



MICHAEL M. TSONTOS S.A



www.dryice.gr



1. About MICHAEL TSONTOS S.A - DRY ICE APPLICATIONS

Dry Ice applications started off as a separate company in 2006, named "Dry Ice Technology – D.I. Tech Ltd.", operating as a subsidiary of the parent company MICHAEL M. TSONTOS S.A . In 2009, its legal establishment was discontinued as it merged with MICHAEL M. TSONTOS SA. Since then it operates as a branch.

The term '**dry ice**' constitutes the commercial name for the solid / frozen carbon dioxide (CO₂) at **temperature – 78.5°C or – 109.3°F**. The term was created in 1925 from the American company Prest Air Devices in Long Island of New York.

The carbon dioxide (CO₂), which is a colourless, tasteless and odourless gas, is found free in the Earth's atmosphere. Although it is found in relatively small quantities of (roughly 0,03% of the total volume of the atmosphere), it is one of most important gases for the preservation of the life on our planet. The CO₂ is essential for the growth of plants and very important in the maintenance of the Earth's temperature. The breathing of live organisms is considered that it adds daily 28 millions tones of carbon dioxide in the atmosphere. On the contrary, the entire American industry CO₂ can produce only 25.000 tons per day.

The unique characteristic of the dry ice is the **sublimation**, i.e. the change from the solid to the gaseous state without the intermediary phase of deliquescence. Due to this unique attribute and its exceptionally low temperature solid CO₂ is named '**dry ice**' (very cold – no humidity).

The sublimation in combination with the unique cooling ability (– 78.5°C) of the dry ice, constitute the base for innumerable fields of applications. Generally, the main categories of applications are the:

1. Cleaning of industrial production equipment, known as **dry ice blasting**, which is a revolutionary blasting method. It uses small, compact dry ice pellets as the blasting materials, which are accelerated in a jet of compressed air similar to that used in traditional blasting methods.
2. **Food management** using specially insulated containers.
3. **Pharmaceutical and medical products** and **microbiological samples management**, using especially insulated containers.
4. Production of **Special Effects** for shows, nightclubs, social events etc.

The business activity of **MICHAEL TSONTOS S.A** covers all the above mentioned range of applications of dry ice products and services. The industrial production equipment cleaning and the management of products, food, pharmaceutical and medical material constitute the major and the widely known applications of dry ice, with numerous and important comparative advantages against the conventional ice and the traditional methods of cleaning.

The premises of **MICHAEL TSONTOS S.A** dry ice applications branch are located in the Industrial Park of Chania, in Souda. The latest technology equipment and the specialised personnel in technical and managerial level ensure that our company is ready to cover the needs of all of Crete, providing



products and services of high quality. The objective of is the complete satisfaction of the requirements and expectations of its customers with the implementation of services of high quality and the production of excellent products, according to the high specifications that have been set by the company's management. We identify and record the needs of our customers and propose the best tailored solutions.

For more information regarding our products and solutions that cover your needs, please do not hesitate to contact us.



2. The Dry Ice Production Procedure

The dry ice is produced by compressing the liquid CO₂. The heat that is produced by the compression of the liquid is removed (law of Charles), and the CO₂ becomes solid by allowing a rapid decompression. The decompression causes a fall of temperature that freezes part of CO₂ in the form of snow, which is then further compressed into pellets or into blocks.

'Pelletizing' the CO₂



The device that compresses the dry ice into pellets is called pelletizer. After the production, the pellets are placed in specially insulated containers for storage until they are used for the various applications.



The size of dry ice pellets varies between 3 – 16mm. Our company produces pellets of 3 and 16mm.

Dry Ice Pellets



The percentage of sublimation is very low, between 5% to 15% daily, depending on the quality of the container and the environmental conditions. The use of specially insulated containers of approved specifications and certified for dry ice use will keep the rate of sublimation within the above range. Otherwise, if the container is not suitable, the rate of sublimation will be higher. MICHAEL TSONTOS S.A provides all the necessary equipment that is required for the right and safe use of dry ice.

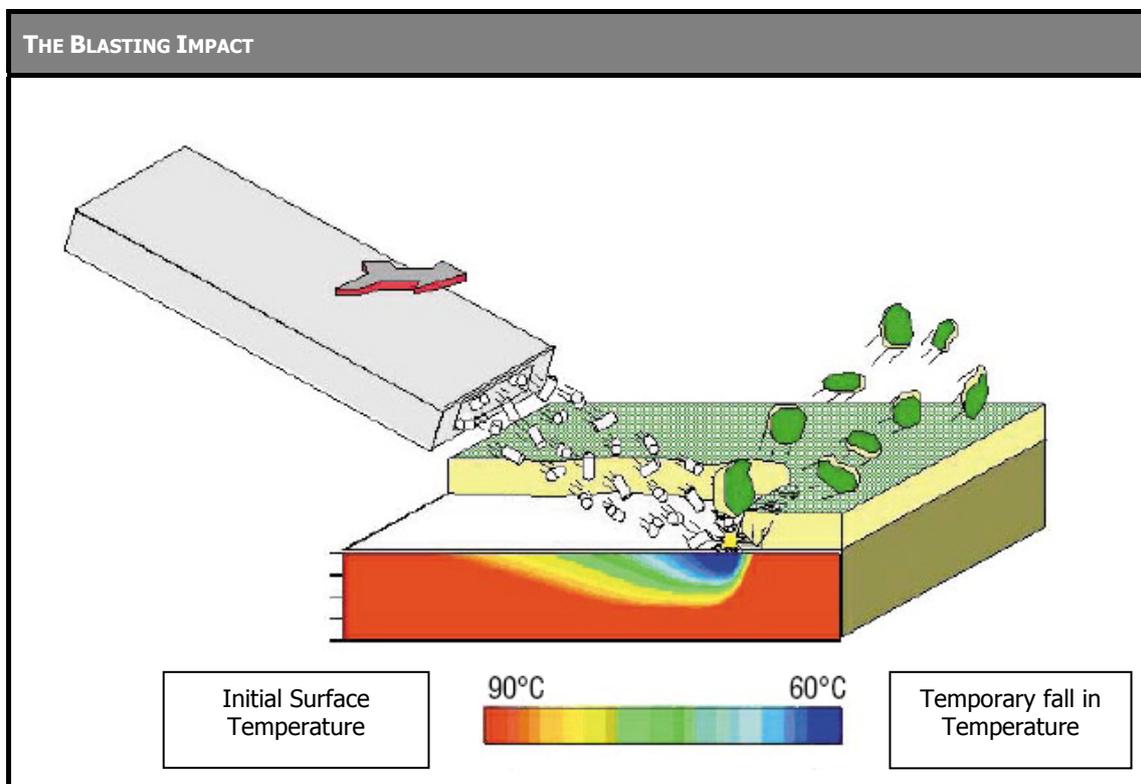
The dry ice production unit includes a tank of liquid carbon dioxide and the production line which is directly connected to the tank. CO₂ is a non – poisonous, non – conductive and inflammable gas. The carbon dioxide is an industrial product that has been collected from the underground geothermal sources in gaseous state, has been compressed into liquid which is then further compressed into a solid form (dry ice). When the CO₂ is returned in the atmosphere during dry ice blasting or through simple sublimation, there is none new produced quantity of CO₂. Only the initial CO₂ from the product is released and returned into the atmosphere.



3. The "Dry Ice Blasting Procedure"

Dry Ice Blasting is a revolutionary cleaning method that uses small, compact dry ice pellets as the blasting material. The dry ice pellets are accelerated in a jet of compressed air via the nozzle that is connected to the blasting unit. The blasting unit is connected to the air preparation plant and the air compressor. The dry ice blasting method is similar to other traditional blasting methods (sand blasting for example).

Dry ice blasting is designed to provide an effective alternative to high – pressure hosing and other traditional blasting methods and replace them in applications in which they fail to deliver the desired results. Moreover, cleaning methods based on hazardous chemicals, solvents, etc can also be effectively replaced by dry ice blasting.



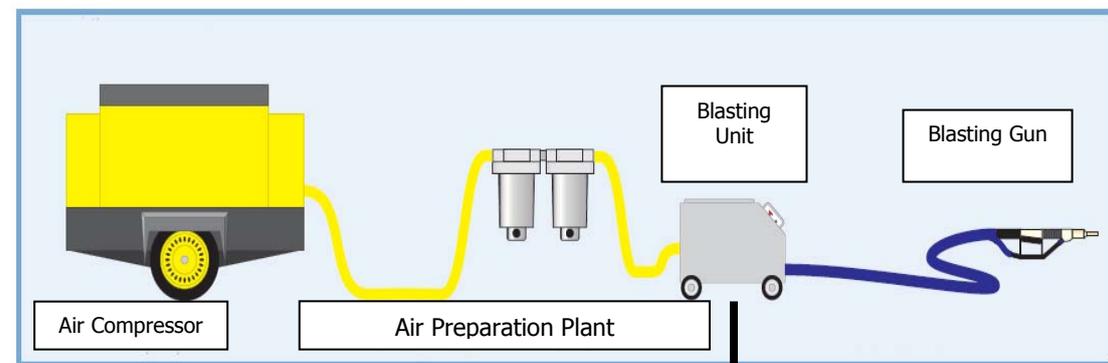
The very low initial temperature of dry ice, which is launched against the surface to be cleaned, causes a thermal shock between the coating that we wish to remove and the surface. The thermal shock in combination with the kinetic energy of the dry ice pellets during the blasting and the sublimation causes a fracture between the coating and the surface. The CO₂ gas expands during sublimation 400 to 800 times which accelerates the cleaning procedure. The coating breaks from inside and the compressed air removes the impurity without creating secondary residues, since the dry ice pellets disappear (sublimate).

The dry ice blasting process is suitable for cleaning surfaces with cavities where the traditional blasting materials would be trapped, would be unable to clean the surfaces and depending on the method, either would leave secondary residues, or leave humidity on the surface (for example from high

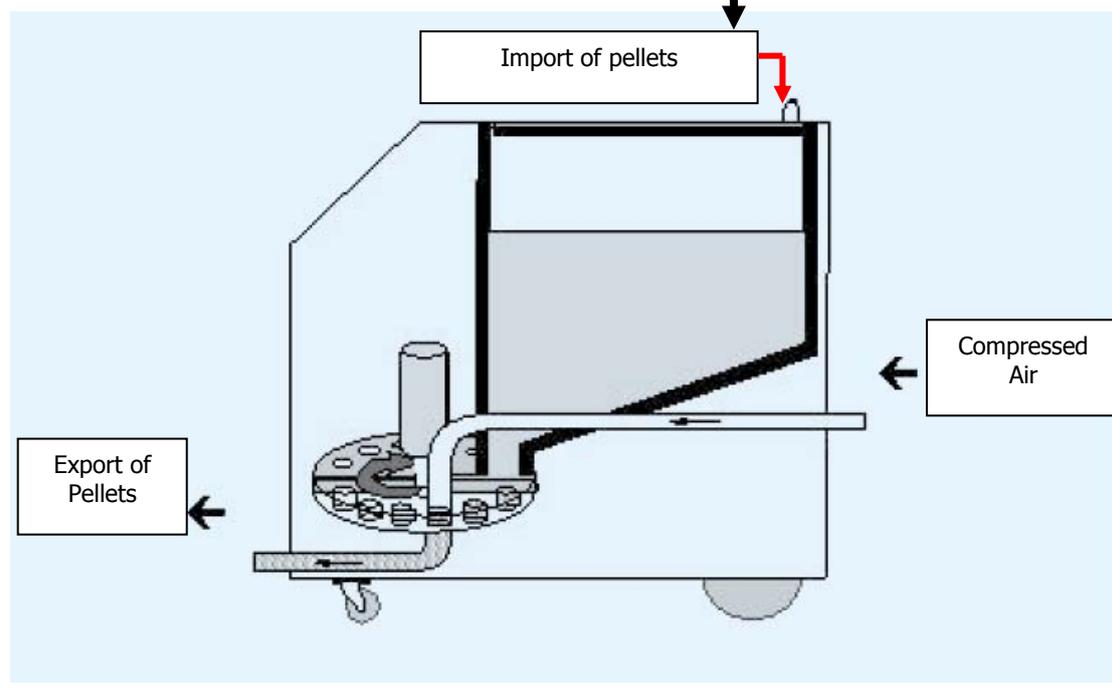


pressure water or steam). This does not happen with the method of dry ice blasting which leaves the surface dry and clean, based on the unique feature of sublimation upon contact with the surface.

THE DRY ICE BLASTING PROCEDURE



Blasting Unit



Paint, oil, grease, asphalt, bitumen, graffiti, ink, soot, resins, epoxy materials and glue, are a few of the materials that can be removed using the dry ice blasting method.

Dry ice blasting is an advanced revolutionary alternative method of cleaning with proved advantages in comparison to the traditional methods. Dry ice blasting can clean off surfaces from any type of coating where other methods would fall short, both in the result and the cleaning process itself.



Also it is important to point out that the dry ice blasting is a simple and fast process that will often allow production equipment cleaning while in operation without the need for dismantling and costly downtime. The process is completely dry, non – conductive, non-abrasive, and surfaces are therefore treated gently. Dry ice blasting can thus be used on easily damaged surfaces like nickel, chromium and soft aluminium.

Today, dry ice blasting is used effectively in a wide range of applications, from the removal of heavy rust to the cleaning of semiconductors and circuits. Imagine a process that can be applied during the production line operation without damaging the equipment or the need for dismantling the machines as it would be necessary with the usual toxic chemicals, high pressure water and other traditional blasting methods.

Dry ice blasting removes the coatings from surfaces without additional waste treatment and disposal. An indicative number of dry ice blasting applications are shown below:

- Food Industry (confectioneries, bakeries, restaurants etc)
- Printing Factories
- Car Garages
- Oil Factories
- Wine Factories
- Ship yards
- Cleaning of archaeological findings
- Restitution following natural catastrophes (i.e. fire)
- Chemicals Industries
- Graffiti removal



3. Management of Food and other Frail & Sensitive Products

The increasing activity of international trade and the suppression of borders between countries (e.g. European Union) have as result the increased transportation of goods by sea, air and other means chilled or frozen. Due to its unique sublimation and cooling attributes, dry ice constitutes an excellent mean of refrigeration, maintenance and transport of products and other frail materials. Fundamental role in the transportation and shipment of all the above plays a well insulated container certified for dry ice use. A conventional box does not constitute a reliable solution during transportation or shipment of goods. On the contrary, a specially insulated container designed for the transportation/shipment of chilled or frozen products with dry ice, constitutes the right solution. It will decrease the amount of dry ice that is required for the transportation/shipment and will increase the time of maintaining the right temperature of the transported product. When for example, the desirable result is not the deep refrigeration of the product, we can use dry ice in combination with the classic ice. This will allow the extension of the transportation/shipment time for many days, since the superior cooling attribute of dry ice will maintain the common ice and deter its deliquescence.

For the transportation/shipment we will need 4 until 7 kilos of dry ice for every 24 hours depending on the quality and the specifications of the insulated container (see the following table). For the boxes with inferior insulation the quantity of dry ice required will be substantially increased. As we have already mentioned, the best means of transporting goods with dry ice is a well insulated container of approved specifications and certified for transportation/shipment of products with dry ice. This box has been designed in order to 'lose' only 2 to 3 kilos of dry ice for each 9,5 litres of transported volume of products per 24 – hour period. In the table below we present a number of indicative combinations of transportation/shipment of frozen products with dry ice.



TABLE OF AVERAGE DRY ICE QUANTITY FOR THE TRANSPORTATION/SHIPMENT OF FROZEN GOODS IN A INSULATED CONTAINER

QUANTITY OF FROZEN PRODUCT (Kgr)	TRANSPORTATION / SHIPMENT TIME			
	4 HOURS	12 HOURS	24 HOURS	48 HOURS
1	1 KILOS OF DRY ICE	2 KILOS OF DRY ICE	4 KILOS OF DRY ICE	8 KILOS OF DRY ICE
2	1,2 KILOS OF DRY ICE	2,4 KILOS OF DRY ICE	4,7 KILOS OF DRY ICE	8,3 KILOS OF DRY ICE
4	1,6 KILOS OF DRY ICE	3,2 KILOS OF DRY ICE	5,6 KILOS OF DRY ICE	11 KILOS OF DRY ICE
10	2,5 KILOS OF DRY ICE	5 KILOS OF DRY ICE	10 KILOS OF DRY ICE	14 KILOS OF DRY ICE
20	4 KILOS OF DRY ICE	8 KILOS OF DRY ICE	14 KILOS OF DRY ICE	20 KILOS OF DRY ICE
FOR EVERY ADDITIONAL DAY WE ADD 4 – 7 Kgr OF DRY ICE				

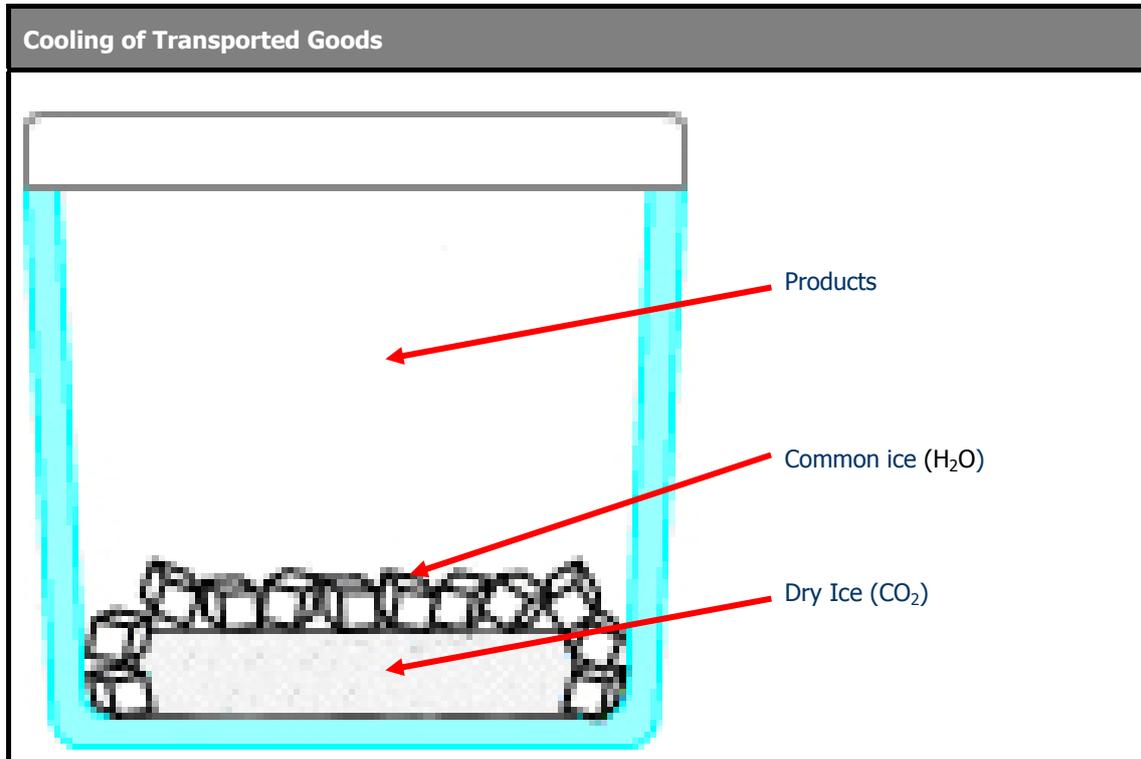
The above values concern a specially insulated container. The conventional container will require more quantity of dry ice since the rate of sublimation will be much higher.

Depending on the desired result – cooling or freezing – we place the dry ice on the top or beneath the transported products. In the following part, we indicatively describe, ways of packing depending on the desirable result.



3.1 Cooling of Transported goods

When packing we place the dry ice and the products as close as possible. The dry ice is placed in the bottom of the container. The transported products must not be in direct contact with the dry ice.



If the container is not divided the space between the dry ice and the products should be filled with common ice and/or pieces of polyester sheets or paper. This will remove the air interferred between the products and the dry ice and on one hand will reduce the rate of sublimation and on the other hand it will prevent the freezing of the products from the direct contact with the dry ice.

The rate of sublimation of dry ice varies depending on the exterior temperature, the pressure of air (in an airplane with lower pressure, the rate of sublimation will be higher), and the quality of the insulated container.

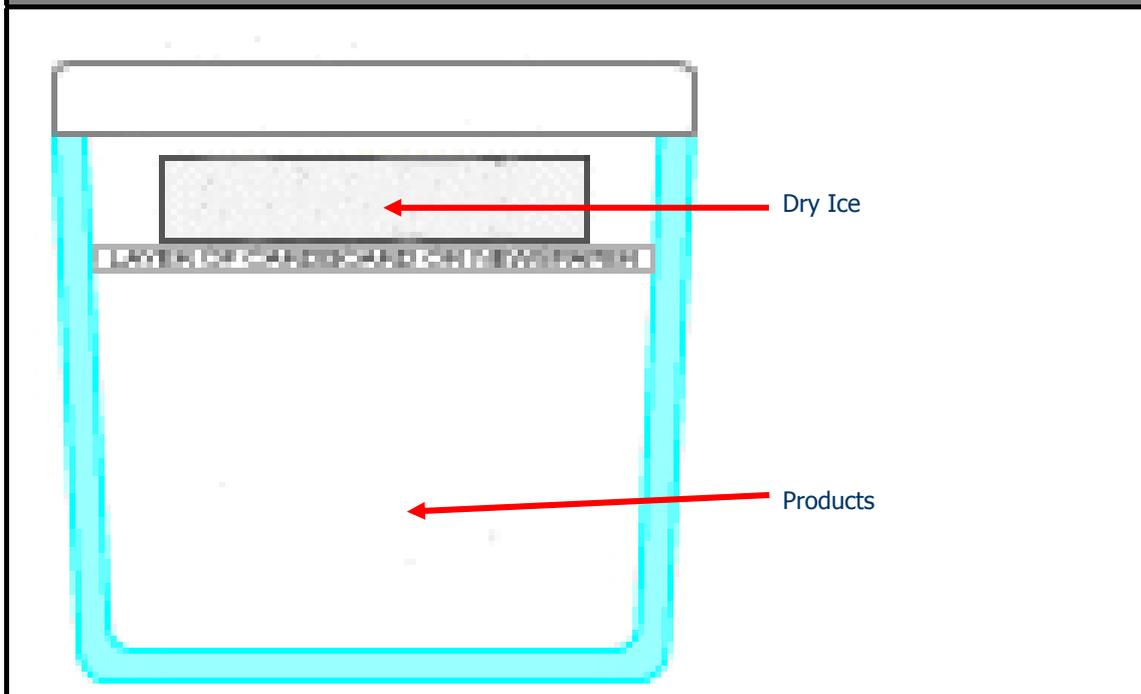
The dry ice, will maintain the temperature of the products in the container until complete sublimation.



3.2 Freezing Goods or Transportation / Shipment of Frozen Goods

When packing we place the dry ice as close to the products as possible, on the on the top of the container. If the container is not divided the space between the dry ice and the products should be filled with a layer of newspaper or cardboard.

Freezing & Transportation/Shipment of frozen Goods





4. Production of Special Effects

The machines of smoke and fog create a number of fascinating special effects. Have you ever wondered how these special effects are created?

One of the most famous ways for the production of these special effects worldwide is based on the dry ice! In other words, when the dry ice comes in contact with hot water there is a chemical reaction which has the form of dense fog, heavier than the air of the atmosphere which lies on the ground and 'hugs' the surfaces like a very fine white sheet. The fog of dry ice is thick, dense, and "heavy" and it is created precisely with the same way as the natural fog in the atmosphere. That is to say with the condensation of water vapour from the atmosphere. Dry ice is used in order to condense the water vapour from the atmosphere. The fog of dry ice does not contain any chemical substance, glycol, or oil and is literally a fog based on the water.

The dry ice fog will not rise, since the dry ice is heavier than air. It covers the ground, it rolls down the stairs by 'hugging' the steps, and it swirls if somebody walks into the fog. It does not create faint beams as the fog which is created by glycol and does not create thin clouds in the air as the fog from the oil machines. The fog of dry ice is odourless, does not contain any chemical substance and does not leave any residue.

The fog machine is filled up with water which is heated up. When the water reaches the right temperature, the special booth of the machine is filled up with dry ice. When we wish to create the fog, we switch on the machine and the hot water is pumped into the dry ice booth, which immediately creates the fog. The fan is activated and the fog flows out via the hose.



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