



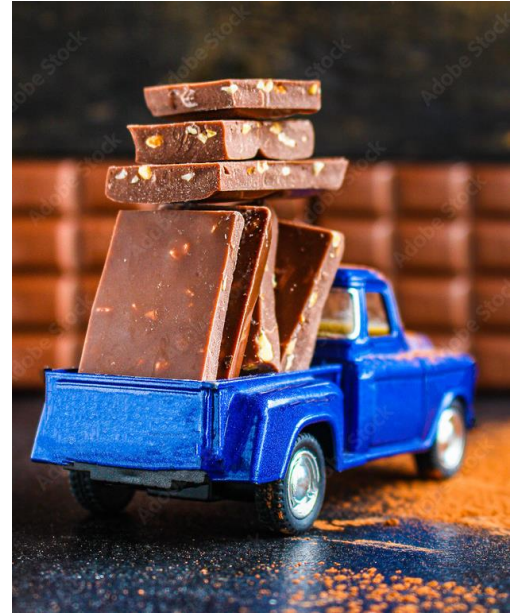
PRODUCT APPLICATION NOTE
PRONGO® - CHOCOLATES



Chocolates - why there is need for cooling solution?

Chocolate and chocolate-based products are perishable in nature and require utmost attention in terms of their quality and temperature sensitivity. Chocolates do not need very low temperatures for their storage and transport as extreme low temperatures change the texture and colour of chocolate completely due to water condensation resulting into frost on its surface. Furthermore, the chocolates filled with liquid also cannot tolerate any frost since the liquid filling inside would expand and crack the outer shell of the chocolate. High temperatures are also not desirable as chocolates become soft, nuts turn rancid and cocoa butter becomes greasy on exposure to high temperatures.

The suitable temperature for storage and transport of chocolates is 18°C to 25°C. The current solution for chocolate transport is conventional reefer trucks and gel packs in EPS (Expanded polystyrene/Thermocol) boxes. The refrigeration unit in these reefer trucks is driven by diesel fuel which is non economical and non-environment friendly. The less temperature accuracy and reusability of thermocol boxes with gel packs makes it less attractive to users.



*This image is for illustration purposes only

PronGO® Solution

PronGO® is an innovative solution which enables the storage and transport of temperature sensitive food like chocolates and chocolate related products through passive cooling. PronGO® solution can maintain the required temperature for longer durations.



Figure 1: Storage of chocolates in (L) Rotomoulded box with PCM tabs (R) Soft bags lined with PCM pouches

For extended hours of last mile delivery up to 48 hours, Phase Change Materials (PCMs) filled in HDPE bottles (thermoTabs) or nylon pouches are used. The encapsulated PCM acts as a medium to provide the cold backup required for long duration temperature maintenance. These tabs/pouches can be used in rotomoulded boxes or softbags depending on the use case.

PCM packs vs gel packs

| Aspect | PLUSS® PCM Pouch | Regular Gel Pouch |
|-----------------------------|---------------------------------------|--|
| Temperature Control | Precise and consistent | Less precise and variable |
| Duration of Cooling/Heating | Extended | Limited |
| Customization | Tailored to specific requirements | Limited customization options |
| Adaptability to Environment | Resilient to ambient fluctuations | Less resilient to environmental changes |
| Reusability | Reusable and environmentally friendly | Typically, single-use |
| Cost-effectiveness | Offers long-term cost savings | Initial cost may be lower |
| Environmental Impact | Lower environmental footprint | May contribute to single-use plastic waste |



Figure 2: Thermocol box with gel packs



Figure 3: (L) PCM pack (R) PCM plastic tab

Advantages

1. Long lasting – It is long lasting, washable and leak proof solution.
2. Reusable – PronGO® is reusable solution compared to one-time use of Ice.
3. Environment friendly – Multiple time use reduces the amount of Ice used for shipping.
4. Easy to use – The solution is user friendly and sophisticated to use.

Performance

PronGO® 310L rotoulded box (Back up 72 hrs temperature <25°C)

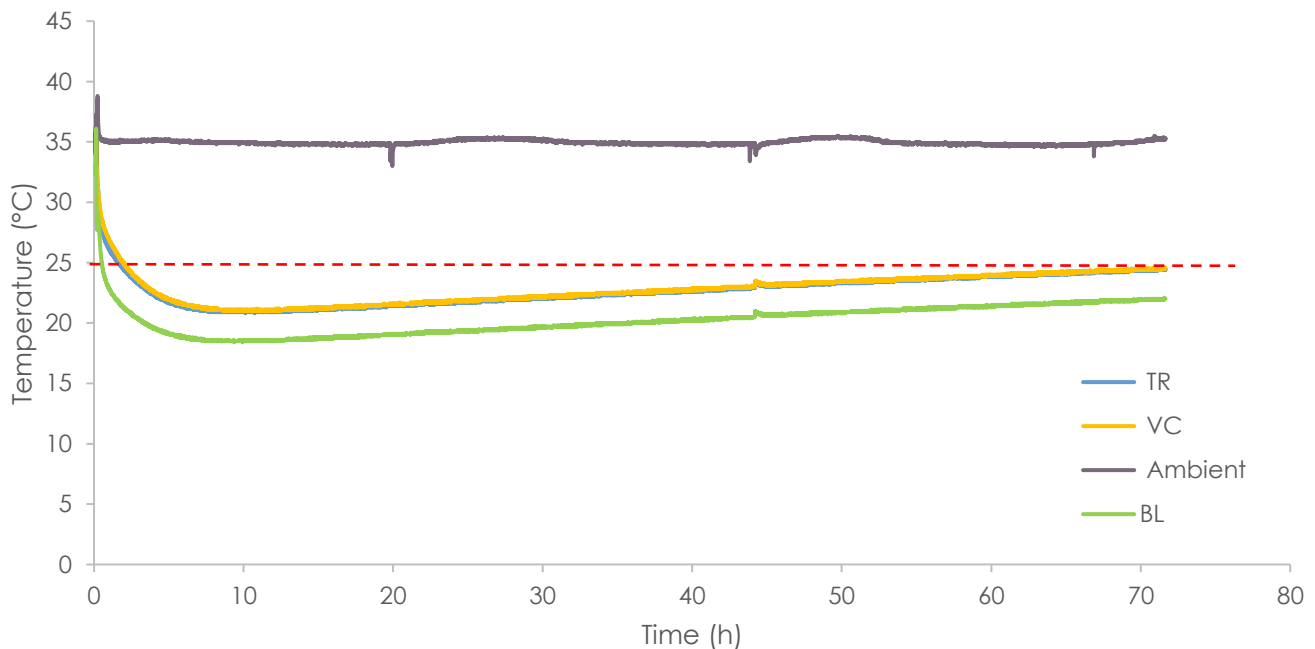


Figure 4: Temperature profiles of chocolate inside the rotomolded box

Four sensors are placed in the trial to measure the temperature of chocolates maintained inside the rotomoulded insulated box with using PCM materials. The positions of the sensors are TR (top right corner), VC (volumetric center), BL (Bottom left corner) of box and ambient temperature. The temperature of the box maintained below 25°C for more than 70 hours in ambient temperature of more than 35°C.

PCM Reeper trucks

Passive temperature-controlled reeper trucks are also an economical solution for chocolate transportation. The electricity driven compressor freezes the PCM during night time and keep the truck ready to use for daytime deliveries. The PCM is encapsulated in high strength alloy steel plates which have high heat transfer capability and high corrosion resistance. These plates are lined on the inner walls of the truck.



Figure 5: (L) 14 feet frozen reeper truck (R) Inside view of reeper truck – PCM plates lined on inner walls of truck

Advantages:

1. Green technology – Reduces carbon emissions and environment friendly solution.
2. Low operational cost – Electricity driven compressor is cost saver in comparison to diesel run compressors.
3. Carefree transportation – During vehicle breakdown or compressor failure, product is safe with PCM reeper truck.
4. Low maintenance cost – Maintenance cost for refrigeration system of truck is low due to less moving part.

Performance:

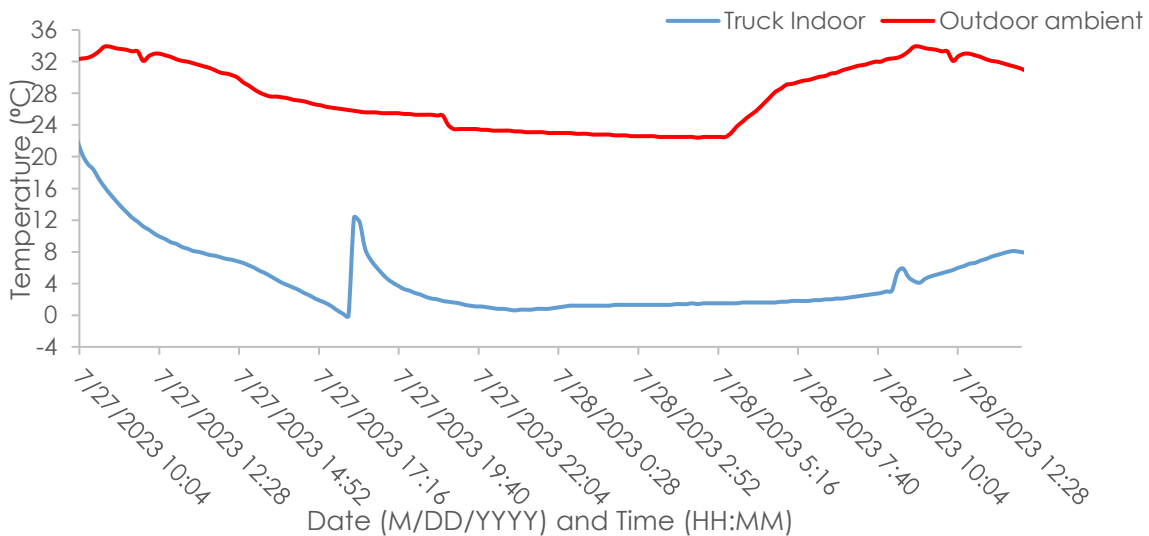


Figure 6: PCM reeper truck indoor temperature for chilled application (2°C to 8°C)

The performance of PCM reefer truck shown in above figure is for chilled application (2°C to 8°C). The chilled truck is used for transportation of dairy products, vegetables, fruits, etc. Similarly, a truck for chocolate can be designed to transport the chocolates more safely and economically.

Case study

PCM reefer trucks are validated by the customer in Sonipat, Haryana to transport Ice-cream. The summary of the case study is given below.

| S. No. | Parameter | Value |
|--------|---|-------------------------|
| 1 | Number of trips | 9 |
| 2 | Maximum distance covered (km) | 350 |
| 3 | Maximum delivery run time (hours) | 12 |
| 4 | Longest trip route | Sonipat to Mainpuri, UP |
| 5 | Average Diesel saved per trip with PCM (L) | 24 |
| 6 | Average Operation cost savings per trip (INR) | 2300 |
| 7 | Annual savings considering 180 trips (INR) | 4.1 lakhs |



Figure 7: (L) 14 feet frozen truck parked at customer site - Sonipat, Haryana for charging (R) Product being loaded in truck for delivery

Disclaimer:

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