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Electrification of heating systems in mild climates using heat pumps and low-temperature thermochemical energy storage

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1 Introduction

According to [1], it is possible to use silica gel particles to store thermochemical energy. Their low desorption temperature (50-90 ºC) makes it possible the use of solar thermal domestic hot water collectors to regenerate the material during the day. The stored energy can then be released at night, when the COP of an air-source heat pump (HP) reaches its minimum due to the low outdoor temperature (the HP must defrost its outdoor unit when temperatures fall below 10 ºC).

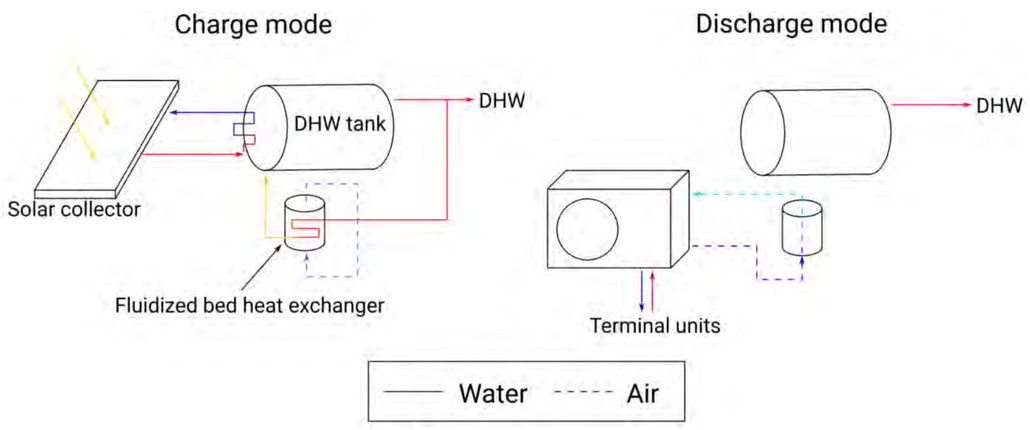

Fig. 1: Working scheme.

2 Experimental test

The experimental rig consists of a 70 mm diameter fluidized bed made of steel in an electric furnace [2]. Silica gel particles will be loaded and tested over several cycles, assessing their energy-storage capabilities and degradation.

Fig. 2: Experimental rig.

3 Granular material characterization

The particle size and shape distributions will be assessed using a Malvern Analytics Morphologi 4 automated microscope. A Freeman FT4 powder rheometer will provide information on the frictional stresses.

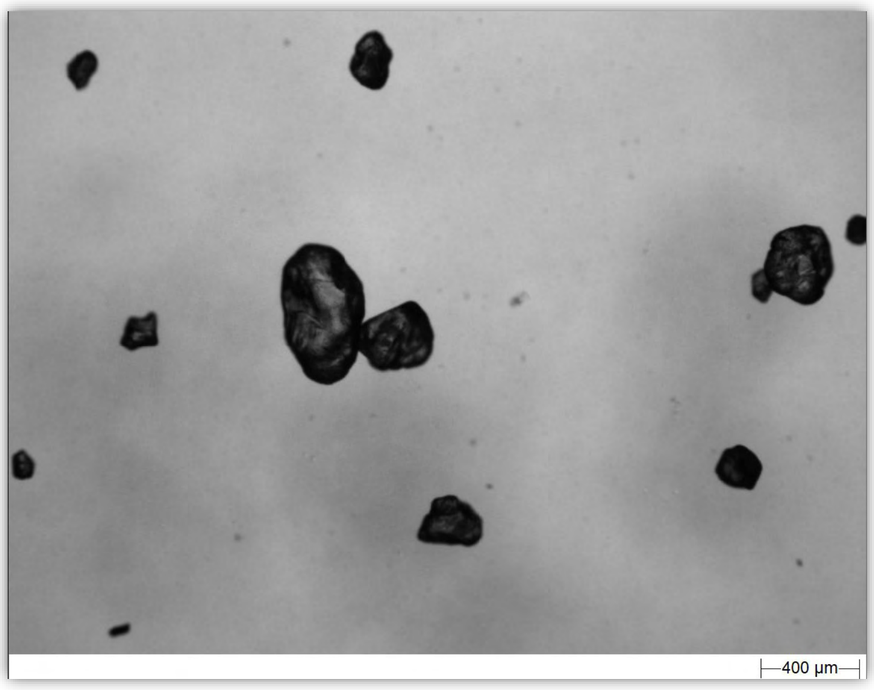

Fig. 2: Silica sand particles (up). FT4 powder rheometer (bottom).

4 Numerical studies

A numerical model using MP-PIC will provide a deeper understanding of the complex hydrodynamic, thermodynamic and chemical behaviour in the fluidized bed [3]. This information is expected to be helpful in the scaling up of the system and in the optimisation of the design and operation.

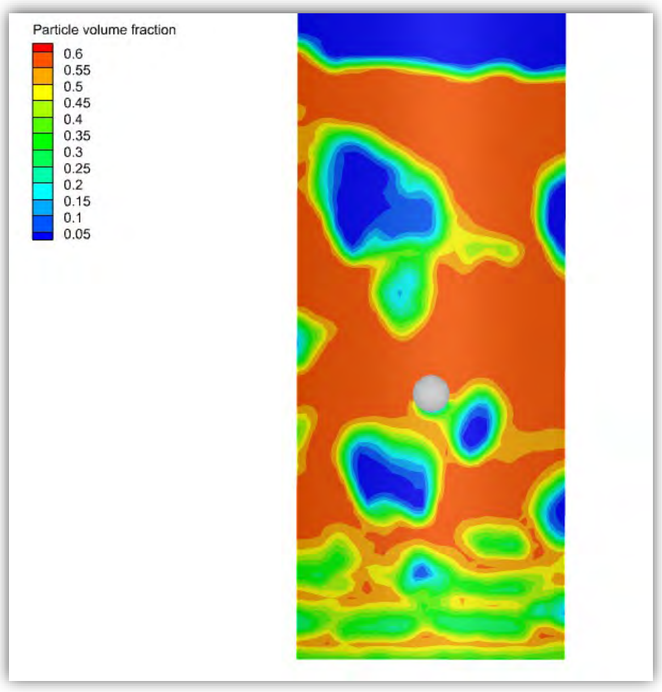

Fig. 3: Image of instantaneous particle volume fraction obtained using MP-PIC numerical simulations.

5 Main interests

- Thermochemical energy storage materials for low-temperature applications.
- Multiphase numerical studies using CFD-DEM, MP-PIC or CFD-CPM or similar techniques.

Bibliography

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