Sponge-Jet and the Oil and Gas Market

Organized by NACE Jubail Section
Al-Jubail Intercontinental Hotel
Jubail Industrial City
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Sponsored by:

Gulf Energy Solutions Co.
Surface Preparation Solutions for the Oil and Gas Industry

World’s Top Petroleum & Petrochemical Companies use and Specify Sponge-Jet as the best available surface preparation technology.
Appropriate Surface Preparation

Cleanliness Levels:
ISO (SA1, SA2-1/2) or SSPC (SP5, SP10, SP7)

Chloride/Chemical
SSPC (SC1, SC2)

Radiological Decontamination:
to free release

Profiling:
0 to 150-plus microns
0 to 6-plus mils
What are Composite Abrasives?

- Composite abrasives are industry acknowledged, products such as Aluminum Oxide, Dupont Starblast® and Steel Grit
- Known for general low dust, excellent profiling and cleaning capabilities as raw abrasives
- These attributes are enhanced when bonded to sponge, with additional benefits of:
  - Dramatically reduced ricochet and rebound
  - Enhanced surface contaminant removal and retention
  - Exponential waste reduction
  - High productivity
  - Increased worker safety and comfort
  - Dramatically reduced blast-related dust
Composite Abrasives

• It is obvious to coating professionals that coatings applied to an appropriately abrasive blasted surface will out perform coatings applied to a hand-tool or water-prepared surface.
• Composite media/Sponge-Jet Sponge Media™ offers the ability to:
  - Increase the quality of the surface preparation
  - Decrease the cost of surface preparation
  - Decrease the time required to complete preservation projects
• NAVSEA has issued Standard Specifications and Preservation Process Instructions for shipbuilding and repairs that approve the use of Sponge Media in areas formerly prepared with hand-tools
Microcontainment™ Technology

Conventional Abrasive Bonded Into Sponge Media

Conventional Abrasive Blasting Media
Reuse Sponge Media up to 15 Times

- Use less abrasive media
- Lower handling costs
- Reduce waste and disposal costs

Blasting 100sqm, requires either 2,000kg of grit or 200kg of Sponge Jet
Sponge-Jet Total Project Savings

Conventional Abrasive Blasting

Sponge Blasting

40% Lower Total Project Costs

- Media Costs
- Containment
- Overblast & Rework
- Handling Costs
- Disposal Costs
- Air Management

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Sponge-Jet Sponge Media™

Silver Sponge Media with Aluminum Oxide

Brown Sponge Media with Dupont® Starblast

Red Sponge Media with Steel Grit
Value-added Benefits

- Blast near other trades and operating equipment
- Limit over-blasting and rework
- Increase the reliability of rotating equipment and compressors
- Reduce transportation and disposal costs by recycling
- Eliminate most of the risks related to traditional surface preparation methods
Value-added Benefits

• Reduce shutdown
• Extend coating life; lessen future maintenance and downtime
• Achieve workplace health and safety goals
• Profile up to 125 microns
• Works with low pressure compressed air (only 7Bar)
Blast in operating plants
Platform Applications

**Construction:**
- Confined spaces
- Structural steel
- Preparing erection and annular tank weld seams
- Profiling/paint preparation of new structural steel
Platform Applications

Maintenance:
- Oil and gas separators
- Cleaning coke or burned residue from boilers
- Pipes and stacks
- Air intakes
- Compressors
- Quarter Accommodations
- Structures
- Legs
- Separators (2)
- Test separator (1)
- Electrostatic Dehydrators (2)
- Slope vessel (2)
PETROBRAS P-37 Platform Production Separators
Petro/Chemical Refineries:

- Stripping distillation tower interiors/exteriors
- Removing Corrosion Under Insulation (CUI) and rust removal of old structural steel
- Interior/exterior tanks
- Pump externals
- Heat exchange condensers
- Cleaning coke or burned residue from boilers
- Boilers
- Removing iron-stained grinding residue from stainless structures
Piping/Infrastructure:
• Pipeline externals
• Compressor stations
• Pump stations
• Removing failed coating and corrosion on floating roof-top tank covers
• Sponge blasting heat exchange condensers, pump stations and gassifiers
• Spot-blasting pipeline externals; under-group and aerial applications
PETROBRAS:

- Platform P-VI
- Tank blasting project
- Reduced labor by 60% associated with clean-up

"An effective reduction of labor force of 60% was confirmed in comparison to the other abrasive processes... reduction of labor force refers to the night shift responsible for the disposal of residues."
Customers Are Saying…

PEMEX:

- Wherever dust restrictions apply, use an alternative like Sponge-Jet
**Customers Are Saying…**

**BP Oil:**
- No lost time accidents during shutdowns (including eye injuries)
- Clean-up is dramatically faster than grit blasting
- Inspection can be done directly after blasting
- Preferred method for most engineers in refinery

Using the Sponge-Jet system enabled other trades to keep working while blasting is being carried out.

- Safety and Environmental Control departments are very impressed with no lost time accidents during the shutdowns due to grit/foreign bodies getting into people’s eyes.
- The speed of clean-up operations is dramatically faster than grit blasting and the area is clean enough for plant inspection to be carried out immediately after blasting.
- The preferred method for most Engineers running a shutdown.
ExxonMobil:
- Identified as attractive alternative to hand tool and power tool cleaning
- Expect to increase coating life 200% to 700% compared to power tool cleaning
- Dust control is simplified
- Work conditions in adjacent crafts are improved
- Net Savings...
  - 42% on insulated Piping
  - 27% on non-insulated
Blister Generation & Osmotic Drive

- Coatings are semi-permeable membranes subjects to vapor bypass
- Blister formation is generally related to one or more of the following differentials around the coating
  - Pressure
  - Electric Potential
  - Salts or chloride concentrations.
  - Temperature
- These differentials generate an effect known as Osmotic Drive, that allows the pass of vapor or humidity from one side of the coating to the other, finally generating Blisters
- By eliminating or controlling these differentials we will be able to reduce the chance of Blisters to be created
Blistering / Osmotic Drive

FIGURE 1.A
Blistering / Osmotic Drive

![Diagram showing blistering and osmotic drive with labels for steel substrate, chloride contaminant, and coating (membrane).]

**FIGURE 1.C**
Blistering / Osmotic Drive

FIGURE 1.D
Chloride Removal

- Composite Media removes or reduces surface contaminants, such as chlorides from substrates as it prepares the surface.
- This is accomplished in one step rather than the conventional wash / blast / wash procedure.
- Surface chloride levels were reduced from 200 micrograms per square centimeter, down to less than 7mg/cm² (SC2) with single-pass blasting with composite Sponge Media abrasives.
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• This is accomplished in one step rather than the conventional wash / blast / wash procedure.

• Surface chloride levels were reduced from 200 micrograms per square centimeter, down to less than 7mg/cm² (SC2) with single-pass blasting with composite Sponge Media abrasives.
A recent study performed by the MRI labs, concluded that the level of emissions and breathable particles generated by Sponge Media blasting while blasting in an open space, is significantly lower than levels measured on the outside of a filtered blasting cabin while blasting with any of the traditionally used dry abrasive.
Airborne Contaminant Comparison

60 mg/m³

Sand Blasting
Sponge Blasting

40

20

0.05
Offshore is our business

Blast Where You Want.
CHLORIDE REMOVAL

WITH SPONGE-JET’S

“RECYCLABLE ENCAPSULATED ABRASIVE MEDIA”
CHLORIDE REMOVAL

with

“RECYCLABLE ENCAPSULATED ABRASIVE MEDIA”
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
Small cells expand after impact and “vacuum” the surface of small residual dust and contaminants; they also capture fragmenting abrasive and coating.
BACKGROUND ON ENCAPSULATED ABRASIVE MEDIA

Conventional Abrasive Blasting

Encapsulated Abrasive Media
BACKGROUND ON ENCAPSULATED ABRASIVE MEDIA
Encapsulated Abrasive Media blasting can reduce dust levels as much as 98% compared to conventional abrasive blasting.
Overview of Chloride Issue: Why all the concern?

Why Do Coatings Fail?

- Surface Preparation: 75%
- Coating: 10%
- Wrong Coating Selection: 8%
- Wrong Application: 5%
- Environmental: 2%
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)**
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
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
Increased Emphasis on Residual Chloride

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

<table>
<thead>
<tr>
<th></th>
<th>Chloride</th>
<th>Soluble Ferrous</th>
<th>Sulfates</th>
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<tbody>
<tr>
<td>SC 1</td>
<td>0 µg/cm²</td>
<td>&lt;0 µg/cm²</td>
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<tr>
<td>SC 2</td>
<td>&lt;7 µg/cm²</td>
<td>&lt;10 µg/cm²</td>
<td>&lt;17 µg/cm²</td>
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<td></td>
<td>(70 mg/m²)</td>
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<tr>
<td>SC 3</td>
<td>50 µg/cm²</td>
<td>&lt;50 µg/cm²</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>(500 mg/m²)</td>
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</tr>
</tbody>
</table>
South Korean Study Published through IMO

Maximum Allowable Chloride Concentration
(From 12 Separate Technical Sources)

Number of Sources

Maximum allowable chloride concentration mg/ m²
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
1997 First Laboratory Data indicating Encapsulated Media is Effective at Chloride Removal

- Panels contaminated in ASTM B117 Salt Fog Cabinet
- Initial Chloride 400 μg/cm² (4000 mg/m²)
- To achieve less than 10 μg/cm² (100 mg/m²) via standard aluminum oxide blasting required a three step process:
  - Blasting
  - Demineralized water wash
  - Rusting and Re-blasting
- To achieve less than 10 μg/cm² (100 mg/m²) via encapsulated media blasting required a single blast
2001 Study Confirms Encapsulated Media is Effective at Chloride Removal – but no recycling occurred

• 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 µg/cm² to 20 µg/cm² with the coal slag prepared panels
• Remaining chloride levels were consistently below 5 µg/cm² with the encapsulated media prepared panels
Chloride Removal Comparison

![Graph showing chloride removal comparison](chart.png)

Chloride mg/ m²

Test 1 Test 2 Test 3 Test 4

- Before
- Coal Slag
- Encapsulated Media

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Residual Chloride Comparison - A

Contaminated Panels  Blasted w/ Encapsulated Abrasive

200 µg/cm²

100

75

50

25

Panel 1  Panel 2  Panel 3  Panel 4

Blasted - Sponge Media

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Residual Chloride Comparison - B

- Encapsulated Media
- Coal Slag

20 μg/cm²

Panel 1  Panel 2  Panel 3  Panel 4
• Spot repairs on cooling water pipe
• Prior to abrasive blasting, chloride levels were 40 µg/cm² (400 mg/m²)
• 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/cm² (30 mg/m²) detectable limit of the test
• Media Recycling did occur but controls and documentation were limited
Since the control tests failed to evaluate the effects of recycling, questions remained.
2009 Large Offshore Service Company for PETRONAS contracts to perform rigorous tests

SIRM QAS International and a NACE Inspector are selected to oversee testing and protocol.

If Chloride Removal, profiling and cleaning can be accomplished “online” with a single process the cost savings offshore would be significant.
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

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<table>
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<tr>
<th>LOCATION AREAS</th>
<th>Tanjung, Maintenance Services 1</th>
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<tr>
<td>DATE OF TEST</td>
<td>14 MAR 2009 17:00:1 (RS)</td>
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<table>
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<tr>
<th>TEST RESULT</th>
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<td>Test Panel</td>
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<tr>
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Notes: 1) Acceptance criteria = 3000/1% or 25 mg/m² or 25 p.p.m.
2) Test are taken randomly and the results serve as a guide only owing to varying concentration and distribution of chlorides not under control.

- 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
# Test Results

<table>
<thead>
<tr>
<th>SIRM TEST</th>
<th>Sponge Recycles</th>
<th>Surface Test Bresle</th>
<th>Abrasive Media Test Kitagawa Tube</th>
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<tbody>
<tr>
<td>Test Panel</td>
<td>Plate mg/m²</td>
<td>Media mg/m²</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>Not Blasted</td>
<td>82</td>
<td>15</td>
</tr>
<tr>
<td>1</td>
<td>New</td>
<td>Error*</td>
<td>20</td>
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<td>2</td>
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<td>Error*</td>
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<td>7</td>
<td>6</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

* 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.
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

✓ 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
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.

THANK YOU..