Solar Absorption Material for Concentrated Solar Power
Technology #13251

Applications

Concentrated Solar Power (CSP) systems function by reflecting sunlight toward a central receiver, where the sunlight is captured as thermal energy. This technology provides an alternative design for such a receiver.

Problem Addressed

In existing designs, thermal energy is captured by heating up a fluid that is pumped through the receiver. Cold fluid is pumped to the receiver to be heated by the incident sunlight, then hot fluid is pumped away to power a heat engine. However, heat loss is incurred as the fluid is pumped around, reducing its efficiency. Furthermore there are two traditional temperature limits: (1) the fluid can typically only store heat up to a certain level before decomposing (usually at a limit of 600°C) and (2) the tubes have their own temperature limits and often fail because of thermal cycling. The thermal energy also cannot be stored for later use.

Technology

This technology proposes a receiver which comprises an insulated tank filled with a transparent fluoride or chloride salt bath containing nanoparticles. Fluoride and chloride can operate at temperatures significantly above 1000°C. Most of the light enters the molten salt and is absorbed by the salt and any nanoparticles within the salt. The use of nanoparticles allows controlled bulk heat absorption. Heat absorption in the bulk fluid eliminates the heat transfer limits associated with heat absorption on heat transfer surfaces. The salt bath both collects and stores the energy.

Advantages

- Higher efficiency from increased thermal energy absorption and storage
- Low capital costs from reduced pumping requirements

Related Links

- This technology is designed to be used in conjunction with this technology for a High Efficiency CSP system (MIT Case 16037), but can be implemented with general CSP systems as well.
- The salt tank can be positioned on or underground — positioned relative to the reflecting mirrors in the configuration recommended by this technology for a High Efficiency CSP system (MIT Case 16037). The tank itself can be designed for greater thermal energy retention using this technology for a CSP receiver (MIT Case 16038).
Related Technologies


Categories For This Invention:

Energy
Solar
Solar Thermal Conversion

Intellectual Property:

Concentrated solar power system
US Patent Pending
2017-0010023
Concentrated solar power system
Issued US Patent
9,273,883
Concentrated solar power system
Issued US Patent
9,488,386

Inventors:

Charles Forsberg
Jacopo Buongiorno
Alexander Slocum
Adam Paxson
Daniel Codd

Publications:

Preliminary Optical, Thermal and Structural Design of a 100 kWth CSPonD Beam-down On-sun Demonstration Plant
Energy Procedia. Volume 75, August 2015, Pages 2163-2168
Design of a 100 kW Concentrated Solar Power on Demand Volumetric Receiver With Integral Thermal Energy Storage Prototype
ASME 2015 Power Conference
July 2015
Experimental Investigation of Divider Plate Assisted Thermocline Storage
ASME 2015
June 2015
Optimal Design and Operation of a Solar Energy Receiver and Storage
External Links:

Precision Engineering Group
http://pergatory.mit.edu/
Center for Advanced Nuclear Energy Systems

Image Gallery: