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Sourcing and Applications of Materials with Phase Change

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Abstract

Phase change materials (PCMs) have recently been introduced to improve the thermal properties of building materials, including thermal mass, thermal inertia, and specific heat capacity. PCMs are substances capable of storing and releasing a large amount of heat energy when undergoing phase transitions. These are grouped into three main categories, namely organic, inorganic and eutectic mixtures. The incorporation of PCMs into materials such as concrete and gypsum significantly increases their thermal mass, which helps regulate the interior temperature of buildings. Consequently, energy conservation in buildings through Thermal Energy Storage (TES) becomes more achievable.

The advantages of using PCM for the accumulation of thermal energy and cold, respectively, in construction and air conditioning installations, as well as in other fields, has led several companies to produce different PCMs for commercial applications. Based on the external climatic parameters corroborated with the comfort microclimate: indoor, the technical applications of PCM can have the following destinations: heat storage systems; cold accumulation systems; mixed heat and cold storage systems. Regardless of the field and technical method of use, PCM applications are similar to regenerative heat exchangers, being characterized by cyclic operation, the exchanger being successively traversed by thermal agents. The most widely used inorganic PCMs in the temperature range specific to buildings and air conditioning installations are: Crystallohydrates: $AB \cdot nH_2O$, are crystalline solids derived from salts containing water molecules. Crystallohydrates are similar to alloys composed of salts, in most cases inorganic and water, which form a crystalline solid; Metals and metallic binary (eutectic) solutions have low melting/solidification temperatures. The main advantage of metallic PCM is determined by the high thermal conductivity compared to the other PCMs. The bibliographic study indicated few references to metallic PCMs.

The main advantages of binary solutions with PCM: variable temperature range of the phase change, depending on the composition; at eutectic concentration, the phase change is sudden, similar to pure substances; The latent heat volume is slightly higher than in the case of organic substances. Since binary solutions are a novelty in the field of technical applications, there is not enough information regarding their thermophysical properties. The advantages of using PCM for the accumulation of thermal energy and cold, respectively, in construction and air conditioning installations, as well as in other fields, has led several companies to produce different PCMs for commercial applications.

The applications of phase-change materials (PCM) have become of great interest in recent years due to the beneficial effects on the thermal, mechanical and durability properties of building and paving materials. PCMs can alter the thermal mass and thermal inertia of building materials, thereby improving thermal energy storage.