The Green Clean: Remove Corrosion & Other Contaminants with Environmentally Responsible Dry Ice

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WHAT IS DRY ICE?

• Generic name for solid CO$_2$
• By-Product - industrial processes
• Made from reclaimed CO$_2$
• Scrubbed, liquefied, transported
WHAT IS DRY ICE CLEANING?

The dry ice cleaning process uses solid CO₂ “dry ice” as the media propelled at high velocities.

A unique feature of dry ice is its ability to sublime upon impact leaving no secondary waste.
BENEFITS OF DRY ICE CLEANING

- Faster than traditional methods
  - Clean on line, in place, while hot
  - Less down-time = more run-time
- Produces a cleaner clean
  - Cleans in tight spaces with precision
  - Does not leave residue
- Non-Abrasive
  - Will not etch, profile, or damage most metals
- Dry cleaning process
  - Non-Corrosive
  - Non-Conductive
- Environmentally Friendly
  - No secondary waste stream
  - Eliminate or reduce chemicals
  - Non-Toxic and Food-safe
  - Dry ice CO$_2$ is recycled
HARDNESS OF DRY ICE

Mohs Hardness Scale for Mineral

1 – Talc
2 – Gypsum (Dry Ice ≈ 2.0)
3 – Calcite (Baking Soda ≈ 2.5)
4 – Fluorite (Corn Cob ≈ 4.5)
5 – Apatite (Walnut Shells ≈ 5.5)
6 – Feldspar (Crushed Glass ≈ 5.5)
7 – Quartz
8 – Topaz (Garnet ≈ 8.0)
9 – Corundum (Alum. Oxide ≈ 8.5)
10 – Diamond
HOW DRY ICE BLASTING WORKS

- **Pellet Kinetic Effect**
  
  Particle has little hardness, velocity is key

- **Thermal Shock Effect**
  
  Surface effect only
  
  Temperature gradient created between contaminate & substrate

- **Gas Expansion Effect**
  
  Volume expands 800 times when solid converts to gas
  
  Pulls contaminate off of substrate from the inside out
FORMS AND BENEFITS OF PARTICLE SIZE

**3mm Pellets**

- More Mass = more Aggression
- Usually Better thick, brittle contaminates

**MicroParticles (0.3mm)**

- Less Mass = Less Aggression
- Usually Better for thin, hard contaminates
Benefits Of Particle Size

3.0 mm dia. Pellets

0.3mm dia. MicroParticles

**Safe**: Can be fragmented or split down to 0.6 mm dia.

**Greater Flux Density**: 1,00X more Surface Strikes = more uniform clean

**Quieter**: Less air required to fully accelerate

**Safer**: Less kinetic energy on delicate substrates

**Economical**: Less dry ice & less air
**DRY ICE DELIVERED**

- 3mm *high density* dry ice is available from a variety of industrial gas companies.
- It can be delivered directly to the job site.
- Dry ice will be delivered in an insulated container. The shelf life is generally 5-7 days (~5-10% sublimation per day), but is dependent upon application (gradually softens).
MOBILE PRODUCTION
PORTABLE AIR SYSTEMS

The Sullair 375HH rotary screw portable air compressor delivers 375 cfm at 200 psig or 10.6 m³/min at 14 bar.

Portable diesel compressors are a necessity to run your blasting operation, but they often supply hot and moist air, which can alter the integrity of your ice and hamper the performance of your blasting system.

- The Cold Jet After Cooler will remove up to 80% of moisture from the ambient air.
- It will cool the compressed air, which can reach temperatures of 180° - 200° F to within approximately 5° of the ambient temperature.
## VALUE OF DRY ICE BLAST CLEANING

Consider cleaning from a beginning to end process, dry ice blasting eliminates many costly and time consuming steps in a multi-stage cleaning process.

<table>
<thead>
<tr>
<th>Cleaning Stages</th>
<th>Common Steps &amp; Considerations</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Pre-Cleaning</td>
<td>1. Scheduled outage&lt;br&gt;2. Cool down production line&lt;br&gt;3. Isolate &amp; Purge&lt;br&gt;</td>
<td>Dissemble&lt;br&gt;</td>
</tr>
<tr>
<td>2) Cleaning</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Application: Cleaning Precision Rotational Equipment (Power Generation)**

**Applications**
- Turbines
- Compressors
- Motors
- Generators

**Previous Method**
- Hand clean, light media blast (corn, walnut, soda), chemical clean

**Cold Jet Advantages**
- Faster, better clean, greater production efficiencies, minimized re-deposition (not as dusty and dirty), minimize hoarding
Cleaning on-board production equipment improves efficiency by reducing gas and oil consumption.
Power Generation

Annual cleaning of salt and carbon buildup from an 8,000 kilowatt turbine used to propel a pump transporting gas to a cavern system; **90% reduction in time.**

Without Cold Jet = 5 days by hand

With Cold Jet = 4 hours with DIB
ELECTRICAL

Electrical control panel for a compressor, motor or other operating equipment

Without Cold Jet

With Cold Jet

Sensitive Electrical
Excellent performance results cleaning Heat Exchangers, such as plate exchangers, fin-fans (convection section or re-boilers), shell side tube bundles, and exterior tube shells.

Without Cold Jet

With Cold Jet

“"We have found that since cleaning (Fin-Fans using Dry Ice Blast Cleaning) that the heat exchange is a lot better than before, to the extent that fans are being shut off that are normally operating at this time of year. Plant operations personal have also noticed a big improvement in their ability to cool the process."

Shell Canada – Jumping Pound Complex
Arial Coolers

Cleaning Fin-Fan with shaved ice at low air pressures removes surface contaminants for improved efficiency, allowing shut down of some fans in the cooler as process temperatures drop.
HEAT EXCHANGERS

Substation Transformer Oil Cooler Heat Exchanger

Cleaning the coils with dry ice while the fans are running and the heat exchanger is operating.
RADIATORS
**Application:** Hydrocarbon spills, coke, heavy ends, paraffin, sulphur, carbon, etc. (General Cleaning)

**Applications**
- Production units
- Loading areas
- Any fire damage on site
- Rotary pumps
- Rigs
- Tanks/Vessels
- Pipeline
- Electrical components

**Previous Method**
- Hydro blasting, chemical cleaning, grit blasting

**Cold Jet Advantages**
- Faster, better clean, with no secondary waste stream, no hoarding, better heat transfer
GENERAL MAINTENANCE

Remove oil, grease & dirt from pumps, valves, motors, fittings, walls, and floors.

Cleaning in Action

Asphalt Removal

Dirt and Debris on motor

Removing Corrosives from Exterior Refinery Vessel

Oil, Grease & Dirt from a bearing housing
Reduce risk of fire by cleaning spilled hydrocarbons, asphaltines, coke, heavy ends, paraffins, sulphur, carbon, from spill prone areas

Cleaning in Action

- Cleaning of a pigging mishap in a compressor building that resulted in a major spill
BITUMEN, HEAVY OIL & TAR REMOVAL
FIRE RESIDUE

Cleaning of heavy carbon buildup caused by electrical fires from cabinet components and closed or open bus bars (to avoid arcing)
GENERAL MAINTENANCE

Overhaul of compressor pistons used in a natural gas plant or refinery.

Without Cold Jet

With Cold Jet

Piston Head

Cleaning in Action
APPLICATIONS

Non-Destructive Testing - Wet Florescent Magnetic Particle Inspection (Surface Preparation)

**Utilization:** Surface prep of Pressure Vessels, Production and Storage Vessels, Rotating equipment components, Pipeline, Production equipment

**Previous Method:** Grit Media Blasting, Hand Cleaning (wire brushing), Hand Grinding

**CJ Advantages:** Faster, better clean (typically done during a critical path outage), no peening, or packing, open potential cracks allowing dye penetrant access, minimization of pre-job preparation, no hoarding, no secondary waste stream to remove (like grit) no damage to valves, pumps, compressors, etc.
Can you guess how many different surfaces?

1) Aluminum
2) Steel
3) Plastic
4) Rubber
5) Glass
PAINT REMOVAL

Due to the chemical components of paint, including lead in some cases, all traditional methods of cleaning and removal leave an extremely hazardous secondary waste stream (water, sand, soda, walnut shell etc.)

Paint can be a difficult medium for removal as there are many external factors that influence the actual paint, or the substrate it's on.

There are 1000 different paints on a 1000 different surfaces applied by 1000s of different people.

NO TWO PROJECTS ARE THE SAME
SURFACE PREPARATION

When prepping a surface for painting, it is essential that it be free of surface contaminants, including oils, debris, micro-organisms and loosely adhered oxidation (rust).
SURFACE PREPARATION

Cleaning of component parts in preparation for repainting and refitting.

Without Cold Jet

With Cold Jet

Well Head
MIXED MEDIA

Mixed Media

• less abrasive usage 80-95% less
• no dry time
• 90% production/clean rate of traditional sand blasting
• no masking
• minimal – if any – containment
• surface profile achieved 2-5 mils
• no personal air supply i.e. low dust levels
• SP 10/SA 2.5 cleanliness level
Abrasive Mix Blasting
Conclusion/Questions