westlab

Phase Change Material (PCMs)

PCMs can hold a more stable payload temp. than dry ice.

What are PCMs?

Phase Change Material (PCMs) refers to a category of substances that absorb and release large amounts of energy (latent heat) when going through the temperature at which they change phase.

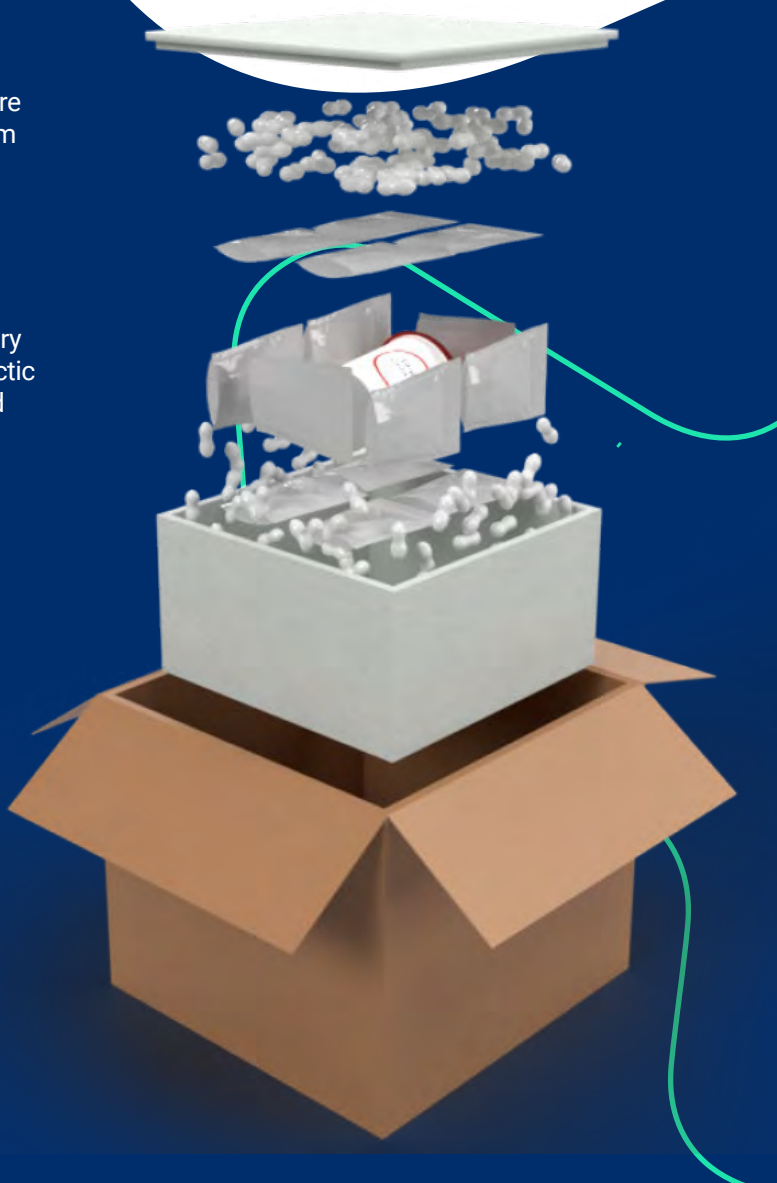
The change in state is typically from liquid to solid, however there are some exceptions to this such as dry ice, which changes from a gas directly into a solid.

Dry ice has been a widely used coolant in the Life Science and Pharmaceutical industry for many years, in the transporting of products at an ultra-cold temperature.

This article addresses PCMs as a category that is separate to dry ice. The PCMs referred to in this article are in the sub-zero eutectic PCM category, however PCMs can be produced in the ultra-cold ranges, as well as positive ranges (above freezing).

Dry Ice

PCMs



Benefits of PCM vs. Dry Ice

PCM

Pros

- Different PCMs can be specified for different temperature ranges.
  - Using a coolant that is close to the desired temperature of the product being shipped ensures energy is being used efficiently.
- Can be encapsulated
  - No dangerous gasses released.
- Reusable.
  - Lower carbon footprint
  - Lower overall cost
- Can be stored for long periods of time in ambient conditions before being used.
- Can be frozen onsite in most commercial freezers.
- Less energy intensive production processes.
- Can hold a more stable payload temperature than dry ice.
- No need to label as a dangerous product for shipments.
- Easily handled before freezing (Precautions should be taken when handling frozen ultra-cold PCM.

Cons

- Less energy dense than dry ice (lower latent heat).
  - More coolant may be required.
- Typically more expensive (pound-for-pound) than dry ice.
  - Initial purchase costs may increase
- Condensates as the PCM rises to 0C (Below 0C the condensation freezes on the casing).
  - Some moisture may transfer to the product.

DRY ICE

Pros

- Very high energy density (latent heat).
  - Requires less coolant in some applications
- Relatively cheap
  - Lower purchase cost
- No return services required.
- No condensation since the solid sublimates to a gas.
  - Shipped product remains dry
- Ultra-cold freeze temperature makes it ideal for a lot of applications.

Cons

- Risks of anoxia due to high levels of CO2.
  - Limits of how much can be used in enclosed transport spaces.
- Single use product.
  - Higher carbon impact
  - Higher lifetime cost
- Tightly sealed containers can explode as it sublimates.
  - Must be shipped as a dangerous product.
- Must be stored below 80C to prevent sublimation.
- Must be handled with caution.
- Large temperature differential between most products being shipped and the temperature of dry ice.
  - Expends additional energy over-cooling the surrounding environment.
  - Often ‘burns’ products due to the extreme cold.