are non-visible )
- **SPECIFICATIONS MAY NOT ADEQUATELY ADDRESS NON-VISIBLE CONTAMINANTS.**
  - ( Residual salts are a leading cause of premature coating failure )
  - ❖ **TESTING & REMOVAL IS ALWAYS MUCH LESS COSTLY THAN THE EXPENSES OF PREMATURE FAILURE REPAIRS!**
  - ❖ **SALTS ARE A CONTROLLED VARIABLE!**

# BONDING STRENGTH

**Why are salts left behind if they are water soluble?**

**The electrochemical attachment of the salts to the substrate are greater than the forces applied to remove them.**

# CORROSION PROCESS

For galvanic corrosion to occur we must have four things:

Anode

Cathode

Metallic Pathway

Electrolyte



“LET’S HURRY UP AND PAINT  
BEFORE IT TURNS ON US!”



“LET’S HURRY UP AND PAINT  
BEFORE IT TURNS ON US!”

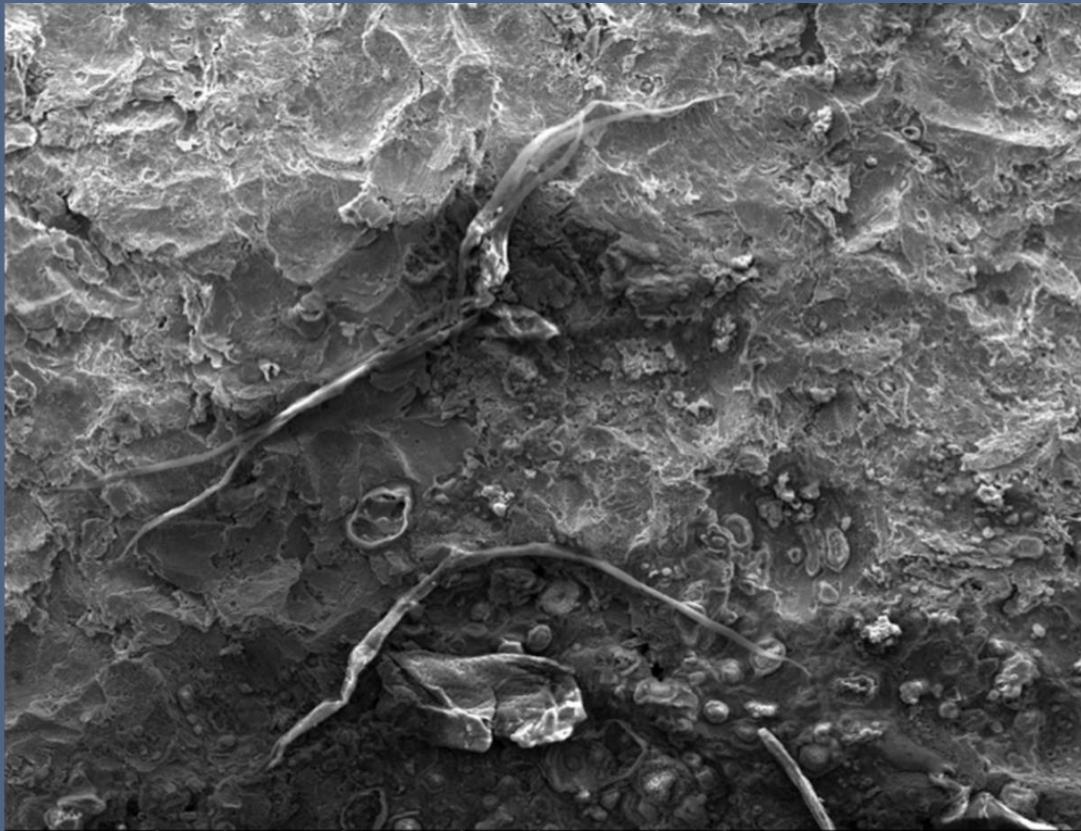


“LET’S HURRY UP AND PAINT  
BEFORE IT TURNS ON US!”

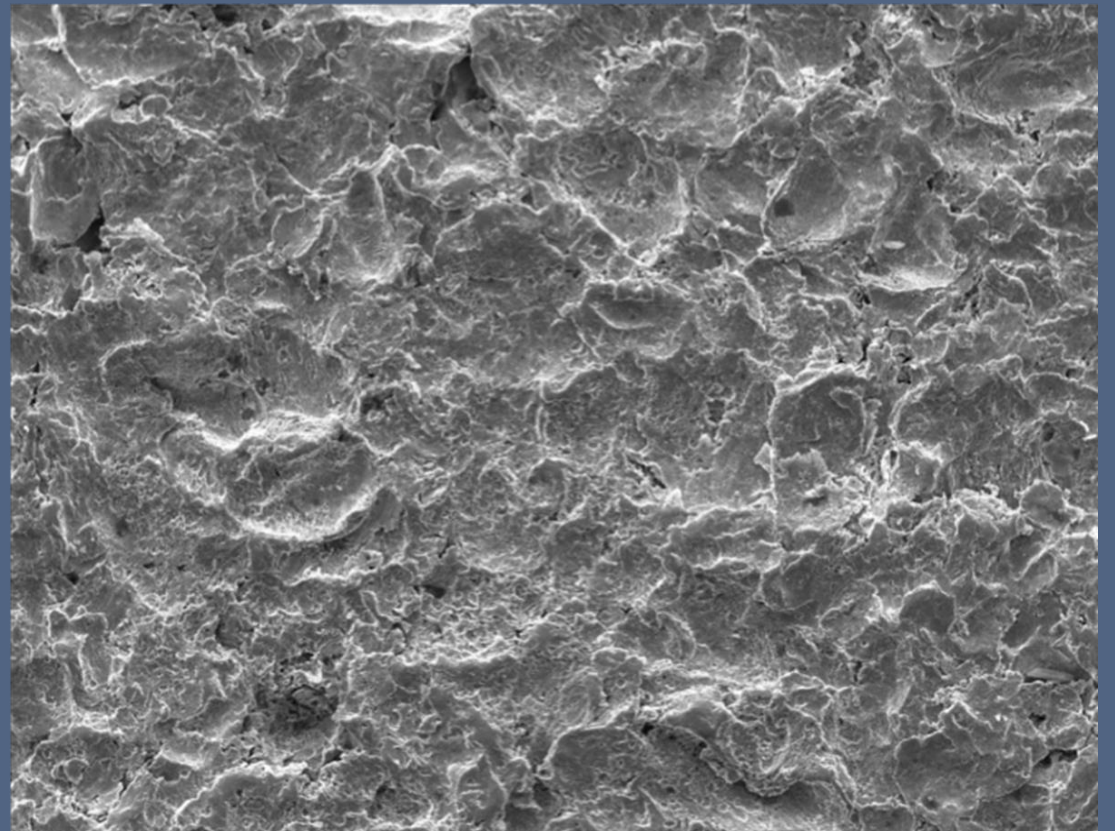


# COMPARISON

**WHITE METAL BLAST SURFACE  
UNDER MAGNIFICATION**



**CONTAMINANT FREE WHITE METAL  
AFTER TREATMENT - 3,000 PSI WASH**



# Risk Levels for Soluble Salts

<b>Soluble salt</b>	<b>Chloride</b>	<b>Nitrate</b>	<b>Sulfate</b>
<b>Unit</b>	<b><math>\mu\text{g}/\text{cm}^2</math></b>	<b><math>\mu\text{g}/\text{cm}^2</math></b>	<b><math>\mu\text{g}/\text{cm}^2</math></b>
<b>Low Risk</b>	<b>0 to 3</b>	<b>0 to 5</b>	<b>0 to 10</b>
<b>Medium Risk</b>	<b>3 to 8</b>	<b>5 to 10</b>	<b>10 to 20</b>
<b>High Risk</b>	<b>&gt;8</b>	<b>&gt;10</b>	<b>&gt;20</b>

# CORROSION AT WELD SEAMS



# CORROSION AT WELD SEAMS



# WELDING ROD FLUX

- Flux for welding cast iron: Fluxes for gray iron rods usually composed of borates or boric acid, soda ash and small amounts of **sodium chloride,etc.**
- Flux for welding magnesium and its alloys: Flux must be applied to all edges to be welded and to the welding rod when welding magnesium and its alloys. A flux may contain **sodium chloride**, potassium fluoride, **magnesium chloride**, barium fluoride.
- Source: [www.niagarathermal.com](http://www.niagarathermal.com)



# CHLORIDES IN WELDING ROD FLUX



# OSMOTIC BLISTERING

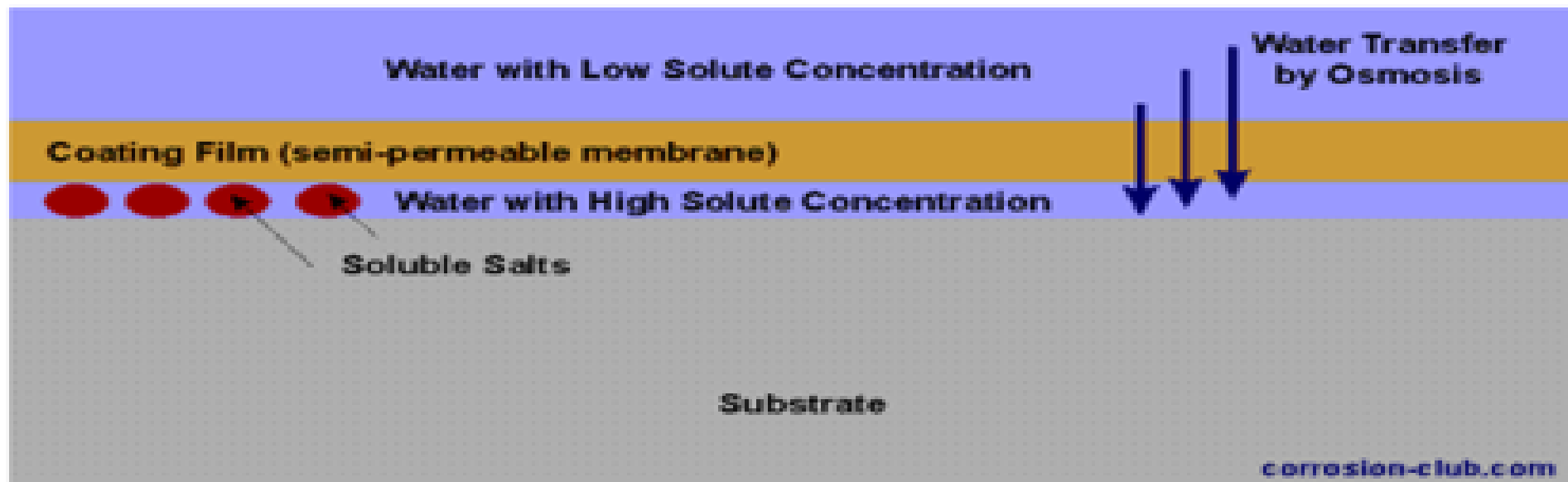
One of the most  
common failure modes  
for coatings in wet  
service environments.

# OSMOTIC BLISTERING

## **What is Osmosis?**

**Osmosis quite simply is the physical process by which a liquid from a weaker medium is drawn through a semi-permeable membrane into a stronger liquid medium.**

# Salts: Osmosis & Permeation



*Coating Failures from salt induced corrosion*

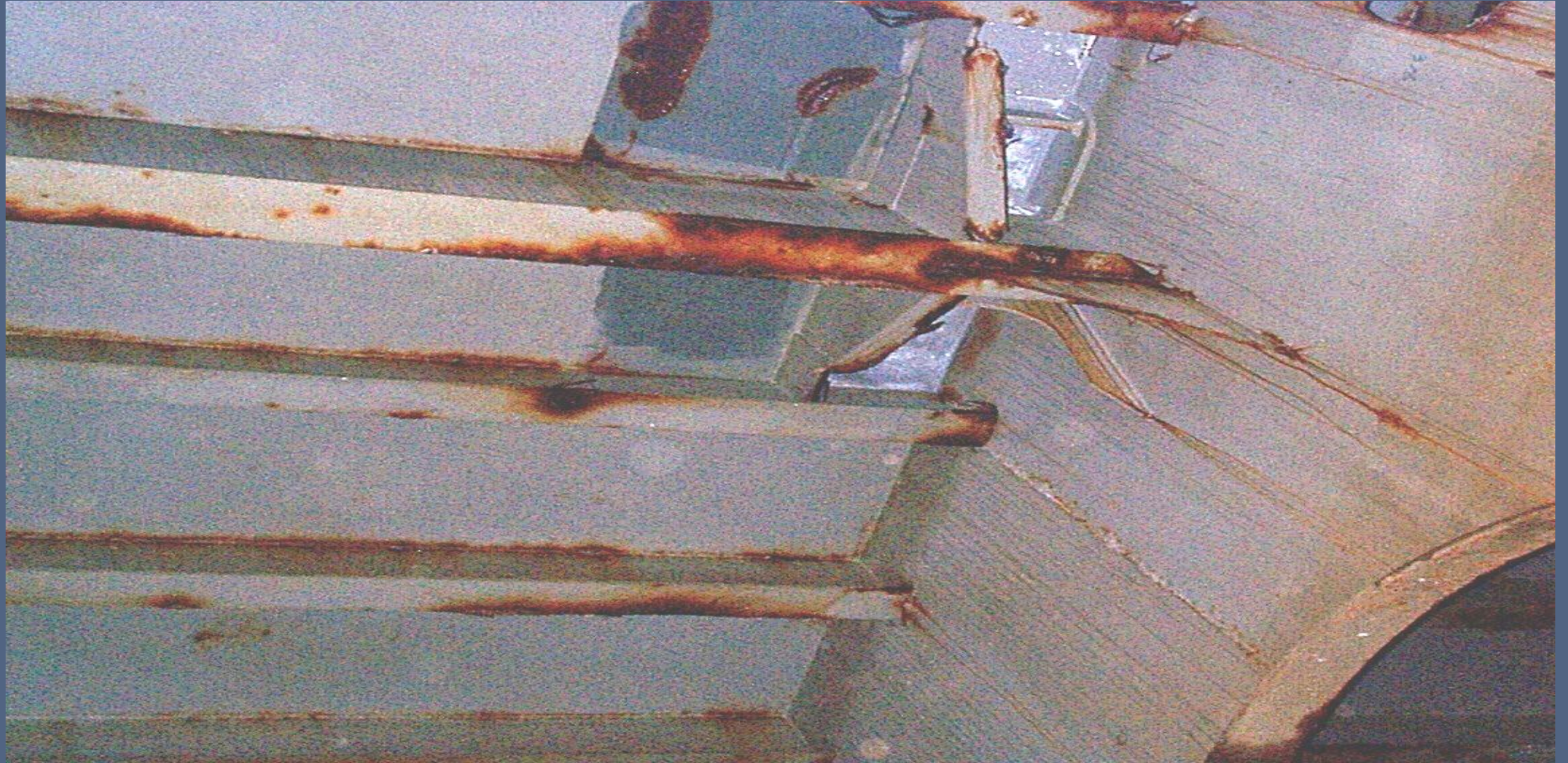
# OSMOTIC BLISTERING



# OSMOTIC BLISTERING



# COMMON FAILURE “HOT SPOTS”



# COMMON FAILURE “HOT SPOTS”





**IF SOLUBLE SALTS ARE NOT REMOVED FROM THE SURFACE, THE  
CORROSION PROCESS WILL CONTINUE, PAINTED OR NOT!**

# TESTING FOR SOLUBLE SALTS

***SOLUBLE SALTS*** THAT CONTAMINATE  
A SURFACE ***ARE*** TYPICALLY ***INVISIBLE***  
THEREFORE SOME METHOD OF TESTING  
MUST BE PERFORMED TO DETERMINE IF  
SUCH CONTAMINATION EXISTS!

# Coating Economics

Total Surface Area:	90,000 ft <sup>2</sup>	Service: Tank Lining
Insufficient Surface Prep:	\$500,000	5 yr coating cycle
Proper Surface Prep:	\$515,000	20 + yr coating cycle

Cost/ft <sup>2</sup> /yr (today's \$):	Cost /yr over 20 yrs
Insufficient Surface Prep:	\$1.11/ft <sup>2</sup> /yr
Proper Surface Prep:	\$0.28/ft <sup>2</sup> /yr



Based on actual experience by NAVFAC since instituting revised specifications in 1995.









**THANK YOU!**

**CHLOR\*RID INTERNATIONAL, INC.**

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