HIMACOOL™

PCM BASED GRID FREE COLD ROOM

With Integrated Phase Change Materials (PCM) based on Thermal Energy Storage system

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Founded in 1994, Pluss Advanced Technologies started with R&D and manufacturing of specialized polymers. In 2007 Pluss commenced development in the field of Phase Change Materials (PCMs) technology. In 2012, the company raised equity funds from Tata Capital Innovations Funds and expanded R&D, developed and commercialized first of its kind temperature control solutions using proprietary materials, addressed unmet need of temperature control across refrigeration, cold storage, cold-chain logistics, HVAC, and healthcare sectors. The company today has a global presence with its own subsidiary in Netherlands. Pluss has received several awards and recognitions, including the CII Innovation award twice, in 2014 and 2017. It has also received the Massachusetts Institute of Technology's Innovators under 35 awards, in 2016 and 2017. Since 2021, Pluss is a subsidiary of Carborundum Universal Limited (CUMI), which is a Murugappa Group company.

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About Himacool™

Himacool™ is a thermal energy storage (TES) based 24x7 micro cold room which enables cooling at a fixed temperature range, even after sunset. Thermal energy storage (TES) technology eliminates the dependency on electrical batteries for cooling during non- sunshine hours.

The Technology

1. During sunshine hours, electrical energy is produced by solar PV modules. These modules installed on roof of the cold-room convert light energy into electrical energy, and this electrical energy powers the refrigeration system to reduce the room temperature.
2. As a result, Himacool™ functions on solar energy to run the condensing unit during the day and simultaneously, stores thermal energy in Phase Change Material (PCM) based ThermoTab™ *active* plates.
3. The ThermoTab™ *active* plate is a set of cold-framed and welded sheets of steel. The interior section of the plate has evaporator coils running through it and the remaining space is filled with PCM.
4. When the refrigerant flows through the evaporator coils, the PCM freezes and uses the stored thermal energy to maintain the temperature throughout the night.
5. In retrospective, Himacool™ operates for 24 hours on receiving only 6-7 hours of sunlight.

PCM-Phase Change Materials

PCM is used to describe materials that use phase change (solidify, liquify, evaporate or condense) to absorb or release large amounts of energy at constant temperatures. PCMs leverage the natural property of latent heat to help maintain product and environment temperature for extended periods of time.

Advantages:

- **Electrical battery free:** Installed PCM plates act as thermal batteries.
- **High quality produce:** Himacool™ functions as farm gate for farmers.
- **100% grid and diesel free:** Powered by solar energy; net-zero carbon footprint.
- **Increases farmers' income** and encourages entrepreneurship.
- **Customized** size solutions up to 50 MT available.
- **Chilled Temp. range:** +2 ° C to +8 ° C.

  Frozen Temp. range: -18 ° C to -25 ° C.

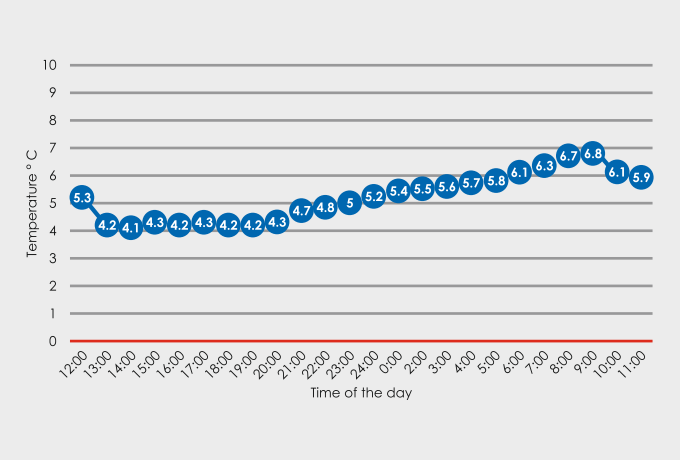
Compatibility

If different products are being stored in the same room, there is a risk of transferring of odours and release of ethylene, an artificial ripener. The table below shows the more important compatibilities.

	Apples	Bananas	Cabbage	Grapes	Oranges	Potatoes	Vegetables
Apples	-	NC	SC	C	C	SC	C
Bananas	NC	-	NC	C	NC	NC	C
Cabbage	SC	C	-	SC	NC	SC	SC
Grapes	C	C	SC	-	C	C	C
Oranges	C	NC	NC	C	-	C	C
Potatoes	SC	NC	SC	C	C	-	C
Vegetables	C	C	SC	C	C	C	-

Y= Yes, N=No, SC= Slightly compatible

The data on average chilled temperature range (2°C-8°C) maintained inside the Himacool™ at our installation site in Bhadrak (Odisha, India) is shown in the below graph. The average ambient temperature was in the range of 28°C to 35°C.



Critical Temperature

All fruits and vegetables have a 'critical temperature' below which undesirable and irreversible reactions take place, thereby resulting in food spoilage. The storage temperature always must be above this critical temperature.

Critical temperatures for some of the important crops are:

Commodity	Critical Temperature (°C)
Apple	-1 - 3
Beans, green	4 - 7
Brinjal	0 - 2
Cabbage	0 - 2
Carrots	0 - 2
Cauliflower	0 - 2
Cucumber	7 - 10
Grapes	-1 - 1
Lemons	4 - 15
Lime	3 - 10
Mango	11 - 18
Potato	1.5 - 4

SUSTAINABLE DEVELOPMENT GOALS

ACHIEVED USING THIS TECHNOLOGY

2 ZERO HUNGER	Zero hunger
7 AFFORDABLE AND CLEAN ENERGY	Clean and affordable energy
11 SUSTAINABLE CITIES AND COMMUNITIES	Sustainable cities and communities
13 CLIMATE ACTION	Climate action

Recognition for PLUSS®

GITA- Global Innovation & Technology Alliance - 2022

FICCI- DST Lockheed Martin Award - 2015

WWF- Climate & Energy – 2021

TCL- Supply Chain Innovation Award for Pharmaceuticals - 2018

DST, GI- Department of Science & Technology, Government of India - 2020 & 2017

BIRAC- Sparsh Grant - 2022

UNIDO- FLCTD Innovation Challenge - 2018 & 2022

MIT- Innovators under 35 India Award - 2016 & 2017

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