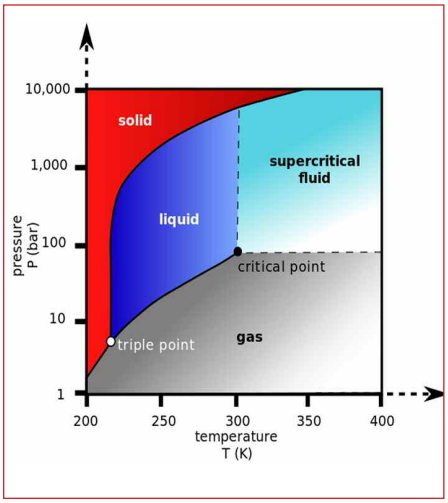
Dry Ice and CO_2 in Transportation

Dry ice in general

What is dry ice? In physics, the term "state of matter" is one of the distinct forms that matter takes on such as solid, liquid and gas (more exist, but won't be viewed in this case). The best example for discussion is the different states of matter water can assume.

In all of the above mentioned states of matter, the pressure also has an important role to play, thus the temperature values discussed in this article are only valid at a pressure of 1013.25 hPa (1atm).

A state point of water exists, where, at a certain temperature and pressure, all 3 states coexist. That point is 0.01°C and a partial vapor pressure of 0.006 atm. The phenomenon is known as the triple point of water.



BY BEN FINNEY MARK JACOBS [CC0], VIA WIKIMEDIA COMMONS

Triple point of Co_2

Dry ice is frequently used to package items that must remain cold or frozen during transportation, such as ice cream or biological samples, without the use of mechanical cooling.

Dry ice is CO_2 in its solid phase. Carbon Dioxide turns into dry ice at –78.5°C (at 1 atm). The triple point of CO_2 is –56.60°C at 5.11 atm.

When a matter changes directly from solid to gas, it is called sublimation. When the matter changes directly from gas to solid it is called deposition. During the sublimation transition, dry ice melts and is directly vaporized into its gas phase. The liquid phase is only achievable when the temperature and pressure allow it, please see the triple point of CO_2 diagram.

continued

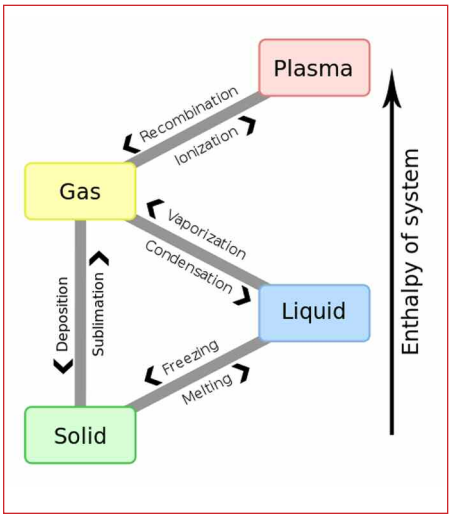
rotronic
MEASUREMENT SOLUTIONS

Dry ice used during transportation?

Dry ice is often used as a coolant during transportation of temperature sensitive products due to the fact that it is colder than water ice and CO_2 has no liquid phase in standard atmospheric conditions. When dry ice melts, it sublimates so there is only an increase of CO_2 levels and no liquid residue.

Dry ice is used widely in the transportation business for both frozen and non frozen goods. If the product is in direct contact with the dry ice, it will freeze. Depending on the insulation used, the temperature of the product can vary.

The main advantage of dry ice is that it has twice the cooling energy of water ice and that dry ice will sublimate at a rate of 1% of its total mass per hour in an insulated container (14% at room temperature).



Phase transition diagram

Precautions need to be taken when handling dry ice. Because dry ice is so cold, handlers should use cryogenic gloves for example. As dry ice sublimates into gas, it is important not to pack it in a gas tight container to avoid an explosion.

1kg of dry ice will produce 0.45m^3 of CO_2 gas. Therefore it is very important to monitor the rooms where the packages are stored or loaded/unloaded.

As CO_2 is an odorless and colorless gas, it is very important for life safety to always monitor the CO_2 level when using dry ice. CO_2 is capable of causing asphyxiation at high concentrations.

In the workplace exposure limitations exist: short term, 15 minutes, 15,000 ppm and long term (8 hours) 5,000 ppm.

135 Engineers Road, Hauppauge, NY 11788
Tel. 631-427-3898 • Fax. 631-427-3902 • info@rotronic-usa.com

rotronic MEASUREMENT SOLUTIONS