Proceedings in the Development of PCM Modules for Seasonal Heat Storage

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ABSTRACT

This thesis deals with thermal energy storage (TES) by the aid of supercooled phase change materials (PCM) based on sodium acetate trihydrate, and addressing certain issues encountered in on-going research, while elucidating the importance TES with PCM might hold in a future energy system. This technology seeks to counter the consequences of the fluctuating supply of renewable energy sources of energy and provide seasonally independent heat at a high security of supply, whilst aiding the introduction of higher shares of renewable power into the energy system.

Thermal energy storage have been researched and utilized for well over a century, while the supercooling property of several heat storage materials have been largely overlooked. Using this property actively, significant amounts of energy can be stored latently for extended periods of time - without any losses related to the length of storage. When combined with solar heating, this proves an interesting opportunity for dwellings to be self-sufficient with heat for all building technical services, like heating and hot water, etc. Simulations conducted by Schultz & Furbo (2007) demonstrates that a reasonably small amount of collector surface and storage volume respectively proves sufficient to supply a Danish household, without any auxiliary heating, if constructed in accordance with Energistyrelsens *Bygningsklasse 2020*-directive. Issues surfacing during the attempts do develop successful prototypes of such PCM-modules are being addressed during the course of this project, and among them follows:

- Small-scale experiments on the PCM composition (ratio of water to sodium acetate) for improved stability during supercooling, and;
- Determine latent heat of fusion for compositions exceeding 42 % water.
- Strength analysis to determine and improve problem areas in preceeding, deformed and failed module prototypes, incapable of cooping with high pressure.
- Socioeconomic perspectives on potential impacts on the existing energy system.
- Private economic analysis, simulating performance on the tested compositions and degree of solar fraction.

Recognizing the world as an entity with a finite amount of resources, mankind is quickly running out of our primary carriers of energy as fossil fuels are being depleted at an ever-increasing rate. While renewable sources of energy are being implemented worldwide as a response to the fossil depletion, one common denominator identifies and problematize them: With the exception of hydropower, they are all highly fluctuating and rather unpredictable - very much in contrast to mankind's demand for power and heat, thus emphasizing the importance thermal energy storage might hold in a future energy system.

REFERENCES

Schultz, J. M. & Furbo, S. (2007) Solar Heating Systems With Heat of Fusion Storage With 100 % Solar Fraction for Solar Low Energy Buildings, ISES Solar World 2007 Congress Proceedings, Beijing, China.