CHLORIDE REMOVAL

WITH SPONGE-JET'S

"RECYCLABLE ENCAPSULATED ABRASIVE MEDIA"

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Vice-President, International
Sponge-Jet, Inc.

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CHLORIDE REMOVAL

with

“RECYCLABLE ENCAPSULATED ABRASIVE MEDIA”

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ABSTRACT: This Paper Presents

- Define “Recyclable Encapsulated Abrasive Media”.
- Overview of the Chloride Issue
- 2002 Study showed high levels of chloride removal with non recycled sponge media
- Recent tests indicate that chloride removal can be effectively performed while recycling media
- Blasting with “Recyclable Encapsulated Abrasive Media” can frequently reduce chloride concentrations to below typically specified levels in a single process
- Cost and Speed are favorable to other technologies, which require multi-step procedures such as abrasive blast, water or chemical wash and final abrasive blast to achieve specified levels of surface contaminants

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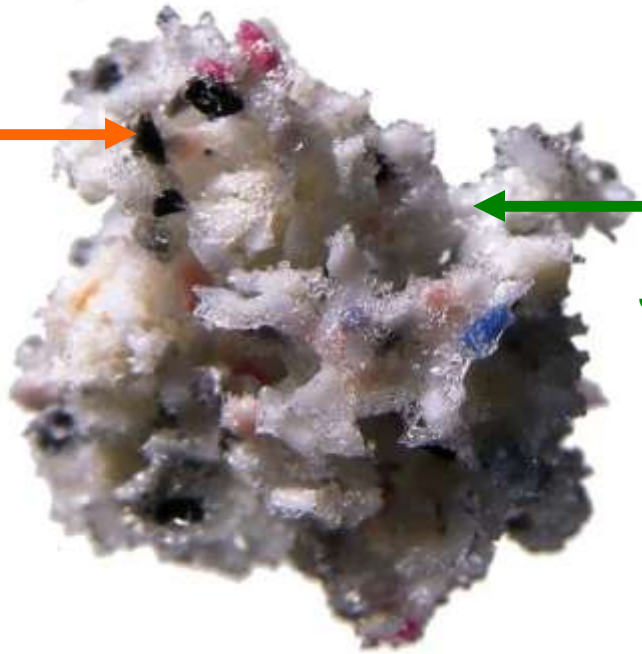
BACKGROUND ON ENCAPSULATED ABRASIVE MEDIA

1 Abrasive



Encapsulating Sponge Material 1

Small cells expand after impact and "vacuum" the surface of small residual dust and contaminants; they also capture fragmenting abrasive and coating

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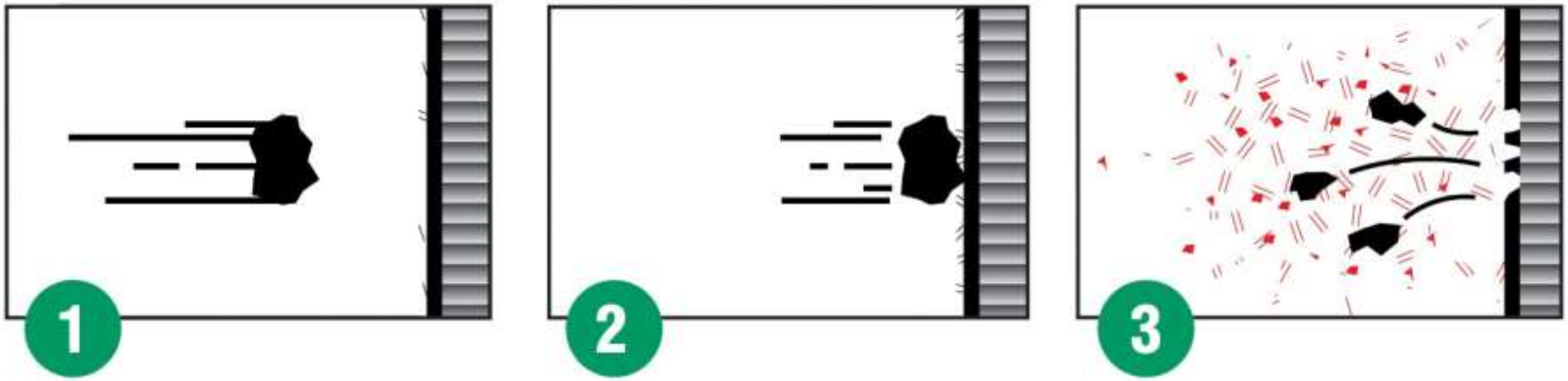
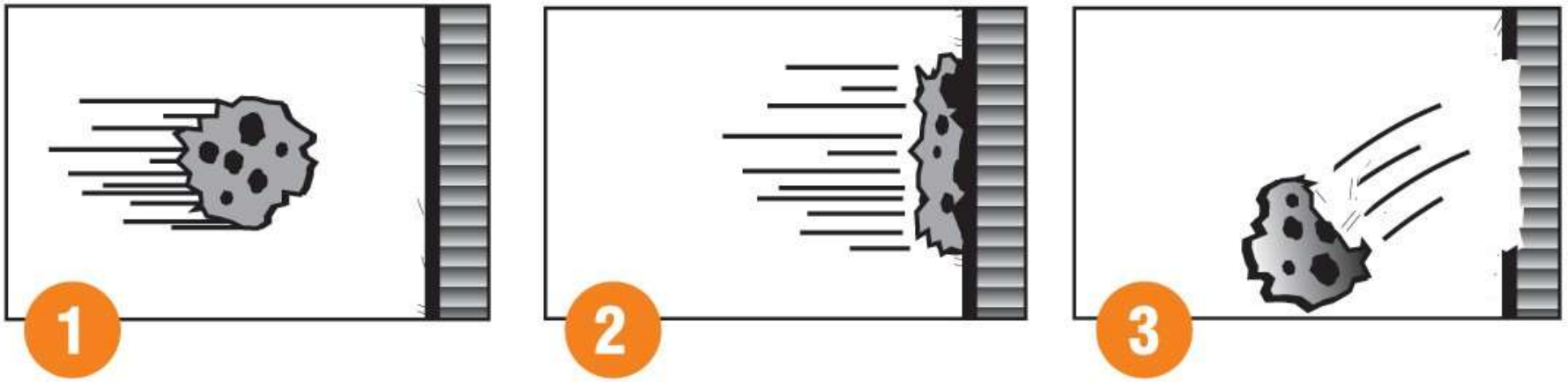
BACKGROUND ON ENCAPSULATED ABRASIVE MEDIA



Conventional Abrasive Blasting



Encapsulated Abrasive Media

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BACKGROUND ON ENCAPSULATED ABRASIVE MEDIA

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BACKGROUND ON ENCAPSULATED ABRASIVE MEDIA

Encapsulated Abrasive Media

Ordinary Blasting

Encapsulated Abrasive Media blasting can reduce dust levels as much as 98% compared to conventional abrasive blasting

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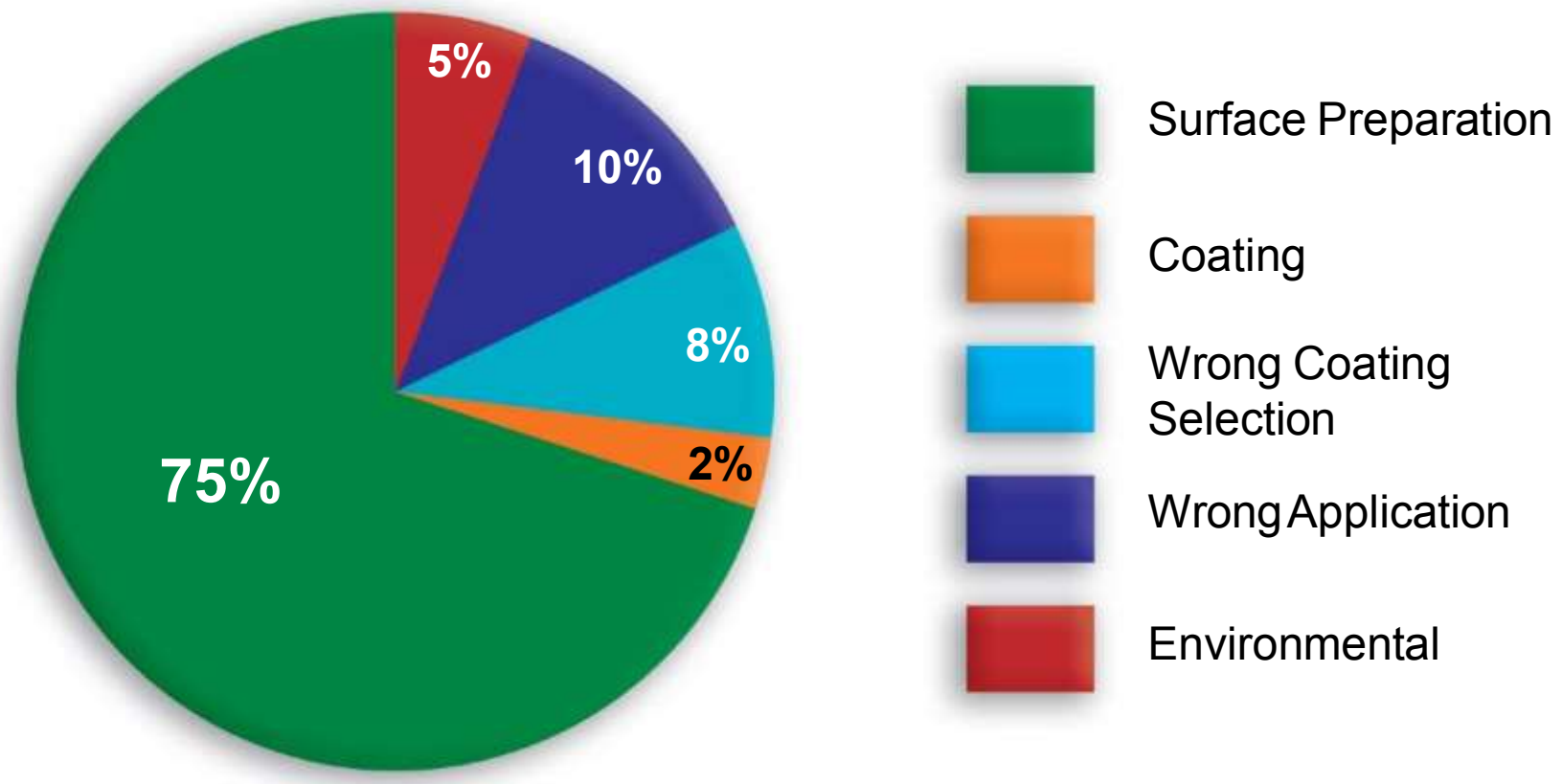
Overview of Chloride Issue: Why all the concern?

Why Do Coatings Fail?



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Overview of Chloride Issue: Goals of Surface Preparation

Proper Surface Preparation:

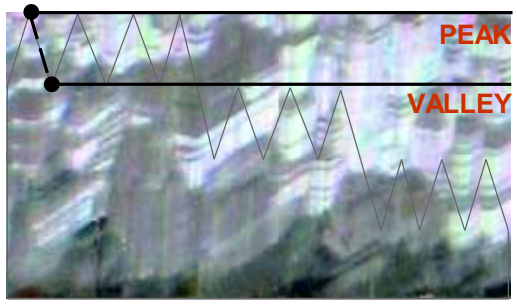
Cleanliness (Visual)

Decontamination (Invisible)

CHLORIDES & SULFATES
OIL RESIDUE
LEAD
ASBESTOS
PCBs
LOW-LEVEL RADIATION

Profile (Measurable)

Microns / Mils



"75% of coating failures are the result of poor surface preparation"

"It should be remembered that when defects are exposed by blast cleaning and subsequently removed by grinding, it is necessary to re-prepare the immediate area to retain the surface profile."

"All coating systems will perform better on properly cleaned surfaces with a good surface profile"

SOURCE: NACE Coating Inspector Program (Level 1)

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Overview of Chloride Issue

- Coatings are semi-permeable membranes subject to vapor transport
- Blister formation is often a result of one or more differentials across the coating:
  - -Pressure
  - -Temperature
  - -Electrical Potential
  - **-Soluble Concentrations *(salts / chlorides)***

- Differentials create osmotic drive, vapor transport and blistering
- Coating life can often be improved by reducing any differential across the coating - such as Chloride concentration

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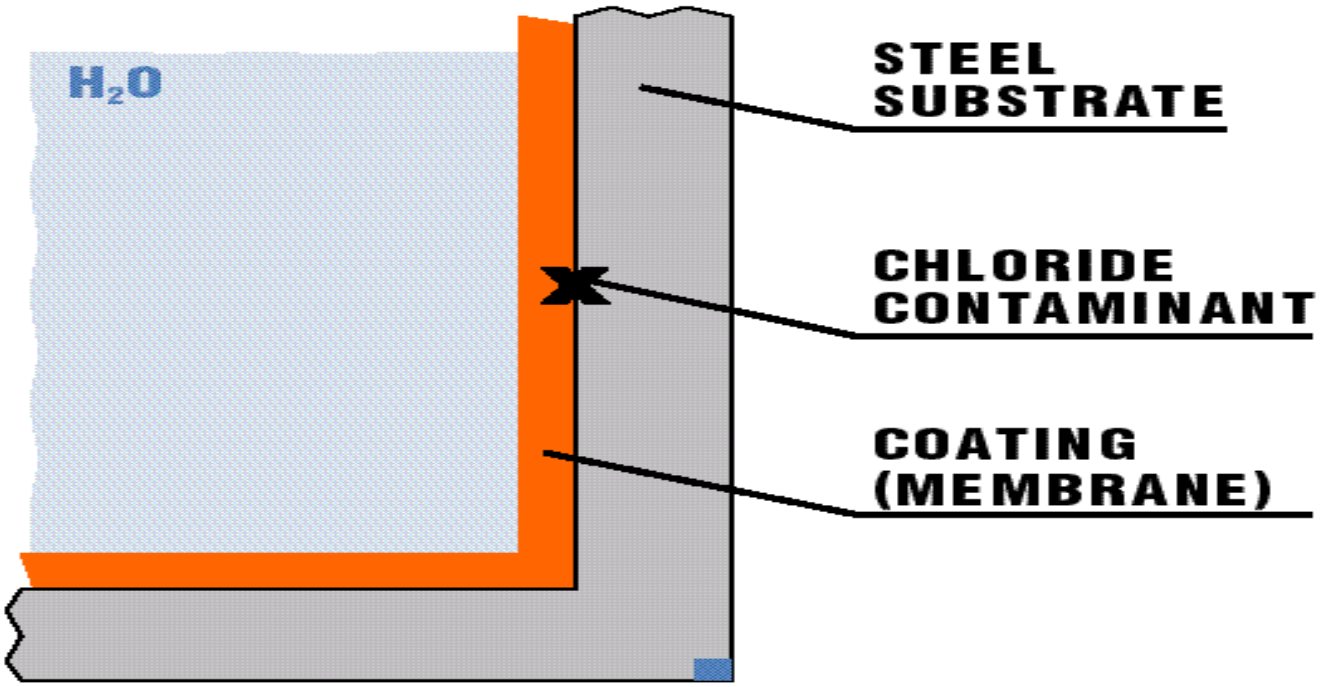
H_2O
STEEL
SUBSTRATE
CHLORIDE
CONTAMINANT
COATING
(MEMBRANE)

FIGURE 1.A

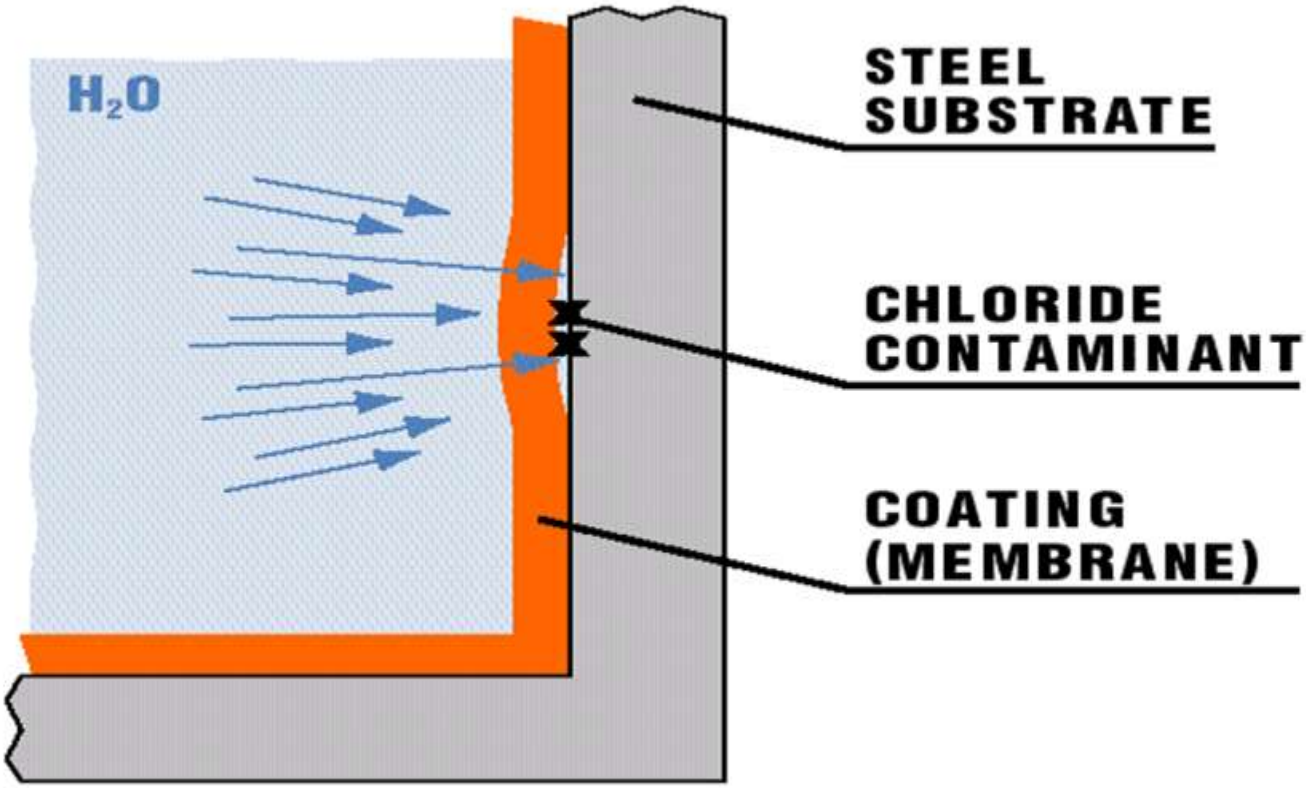
H_2O
STEEL
SUBSTRATE
CHLORIDE
CONTAMINANT
COATING
(MEMBRANE)

FIGURE 1.B

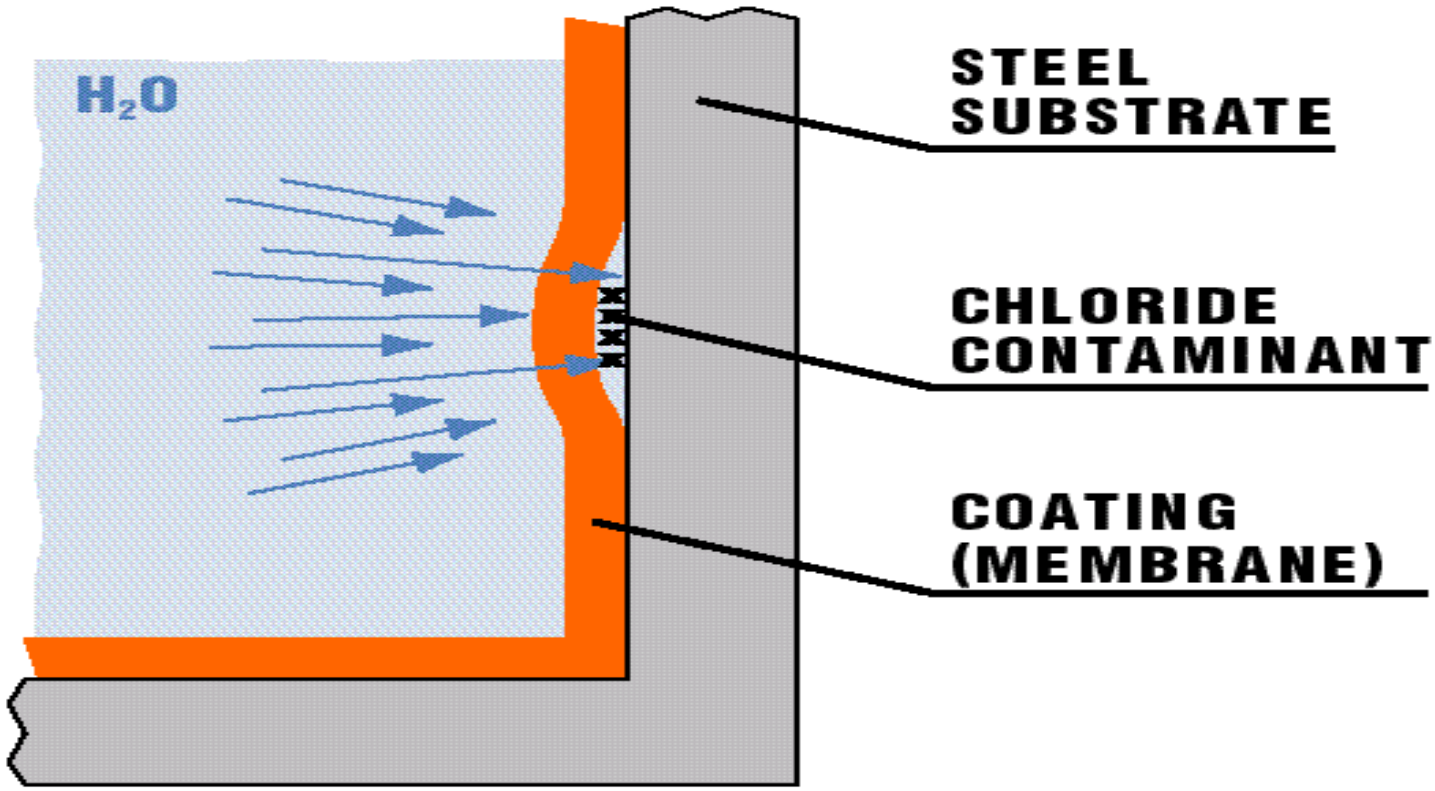
H_2O
STEEL
SUBSTRATE
CHLORIDE
CONTAMINANT
COATING
(MEMBRANE)

FIGURE 1.C

Blister Formation: Osmotic Drive

Blister and Failure

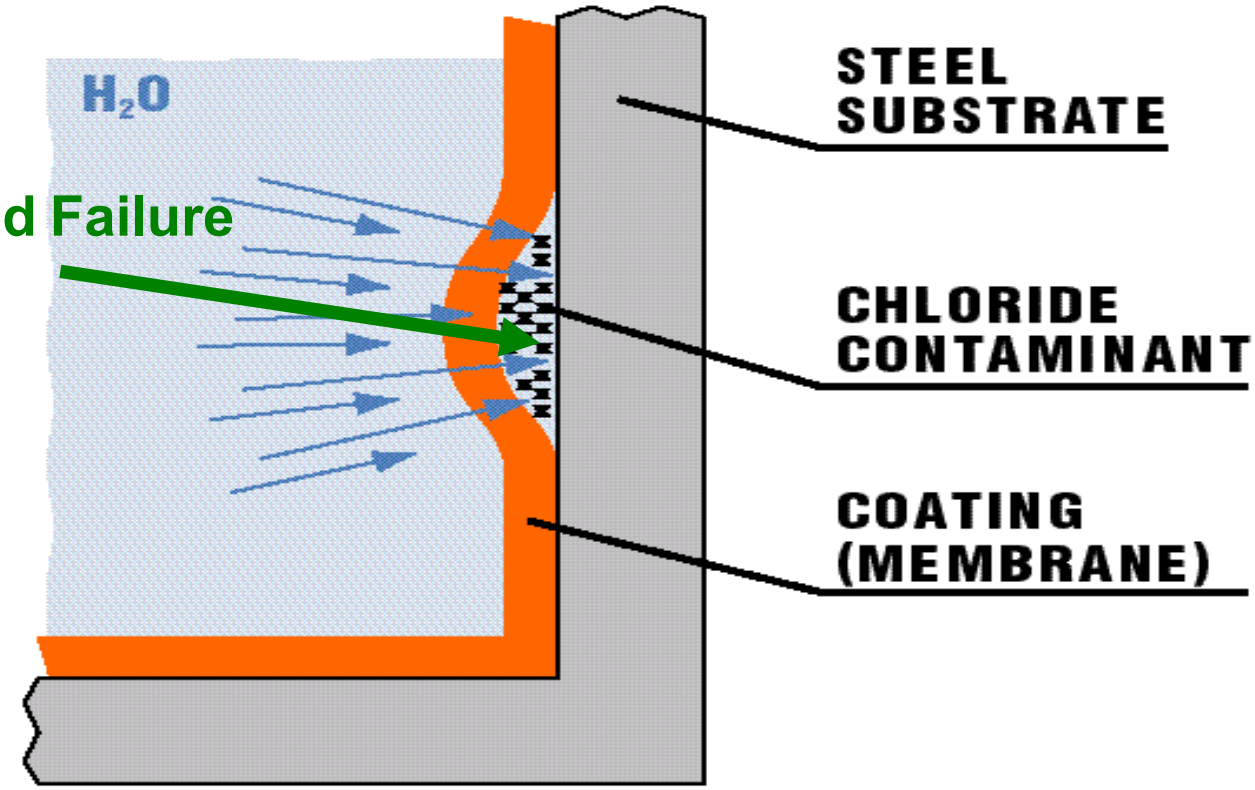

FIGURE 1.D

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Increased Emphasis on Residual Chloride

- **NASA – 5µg/cm²**

- **US NAVY**
  - **1990's 10 µg/cm² (100 mg/m²) non-immersion and 5 µg/cm² (50 mg/m²) immersion**
  - **2000 5 µg/cm² (50 mg/m²) non-immersion and 3 µg/cm² (30 mg/m²) immersion**

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Increased Emphasis on Residual Chloride

SSPC has established standard levels of defined cleanliness for *invisible contaminants*

	Chloride	Soluble Ferrous	Sulfates
SC 1	0 µg/cm²	<0 µg/cm²	<0 µg/cm²
SC 2	<7 µg/cm² (70 mg/m²)	<10 µg/cm²	<17 µg/cm²
SC 3	50 µg/cm² (500 mg/m²)	<50 µg/cm²	n/a

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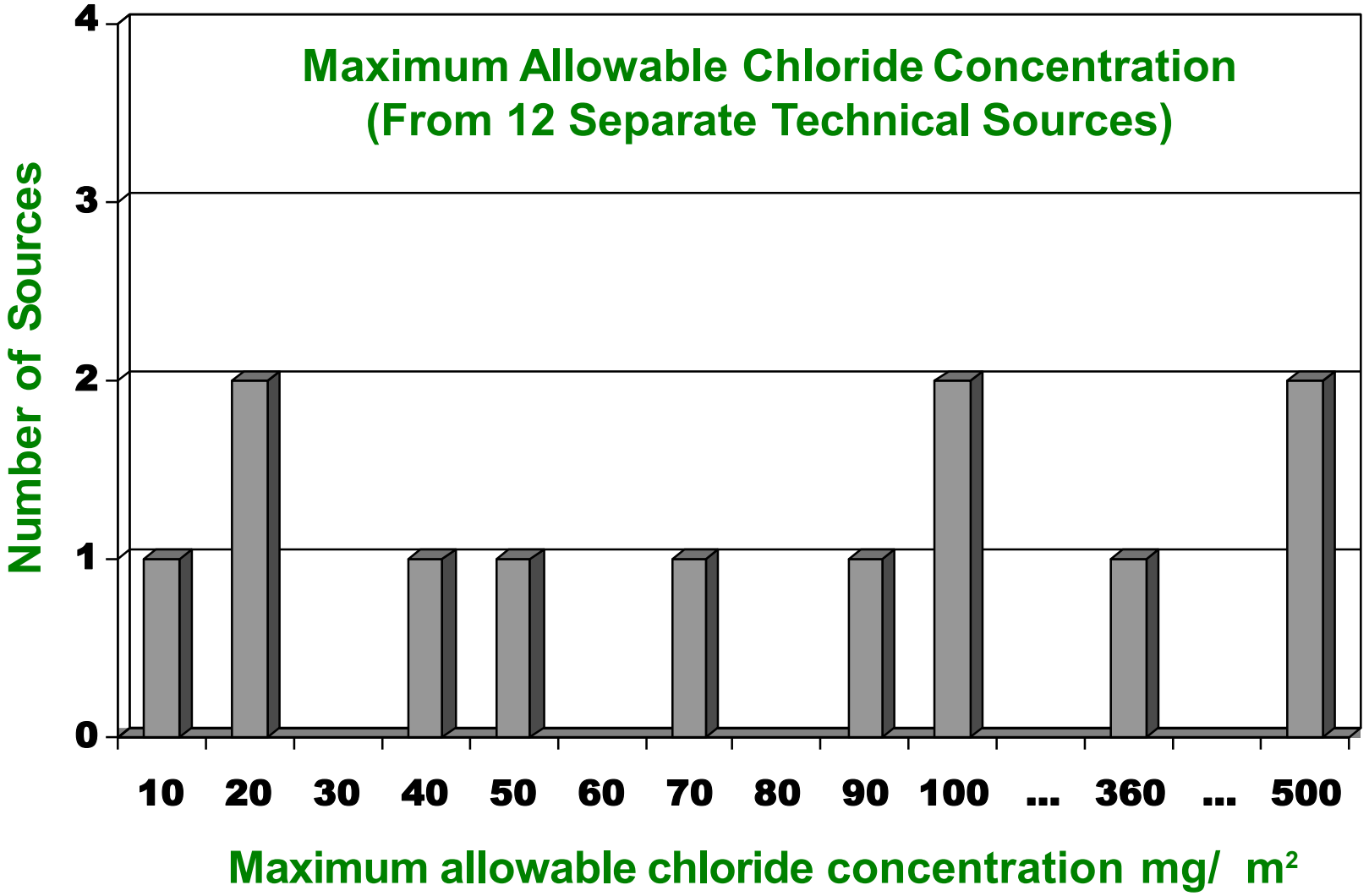
South Korean Study Published through IMO



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Methods for Chloride Removal

- Conventional Abrasive Blasting followed by a rinse with Steam, Water or chemical treatment. Followed by a second blast
- UHP or HP water blast in conjunction with traditional abrasive blasting when profile is required
- Encapsulated Abrasive Blasting

PHOTOS COURTESY OF SUPPLIERS

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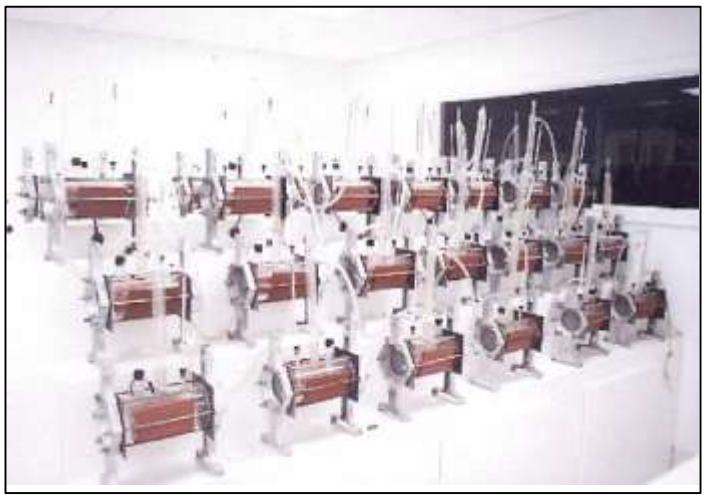
1997 First Laboratory Data indicating Encapsulated Media is Effective at Chloride Removal



PHOTOS COURTESY OF ARC COMPOSITES DIVISION, AW CHESTERTON CO.

- Panels contaminated in ASTM B117 Salt Fog Cabinet
- Initial Chloride 400 µg/cm^2 **(4000 mg/m^2)**
- To achieve less than 10 µg/cm^2 **(100 mg/m^2)** via standard aluminum oxide blasting required a three step process:
  - Blasting
  - Demineralized water wash
  - Rusting and Re-blasting
- To achieve less than 10 µg/cm^2 **(100 mg/m^2)** via encapsulated media blasting required a single blast

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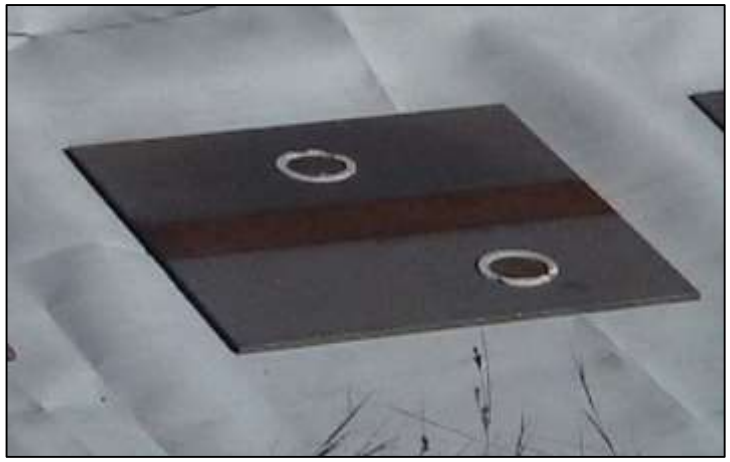
2001 Study Confirms Encapsulated Media is Effective at Chloride Removal – but no recycling occurred



PHOTOS COURTESY OF SPONGE-JET, INC.

- Four panels were contaminated with varying levels of sea salt
- Half of each panel blasted to SSPC-SP5 with 12/40 coal slag
- Half of each panel blasted to SSPC-SP5 with encapsulated media containing 30 grit aluminum oxide
- Remaining chloride levels were between 9 $\mu g/cm^2$ to 20 $\mu g/cm^2$ with the coal slag prepared panels
- Remaining chloride levels were consistently below 5 $\mu g/cm^2$ with the encapsulated media prepared panels

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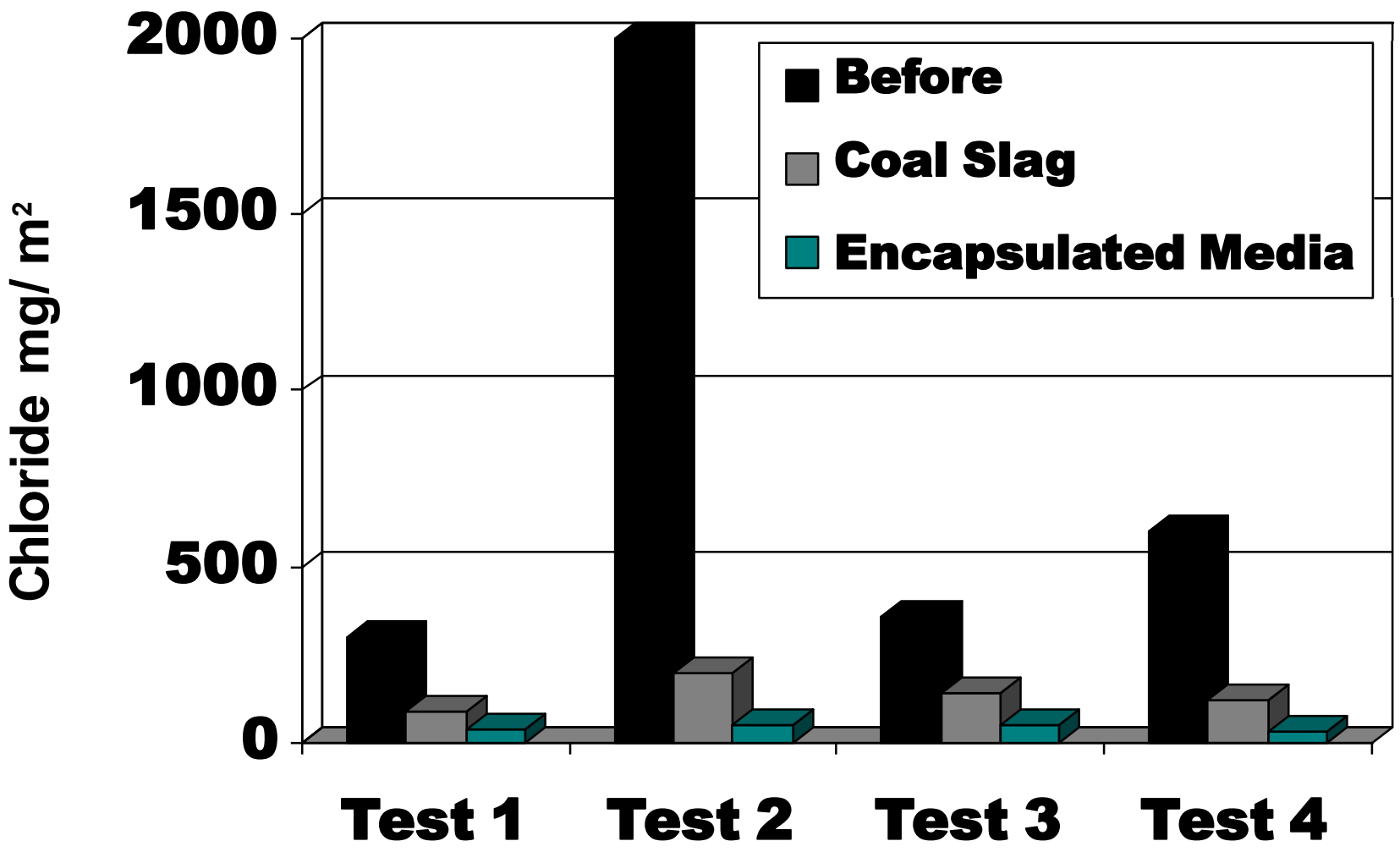
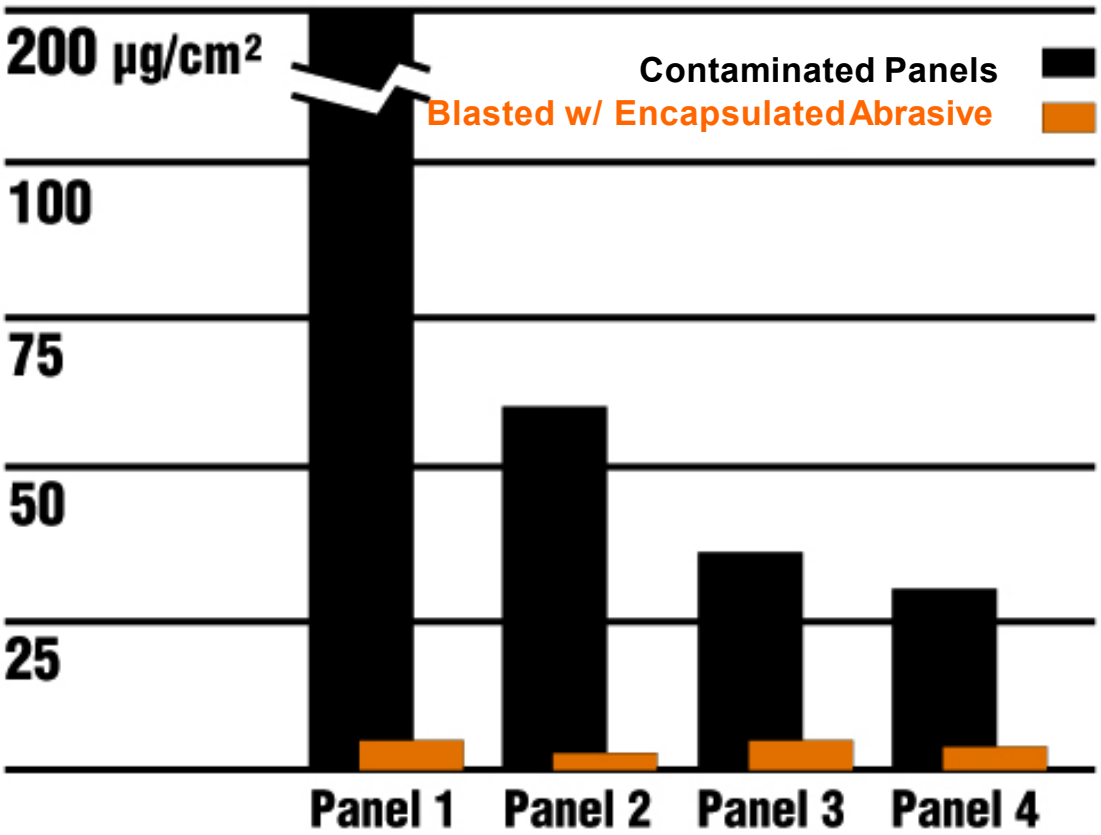
Chloride Removal Comparison



Residual Chloride Comparison - A



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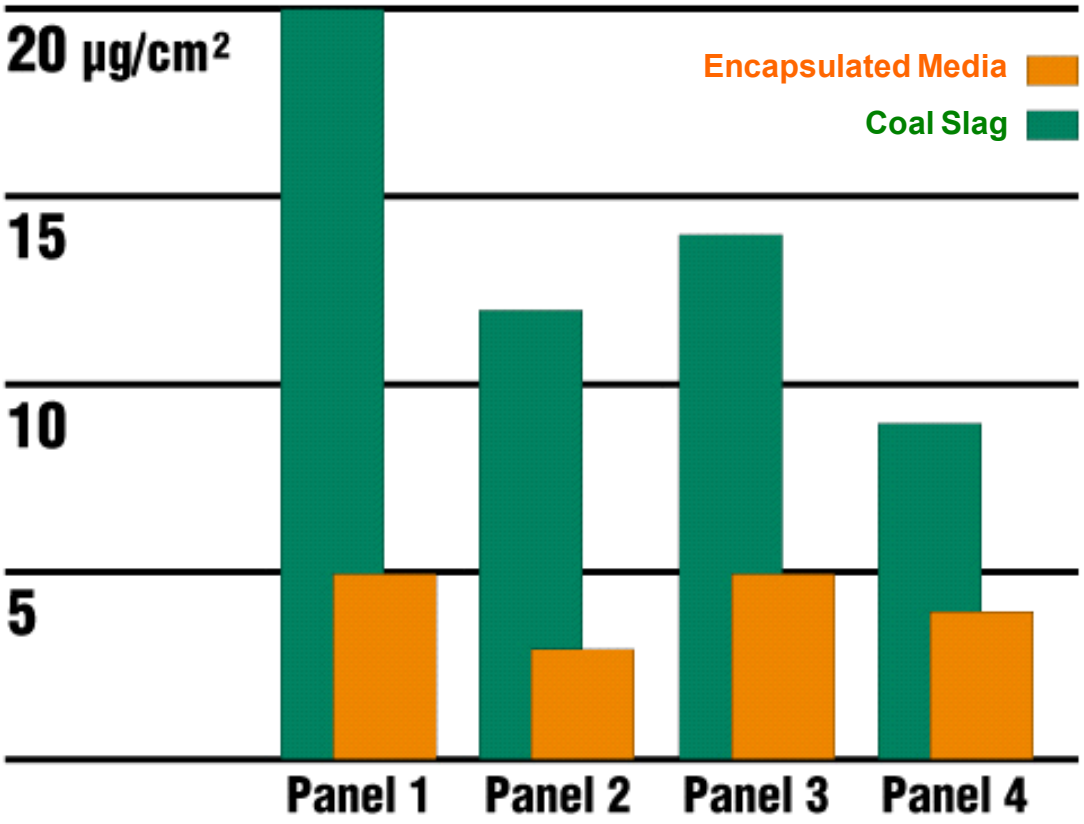
Residual Chloride Comparison - B



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2002 Case History - Newark Airport

PHOTOS COURTESY OF GENERAL MAGNAPLATE, INC.

- Spot repairs on cooling water pipe
- Prior to abrasive blasting, chloride levels were 40 µg/cm^2 **(400 mg/m^2)**
- Encapsulated abrasive media was used to abrasive blast the surface to a SSPC-SP5 cleanliness with a 3-5 mil profile
- Chloride measurements after blasting were below the 3 µg/cm^2 **(30 mg/m^2)** detectable limit of the test
- Media Recycling did occur but controls and documentation were limited

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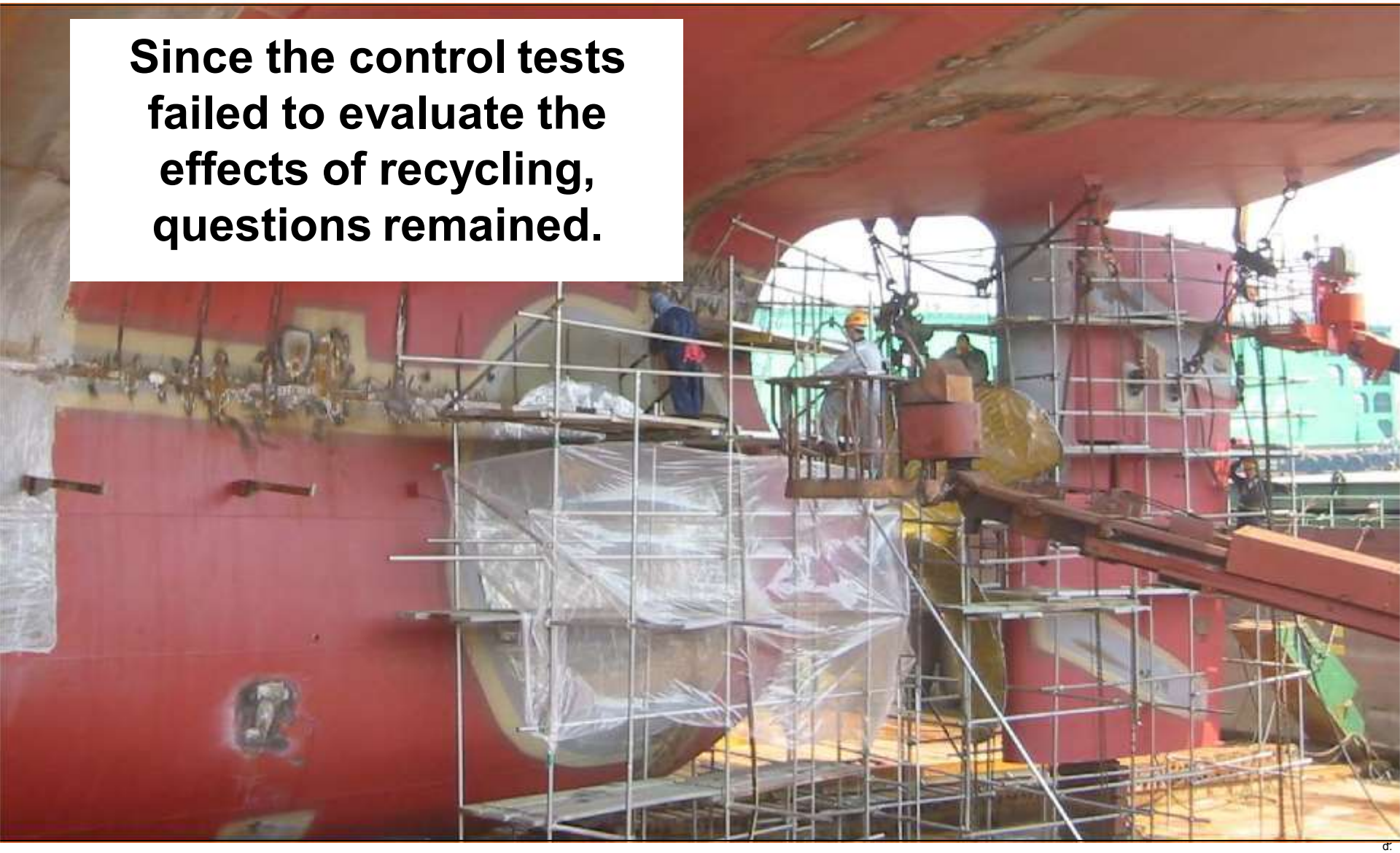
Recycling of the Encapsulated Abrasive still Questioned

Since the control tests failed to evaluate the effects of recycling, questions remained.



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2009 Large Offshore Service Company for PETRONAS contracts to perform rigorous tests

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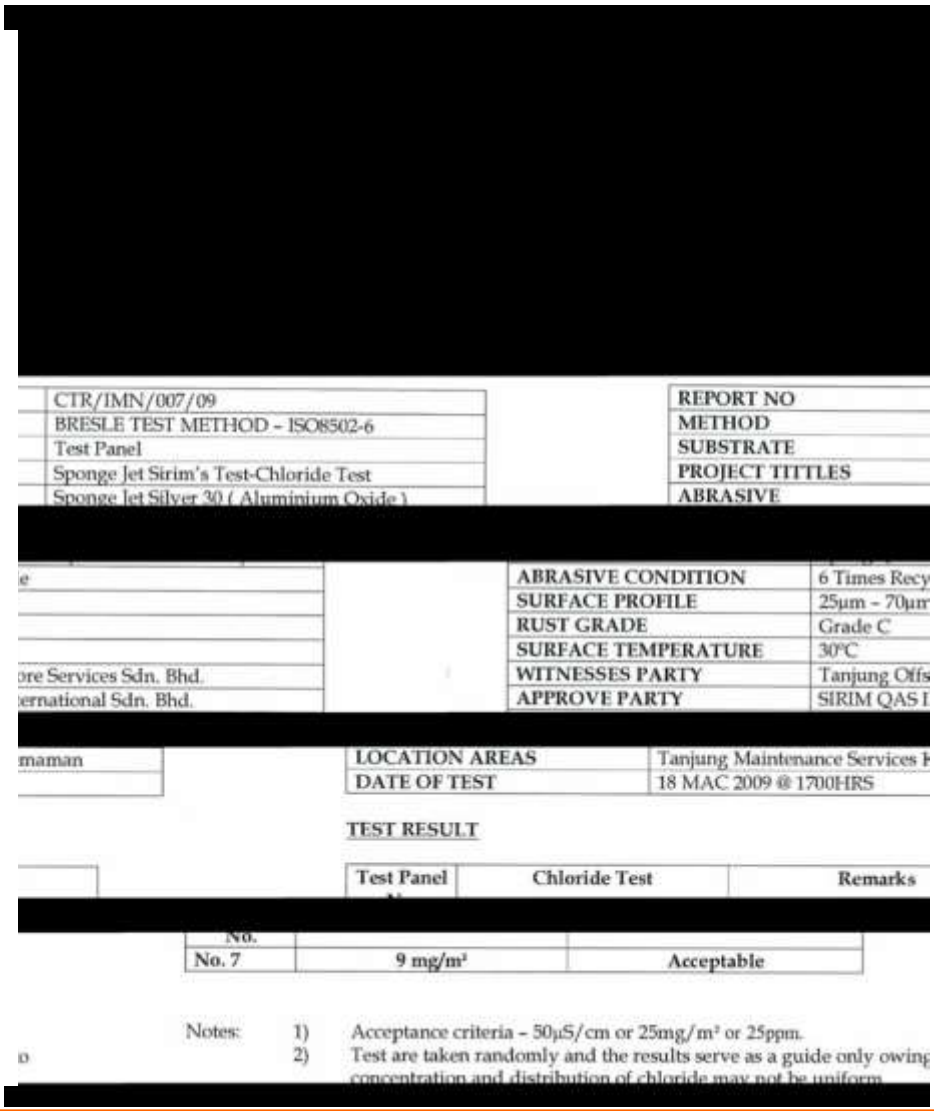
Challenge – Can they reliably Meet specification?

- ✓ **PETRONAS requires chloride levels below 25 mg/m²**
- ✓ **Can 25 mg/m² be reliably achieved**
- ✓ **Will PETRONAS engineering accept encapsulated abrasive as the general method of surface preparation**

GOAL

1) **Quantify ability to remove chlorides**
2) **Do chlorides in recycled media increase**
3) **Document achievement of surface profile for PETRONAS approval**



CTR/IMN/007/09	REPORT NO
BRESLE TEST METHOD – ISO8502-6	METHOD
Test Panel	SUBSTRATE
Sponge Jet Sirim's Test-Chloride Test	PROJECT TITTLES
Sponge Jet Silver 30 (Aluminium Oxide)	ABRASIVE
[redacted]	
[redacted]	ABRASIVE CONDITION: 6 Times Recy
[redacted]	SURFACE PROFILE: 25µm – 70µm
[redacted]	RUST GRADE: Grade C
[redacted]	SURFACE TEMPERATURE: 30°C
ore Services Sdn. Bhd.	WITNESSES PARTY: Tanjung Offs
ernational Sdn. Bhd.	APPROVE PARTY: SIRIM QAS I
[redacted]	
maman	LOCATION AREAS: Tanjung Maintenance Services H
	DATE OF TEST: 18 MAC 2009 @ 1700HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
[redacted]		
No. 7	9 mg/m²	Acceptable

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m² or 25ppm.
2) Test are taken randomly and the results serve as a guide only owing concentration and distribution of chloride may not be uniform

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Test Protocol utilized ISO 8502-6: 1995 Bresle Method

- ✓ Chloride contaminated test panels, Rust Grade C, Grade A with existing High Build Marine Coating
- ✓ Test Panels + Target Panels to fully use media and expose it to contaminants with each cycle
- ✓ Average starting chlorides 82 mg/m² then cleaned to Sa2 ½ remaining media blasted on target plate
- ✓ Media recovered, recycled and blasted again repeated for 7 cycles
- ✓ Complete documentation by oversight inspectors

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Test Results

SIRM TEST		Surface Test Bresle	Abrasive Media Test Kitagawa Tube
Test Panel	**Sponge Recycles**	**Plate mg/m2**	**Media mg/m2**
Control	**Not Blasted**	**82**	15
1	New	Error*	20
2	1	Error*	
3	2	14.5	
4	3	14.5	
5	4	11.5	
6	5	11	52
7	6	9	

*** NOTE: The data from the first two blast cycles was later found to be in accurate due to some cross contamination of salt laden water due to a leak in an after cooler unit.**

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Increased recycling improved cleaning efficiency!

- ✓ Results showed that Chlorides do remain in the "Recyclable Encapsulated Abrasive Media" but have no net effect on chloride removal
- ✓ Consistent with earlier testing the "Recyclable Encapsulated Abrasive Media" was extremely effective at Chloride Removal and consistently met the specified requirements
- ✓ Based on results PETRONAS was satisfied and now allows and specifies this process for surface preparation throughout its facilities and assets
- ✓ Contractors now perform paint removal, surface profiling, blasting to Sa 2 ½ visual cleanliness and chloride removal below 25 mg/m² all in one step

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Conclusion

- **"Recyclable Encapsulated Abrasive Media" is an effective DRY method to remove surface contaminants such as chlorides without the use of water or chemicals**
- **Blasting with "Recyclable Encapsulated Abrasive Media" can frequently reduce chloride concentrations to below typically specified levels in a single process and is superior to conventional abrasive blasting in cleaning effectiveness**
- **Cost and Speed of "Recyclable Encapsulated Abrasive Media" is favorable to other technologies which require multi-step procedures such as (abrasive blast + water or chemical wash + final abrasive blast) all to achieve specified levels of surface contaminants**

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Thank You

Complete copies of the Paper as well as full copies of the Independent test report are available if you see me after the presentation or stop by the Sponge-Jet Booth # 607.

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