Thorough and Abrasion Free

Blast Cleaning with Dry Ice

A new industrial cleaning technique has gained widespread acceptance in recent years. Blast cleaning with dry ice promises numerous advantages for users, e.g. cleaning of machines during operation, no damage even to sensitive surfaces, and reduced waste disposal costs. Numerous possibilities of cost savings result from the physical properties of dry ice. Although not disassembled, machines and tools can be cleaned very effectively.

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Dry ice is the common term for the solid state of carbon dioxide (CO_2). Dry ice is a white substance similar to ice at atmospheric pressure at -78.5 °C. Its hardness is comparable to that of plaster, i.e. it can be classified as very soft. If energy is supplied (e.g. heat from the surroundings), dry ice passes directly into the gaseous state, i.e. in contrast to water ice there is no liquid **(Figure 1)**. For use as a blasting agent dry ice is produced in the form of pellets resembling rice grains. They are stored in thick-walled insulated boxes to guarantee the best possible quality during the storage period (one to two weeks).

Principles of blast cleaning

Based on DIN 8200, blast cleaning can be defined as a technique in which blasting agents (here pellets) are accelerated in a blasting machine and then impinge upon a workpiece, thus cleaning it. In dry ice blast cleaning the pellets are accelerated to approximately the speed of sound with a stream of compressed air in a specially designed blasting machine. The blasting machine with pellet storage can work by suction or pressure. A suction blasting machine is simpler in design, and hence less expensive, than a pressure blasting machine. However, the latter has a higher cleaning speed, a greater range of blast performance, a wider choice of nozzles equipment, and thus a wider range of applications. The blasting machine has an insulated tank for temporary pellet storage. The filling is usually sufficient for just under one hour's cleaning. The pellets are then transported in flexible blasting hoses to a blasting nozzle. There they are accelerated to their final speed. The length of the blasting hose can easily reach 20 - 30 metres or more, depending on the machine being used. The blasting nozzle is guided either manually or by a handling machine. A wide range of pressure blasting nozzles with special features is available (e.g. very angled, 80 mm outlet width or to clean inside pipes), permitting blasting agents and compressed air to be used efficiently for any given cleaning job.

Cleaning is the result of the interaction of several physical effects. The uppermost layer of the workpiece with its coating of dirt is suddenly cooled when hit by the highly turbulent stream of pellets and air. The coating becomes brittle and loses its elasticity. Different coefficients of expansion cause thermal stresses between the coating and the underlying surface. The formation of microscopic cracks makes it easy for further pellets to penetrate the coating. As a result of the kinetic energy released on impact with the coating, the pellets are transformed into extremely small particles, causing a direct transition into the gaseous state (sublimation). The coating is removed by the increase in volume (by a factor of approx. 500!) that is caused by this transition from a solid to a gaseous state and the energy released by the pellets hitting the coating already loosened from the underlying surface by thermal stresses **(Figure 2)**.

As they are not very hard, the pellets can be used to clean even sensitive surfaces (plastics, rubber parts, glass, polished metal surfaces, etc.) without causing any damage. The substance removed is uncontaminated by residual blasting agents. The cleaned surfaces are virtually free of oil and grease (e.g. for subsequent painting) so that there is often no need for solvents **(Figure 3)**.

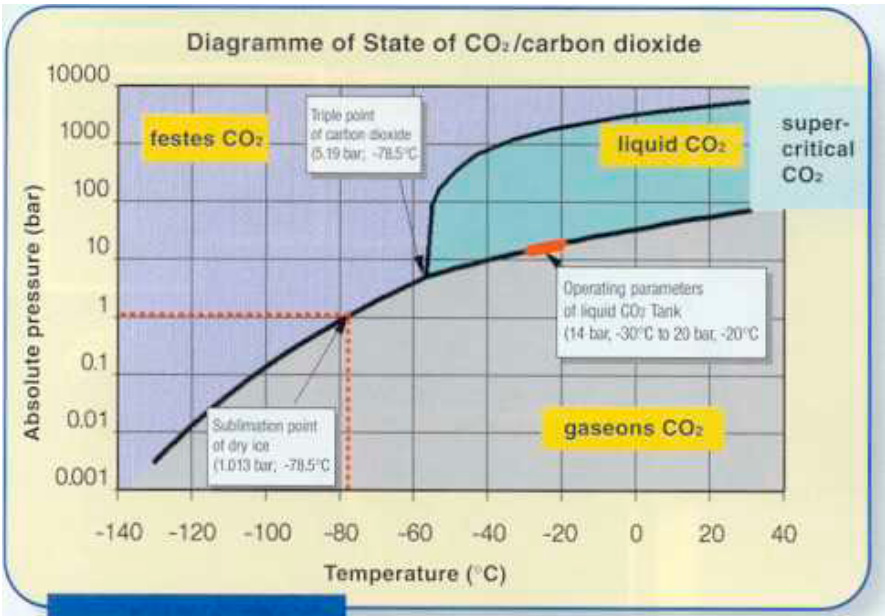

Figure 1: The states of CO_2

Reduced downtimes

This cleaning technique has many advantages for users. Thanks to a blasting agent that vanishes into thin air, many machines can be cleaned while in operation. This can considerably reduce downtimes and thus increase productivity as no time is lost for assembly work and cooling and warming of machines. In addition, as no water is used, there is no need for extensive drying before the machine can be started up again. Fine adjustment of the cleaning action, soft pellets and flexible handling allow complex machines containing all kinds of different materials to be cleaned. Examples of machines that can be cleaned in one step include machines with shaped surfaces, inspection windows, hydraulic pistons, and pneumatic control hoses. As no solvents are used, there is also no danger of subsequently produced goods being contaminated. Moreover, the use of the technique considerably reduces the downtimes of high-quality components that are

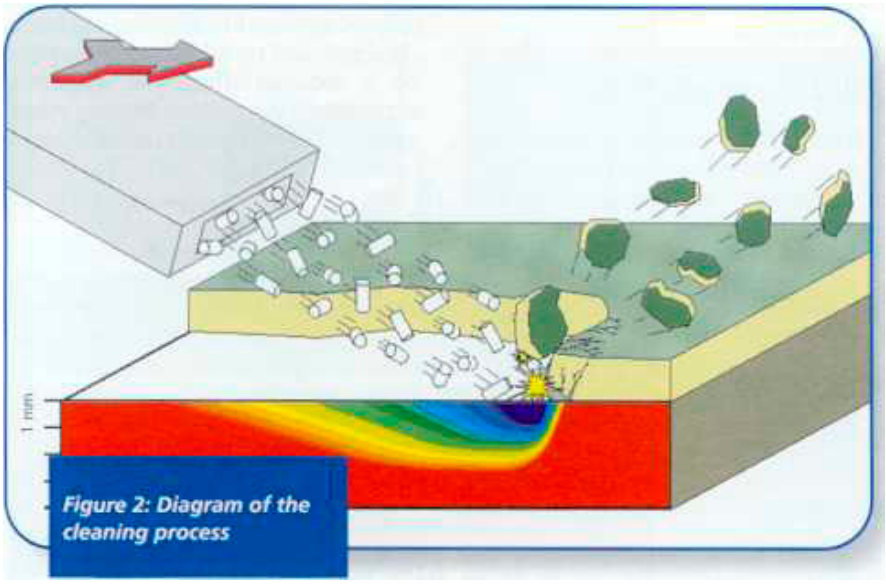

Figure 2: Diagram of the cleaning process

Figure 4: Coffee producing machine

Figure 3: Partially cleaned mixer in a sweets factory

often very prone to wear. Waste disposal costs can be reduced significantly as costly cleaning or disposal of contaminated cleaning agents – mainly water – is no longer necessary.

Meanwhile the technique has found applications in almost every branch of industry. For example, CO_2 blast cleaning has now become the standard technique for cleaning welding plants, furnaces, turbines, generators, throughout the pharmaceutical and chemical industries, printing machines, building facades, and control cabinets. Further examples include the cleaning of moulds and tools for almost all moulded products (PU, rubber, aluminium, foodstuffs, etc.). The elimination of both solvents and water is especially advantageous for production machines in the food industry.

Typical applications in the food industry

In bakeries gum arabic is often used as a thickening agent, emulsifying agent and stabiliser. Unfortunately, it becomes deposited as a gluey mass on components such as conveyor belts, thus slowly causing blockages. Besides the direct effect on production when the conveyor belt stops, there is also a constant danger that the drive motors burn out as a result of overloading. The dry ice blasting technique allows the conveying equipment to be cleaned while in operation.

Packaging machines for cheese become dirty with waste, cheese coverings and packaging foil. Regular cleaning is essential for reasons of hygiene. The advantages of using dry ice blast cleaning are the elimination of water and solvents, and the bacteriostatic effect of CO_2. Because no drying processes and post-cleaning are necessary the time required before starting up plant again is considerably reduced. A cleaning interval of one month has proved appropriate.

Machines used in coffee production have to be cleaned periodically to remove waste. Because of the nature of the product water must be avoided by all means. With the CO_2 blast cleaning technique it was possible to clean the relevant parts of the machine completely within a short time **(Figure 4)**. Further drying was not required. The elimination of solvents was also a positive aspect here.

Highly polished moulds made of special plastics are often used in the manufacture of chocolate products. Cleaning these moulds in the past with water and solvents subsequently involved much work to ensure that there were absolutely no traces of any cleaning agents left on the mould surface. The use of the CO_2 blast cleaning technique is gentle on the polished surfaces thanks to the soft blasting agent, and no additional post-cleaning is required. Thus, the apparatus required and the costs of treating waste water containing solvents can be reduced considerably.

Blast cleaning with dry ice

The technique of blast cleaning using dry ice pellets offers many ways of saving costs in industrial cleaning processes. The decisive factors here are the diversity of the possible applications, the flexible and mobile concept behind the machine, the non-abrasive blasting agent, which acts without affecting the surface, the bacteriostatic effect of CO_2 and the fact that the blasting agent literally just vanishes into thin air. Savings are thus possible as a result of a reduction in downtimes, less wear on surfaces and a reduction in waste disposal costs.

Certified Kosher

A special problem occurred with the cleaning of the product boiler in a fat hydrogenation factory producing kosher products. Hitherto, the cleaning results or the cleaning agents could not be considered as kosher. This problem has now been solved with the Cryoclean technique. Tests by a Jewish rabbi have confirmed the required purity.