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Operation results of a closed sorption heat storage prototype

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Abstract

In the frame of the EU funded project COMTES a closed sorption heat storage demonstrator based on sodium hydroxide as sorbent and water as sorbate, has been developed. The system operates on a hybrid basis. Heat is stored in sensible hot water tanks for diurnal storage and in the sorption system for seasonal storage. The benefits of both systems can be utilised, namely low charging and discharging losses in diurnal storage and low heat losses during storage time in seasonal storage. In the absorption heat storage system the heat and mass exchangers were developed on a tube bundle falling film basis, as is common in absorption chillers. In testing the heating (absorption) process of the sorption system, issues were encountered with tube wetting as well as speed of absorption. It was found that absorption did occur, but much slower then expected. This resulted in a highly reduced increase of temperature and decrease of concentration. It is proposed that novel heat and mass exchanges are requires for absorption heat storage systems.

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Keywords: Seasonal heat storage, Demonstrator, Operation results, Sodium hydroxide.

1. Introduction

In the frame of the EU funded project COMTES a closed sorption heat storage demonstrator based on sodium hydroxide (NaOH) as sorbent and water as sorbate, has been developed [1]. The system operates on a hybrid basis [2]. Heat is stored in sensible hot water tanks for diurnal storage and in the sorption system for seasonal storage. It is expected that the benefits of both storage types can be utilised, namely low charging and discharging losses in diurnal storage and low heat losses during storage time in seasonal storage.

The complete system has been built into and onto a 7 m long shipping container. Figure 1 shows the demonstrator system from the outside, and figure 2 shows the system from the inside. A solar collector field with an

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active area of 18 m^2 serves to supply heat for operation. The sorption system was designed to have a thermal power output of up to 8 kW [3]. The heat converter consists of two tube bundle falling film heat and mass exchangers. One serving as absorber and desorber (AD unit), and the other operating as condenser and evaporator (EC unit) [3, 4]. The AD unit features 18 times 4 tubes with an outer diameter of 12 mm, inner diameter of 10 mm and an active length of 300 mm. The EC unit is designed much larger containing 12 times 16 tubes with an outer diameter of 12 mm, inner diameter of 10 mm and an active length of 700 mm. Both the AD and EC units are furnished with a manifold consisting of an array of dripping nozzles whereby the sorbent and sorbate fluids are evenly distributed on the tubes. Figure 3 shows the technical drawing of the AD and EC unit. They are sideways interconnected through a large opening for unhindered vapour exchange.

Fig. 1. *Picture of the complete system from the outside. Solar collectors with an active area of 18 m^2 are mounted on top and on the side of the shipping container.*