Sand-less SANDBLASTING

By Jeffrey Lapointe

Dry ice blasting - an overview

Dry ice blasting is a relatively new cleaning process using solid CO_2 pellets. The pellets sublimate (convert directly from a solid blast pellet to a vapor) leaving no residue. The process has grown considerably in popularity as a replacement for common sand blasting, largely due to its environmental and production benefits. Because of tremendous environmental regulations and their need to reduce costs, industry has discovered that it is in its best interests to minimize wastes. There is also a growing consciousness among professionals concerning the global environmental impact of their production practices. Such benefits are accentuated due to performance gains through dry ice blasting — little or no production downtime, quality of clean equipment and negligent damage.

What is dry ice?

Dry ice pellets are made by taking liquid carbon dioxide from a pressurized storage tank and expanding it at ambient pressure to produce snow. The snow is then compressed with a die to make hard pellets.

The process

With the dry ice blasting process, CO_2 particles are propelled at supersonic speed, impacting and thus cleaning a given surface. The particles are accelerated by compressed air, just as with other blasting methods. There are three specific steps involved in dry ice blasting.

Step #1 - Energy Transfer. Dry ice pellets are propelled out of the blasting gun at supersonic speed and impact the surface. The energy transfer knocks off the contaminant without abrasion. The force of this impact is the primary means of cleaning.

Step #2 - Micro-Thermal Shock. The cold temperature of the dry ice pellets hitting the contaminant creates a micro-thermal shock (caused by the dry ice temperature of 79°C) between the surface contaminant and the

substrate. Subsequent cracking and delamination of the contaminant furthers the elimination process.

Step #3 - Gas Pressure. In the final phase of the process the pellet explodes on impact. As the pellet warms, it converts to a harmless gas, which expands rapidly underneath the contaminant surface. This forces off the contaminant from underneath. The contaminant is then relocated, typically falling to the ground. Since the CO_2 evaporates, only the contaminant is left for disposal.

Operating details

A few details need to be considered to operate dry ice blasting equipment. Although using dry ice is relatively safe, basic safety matters do need to be followed. Ear protection is necessary, as the process can get incredibly noisy. Second, because the temperature of dry ice can be as low as -79°C (-109°F), gloves should always be worn when working with it. Finally, as with any dusty area, a mask is recommended for eye and nose protection. Wearing standard eye and ear protection for sand blasting or pressure washing is just as acceptable for dry ice blasting. Never point the gun at another person.

Blasting in an enclosed area is safe with proper ventilation. Because CO_2 is 40 percent heavier than air, placement of exhaust fans at or near ground level is necessary when blasting in an enclosed area. In an open shop environment, existing ventilation is sufficient to prevent undue CO_2 buildup.

As for air system requirements, a large number of applications using dry ice blasting equipment only require between 80 to 100 psi and 120 to 150 CFM. An evaluation of system air is usually recommended to determine if the facility has sufficient capabilities to run dry ice blasting equipment at the levels desired for each specific application.

Dry ice blasting compared to traditional methods

Figures 1 and 2 give a perspective of how dry ice blasting compares with traditional cleaning methods — sand blasting, solvents and others.

Cleaning Method Comparison

Issue	Traditional	Dry Ice Blasting
Equipment Downtime	Cleaned in dedicated cleaning area; Disassembly/reassembly; Drying time required	Equipment can be cleaned in place; Dry process - equipment restart immediately after cleaning
Hazardous Waste	Intensive hand scrubbing; Lengthy cleanings; Follow-up cleaning-up can be lengthy	Dramatically reduced - often completed in a quarter of time or less
Quality of Cleaning	Poor to average	Excellent
Potential Equipment Damage	Grit abrasions; Grit contamination; Movement of equipment to and from cleaning area	No equipment damage; Preventive maintenance very realistic as labor hours are significantly reduced
Safety	Health threats from solvents; Water-based cleaning pose hazards around electrical equipment; Threats to environment	Standard safety precautions; Dry process - safe around electrical equipment
Cost	Cleaner becomes additional hazardous waste; expensive solvents; Additional labor	Minimal - cost of dry ice

Figure 1

Blast Cleaning Comparison Chart

Blasting Cleaning Technique	Waste for Disposal	Abrasive	Toxic	Electrically Conductive
Dry Ice	No	No	No	No
Sand	Yes	Yes	No*	No
Glass Beads	Yes	Yes	No*	No
Walnut Shells	Yes	Yes	No*	No
Steam	No	No	No	Yes
Solvents	Yes	No	Yes	Yes

** Each of these blast-cleaning materials becomes contaminated upon contact if used to clean hazardous objects. These materials are then classified as toxic waste requiring safe disposal along with the removed contaminates.*

Figure 2

Benefits of dry ice blasting technology

Dry ice blasting provides a number of benefits over competing processes.

Decreased downtime through cleaning in-place. Equipment can be cleaned in-place and hot in most situations, dramatically shortening downtime and labor necessity for disassembly, transport of the equipment to and from the designated cleaning area, and reassembly as well as cool-down and subsequent reheating.

Faster and more thorough cleaning. Dry ice blasting provides a superior cleansing in less time than scrubbing with abrasive pads or wire brushes. The blasting method cleans in crevices that can't be reached by hand. As a result, equipment runs more efficiently and potential leaks are revealed earlier, possibly preventing major system failures.

Nuclear power plant decontamination – Pacific Northwest. Primary benefit: waste disposal cost savings

Dry ice blasting is currently being used in a six-month project to clean the inside of the containment dome of a nuclear power plant in the Pacific Northwest. The dome has built up dirt, oils and other contaminants that are radioactive and need to be removed. The primary benefit of cleaning with dry ice for this application is the tremendous savings in waste disposal costs. Since dry ice sublimates on contact, the facility is saving hundreds of thousands of dollars in secondary disposal costs. Traditional methods such as sand blasting would result in an additional radioactive contaminant once in contact with the target surfaces and would have to be removed as hazardous waste.

Electric motor cleaning – Visalia Electric. Primary benefit: environmentally safe cleaning

Visalia Electric in Visalia, Calif. has been using dry ice blasting to clean large generators and industrial electric motor rotors and windings. Previously, they cleaned with walnut shells and occasionally with sand and chemical solvents. Due to increasing and stricter environmental regulations, Visalia turned to dry ice cleaning. As a result, they are now well within the EPA guidelines. They are also saving close to $600 per week in disposal costs.

Industrial equipment cleaning – Malden Mills. Primary benefit: faster cleaning

Malden Mills of Lawrence, Mass., manufacturers of Polartec clothing, is currently using dry ice blasting to clean large industrial tumbler dryers. The dryers have become coated with years of fabric residues. Previously, they tried cleaning with chemical solvents, pressure washing and hand scrubbing. One tumbler took up to two workers two full workweeks to thoroughly clean. Upon using dry ice cleaning, the completion time was reduced to only one day.

Disaster recovery – Mold Masters Inc. Primary benefit: more thorough cleaning

Mold Masters in Anoke, Minn., turned to dry ice blasting as a means of providing a faster and more thorough removal of black mold from wood at residential home sites. A home infested with black mold typically required three technicians working three days with hand sanders. The cleaning time was reduced to two technicians working no more than one day. The results were more thorough as the dry ice cleaned cracks and crevices that would have proven unreachable with other methods.

Elimination of equipment damage. Cleaning methods such as sandblasting leave an aggressive and abrasive effect on the surface. They can actually remove part of the surface, changing its structure considerably. Dry ice is non-abrasive and does not change a surface's structure. Rather, the process lifts the contaminants away. Also, because equipment can now be cleaned in place, potential damage from moving equipment to and from a designated cleaning area is eliminated.

Reduction or elimination of solvents. Dry ice pellets are just carbon dioxide and thus present no concerns pertaining to toxicity that are inherent in solvents. This can be a critical advantage for companies needing to comply with environmental regulations or improve worker safety.

Reductions in waste disposal. With some cleaning methods, including solvents and sand blasting, the cleaning agent becomes a secondary contaminant and must be disposed of

Photos shows contaminated valve in place tagged for cleaning.

Cleaning nearly complete with valve still in place. Note there is little debris to remove for disposal

as toxic waste in addition to the primary contaminant. Because dry ice pellets vaporize upon contact, the only waste created is the contaminant itself. This alone can result in significant waste and cost reduction.

Increased safety. Dry ice blasting pellets are non-toxic and non-hazardous, which benefits the environment and eliminates the risk of contamination for employees, end products and equipment. **PE**

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