GREENERGIZE Your Packaging

PCM for Temperature Controlled Packaging

- The industry uses gel packs, ice and dry ice
- Consumers are looking for better methods to:
  - control temperature
  - reduce shipping weight
  - reduce packaging waste
  - reduce carbon footprint
- Some are using qualified containers which use higher quality insulating material and PCM for effective temperature control

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PCM – Phase Change Material

Phase Change Materials (PCM) oscillate between solid and liquid phase within a certain temperature range absorbing or releasing thermal energy as latent heat.

When the environment's temperature is higher than that of the PCM, heat transfers from the surroundings to the material which creates a **cooling effect** and changes the PCM's state from solid to liquid.

When the environment's temperature is lower than that of the PCM, heat transfers from the PCM to it's surroundings, generating a **warming effect** and changing the PCM back to it's solid state.

PCMs are classified as latent heat storage (LHS) units.

Phase change occurs at a relatively constant temperature.

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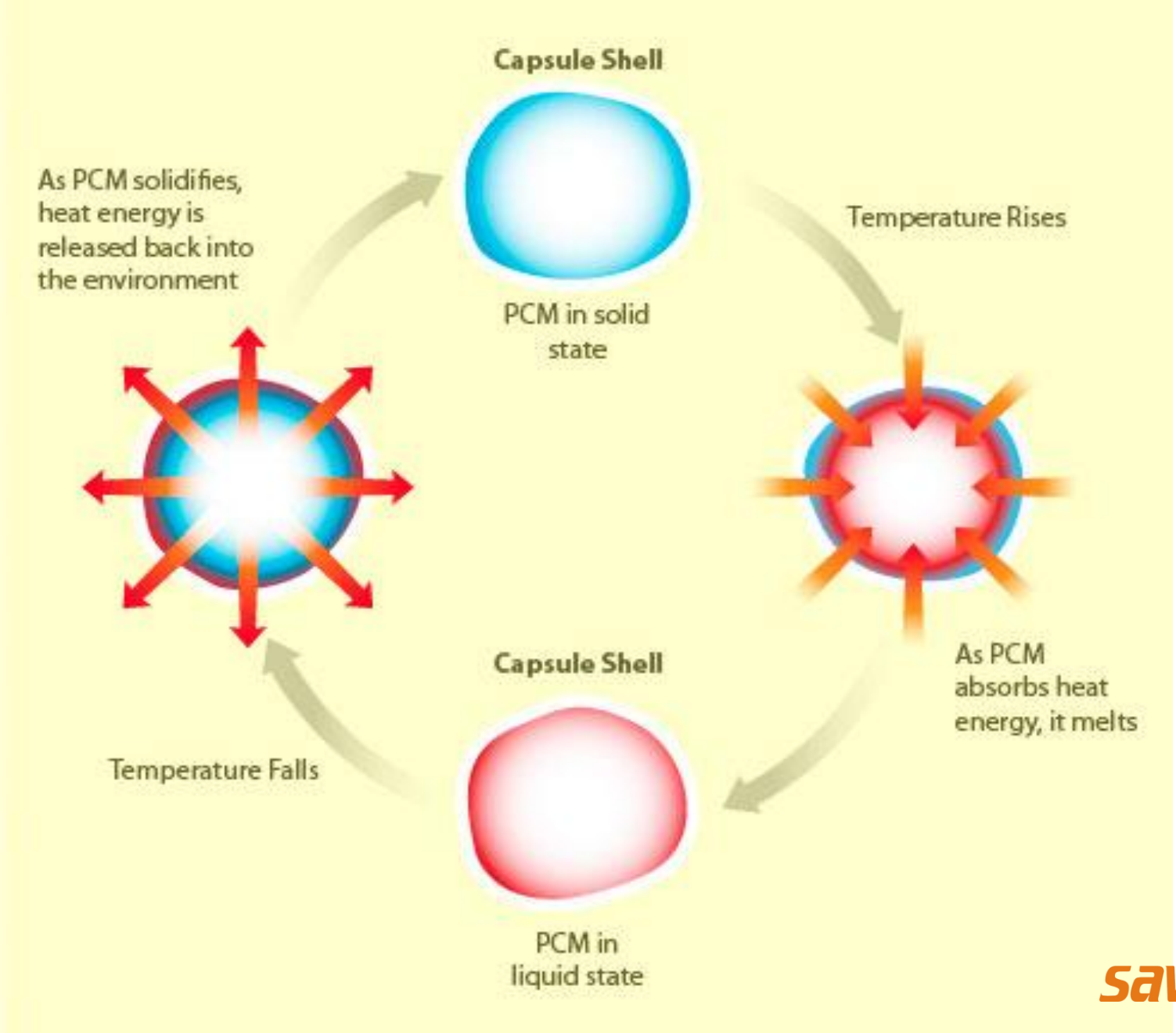
PCM Life Cycle



PCM, a Sustainable Technology

- Consumption of PCM products on a large scale is expected to reduce energy demand by up to 50% by 2050
- By incorporating PCM in different applications, companies can earn 10-20 times more carbon credits than compared to other green materials
- Most of the available PCM have a long operating life of approximately 20 to 30 years and need very little maintenance
- PCMs have 5 to 6 times more heat storage capacity compared to other materials

Source: Advanced Phase Change Material (PCM) Market Global Forecast (2010 – 2015) by MarketsandMarkets

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Types of Phase Change Materials

	Inorganic – Salt Hydrates	Organic – Petroleum Based	Organic – Biobased
Latent Heat (cbm)	High	Low	low
Toxicity	Non-Toxic	Can be Toxic	Non-Toxic
Flammability	Non-Flammable	Flammable	Flammable
Corrosion	Yes	N/A	N/A
Stability	Yes	Yes	Yes
Renewable	Yes	No	Yes
Biodegradable	water based	N/A	Yes
Density	higher than water	lower than water	lower than water

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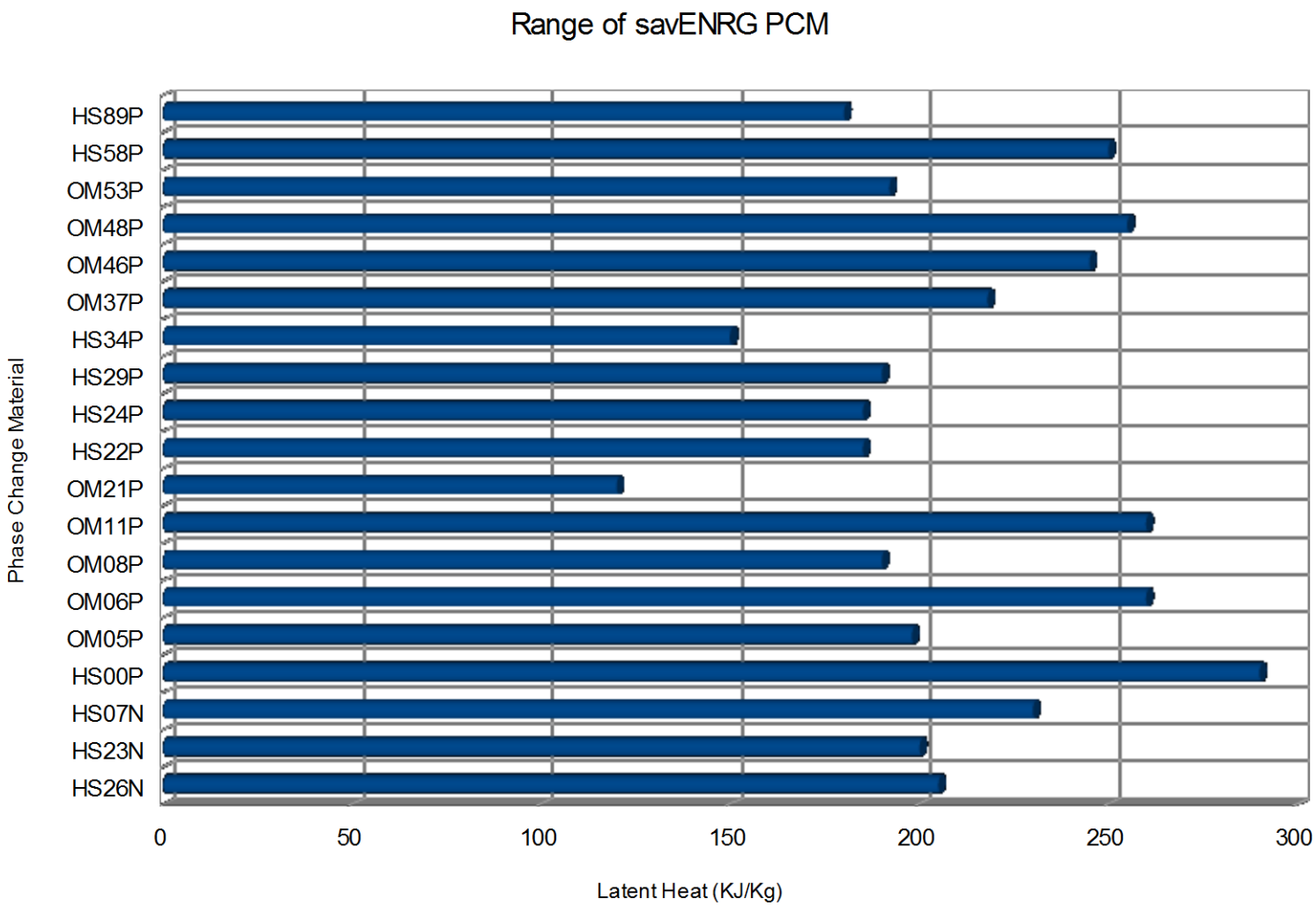
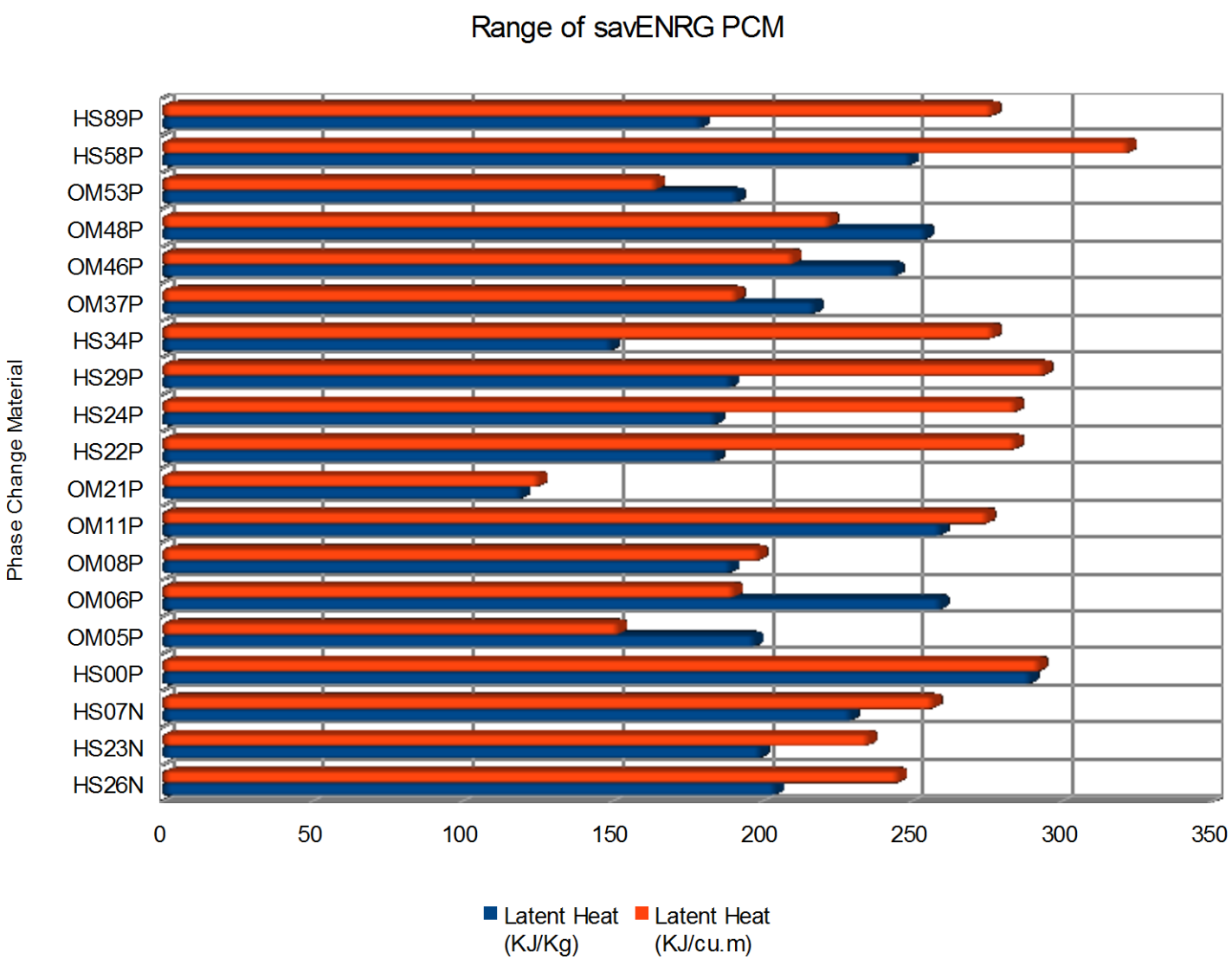
savEnrg™ PCM Latent Heat KJ/Kg



savEnrg™PCM Latent Heat

KJ/Kg vs KJ/cu.m



T-History Test

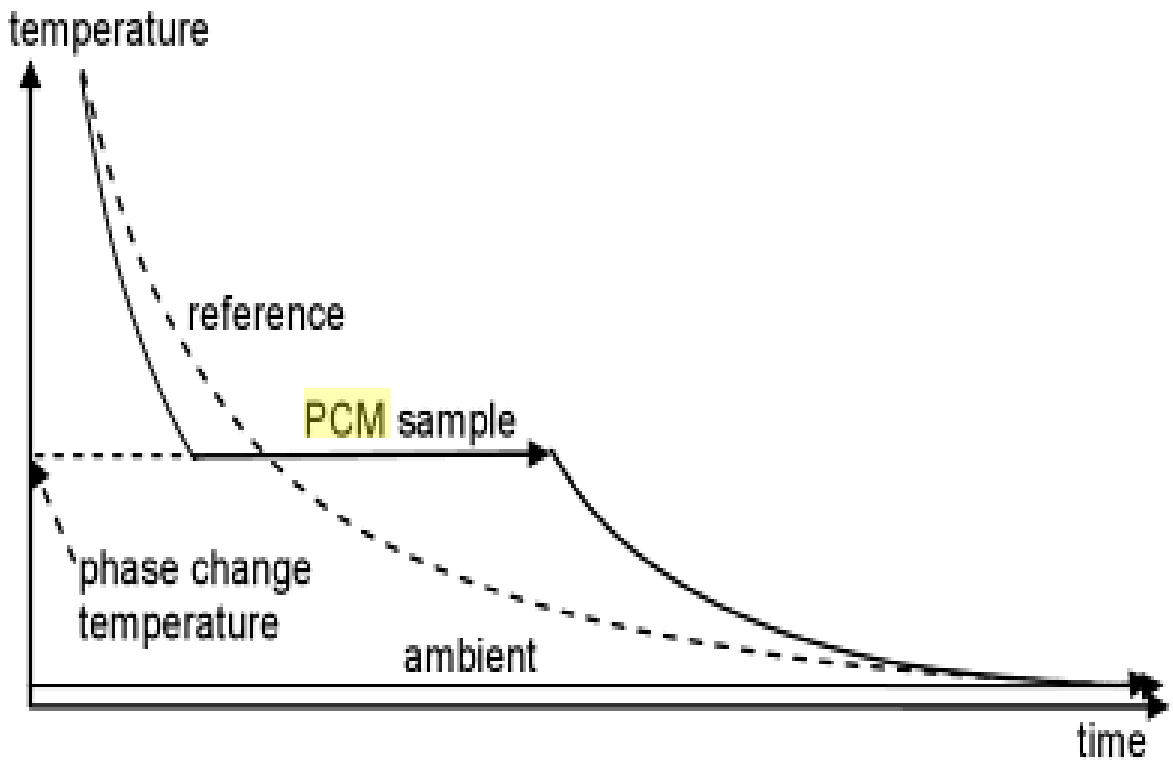
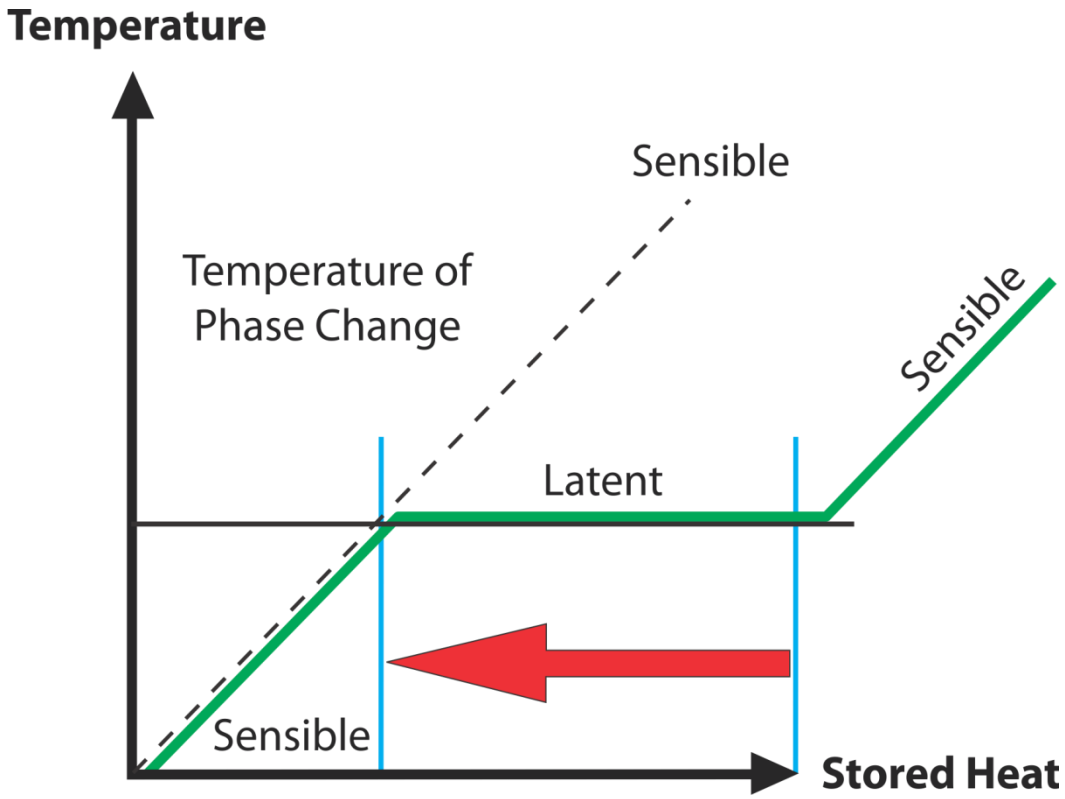


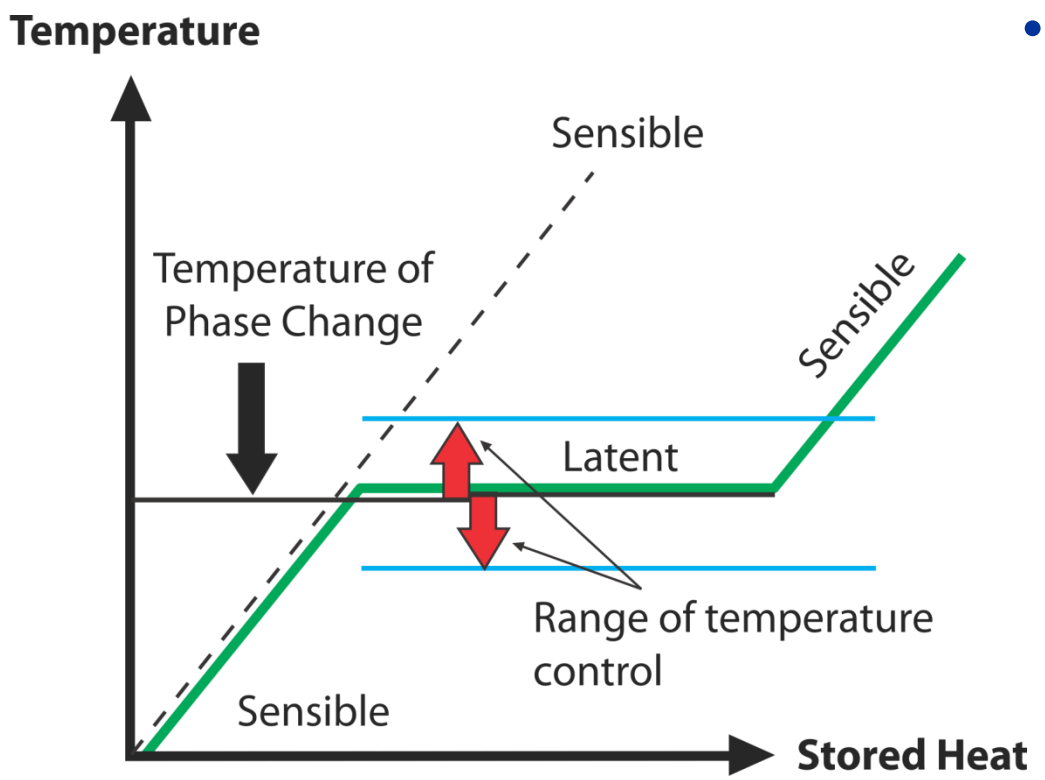
Fig. 3.17. T-history of a sample with a latent heat effect, and a reference with only sensible heat, during cool down at constant ambient temperature.

Phase Change Energy Storage for Temperature Control



At phase change point – energy is absorbed with almost no change in temperature. Technology enables high thermal energy storage for heating or cooling needs when and where needed.

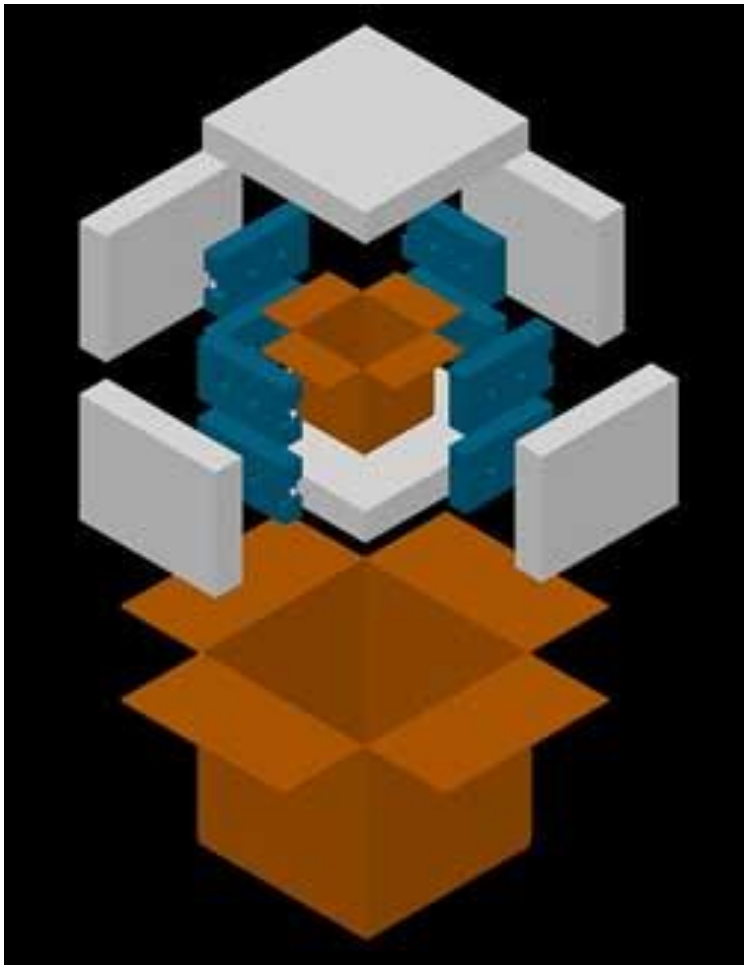
Efficiency of Temperature Control



- The temperature can be controlled within +/-3 degrees depending upon the type of insulation. PCM is not a substitute to insulation. It adds thermal mass for a suitable temperature.

savEnrg™ PCM Cold Chain Refrigerants

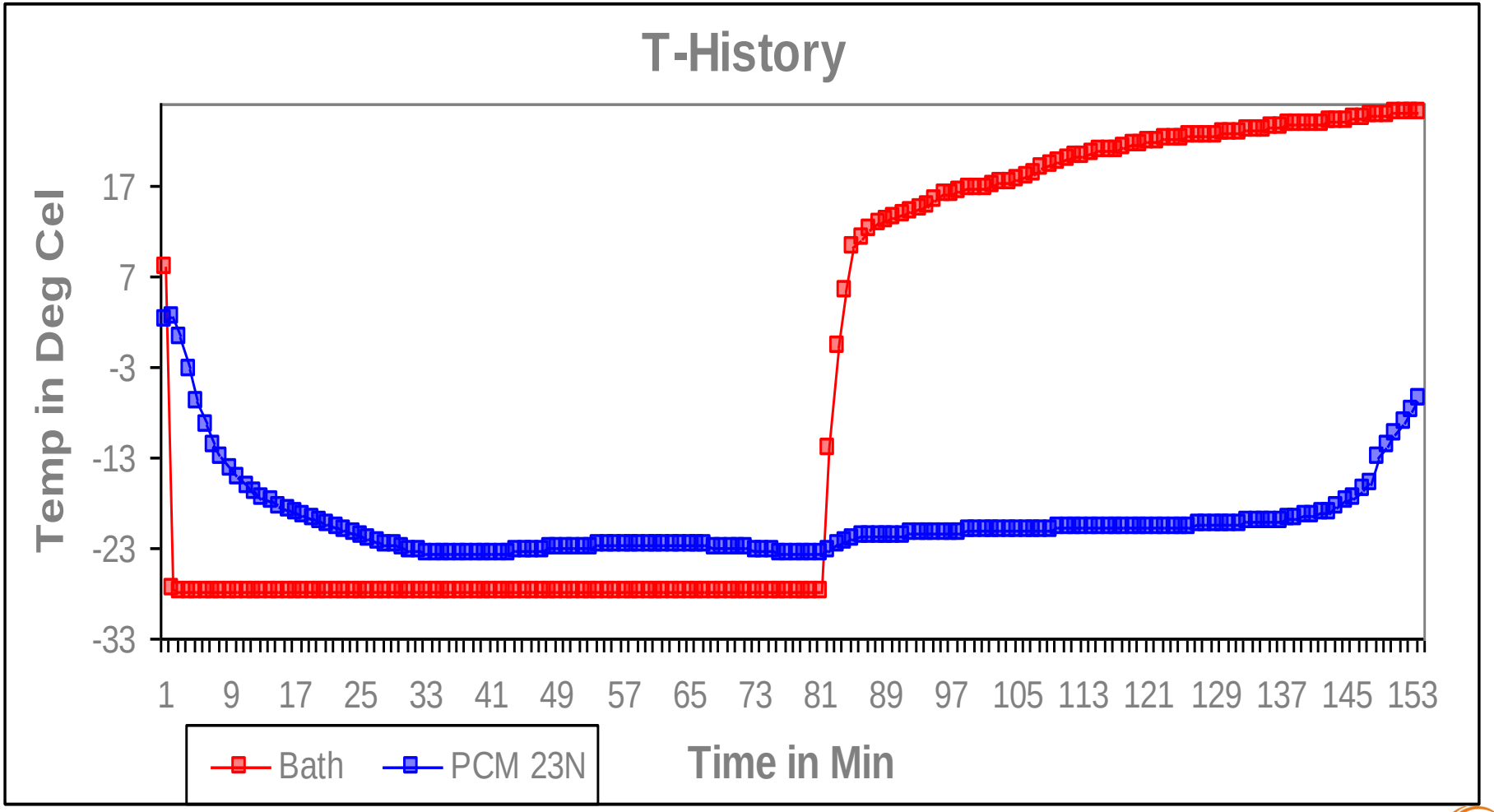
- savENRG™ Ice Pack PCM-HS23N
  Operating Range -26ºC to -20ºC
- savENRG™ Freezer Pack PCM-HS07N
  Operating Range: -10ºC to -4ºC
- savENRG™ Cold Pack PCM-HS00P
  Operating Range: -3ºC to +3ºC
- savENRG™ Cool Pack PCM-OM06P
  Operating Range: +2ºC to +8ºC
- savENRG™ Warm Packs PCM-HS22P
  Operating Range: +19ºC to +25ºC
- savENRG™ Incubation Pack PCM-OM37P
  Operating Range: +34ºC to +40ºC



savEnrg™ PCM Ice Packs

- Ideal for transport of products at temperatures below -15° C
- Filled with PCM-HS23N with phase change @ -23° C
- Freeze completely at temperatures below -28° C
- Latent heat capacity of 200KJ/Kg
- Volumetric latent heat of 236 KJ/cu.m
- Safe substitute for Dry Ice and propylene glycol
- Made from **Non-toxic and non-flammable** hydrated salts
- Tested for 3000 cycles

PCM-HS23N for Ice Packs



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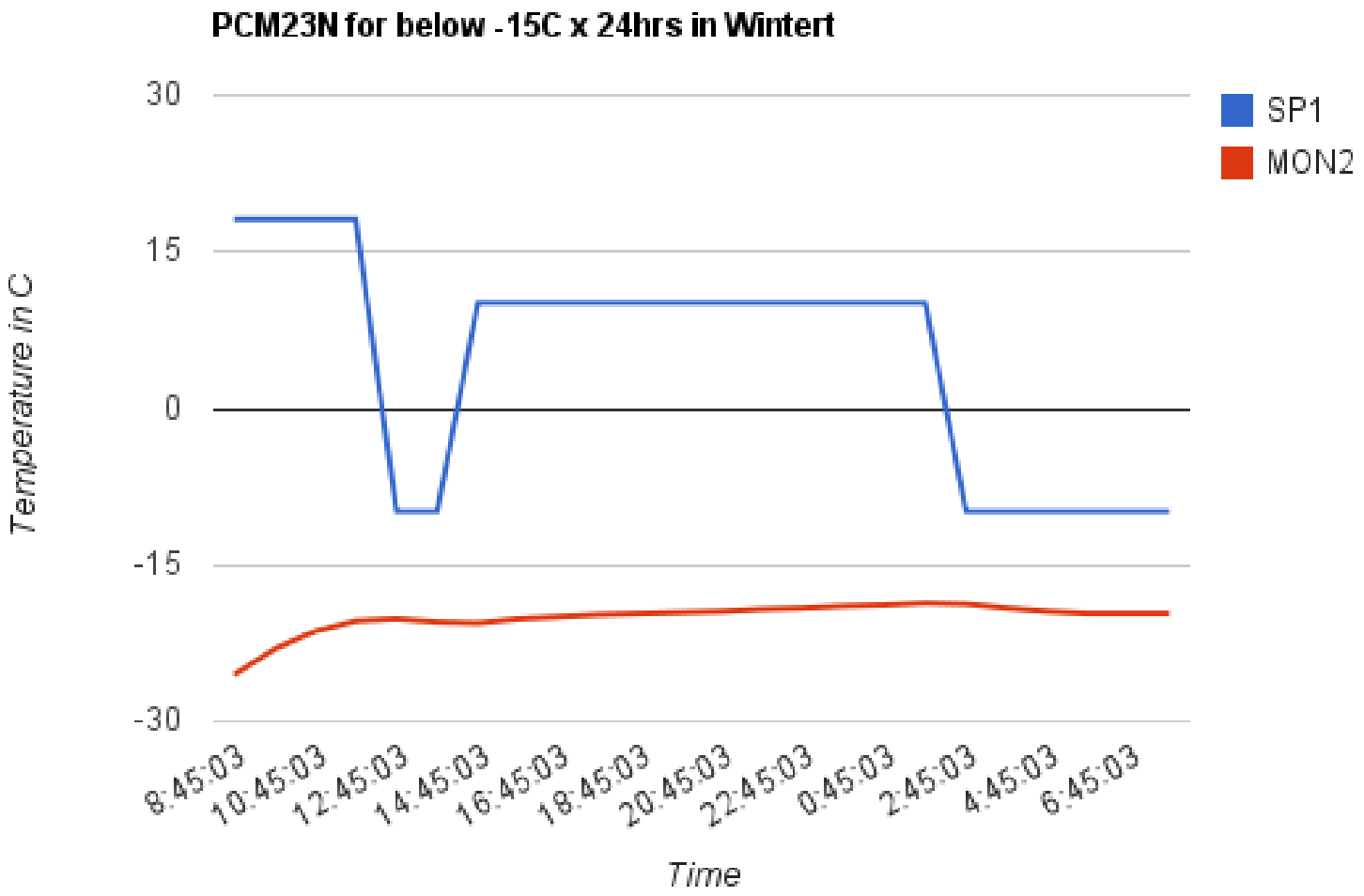
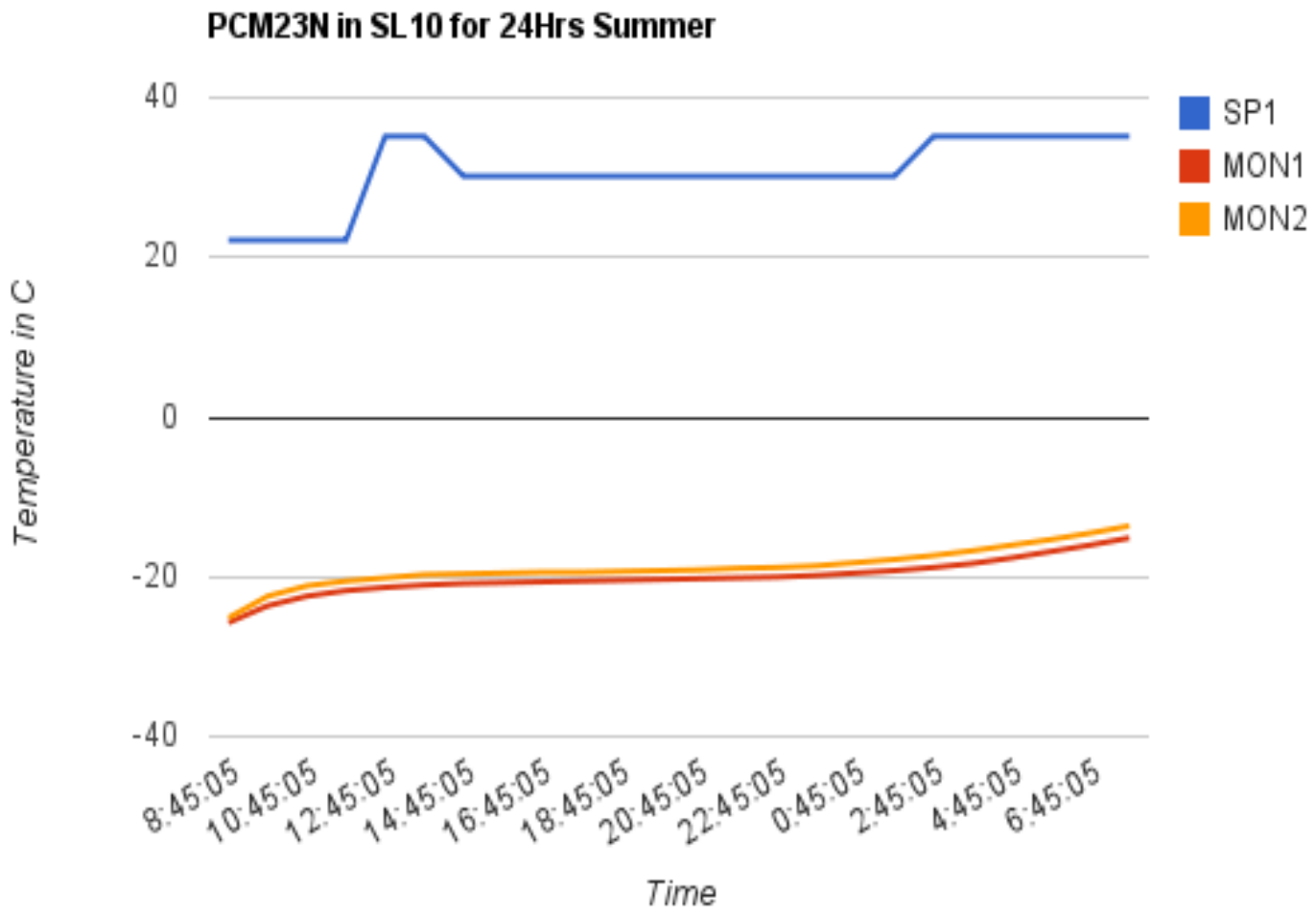
Temperature Graph for Ice packs with PCM-HS23N

Below -15C for 24Hr in 12”x9”x9” with 1” EPS per ISTA7D Winter



Temperature graph for Ice packs with PCM-HS23N

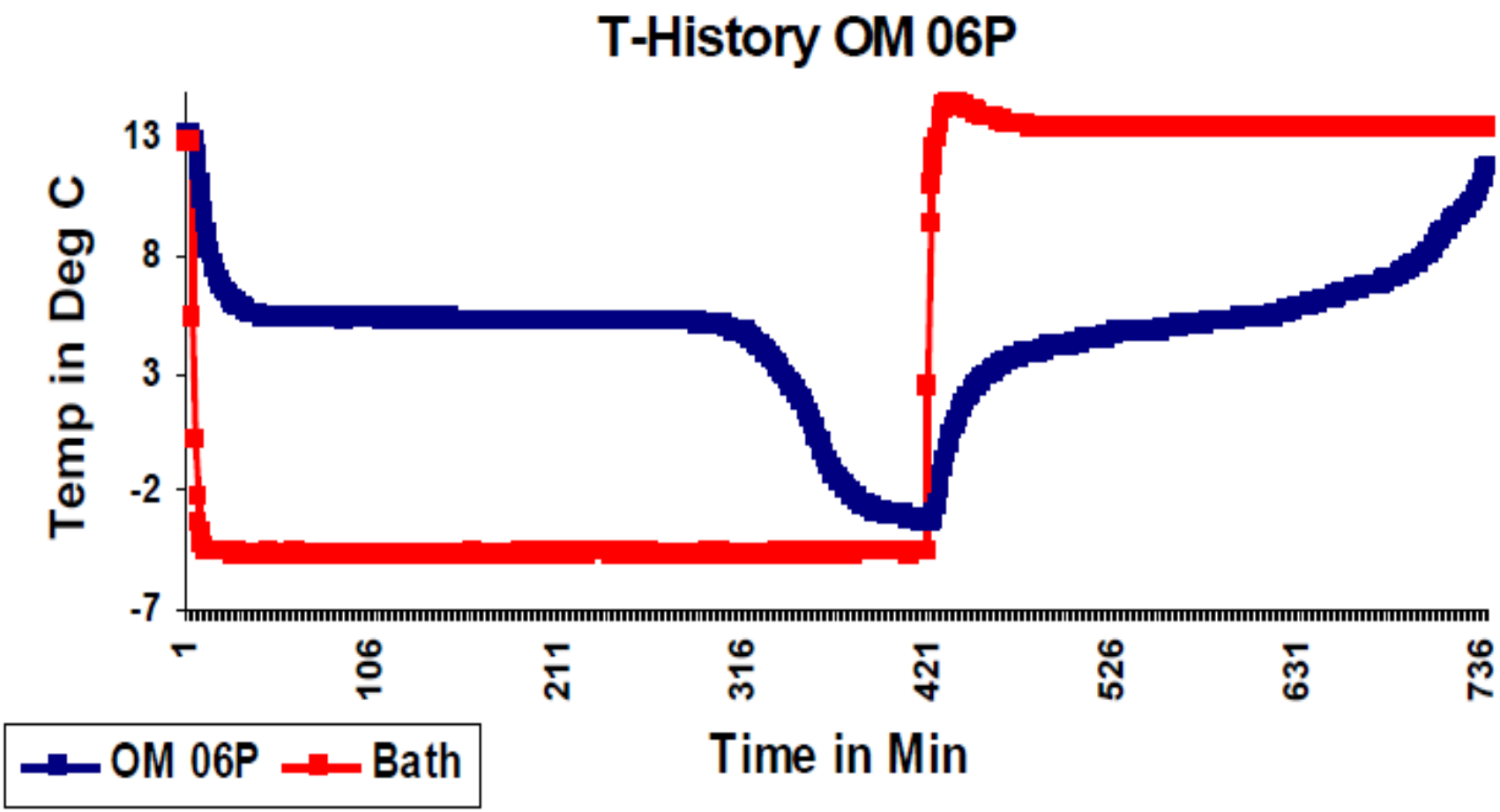
Below -15C for 24Hr in 12”x9”x9” with 1” EPS per ISTA7D Summer



savEnrg™ PCM Cool Packs

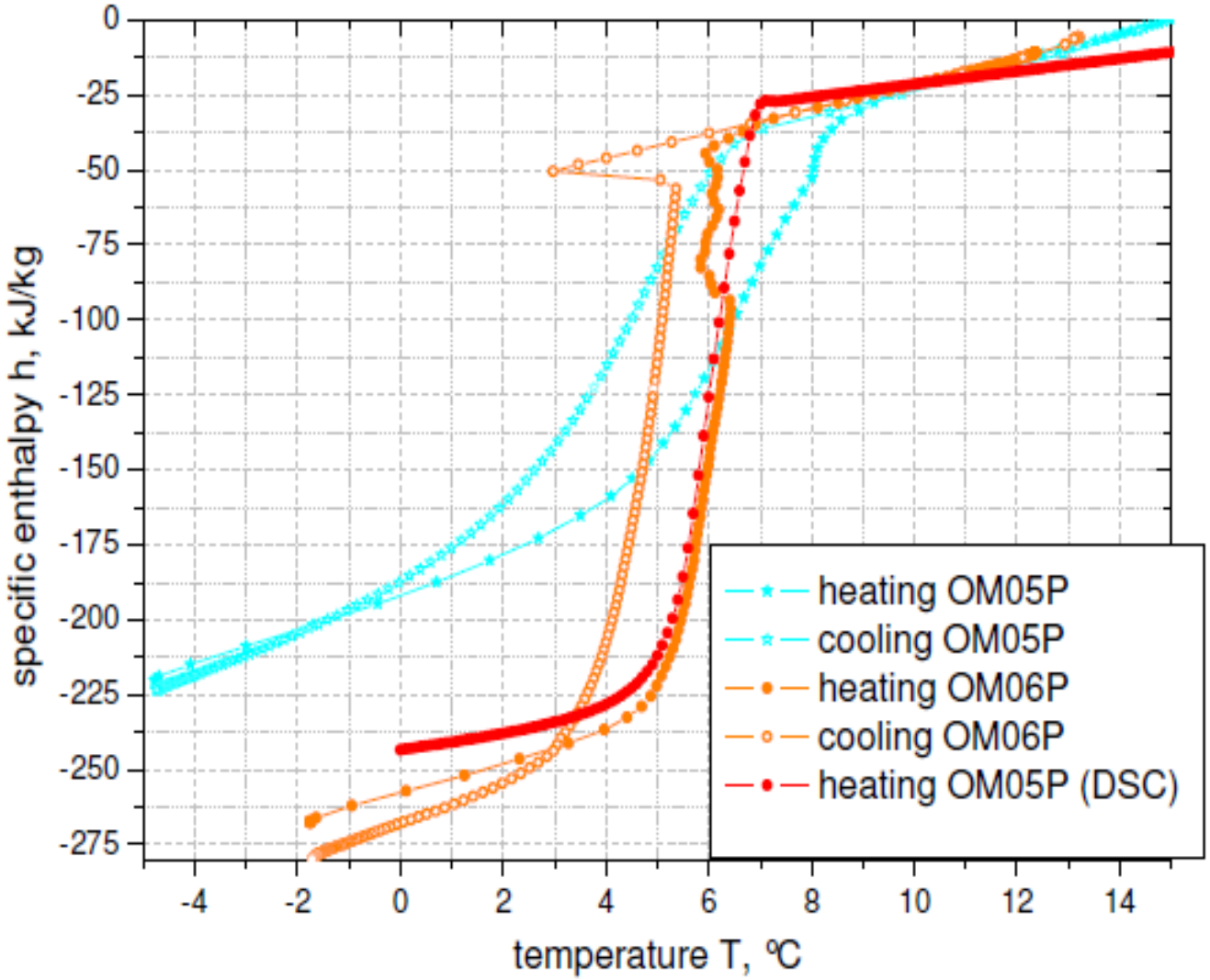
- Ideal for transport of products between +2° C to +8° C
- Filled with PCM-OM06P with phase change point @ +5.5° C
- Freeze completely at temperatures below +2° C
- No super cooling
- Latent Heat Storage capacity 260KJ/Kg
- Volumetric Latent Heat 191KJ/cu.m
- Made from non-toxic organic materials
- Tested for 5000 cycles

PCM-OM06P T-History



Third Party Test Results at ZAE BAYERN, Germany

ZAE BAYERN



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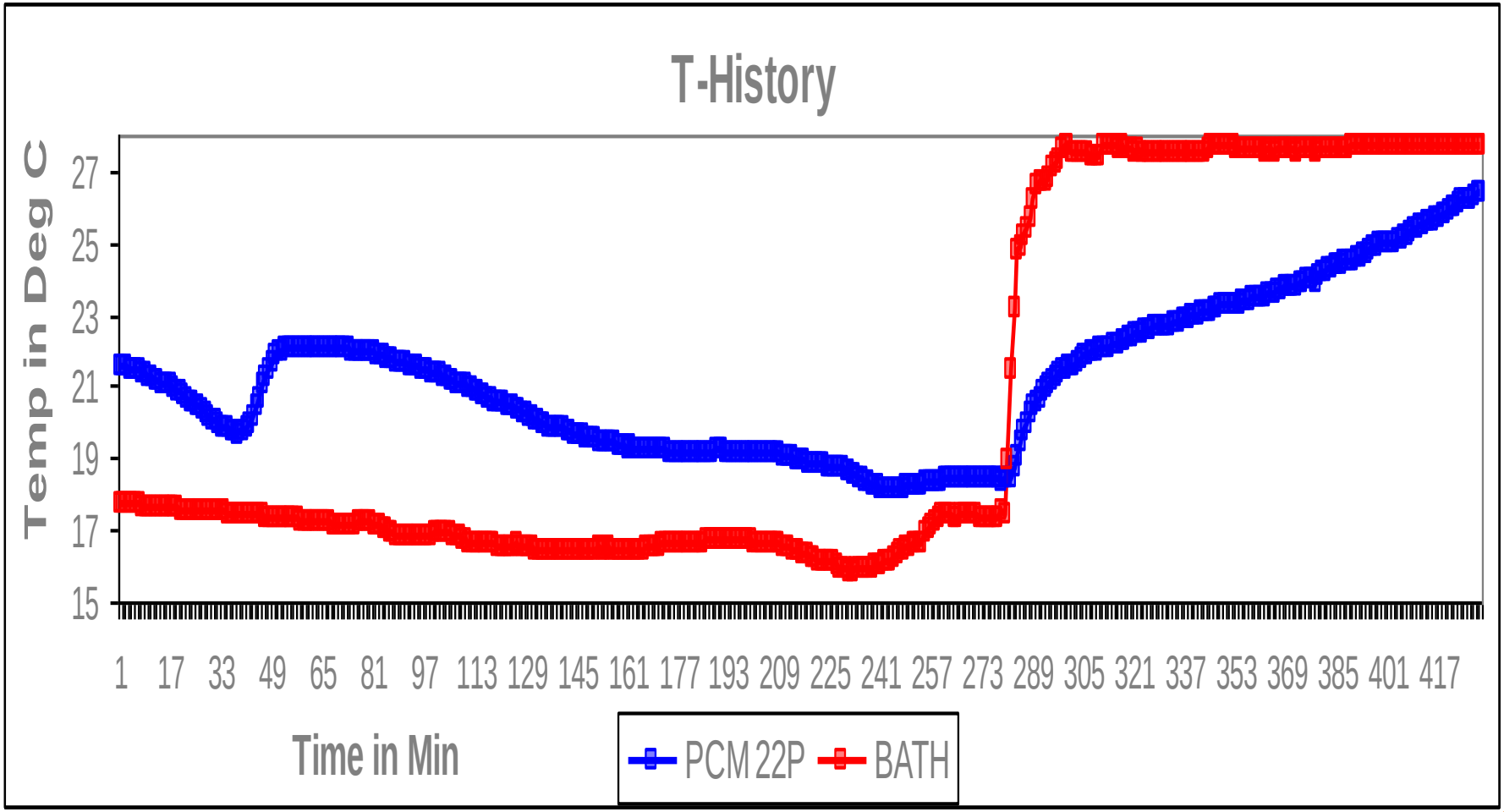
savEnrg™ PCM Warm Packs

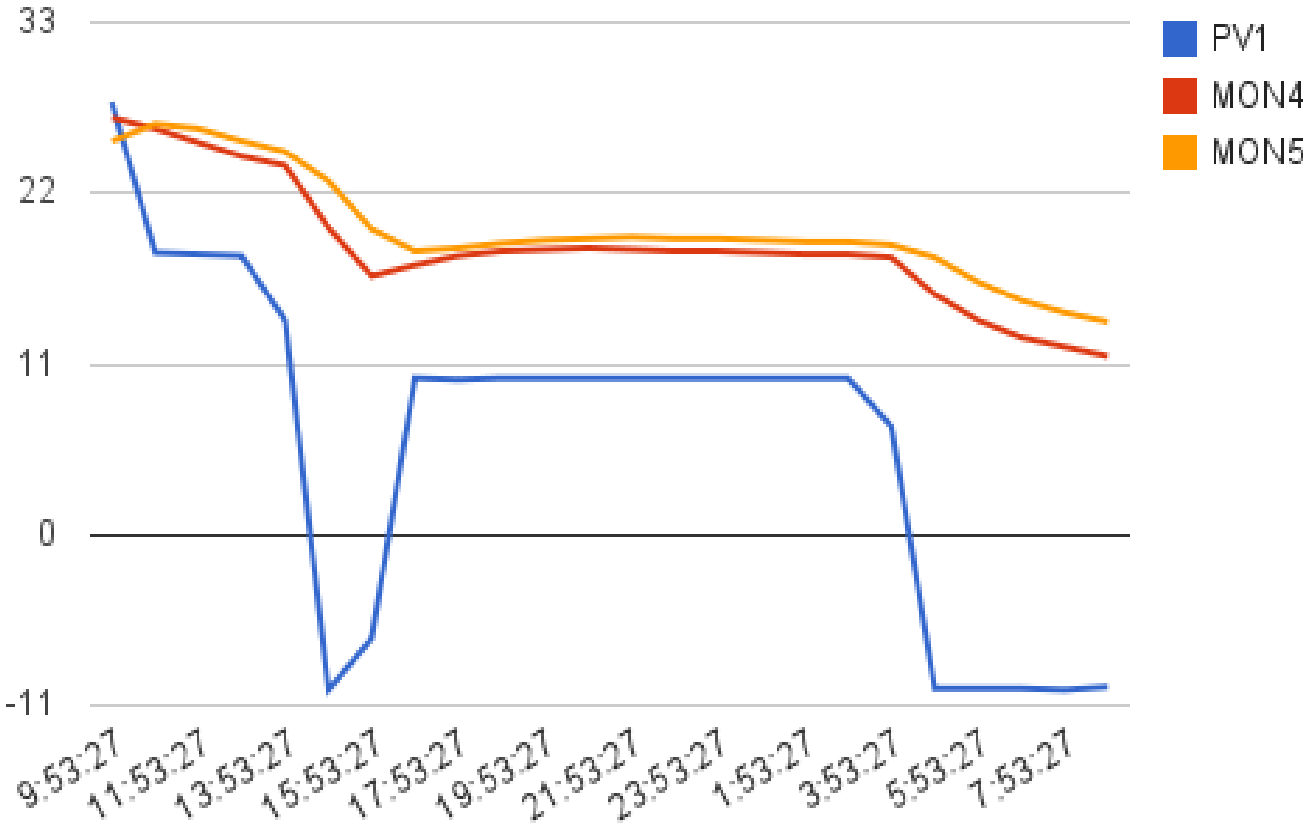
- Ideal for transport of products at controlled room temperature
- Filled with PCM-HS22P with phase change @ +22° C
- Freeze completely at temperatures below +16° C
- Latent heat storage capacity185KJ/Kg
- Volumetric latent heat 285KJ/cu.m
- In hot ambient shipping environments, maintain temperatures between +22° C and +27° C
- In cold ambient shipping environments, maintain temperatures between +18° C and +22° C .
- Made from **Non-toxic and non- flammable** salt hydrates
- Tested for 3000 cycles

PCMHS-22P for Warm Packs



Temperature graphs for Warm packs with PCM-HS22P

18C for 24hr in 12”x9”x9” with 1” EPS per ISTA7D Winter



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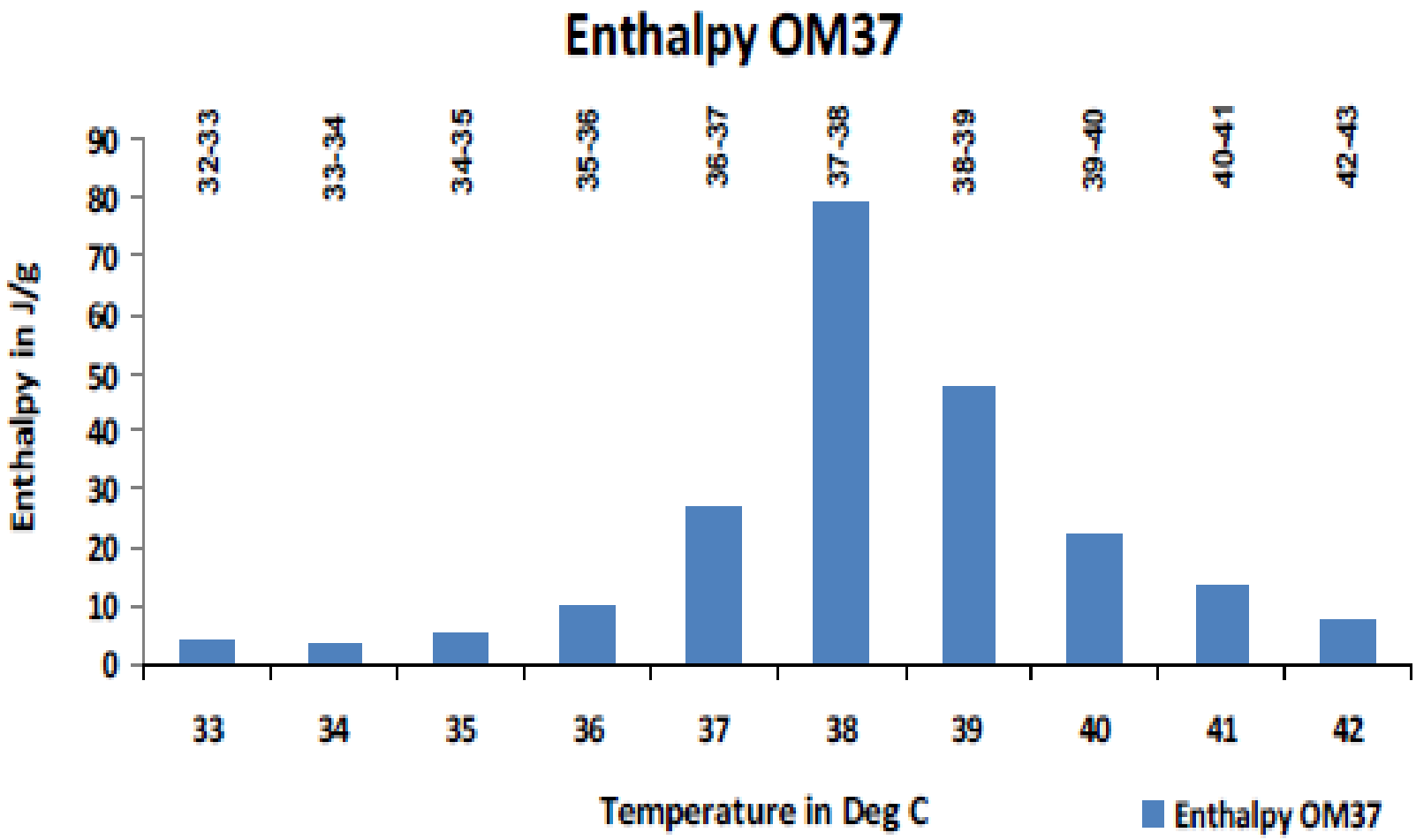
savEnrg™ PCM Incubation Packs

- Ideal for transport of products at body temperature
- PCM-OM37P with phase change @ +37° C
- Freeze completely at temperatures below +32° C
- Latent heat storage capacity 218KJ/Kg
- Volumetric latent heat 192KJ/cu.m
- Made from non-toxic, bio-based organic products
- Expected life of 5000 cycles

PCM-OM37P Enthalpy



PCM Cold Chain Refrigerants

Model Number	PCM COLD CHAIN REFRIGERANTS
Model #	**Ice Pack : -23C (-10F) Phase Change**
IcePack5x6	200gram (7oz) PCM-HS23N in 150micron Nylon Pouch (ID) 110mmx145mm (4.3"x5.7")
IcePack8x6	500gram (18oz) PCM-HS23N in 150micron Nylon Pouch (ID) 180mmx145mm (7"x5.7")
IcePack11x6	1150gram (40oz) PCM-HS23N in 1Ltr HDPE Bottles 280mmx145mm (12"x5.7")
IcePack11x9	1400gram (50oz) PCM-HS23N in 1.2Ltr HDPE Bottles 300mmx235mm (11.5"x9.25")
IcePack18x8	1400gram (50oz) PCM-HS23N in 1.2Ltr HDPE Panel 450mmx200mm (18"x8")
Model Number	PCM COLD CHAIN REFRIGERANTS
Model #	**Freezer Pack: -7C (20F) Phase Change**
FreezerPack5x6	200gram (7oz) PCM-HS07N in 150micron Nylon Pouch (ID) 110mmx145mm (4.3"x5.7")
FreezerPack8x6	500gram (18oz) PCM-HS07N in 150micron Nylon Pouch (ID) 180mmx145mm (7"x5.7")
FreezerPack11x6	1100gram (39oz) PCM-HS07N in 1Ltr HDPE Bottles 280mmx145mm (12"x5.7")
FreezerPack11x9	1300gram (46oz) PCM-HS07N in 1.2Ltr HDPE Bottles 300mmx235mm (11.5"x9.25")
FreezerPack18x8	1300gram (46oz) PCM-HS07N in 1.2Ltr HDPE Panel 450mmx200mmx20mm (18"x8")
Model Number	PCM COLD CHAIN REFRIGERANTS
Model #	**Cold Pack: 0C (32F) Phase Change**
ColdPack5x6	180gram (6oz) PCM-HS00P in 150micron Nylon Pouch (ID) 110mmx145mm (4.3"x5.7")
ColdPack8x6	450gram (16oz) PCM-HS00P in 150micron Nylon Pouch (ID) 180mmx145mm (7"x5.7")
ColdPack11x6	1000gram (35oz) PCM-HS00P in 1Ltr HDPE Bottles 280mmx145mm (12"x5.7")
ColdPack11x9	1200gram (42oz) PCM-HS00P in 1.2Ltr HDPE Bottles 300mmx235mm (11.5"x9.25")
ColdPack18x8	1200gram (42oz) PCM-HS00P in 1.2Ltr HDPE Panel 450mmx200mm (18"x8")
Model Number	PCM COLD CHAIN REFRIGERANTS
Model #	**Cool Pack: +5.5C (42F) Phase Change**
CoolPack5x6	150gram (5oz) PCM-OM06P in 150micron Nylon Pouch (ID) 110mmx145mm (4.3"x5.7")
CoolPack8x6	350gram (12oz) PCM-OM06P in 150micron Nylon Pouch (ID) 180mmx145mm (7"x5.7")
CoolPack11x6	850gram (30oz) PCM-OM06P in 1Ltr HDPE Bottles 280mmx145mm (12"x5.7")
CoolPack11x9	1000gram (35oz) PCM-OM06P in 1.2Ltr HDPE Bottles 300mmx235mm (11.5"x9.25")
CoolPack18x8	1000gram (35oz) PCM-OM06P in 1.2Ltr HDPE Panel 450mmx200mm (18"x8")
Model Number	PCM COLD CHAIN REFRIGERANTS
Model #	**Warm Pack: +22C (72F) Phase Change**
WarmPack5x6	200gram (7oz) PCM-HS22P in 200micron Nylon Pouch (ID) 110mmx145mm (4.3"x5.7")
WarmPack8x6	500gram (18oz) PCM-HS22P in 200micron Nylon Pouch (ID) 180mmx145mm (7"x5.7")
WarmPack11x6	1700gram (60oz) PCM-HS22P in 1Ltr HDPE Bottles 280mmx145mm (12"x5.7")
WarmPack11x9	2400gram (87oz) PCM-HS22P in 1.2Ltr HDPE Bottles 300mmx235mm (11.5"x9.25")
WarmPack18x8	1800gram (64oz) PCM-HS22P in 1.2Ltr HDPE Panel 450mmx200mm (18"x8")
Model Number	PCM COLD CHAIN REFRIGERANTS
Model #	**Incubation Pack: +37C (99F) Phase Change**
IncubationPack5x6	150gram (5oz) PCM-OM37P in 150micron Nylon Pouch (ID) 110mmx145mm (4.3"x5.7")

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Pack 5” x6” – 150 Micron Nylon Pouch (ID) 110mmx145mm (4.3"x5.7")

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Pack 8”x6” – 150 Micron Nylon Pouch (ID) 180mmx145mm (7”x5.7”)

Pack 11”x6” – 1 Ltr HDPE Bottles 280mmx145mm (12”x5.7”)

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Pack 11”x9” - 1.2 Ltr HDPE Bottles 300mmx235mm (11.5”x9.25”)

Pack 18”x8” - 1.2 Ltr HDPE Panel 450mmx200mm (18”x8”)

PCM Applications

POSITIVE TEMPERATURE APPLICATIONS

NEGATIVE TEMPERATURE APPLICATIONS

Thank you

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Phase Change Materials

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