

## UNIT II THERMAL STORAGE SYSTEM

### Phase change storage system

Phase change materials based thermal storage systems operate on the principle of latent heat absorption and release during phase transitions, typically from solid to liquid and vice versa. The key advantage of these systems is the ability to store and releases large amounts of energy at nearly constant temperature, making them ideal for temperature-sensitive applications like HVAC, solar thermal and electronics cooling.

The basic components of a phase change material system include:

**Phase change materials container/ Module:** Holds the phase change material

**Heat Exchanger:** Facilitates heat transfer between the phase change material and heat transfer fluid

**Insulation:** Minimizes heat losses during storage.

During charging, the phase change material absorbs heat and melts, storing latent heat.

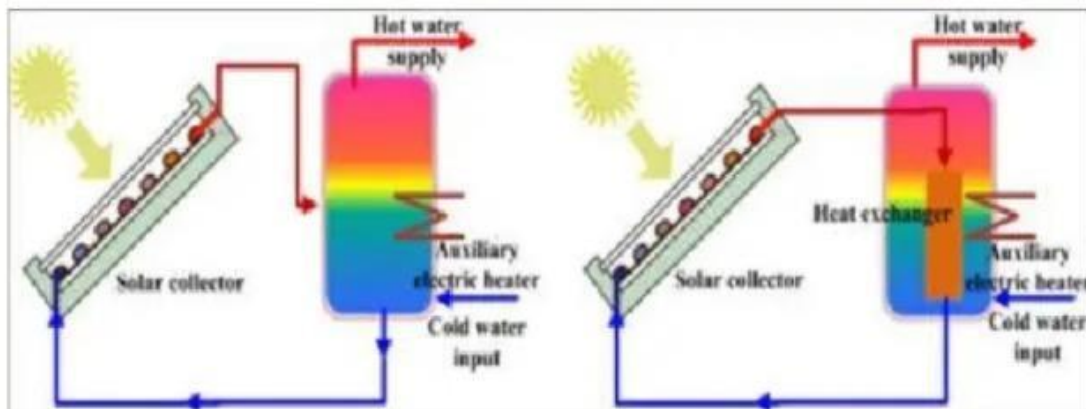
During discharging, the phase change material solidifies, releasing the stored energy. The design must ensure efficient heat transfer since phase change materials typically have low thermal conductivity. Techniques like embedding metal fins, encapsulating phase change material in high conductivity containers, or using composite phase change materials are used to enhance thermal performance.

Other design factors include:

**Melting temperature:** should match the required operating temperature.

**Thermal cycling stability:** phase change material should endure many melting/freezing cycles without degradation.

**Container compatibility:** Prevents leakage and chemical reaction between phase change material and container.



**Advantages:**

- High energy storage density
- Energy efficiency & load shifting
- Reduced carbon emissions

**Disadvantages.**

- High cost
- Leakage risks
- Low thermal conductivity
- Material degradation overtime

**Applications:**

Phase change material systems are widely used in **solar cooking, building temperature regulation and industrial heat recovery.**