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Mobile Sorption Heat Storage in Industrial Waste Heat Recovery

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Abstract

Mobile energy storage systems working with Zeolite in an open sorption system can utilize industrial waste heat in cases where a pipeline bound connection is not cost sufficient. A demonstration plant using extraction steam from a waste incineration plant to charge the storage with 130 °C hot air and an industrial drying process as customer 7 km far away from the charging station was built, operated and monitored over one year. The storage contains 14 tons of Zeolite and uses at the discharging station exhaust air from the dryer with 60 °C and 0.09 kg/kg humidity to realize a storage capacity of 2.3 MWh, saves 616 kg carbon dioxide per cycle and shows no degradation within accuracy of the measuring equipment. Maldistribution through the packed bed of zeolite prohibit the desired power output. The prime energy costs can be reduced down to 73 €/MWh considering a small scale mass production.

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*Keywords:*Mobile Storage, Open Sorption System, Zeolite, Waste Heat

1. Introduction

The use of industrial waste heat to supply energy in remote locations is one way to reach better energy efficiency. Mobile energy storage systems transported by truck may bridge the gap between heat source and demand site in cases where a pipeline-bound connection cannot be realized cost effectively.

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For the transportable heat storage unit, phase change materials or sorption materials are promising candidates due to their high energy storage capacity. Different basic studies on the economics showed, that it should be possible to operate such an energy distribution system cost effectively in cases with heat demand during the whole year.

Based on this result ZAE Bayern and its partner IndustrieanlagenHoffmeier GmbH started a project to develop and build a prototype of a mobile storage based on an open sorption system, working with a packed bed of zeolite as adsorbent. A pilot plant with a waste incineration plant as heat source and an industrial drying process as customer was built and operated for more than one year. The major aim of the project was to demonstrate the practicabillity of a mobile heat storage based on an open sorption process and to determine the costs per MWh of transported energy to run the system cost effectively.

2. Methods

A pilot plant with two storages was built to test the system under real conditions. The storage design process was already described in [1]. Fig. 1shows the air flow and the principle of the charging process. Heat source for charging is extraction steam from a turbine of the waste incineration plant which heats up ambient air to 130 °C with a steam/air heat exchanger. For better energy efficiency a heat recovery system with a cross flow air/air heat exchanger was installed, which saved around 1 MWh at each cycle.

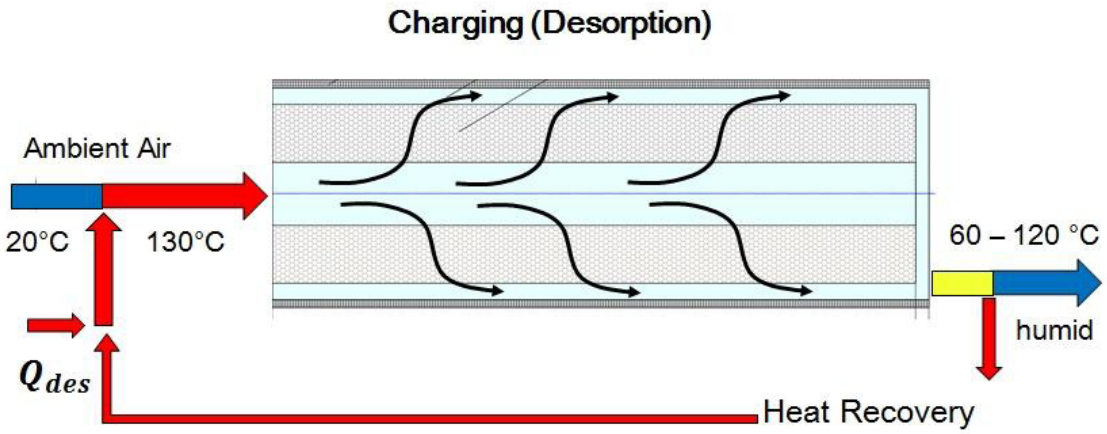

Fig. 1. Schematics of the chaging process with heat recovery.

Fig.2 showed the principle of the discharging process. The air flow through the storage is reversed compared to the charging process. This design minimizes the heat losses during charging and discharging because of the insulation effect of the packed bed. The zeolite storage is used as fuel saver to support the gas burner in the drying process and uses the humid exhaust air form the dryer to release the stored energy.