Today, CO$_2$ blasting is being effectively used in a wide array of applications from heavy slag removal to delicate semiconductor and circuit board cleaning. Imagine a process that can be used on-line without damaging equipment or requiring a machine “teardown”. Unlike conventional toxic chemicals, high pressure water blasting and abrasive grit blasting, CO$_2$ blasting uses dry ice particles in a high velocity air flow to remove contaminates from surfaces without the added costs and inconvenience of secondary waste treatment and disposal.
INTRODUCTION

In the early 1930’s, the manufacture of solid phase carbon dioxide (CO₂) became possible. During this time, the creation of “dry ice” was nothing more than a laboratory experiment. As the procedure for making dry ice became readily available, applications for this innovative substance grew. Obviously, the first use was in refrigeration. Today, dry ice is widely used in the food industry for packaging and protecting perishable foods.

In 1945, stories exist of the U.S. Navy experimenting with dry ice as a blast medium for various degreasing applications. In May 1963, Reginald Lindall received a patent for a “method of removing meat from bone” using “jetted” carbon dioxide particles. In November 1972, Edwin Rice received a patent for a “method for the removal of unwanted portions of an article by spraying with high velocity dry ice particles”. Similarly, in August 1977, Calvin Fong received a patent on “Sandblasting with pellets of material capable of sublimation”.

The work and success of these early pioneers led to the formation of several companies in the early 1980’s that pursued the development of dry ice blasting Technology. In 1986, Dr. Newell Crane founded Cold Jet Inc.

TECHNOLOGY EVOLUTION

Dry ice pelletizers and blast machines entered the industrial markets in the late 1980’s. At this time, the equipment manufactured the solid CO₂ particles and blasted the dry ice particles all within one unit. These systems required a source of liquid CO₂ as well as compressed air. The physical size of the equipment (6ft (1.8m) x 8ft. (2.4m) x 10ft. (3m)) made mobility difficult and often access to applications was impossible. Furthermore, the high capital cost (~$200,000) of these earlier machines was prohibitively high for all but a few applications. The early integrated systems required 250 to 300 PSI (17 to 21 bar) of air pressure to be effective. The corresponding sound level at these high pressures was in access of 135 dB.

By the early 1990’s, the requirement for a dry ice pellet distribution infrastructure was realized. By having pellet delivery, the pellet making process could be separated from the pellet blasting process. Pellets are now delivered in insulated urethane containers that vary in size or pellet amount from 100 lbs. to 1200 lbs. (45 to 545 kg). While the container is sealed, the pellets will stay “good” for 5 to 7 days. The sublimation rate is approximately 5% per day. Once the seal is broken and the lid is opened, the pellets should be used within 2 to 3 days depending on climate.
By separating the pellet manufacturing from pellet blasting process, the size and cost of the blast equipment was greatly reduced. A blast unit could be purchased for $40,000 to $60,000 and the CO₂ pellets were slowly becoming available in portions of the country for $0.35 per pound ($0.77 per kg). At this point, the capital cost and operating cost of the equipment as well as the smaller blast unit size (48 in. (1.2m) x 3 in. (0.8m) x 4 in. (1.2m)) opened new markets to the fledgling industry. The blast equipment still required 200 to 300 PSI (13.8 to 20.7 bar) air pressure to be effective. Since most plant air systems produce 70 to 100 PSI (4.8 to 6.9 bar), an expensive air compressor had to be purchased along with the CO₂ blasting equipment. Also, the noise level of the equipment was still high, 130+ dB.

By 1994, aerospace technology was applied to the blast nozzle design as well as the pellet flow within the hopper. The result was a dry ice blast system that effectively cleaned at shop air pressures (80 PSI or 5.5 bar) and the noise levels dropped to a range of 90 dB to 115 dB. The overall size of the blast equipment was reduced to 45 in. (1.1m) x 20 in. (0.5m) x 40 in. (1.0m) and 250 lbs. (114 kg). Also, pellet availability was increasing and the pellet price was dropping to $0.25 per pound ($0.55 per kg) in many markets.

Today, the price range of dry ice blasting equipment varies from $10,000 to $40,000 depending on size and type of unit. Some blast systems are as small as 30 in. (0.7m) x 18 in. (0.4m) x 40 in. (1.0m) and weight 115 lbs. (52.3 kg). The pellet price in some markets is as low as $0.15 per pound ($0.33 per kg). The average pellet consumption rate is approximately 1.7 pounds per minute.

**WHAT IS DRY ICE?**

Dry ice is the solid form of carbon dioxide (CO₂), which is a colorless, tasteless, odorless gas found naturally in our atmosphere. Though it is present in relatively small quantities (about 0.03% by volume), it is one of the most important gases we know of.

CO₂ is a natural medium, which serves many life sustaining purposes. It is a key element involved in the carbon cycle; it is the only source of carbon for the carbohydrates produced by agriculture; it stimulates plant growth; and it helps to moderate the overall temperature of the earth. Animal respiration is believed to add 28 million tons of carbon dioxide per day into the atmosphere. By contrast, the U.S. CO₂ industry can supply only 25,000 tons per day and 95% of this amount is from by-product sources, or less than 0.04% of the other sources combined.

With a low temperature of -78°C, dry ice solid has an inherent thermal energy ready to be tapped. At atmospheric pressure, solid CO₂ sublimes directly to vapor without a liquid phase. This unique property means that the blast medium
simply disappears, leaving only the original contaminant to be disposed of. In addition, cleaning in water sensitive areas (e.g. in the vicinity of electrical cabinets) is now practical.

The grade of carbon dioxide used in blasting is the same as that used in the food and beverage industry and has been specifically approved by the FDA, the EPA and the USDA. Carbon dioxide is a non-poisonous, liquefied gas that is both inexpensive and easily stored at work sites. Of equal importance, it is non-conductive and non-flammable.

CO₂ is a natural by-product of several industrial manufacturing processes such as fermentation and petrolchemical refining. The CO₂ given off by the above production processes is captured and stored without losses until needed. When the CO₂ is returned to the atmosphere during the blasting process, no new CO₂ is produced. Instead, only the original CO₂ by-product is released.

**DRY ICE BLASTING MEDIUM MANUFACTURE**

In dry ice blasting, there are several methods used to manufacture the dry ice blasting medium. One technique is to shave dry ice granules from solid dry ice block at the blasting machine. This generally produces sugar-crystal sized dry ice granules, which must be used quickly due to fast sublimation (due to their high surface area-to-volume ratio).

Another technique is to manufacture hard pellets of dry ice in a pelletizer and then immediately blast with the pellets or store the pellets in an insulated container until the pellets are required. These pellets are generally on the order of 2 to 3 mm in diameter, and 0.3 to 1 cm in length. In this method, dry ice is manufactured by flashing pressurized liquid CO₂ into snow, followed by compression of the snow into solid form. The snow is either directly nuggetized into pellets (mechanical compression) or is extruded into solid pellet form through a die under hydraulic pressure. The latter process allows for more efficient conversion from the liquid phase to the solid phase. Generally, it is desirable to have pellets that are well compacted, to minimize entrapment of gaseous CO₂ and/or air that may affect product quality. As can be seen in Table I, the yield achieved when flashing liquid carbon dioxide into snow increases as the temperature of the liquid CO₂ decreases, so it is important to pre-chill the incoming liquid CO₂ via heat exchangers with the outgoing CO₂ vapor. Figure 1 is a block diagram showing a basic pelletization process.
FIGURE 1. Pelletization Process.

Several manufacturers make dry ice pelletizers which may prove beneficial to have on-site for customers with high pellet demand. Facilities required for such an arrangement are generally as follows: a refrigerated liquid CO\textsubscript{2} tank, a pelletizer, and liquid CO\textsubscript{2} lines to reach the equipment. Some manufacturers make combined dry ice pelletizer/blast machines that manufacture dry ice and blast all in one operation. Facilities required for such an arrangement are: An air
compressor (typically either 120 PSI at 250 scfm or 350 PSI at 250 scfm), a liquid CO2 tank, a pelletizer/blast machine, compressed air hose and liquid CO2 lines to reach the equipment, blast hose from the machine to the blasting operation, and the appropriate nozzle(s) for the application. This equipment is best suited to high volume, continuous blasting applications where the cost savings of manufacturing pellets on-site justifies the capital expenditure for the system.

HOW DOES DRY ICE BLASTING WORK?

Dry ice particle blasting is similar to sand blasting, plastic bead blasting, or soda blasting where a medium is accelerated in a pressurized airstream (or other inert gas) to impact the surface to be cleaned or prepared. With dry ice blasting, the medium that impacts the surface is solid carbon dioxide (CO2) particles. One unique aspect of using dry ice particles as a blast medium is that the particles sublimate (vaporize) upon impact with the surface. The combined impact energy dissipation and extremely rapid heat transfer between the pellet and the surface cause instantaneous sublimation of the solid CO2 into gas. The gas expands to nearly eight hundred times the volume of the pellet in a few milliseconds in what is effectively a “micro-explosion” at the point of impact. Because of the CO2 vaporizing, the dry ice blasting process does not generate any secondary waste. All that remains to be collected is the contaminant being removed.

As with other blast media, the kinetic energy associated with dry ice blasting is a function of the particle mass density and impact velocity. Since CO2 particles have a relatively low hardness, the process relies on high particle velocities to achieve the needed impact energy. The high particle velocities are the result of supersonic propellant or airstream velocities.

Unlike other blast media, the CO2 particles have a very low temperature of -78°C. This inherent low temperature gives the dry ice blasting process unique thermodynamically induced surface mechanisms that affect the coating or contaminant in greater or lesser degree, depending on coating type. Because of the temperature differential between the dry ice particles and the surface being cleaned, a phenomenon known as “fracking” or thermal shock can occur. As a material temperature decreases, it becomes embrittled, enabling the particle impact to break-up the coating. Refer to Figures 2 and 3.
FIGURE 2. Thermal shock induces micro-cracking in the surface coating.

FIGURE 3. CO₂ gas expansion and pellet kinetic effects break away and remove coating particles.

Also, the thermal gradient or differential between two dissimilar materials with different thermal expansion coefficients can serve to break the bond between the two materials. This thermal shock is most evident when blasting a non-metallic coating or contaminant bonded to a metallic substrate.
Even at high impact velocities and direct “head-on” impact angles, the kinetic effect of solid CO₂ particles is minimal when compared to other media (grit, sand, plastic bead, etc.). This is due to the relative lack of hardness of the CO₂ particles and the almost instantaneous phase change to a gas on impact, which effectively provides an almost nonexistent coefficient of restitution in the impact equation. Because CO₂ blasting can be optimized to be, in effect, non-abrasive, the process may be applied to a wide range of materials without damage. Soft metals such as brass and aluminum cladding can be CO₂ blasted for the removal of coatings or contaminants without creating surface stresses (pinging), pitting, or roughness.

**BLAST MACHINE TYPES**

There are two general classes of blast machines as characterized by the method of transporting pellets to the nozzle: two-hose and single-hose systems. In either type of system, proper selection of blast hose is important because of the low temperatures involved and the need to preserve particle integrity as the particles travel through the hose.

In the two-hose system, dry ice particles are delivered and metered by various mechanical means to the inlet end of a hose and are drawn through the hose to the nozzle by means of vacuum produced by an ejector-type nozzle. Inside the nozzle, a stream of compressed air (supplied by the second hose) is sent through a primary nozzle and expands as a high velocity jet confined inside a mixing tube. When flow areas are properly sized, this type of nozzle produces vacuum on the cavity around the primary jet and can, therefore, draw particles up through the ice hose and into the mixing tube where they are accelerated as the jet mixes with the entrained air/particle mixture. The exhaust Mach number from this type of nozzle, in general, is slightly supersonic. Advantages of this type of system are relative simplicity and lower material cost, along with an overall compact feeder system. One primary disadvantage is that the associated nozzle technology is generally not adaptable to a wide range of conditions (i.e. tight turns in a cavity, thin-wide blast swaths, etc.). Also, the aggression level and strip rate of the two-hose system is less than that of comparable single-hose blast machines.

In a single-hose system, particles are fed into the compressed air line by one of several types of airlock mechanisms. Reciprocating and rotary airlocks are both currently used in the industry. The stream of pellets and compressed air is then fed directly into a single hose followed by a nozzle where both air and pellets accelerate to high velocities. The exhaust Mach number from this type of nozzle is generally in the 1.7 to 3.0 range, depending on design and blast pressure. Advantages of this type of system are wide nozzle adaptability and the highest available blast aggression levels. Disadvantages include relatively higher material cost due to the complex airlock mechanism.
Blast machines are also differentiated into Dry Ice Block Shaver Blasters and Dry Ice Pellet Blasters. The Block Shaver machines take standard 60 lb. dry ice blocks and use rotating blades to shave a thin layer of ice off the block. This thin sheet of dry ice shatters under its own weight into sugar-grain sized particles. These particles then fall into a funnel for collection. A two-hose delivery system is used to transfer the particles at the bottom of the funnel to the surface to be cleaned. The low mass of these particles combined with the inefficient two-hose system limits the block shavers to light duty cleaning. Because the shaved ice machines deliver a particle blast with high flux density (Number of particles striking a square area of surface per second), they are effective on thin moderately hard coatings such as air dried oil based paint. The disadvantage of the ice shaver is that the particle size and flux density are fixed, as well as, the particle velocity.

In contrast, Pellet Blast machines have a hopper that is filled with pre-manufactured CO₂ pellets. The hopper uses mechanical agitation to move the pellets to the bottom of the hopper and into the feeder system. As stated earlier, the pellets are extruded through a die plate under great pressure. This creates an extremely dense pellet for maximum impact energy. The pellets are available in several sizes, ranging from 2 mm to 3 mm in diameter. With a single-hose delivery system, the final pellet size and blast flux density exiting the nozzle are governed by the type of blast hose (hose diameter and interior wall roughness) and nozzle used. Because of its design, the single hose pellet blast units are capable of “dialing-in” the correct blast type needed for a wide range of individual coatings or contaminate removal. For example, soft coatings such as rubber, silicone, foams and waxes, release agents, food ingredients, etc. need large pellets with low flux density for maximum strip rate and efficiency. These coatings require maximum thermal energy (i.e. pellets with large mass) and large spacing between pellets (i.e. low flux density) for optimum cleaning performance. In contrast, hard coatings such as paints, varnish, baked on sugars, carbon build-up, etc. require smaller particle size with high flux density and high particle velocity.

Blast machines are further differentiated into all-pneumatic and electro-pneumatic types. All-pneumatic machines have particle feed mechanism and controls operated pneumatically. This may include the use of air motors. The advantage of such a machine is the availability of compressed air at the blast locations, especially outdoors. One disadvantage is that the operation of the machine may be susceptible to disruption due to moisture or contamination in the compressed air supply. In addition, these machines are more prone to freeze-ups and are better suited for light duty spot cleaning applications. Also, if the machine is powered by an air motor, it will have a continuous exhaust of oily air. This same air motor can be easily flooded with water if the air system is not adequately dried.
Electro-pneumatic machines are truly “environmentally friendly” because there is no oily exhaust and these machines are more tolerant of moisture and contaminants in the air supply. The electro-pneumatic machines rarely freeze-up which makes them ideal for automated line applications where around-the-clock blasting is required. Also, these machines provide pulse-free blasting for uniform cleaning and efficient use of the dry ice. There is, however, a slight inconvenience factor associated with supplying both electrical power and compressed air to the machine at each blast location.

One of the most challenging technologies associated with either type of blast machine is the achievement of smooth, continuous pellet feed. One surprising property of dry ice is that it is not smooth or slippery like water ice nor smooth-flowing like sand or glass bead. Instead it is somewhat resistant to flow. Because of this, dry ice blast machines tend to have various agitators, augers and other devices in the hopper to improve pellet flow. Generally, the poorer the quality of dry ice, for example, dry ice that has water ice build-up or a large percentage of CO₂ “fines” or snow, the more difficult it is to flow through a system. An additional property of dry ice is that it is extremely cold and will draw moisture out of the surrounding air in the form of frost. The machine, therefore, must be tolerant of repeated freeze-thaw cycles and the associated moisture accumulation that will take place over time.

Generally the difference between a high quality blast machine and a mediocre one lies in the unit’s ability to do a cleaning job quickly, cost-effectively, and with the reliability of smooth and continuous pellet flow under real-world conditions.

**NOZZLE TECHNOLOGY**

The nozzle is where the dry ice particles are accelerated to the highest velocity possible in order to create an effective blast stream. Figure 4 shows schematics of the two types of nozzles used for dry ice blasting. The physics of two-hose ejector nozzles compared to single-hose convergent-divergent supersonic nozzles operating under the same conditions (i.e., air volume, pressure, temperature, CO₂ particle mass...etc.), shows significantly higher efficiency capability for the described single-hose type nozzles. This difference in capability directly relates to the two-hose ejector nozzle’s overall supplied energy being used not only to accelerate the CO₂ particles, but also to create the vacuum pulling the secondary pellet flow through the secondary hose. Then more energy is drained to mix this low velocity particle flow with the high velocity jet flow in order to accelerate the particle through the two-hose nozzle. In simple terms, the net resultant energy available for pellet acceleration is inherently lower for two-hose systems because much of the available energy is lost simply in combining the CO₂ particle flow with the air-jet flow.
Since the size of the dry ice particles affects the cleaning performance, a blast system should have the flexibility to “Dial-In” the correct particle size. This can be done two different ways. First, the size of the pellet being produced by the pelletizer may be varied. Once the pellet is in the blast machine hopper, the size of the pellet reaching the surface to be cleaned can be varied several ways. The diameter and type of blast hose used will either keep the pellet intact or break the pellet up into smaller particles. Also, the nozzle may be intentionally mis-expanded to produce partially destructive shock waves in the nozzle. Both techniques are used independently or together to optimize the particle size, blast stream velocity, and flux density for any cleaning job.

When sand or any similar medium with very small diameter is used in blasting, the size of the nozzle throat is very large compared to the blast medium. In dry

---

Figure 4. CO$_2$ Particle Blast Nozzle Types.
ice blasting, however, the nozzle throat may only be slightly larger than the dry ice particle being accelerated. Table I is a chart indicating the approximate size of a round nozzle throat for four different levels of blast pressure at a constant airflow of 200 Standard Cubic Feet per Minute (SCFM) and typical flow rate available for blasting operations. At higher pressures, the dry ice particle size needs to be smaller to correspond with the smaller throat size. The high pressure blast stream is described as high velocity small particles with high flux density. Again, this particle blast profile is suited best for removing hard coatings such as paint. The chart shows a larger nozzle throat diameter corresponding to low pressure operations. As stated above, large pellets impacting the surface with low flux density are ideal for cleaning soft coatings.

<table>
<thead>
<tr>
<th>Blast Pressure</th>
<th>Throat Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>psi</td>
<td>bar</td>
</tr>
<tr>
<td>80</td>
<td>5.5</td>
</tr>
<tr>
<td>120</td>
<td>8.3</td>
</tr>
<tr>
<td>250</td>
<td>17.2</td>
</tr>
<tr>
<td>300</td>
<td>20.7</td>
</tr>
</tbody>
</table>

Dry ice blasting nozzles tend to be long as a result of the requirement to accelerate particles to as high a velocity as possible. Therefore, a very long nozzle with a small throat tends to have high scrubbing surface area per unit airflow. This explains the higher efficiency of dry ice low pressure nozzles compared to high pressure nozzles. A minimum cost blast system for industrial use has a design point at 80 psi (5.5 bar), a typical pressure for a plant air system.

**BENEFITS OF CO₂ BLAST TECHNOLOGY**

**Cost Reduction**

The natural sublimation of dry ice particles eliminates the cost of collecting the cleaning medium for disposal. In addition, containment and collection costs associated with water/grit blasting procedures are also eliminated.

**Improved Productivity**

Because CO₂ blast systems provide on-line maintenance capabilities for production equipment (cleaning “on-line”), timely and expensive detooling
procedures are kept to a minimum. Dedicated cleaning cycles are no longer required as preventive maintenance schedules can be adopted which allow for equipment cleaning during production periods. As a result, throughput is increased without adding labor or production equipment.

**Extension of Equipment’s Useful Life**

Unlike sand, walnut shells, plastic beads and other abrasive grit media, dry ice particles are non-abrasive. Cleaning with dry ice will not wear tooling, texture surfaces, open tolerances, or damage bearings or machinery. In addition, on-line cleaning eliminates the danger of molds being damaged during handling from press to cleaning area and back.

**A Dry Process**

Unlike steam or water blasting, CO₂ blast systems will not damage electrical wiring, controls, or switches. Also, any possible rust formation after cleaning is far less with dry ice blasting when compared to steam or water blasting. When used in the Food Industry, dry ice blasting reduces the potential for bacteria growth inherent to conventional water blasting.

**Environmental Safety**

Carbon dioxide is a non-toxic element which meets EPA, FDA, and USDA industry guidelines. By replacing toxic chemical processes with CO₂ blast systems, employee exposure and corporate liability stemming from the use of dangerous chemical cleaning agents can be materially reduced or eliminated completely. Since CO₂ gas is heavier than air (CO₂ gas displaces oxygen), care must be taken if blasting in enclosed areas or down in a pit.

**CURRENT CO₂ BLAST APPLICATIONS**

**Molded Products**

Dry ice blasting cleans unwanted release agents (“parting agent”) and/or residual material buildup from the product contact surfaces. That is, the build-up of release agents or residual product from the hot mold is easily removed. Dry ice blasting allows the tools or molds to be cleaned while the mold is hot and still in the press. This reduces the “press down time due to cleaning” by 80% to 95%. Since the process is non-abrasive, CO₂ blast cleaning will not wear the tools or open critical tool tolerances. Furthermore, “micro-vents” are typically cleaned by dry ice blasting. This eliminates hand drilling of plugged vents needed for optimum gas escape.
The following list outlines typical mold compounds:

- Rubber Molds
- Tire Molds
- Urethane Molds
- High Density Polyethylene Molds
- PET Molds
- Foam Molds
- Banbury Mixers

**Food Industry**

Residual sugars left behind from baking can be readily removed from their fixtures in most cases. Here, as in molding, heat may enhance the removal speed and cleaning characteristics. In many cases the application may be performed on-line.

A key benefit in using dry ice blasting to replace some of the general cleaning (done with water, detergents and sanitizers) is a moisture reduction, thereby, inhibiting the growth of bacteria -- particularly salmonella. Economics has dictated on-line cleaning of fixtures including waffle plates and other similar batter or dough baking and product forming fixtures, oven bands and conveyor belts.

CO₂ blasting has been shown to remove and/or destroy significant biofilm build-ups of listeria and salmonella. Other testing has shown that dry ice cleaning can destroy robust mold spores and eliminate wild yeast strains.

Another benefit is the removal of nut or milk solid allergen contamination. When a processing line changes from making a product containing nuts to a product without nuts, all traces of the nut material must be removed from the line or equipment. This allergen removal need is a relatively new development in the Food Industry and CO₂ blasting is helping bakeries surpass new hygiene requirements.

Typical applications include:

- Food Processing Equipment Cleaning
- Cookie Oven Bands cleaning
- Baking Ovens, Shelves and Tray cleaning without shutting down or disassembly
- Carbon build-up removal from wafer plates
- Flight & Conveyor Cleaning
• Dehydrator Cleaning
• Removal of Ingredient build-up from tanks and vessels
• Cleaning of screws and augers

**Plastic Industry**

A growing market for dry ice blasting is the plastics industry. Applications include removing wax release agent from urethane molds (dash boards, door panels, console components, steering wheels, etc.) or flexible polyurethane foam molds (automotive and general transportation seats). Also, cleaning plastic injection molds while they are hot and in the press increases productivity and quality. Similarly, cleaning plastic injection screws and barrels while they are hot increases productivity.

**Printing Industry**

In the Flexographic Printing Industry, inks and varnish polymers are designed to adhere to most surfaces, resist scratches, and, in some instances, be solvent resistant. These characteristics which make their use attractive also make the removal of dried ink very difficult. Ink buildup on the gears and deck guides causes poor alignment and results in low print quality. To compensate for this phenomenon, plate mounting generally needs adjusting several times to register critical graphics in order to produce an acceptable quality level. Generally, each “press run” to check the register of the colors results in thousands of feet of wasted material. This inherently wasteful process can now be eliminated due to the on-line precision cleaning ability of dry ice blasting.

**Aluminum Foundry Industry**

Similar to the molded rubber industry, dry ice blasting removes release agent build-up from permanent aluminum molds while they are hot and in the press. As the industry shifts to “as cast” molds, it becomes critical for end product tolerances and aesthetics that the release agent be thin and uniform. Therefore, using CO₂ blasting to spot clean the mold while in press throughout the day ensures quality as-cast parts.

**Miscellaneous Tooling**
There are many names and types of production fixtures, but virtually any item that is part of the production process and is difficult to clean on-line or during production hours by traditional means may be an excellent dry ice application. Applications such as:

- Conveyor components cleaning
- Hopper cleaning
- Material handling equipment cleaning
- Car carrier cleaning
- Weld slag removal from robotics, fixtures, carriers
- Removal of oils and grease from chains, machinery, etc.
- Cleaning packaging equipment
- Hot glue systems cleaning
- Palletizers and roller cleaning
- Removal of adhesives

THE FUTURE

We cannot predict the future, but we do know that CO₂ particle blast cleaning is not a mature technology. Only eight years have passed since the process was first introduced and the technology is continuing to experience rapid growth, change and advancement. The dry ice blasting industry has shifted from early adopter niche markets to mainstream markets.

Today’s environmental issues are only the beginning. Legislation on air and water quality will continue to impose stricter regulations on general industry and dry ice blasting is continually moving forward to meet these new demands.

One thing is certain. The successful manufacturing plant of the future will have fully incorporated the CO₂ blast process into its operation.
References

