

LATENT STORAGE DEVICE WITH OPEN-PORED METAL FOAM

It is necessary to store heat in order to degenerate the production and use of heat. This takes place with the network-independent heat supply or to adjust supply and demand of heat according to time and performance.

Industrial process and waste heat, solar heat, or block-type thermal power stations can be taken into consideration as heat source.

If temperature of the storage medium increases when heat is added, we will talk about sensible heat. The measurable increase of temperature is proportional to the heat stored in the medium ($dQ = m \cdot c \cdot dT$). The dependency of temperature of most of the storage media can be disregarded. Therefore, the sensitively stored heat quantity changes linearly with the difference of temperature (fig. 1).

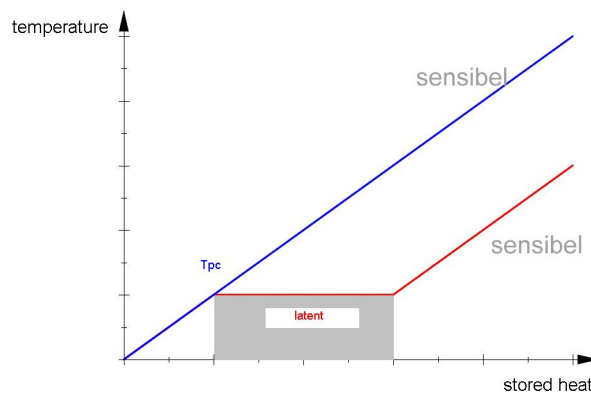


Figure 1: Temperature Sensible Sensible Tpc Latent Stored heat

Latent storage device means the storage of heat in a medium that experiences a phase change. The material starts to melt during the heat addition and the temperature will not increase in spite of the thermal flux. The temperature will continue to increase sensitively (fig. 1) not until the material (PCM: Phase Change Material) has completed the phase change. Due to the phase change it is possible to store heat without a high change of temperature with

high storage density avoidance of temperature peaks or fluctuations for smoothing or buffering

Using H₂O as an example it can be seen that the necessary amount of heat for melting a mass H₂O of ice at 0°C is approximately the same amount of heat to warm up the same mass from 0°C to 80°C. For the phase change of H₂O liquid -> H₂O steam the quintuple amount of heat is necessary in order to warm up H₂O from 0°C to 100°C. This means that 14 % are stored as sensible heat and 76 % are stored as latent heat in steam.

Materials are used for the use of PCM for the climatization that go through

a phase change from solid-liquid because the volume change is the lowest in this process.

A significant bottleneck with regard to the heat storage is the low heat conductivity of the PCMs. Due to the characteristics of open-pored metal foams they are ideal for the structure of compact latent storage devices in stationary and mobile climate control systems because they clearly increase heat conductivity (table 1) use less than 10 % of the useable total volume represent seed crystals and avoid supercooling or overheating therefore allow free shape forming to the incorporation conditions.

In order to use such property potential, the contact between the metal foam and the heat transferring surface is decisive.

Heat conductivity [W/mK]	H_2O	Ice	RT6
With metal foam	6.9	7.4	7.0
Without metal foam	0.57	2.2	0.2

The transformation actually takes place in cold air reservoirs for the mobile use and air conditioning of buildings. The cold air reservoir has approximately 75l of H_2O and a size of 600 x 500 x 250 mm with a cooling capacity of 500 W (fig. 2).



Figure 2:

The latent storage devices for the stationary climatisation are designed as open system that are charged by means of the cool external air during night and discharged by means of the warm air during the day. The construction is carried out as plates and cylinders that are filled with metal foam.

Open-pored metal foams result in a clear improvement of the heat conductivity and dynamics of charge and discharge in latent storage devices. Current trials deal with the heat storage obtained by solar thermal systems.