Technology Offer

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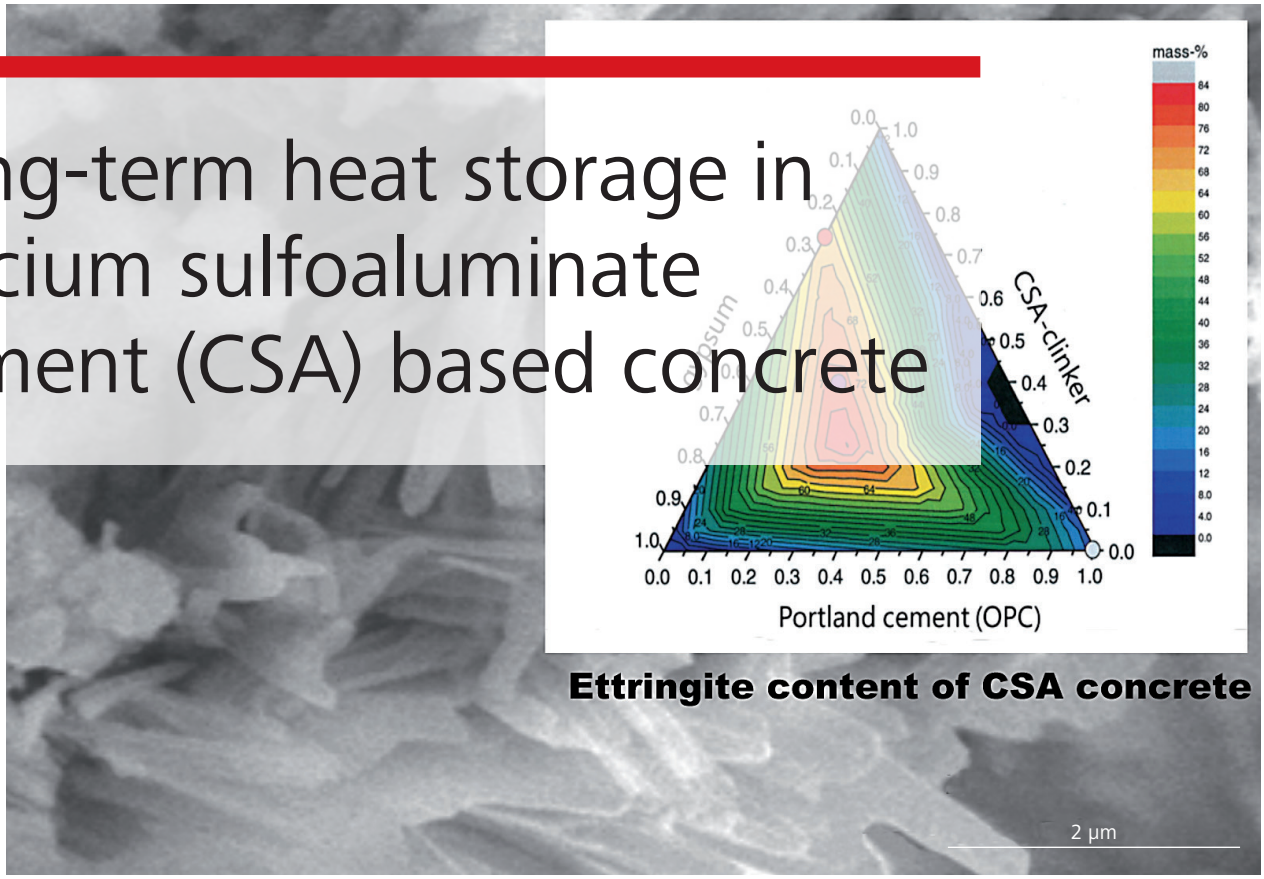
Long-term heat storage in calcium sulfoaluminate cement (CSA) based concrete



Invention

This invention proposes a new heat storage material based on calcium sulfoaluminate cement (CSA) providing a high amount of ettringite. In a fully reversible process – loading by dehydration and recovering by water addition – this innovative cementitious material allows long-term, loss-free heat storage. Relatively high storage energy density at a low transition temperature is reached, permitting a cost-effective application in seasonal solar heat storage systems.

Background

In general, the selection of materials proposed for solar heat storage is based on one of two principal processes: sensible heat storage or latent heat storage. Sensible heat storage utilizes the specific heat capacity of a material, while latent heat storage is based on the change in enthalpy (heat content) associated with a phase change of the material. Long time sensible heat storage requires excellent thermal insulation whereas latent heat storage allows permanent (seasonal) storage without significant energy losses and any special insulation.
Ettringite, one of the cement hydration products, exhibits a high dehydration enthalpy. Calcium sulfoaluminate cement based concrete containing a high amount of ettringite is hence proposed as an efficient latent heat storage material.

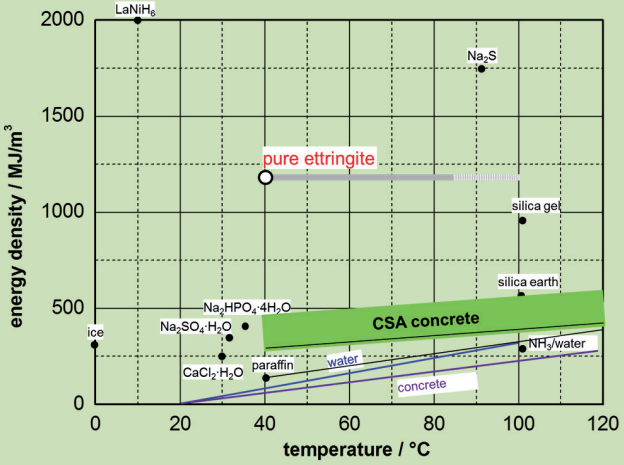
Advantages

Compared to conventional heat storage materials this innovative concrete mixture has a high loss-free storage energy density (> 100 kWh/m^3) which is much higher than the one of paraffin or the (loss-sensitive) sensible heat of water. Like common concrete the

CSA-concrete is stable and even may carry loads. The dehydration of the CSA-concrete is achieved at temperatures below 100°C. The rehydration process occurs as soon as water is added. In contrast to paraffin, the phase change temperature is not fixed and the latent heat may be recovered at any desired temperature. Furthermore the heat conductivity of this material is high, so that the energy transfer from/to an exchange medium is easy. Additionally CSA-concrete is not flammable and absolutely safe regarding any health aspects. The cost of such CSA-concrete is in the order of normal concrete.

Applications

The main application is seen in house heating systems. Solar heat, mostly generated during the summer period by means of roof collectors, can be stored in CSA-concrete until the winter. A part or even the whole annual heating energy may be produced and saved locally by the householder himself.
Additional applications may be in (long-term) storage of process heat. Any temperature source above about 80°C may be used.



Ownership

Empa, Swiss Federal Laboratories for Materials Testing and Research, Ueberlandstrasse 129, CH-8600 Duebendorf; Patent pending

References

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Keywords

Permanent (seasonal) heat storage, CSA-concrete, ettringite, latent heat, high energy density, high thermal conductivity, economic storage material, load bearing storage material

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