PCM screening: the search for latent heat storage materials

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The 6th energy research program of federal government addresses different efforts for realizing Germany`s energy transition strategy. Considering, that not only harvesting of electric power by regenerative sources is of importance, but about 60 % of energy is required as thermal energy for heating and cooling, the heat and cold storage becomes a foremost topic. To compensate efficiently fluctuations of heat supply and need latent heat storage materials (PCM`s) can be applied. Inorganic salts and salt hydrates are promising candidates due to their high storage densities with low temperature differences of the phase change range, their low prizes, the non-toxicity, and the non-inflammability.

Nevertheless, there are some restrictions in thermochemical behavior, that require effortful thermal measurements for identification and characterization of applicability of potential PCM [1]. Thus, inorganic salts show characteristic types of thermal behavior as glass formation, semi-crystallization, a large temperature hysteresis, and incongruent melting behavior (peritectic melt). The experimental search for optimum conditions for reversible melting and crystallization behavior is hence unrewarding.

Furthermore, the selection of pure substances with a suitable melting temperature for the respective application temperature range is very limited. However, the formation of eutectic mixtures from two or more components can significantly increase the amount of potential PCMs for the pertinent temperature range. Since there are currently no suitable concepts for the rational planning of PCM systems, procedures for the efficient screening of these systems must be established. A new approach is presented to get extended insights into the phase equilibria of eutectic systems by means of thermochemical calculation methods (CalPhaD method) [2]. Thus, time-consuming ‘trail-and-error’ procedures can be avoided.

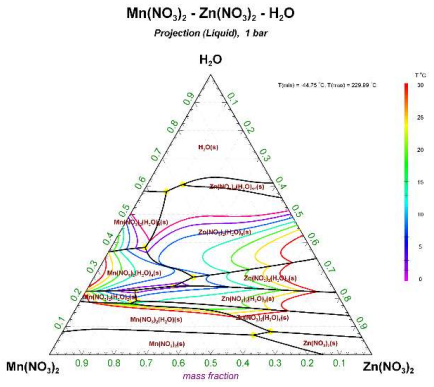

Figure 1: Calculation of formation of ternary eutectic systems of inorganic salt hydrates.

[1] A. Efimova, S. Pinnau, M. Mischke, C. Breitkopf, M. Ruck, P. Schmidt, Development of salt hydrate eutectics as latent heat storage for air conditioning and cooling, *Thermochim. Acta* **2014**, *575*, 276.

[2] C. W. Bale, E. Bélisle, P. Chartrand, S. A. Decterov, G. Eriksson, K. Hack, I. H. Jung, Y. B. Kang, J. Melançon, A. D. Pelton, C. Robelin and S. Petersen, *FactSage Thermochemical Software and* Databases - *Recent Developments*, Calphad, vol. **33** (2009) 295-31.