Fluidized bed chemical energy storage

Can fluidized bed be used for thermal energy storage?
Although the fluidized bed is a well-known technology, its use in thermal energy storage system with PCM has become a topic of interest only in recent years. There are several studies that use fine particles of sensible heat storage materials such as sand in fluidized bed for thermal energy storage, but the ones with PCM are very few.

Can a fluidized bed reactor be used for thermochemical heat storage?
Uchino, T.; Fushimi, C. Fluidized Bed Reactor for Thermochemical Heat Storage Using Ca (OH)2/CaO to Absorb the Fluctuations of Electric Power Supplied by Variable Renewable Energy Sources: A Dynamic Model. Chem. Eng. J. 2021, 419, 129571, DOI: 10.1016/j.cej.2021.129571

What is a laboratory scale fluidized bed?
A laboratory scale fluidized bed is designed, constructed and tested using hot and cold air to simulate thermal storage of solar energy for building heating applications. Efficiency of heat storage and recovery and characteristics of microencapsulated PCMs for optimum performance are discussed based on the experimental results. 2. Experimental 2.1.

How to calculate instantaneous efficiency of a fluidized bed?
The instantaneous efficiency (?) of the fluidized bed as thermal energy storage media with PCM can be calculated as the ratio of recovered heat (Q R) to stored heat (Q S),both calculated according to Equation (1),with the following Equation (2). (2) ? = Q S Q R × 100

What is a fluidized bed?
Fluidized bed is an important unit operation used in many chemical processes,which allows intensified mass and heat transfer due to excellent phase contact and efficient mixing (Mahmoudi et al.,2012).

What are the advantages of fluidized bed reactors?
Until now,fixed bed reactors are the state of the art for TCES systems. However,fluidized bed reactors offer significant advantages for scale-up of the system: the improved heat and mass transfer allows for higher charging/discharging power,whereas the favorable,continuous operation mode enables a decoupling of storage power and capacity.

The unsteady state behavior of fluidized bed thermal storage systems has been modeled in a limited number of studies in the literature, and only for sensible heat. ... Finally, ...

Design of a MW-scale thermo-chemical energy storage reactor. ... Continuous CaO/Ca(OH) 2 fluidized bed reactor for energy storage: first experimental results and reactor ...

Fluidization facilitates a dynamic interplay between solid particles and upward-flowing gases, essential to a

multitude of industrial processes such as drying [], coating [], ...

Preliminary experimental work has been carried out on a fixed bed reactor to cover the topic of chemical cycle stability of storage materials. In order to investigate the ...

For a general fluidized bed reactor that uses gas as the heat transfer fluid, the heat exchange amount is much less than the reaction enthalpy, and the conclusion is established. ...

Alternative designs match different process requirements, in terms of relevant chemical reactions and energy recovery schemes. ... Continuous CaO/Ca(OH)2 fluidized bed ...

Thermal energy storage in the temperature range from 400 °C to 600 °C has been the focus of technological development in recent years. The thermochemical material system ...

A fluidized bed with smooth mixing of solid particles and good heat transfer characteristics has been utilized in various thermo-chemical processes so far [13,14,15,16]. A ...

Thermochemical heat storage presents the advantages over sensible and latent heat storage to achieve higher energy densities and to allow virtually unlimited time scale of ...

Research on high-temperature CaL energy storage systems is in its nascent stages, with the primary focus being on the development and evaluation of appropriate materials [16], ...

The idea of uneven fluidized beds has been explored and pushed further by the University of Naples Federico II and the Italian National Research Council (CNR) with the ...

3. Environmental sustainability: the use of floating carriers in a fluidized bed bioreactor minimizes energy consumption and chemical additives, contributing to the development of low-impact, resource-efficient wastewater ...

TCES reactors with fluidized beds for enhancing heat transfer have also been ... The high thermal input-to-chemical energy storage efficiency ~95% and reactor energy ...

Preliminary experimental work at TUM on a lab scale fluidized bed reactor has been carried out to gain first insights into the topic of chemical cycle stability of storage materials. In addition, the ...

Thermochemical energy storage (TCES) represents one of the most promising energy storage technologies, currently investigated. It uses the heat of reaction of reversible ...

The concept is based on the well established properties of dense fluidized beds of featuring large bed-to-surface heat transfer coefficients, in the order of hundreds of W/m 2 K, ...

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In implementing thermochemical energy storage, the selection of storage medium and the design of the associated discharge process are crucial; in this work the CaO/Ca (OH) ...

Thermal energy storage (TES) is a key factor for increasing the efficiency of concentrated solar power plants. TES using a reversible chemical reaction appears to be a ...

The objective of the present work was to research the storage behavior of a fluidized bed filled with a granular phase change material (PCM) with a small particle diameter ...

Packed bed storage units usually have two (or more) openings, one in the upper part and one in the lower part of the storage bed, to promote thermal stratification. In ...

A simplified dynamic model of a Ca(OH) 2 /CaO-containing fluidized bed reactor was developed by combining a continuously stirred tank reactor model in the solid phase with ...

The concept of countercurrent fluidized beds (CCFB) has recently emerged as a promising design for thermochemical energy storage reactors. However, the interplays among flow structures, ...

A thermochemical heat storage system using Ca (OH)2/CaO in a fluidized bed reactor (FBR) is integrated with a biomass power plant of a steam Rankine cycle (SRC) as one of the Carnot battery systems ...

Thermochemical energy storage (TCES) represents one of the most promising energy storage technologies, currently investigated. It uses the heat of reaction of reversible reaction systems ...

Fluidized beds are widely used in effective heat and mass transfer applications for chemical processes. The beds can also used for storing thermal energy (TES) and offer a ...

A windowedreactor prototype of internally-circulating fluidized bed is tested and demonstrated at laboratory scale for steam gasification of coal cokeirradiated directly by ...

CaCO 3 /CaO thermochemical energy storage (TCES) system has a high heat storage density (1780 kJ/kg) along with high heat storage and release temperature (650-850 ...

In this work, we investigate thermochemical heat storage processes of designed black CaCO 3 pellets under direct irradiation of concentrated solar energy, considering the ...

The CaO/Ca(OH) 2 hydration/dehydration reactions for future energy storage systems for their application in CSP systems have been investigated in a batch fluidized bed ...

In this study, a three-dimensional cold-state gas-solid bubbling fluidized bed model of carbide slag was

constructed for the first time based on the CPFD method, which laid a ...

Mass-producible ?-Al 2 O 3 /CaCO 3 core-shell thermochemical energy storage particles by fluidized bed spray granulation. Author links open overlay panel Lianying Xiong, ...

Chemical Engineering Journal. Volume 264, 15 March 2015, Pages 497-505. Energy storage with PCM in fluidized beds: Modeling and experiments. Author links open ...

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