Indoor Environment
CONNECTIONS Online

March 2003

Contractors Toolbox
Remediation Using Dry Ice Blasting By Charlie Cochrane

Dry ice blasting or cleaning is not a new technology. The process has been around for a number of years in various forms. At first glance, the process looks similar to sand blasting but uses a different aggregate. In truth, dry ice blasting is very different from sand blasting and fills a void where sand blasting is too aggressive to underlying substrates or creates too much residue.

Dry ice cleaning uses frozen carbon dioxide particles as a blasting means. As with sand blasting, the pellets are driven by compressed air through a gun on to the surface to be cleaned. Unlike sand blasting, the dry ice changes from a solid directly into a gas, leaving no residue other than what has been removed. The fact that there is no additional residue has made this method of cleaning valuable in the remediation of hazardous materials where the process adds nothing to the volume of material to be disposed.

The cleaning effect of dry ice is based on three principles: 1) to utilize the thermal effect that the dry ice exercises on the impurities, 2) to utilize the kinetic effect, which the dry ice, by virtue of its speed and its state, physically moves the impurities away from the unit to be cleaned, and 3) the volume extension or sublimation.

- Thermal effect: Dry ice pellets have a temperature of -79 degrees Celsius. The impurities that are hit will be cooled down tremendously then shrink and loosen.
- Kinetic effect: When dry ice pellets leave the nozzle of the blasting pistol, they have kinetic energy. This kinetic force dislodges the surface material. It is the same principle as the sand blasting operations. Although both sandblasting and dry ice blasting use kinetic energy, dry ice pellets are softer and less aggressive than sand aggregates.
- Sublimation effect: When a dry ice pellet strikes a surface, it is immediately transformed from a solid into gas. This process results in the fact that the volume is increased approximately 700 times and causes all loose and brittle units to be torn away from the solid surface where the pellet hits.

In some cases, the thermal effect will be most important (i.e. bitumen, resin, glue). In other cases, the kinetic effect will be most important (i.e. brittle coverings).

As mentioned earlier, dry ice blasting is less aggressive than sand blasting and, as such, is not a replacement to sand blasting but could be used in applications where sand blasting would damage the underlying substrate. Dry ice blasting can be used on processing machinery such as extrusion machines, printing and book binding machines and automobile parts without damage to electrical wiring or other soft material that would be damaged by sand blasting. While dry ice blasting is not new, the value and benefits of dry ice blasting are only now being realized in mold remediation.

There are a growing number of examples where dry ice blasting is a natural fit in mold remediation, predominantly as a labor saving tool. Applications such as carpet adhesive removal, structural wood ablation, duct liner removal and hard surface cleaning lend themselves to the use of dry ice.

In the removal of carpet adhesives and mastics that are impacted by mold, dry ice blasting replaces scrapers, heat guns and chemical applications. With structural wood ablation where the outermost layer of wood is to be removed, dry ice blasting is faster than sanding and is far superior at getting into corners, joints and gaps in the wood. As with sanding, dry ice ablation of laminated beams may impact the structural strength and therefore it is important to consult with the product manufacturers.

Dry ice blasting has recently been used in removing internal insulation from HVAC systems including air handlers, ductwork and other components. In air handlers, the insulation and adhesive can be removed along with loose rust and scale deposits. Ice blasting systems that mount on robotic systems for remediation in duct systems and other remote spaces are now available.
Ice blasting systems come in two basic designs. These designs are single-hose and dual-hose configurations. The dual-hose systems use one hose for compressed air and a second hose for the pellets. The pellets are drawn through the hose to the gun or pistol by the vacuum created by the compressed air, much like a two-hose painting system. The two-hose systems are typically less expensive but lack versatility in nozzle configurations and are less aggressive than single-hose systems.

The single-hose systems combine the pellets and compressed air at the primary unit. The rate at which the pellets are introduced is controlled by a rotary plate or air lock mechanism, which allows the operator to adjust the volume of material and thus the aggressiveness of the cleaning. The single-hose systems typically offer more flexibility in nozzle configurations and levels of aggressiveness. The single-hose design is also adaptable to robotic systems for remote cleaning.

The machines also differ in the form of dry ice that they use. There are block shaver systems and pellet systems. The block shaver system uses solid blocks of dry ice to shave and create the aggregate. The shavings shatter under their own weight into smaller structures that are carried to the gun.

The pellet systems use pre-manufactured carbon dioxide pellets that are commonly available. These pellets range from .04 to .12 inches in diameter and are far more dense than the dry ice shavings, resulting in greater kinetic energy. The pellet system also delivers a highly uniform aggregate to the surface to be cleaned and gives greater consistency in the cleaning process.

Other issues to consider include compressed air needs and the length of the hoses. Some designs limit the hose length to 15 feet while others allow up to 50 feet and more. As with sand blasting, dry ice cleaning is far from quiet and does not lend itself to all applications. However, the technology does offer benefits in a number of mold applications and opens up new markets for those in the field of remediation.

Charles W. Cochrane is president of Cochrane Ventilation Inc. in Wilmington, Mass., and is a past president of National Air Duct Cleaners Association. You can reach him by calling (800) 974-9055 or by email at IAQCVI@aol.com.