



Syndego Hydrate Salts PCMs

Over the years a number of Inorganic Salt Hydrate based Phase Change Materials have been introduced into the market. In some early cases, the product worked very well, but within a few years, performance lagged. This characteristic led to a significant amount of development in the field. By the early 1980's, researchers led by Telkes, Yarbrough, Kosny, Alderman, Lane, and Kimura et al, taught technologies which either solved or led others to discover solutions.

Solutions

One of the basic features of Salt Hydrate based PCMs is that they all depend on a fairly precise water /salt ratio which needs to be maintained. Another interesting feature of salts are that they are often hygroscopic or hydrophobic. This means that they aggressively either pull moisture in from ambient or try to repel moisture and dry out. Either of these causes a change in the necessary salt/water ratio, which leads to degradation of the PCMs performance and ultimately, failure.

Syndego solved the problems of moisture migration in and out of the salts by encapsulating them in an extremely low WVTR (water vapor transmission rate) flexible film, which is then heat-sealed. This laminate film includes multiple layers of aluminum foil, which further enhance its moisture barrier credential. Also an additional amount of salt was added to the formulae, which are hygroscopic, and a small amount of water is added to the hydrophobic formula to make up for any amount of moisture loss or gain that could happen over the years.

Another issue found was that salt hydrates, being heavier than water, tend to settle out of the solution when in the fully melted liquid stage. Some of the crystals then, did not stay properly suspended but settled or precipitated down to the bottom of the container and were eventually unavailable to take part in the reaction. A closer look at this phenomena revealed, this was the primary reason that nucleating agents were thought to be breaking down. They were not, they were settling out of the solution! It became clear that gravity and vapor transmission were the primary issues to be dealt with.

Gravity

Salt Hydrates, being denser than water naturally tend to settle out of a solution. There are several ways to prevent this from happening. One is to control the size and shape of the crystals as they are forming, and another is to add viscosity modifiers to the water/salt solution to help support the crystals. **Syndego** did both, adding another carefully chosen salt, which helps modify crystal formation behavior, and working with thixotropic materials, created a matrix, which prevents settling.

Gravity Continued

Gravity played a large part in other products failure because of precipitation. That is, salt hydrates falling out of the solution. As noted above, controlling the crystals as they form and keeping them properly suspended help, but the package design also plays a key role. By forming the film into small packets, the amount of material in each packet is controlled and reduces the weight and thickness of each packet, thereby limiting gravitational effect.

Packaging

The last of the potential issues with salt hydrates is the volume change between the liquid and solid phases. Once again **Syndego** packaging solves this issue. We leave a 20% empty space in each packet to account for that difference. That space and the flexible nature of our film prevent any issues with physical volume change. The design also prevents a catastrophic failure in the event of a puncture. The potential loss is limited to about a tablespoon of pudding like (viscosity) material.

Salt Hydrates

Salt Hydrates have a number of distinct advantages for use in buildings. Some of which are: Good Thermal Conductivity, High Heat of Fusion, High Latent Heat Capacity (per pound), low cost, and they offer both Latent and Sensible Heat Protection. There are other advantages which make salt hydrates the logical choice. They are Non-Toxic, Not Food or Nesting Material for Vermin, they do not burn, and the raw materials are all Naturally Occurring and Widely Available from Many Different Sources.

Syndego PCMs

Syndego PCMs are the most fully developed of the Salt Hydrate PCMs on the market today. It is the culmination more than 40 years research and dozens of patents, as a quick review at USPTO will show. Indeed, any person in the field who continues to question the viability of Salt Hydrate Phase Change Materials, in particular **Syndego PCMs**, can easily be disabused of the notion with a little research in the area.