

The success story of PCM based Solar Micro Cold Room in Nepal

1. Problem –

Nepal is a mountainous, small and landlocked country. The altitude varies from 60m above mean sea level to the highest peak of the world, Mount Everest 8848m. The horticultural crops like mango, banana, papaya, litchi, guava, pineapple, tomato, potato, radish, brinjal, okra, chilli, cauliflower, cabbage, cucurbits, taro, coconut, and areca nut are grown successfully in a hilly area.

Postharvest losses have been estimated from 20 to 30% for fresh fruits and vegetables and could exceed 50% under adverse conditions. Losses in vegetables and fruits result from harvesting at an improper stage of maturity, direct packing and shipping without the removal of field heat, improper packaging and insufficient grading and sorting, poor transportation and handling and poor storage facilities.

Controlled temperature storage of horticulture produce is one of the options for farmers to avoid wastage of perishables. However, it is an energy-intensive process.

2. Solution –

Pluss Advanced Technologies, Gurugram, Haryana, based company addressed this issue through the energy storage based solution that is grid independent. The innovative solution – PCM based solar micro cold room for storage of varied products, such fruits, vegetables, and fresh horticulture harvest, etc. It uses solar energy as a renewable source for 4 – 6 hours to run the refrigeration system during the day and storing the cold in the PCM which is utilized for remaining 18 – 20 hours.

3. Innovation –

The storage of energy in cold room is achieved through the use of advanced phase change materials (PCM) filled in the eutectic plates i.e. thermoTab active PCM plates, in which Pluss is a pioneer in India. The cold is stored in the form of thermal energy storage (TES) helps to continue the cooling operation during night hours and maintains an ideal temperature range of 2 to 8 deg C remaining 18 - 20 hours. This constant temperature is achieved without any grid electricity or fuel consumption.

Challenges –

Awareness regarding the new and innovative technology of phase change materials for storage of vegetables, fruits, etc. Relatively higher initial capital investment for this.

5. Lessons Learned –

Due to the unavailability of the good transport network and lack of electricity in remote locations across the Nepal country, the wastage of perishables is more and subsequently the loss of income to the farmer. PCM based solar micro cold room is enabling farmers to store tomato, peas, potatoes, cauliflower, amongst other produce. The benefits include:

- Improved quality of perishables produce due to constant temperature storage;
- Higher market value for products;
- Reduced wastage of produce;
- Better bargaining power and prevention of distress selling for the farmers;
- Entrepreneurship opportunities at the rural level through value addition to fresh produce;
- Grid-independent, renewable source of energy for food storage.

PCM based solar micro cold room is helping to achieve sustainable development goals (SDGs) including SDG 2 – Zero Hunger, SDG 7 – Affordable and Clean Energy and SDG 11 – Climate Action. If adopted on a large scale, such technologies will help minimize food wastage, double farmers incomes and generate employment.

6. Photographs and Data monitoring –



Fig 1: PCM based solar micro cold room installed at Mirge, Nepal



Fig 2: Community people using an innovative technology based cold room



Fig 3: Farm produce kept inside the cold room

Details –

- Site Name : Mirge (Dist – Dolakha, Nepal)
- Capacity :5MT
- Solar Plant Size : 5 kWp
- Data monitoring : 26/11/2018 to 10/06/2019

Fig 4: Data recorded for different parameters of PCM based solar micro cold room

Time	Temperature	AC Volt	AC Amp	DC Volt	DC Amp
12:00	5.2	412	NA	621	5.9
13:00	4.2	398	5.4	573	5.2
14:00	4.1	415	NA	623	6
15:00	4.3	401	5.8	579	5.9
16:00	4.2	388	NA	542	5.4
17:00	4.3	Non-sunshine hours - PCM based cooling backup hours			
18:00	4.2				
19:00	4.2				
20:00	4.3				
21:00	4.7				
22:00	4.8				
23:00	5				
0:00	5.2				
1:00	5.4				
2:00	5.5				
3:00	5.6				
4:00	5.7				
5:00	5.8				
6:00	6.1				
7:00	6.3				
8:00	6.7	345	NA	NA	NA
9:00	6.8	351	5.6	483	4.8
10:00	6.1	385	NA	525	4.9
11:00	5.9	398	5.8	572	5.2

The average temperature data monitored inside the PCM based solar micro cold room installed at Mirge (Nepal) is shown in the below graph. The average ambient temperature was in the range of 28 to 35 deg C during the above mentioned period. It is observed that the temperature inside the cold room

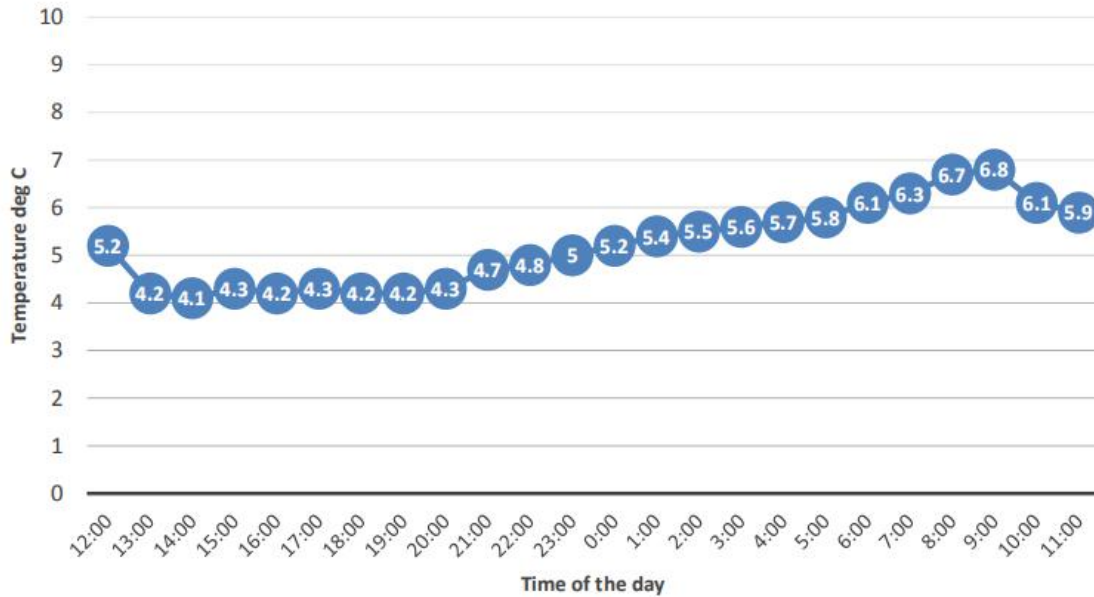


Fig 5: Temperature monitored inside PCM based solar micro cold room