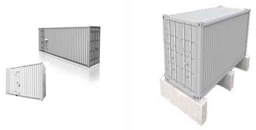
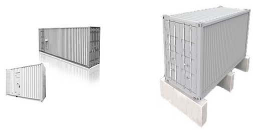
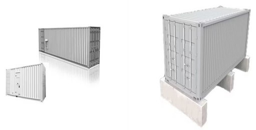
THERMOCLINE STORAGE SYSTEM BOLIVIA



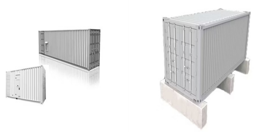
Can thermocline thermal energy storage reduce the cost of a plant? The thermocline thermal energy storage (TTES) system has the potentialto reduce the overall cost of the plant since most of the expensive storage fluid can be replaced by low cost filler material (Gil et al.,2010,Brosseau et al.,2005).



Is thermocline a good thermal power storage system? Thermocline is considered as a favorable solution for thermal power storage systemthat achieves cost reduction for concentrated solar power (CSP) plants. However,Thermocline uses a large quantity of material,often molten salts,in one or two huge tanks several tens of meters high and in diameter.



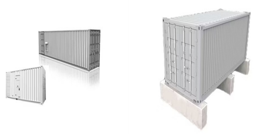
What is a thermocline system? Thermocline is a cost efficient thermal storage systemable to reduce capital costs up to 40%. The objective of NEWCLINE is to develop new thermocline concepts that can be applicable to different CSP plants (PT,CR,LF). Two different,but complementary,concepts related to the materials (media) are proposed.



What are the latest advances in thermal storage based thermocline? The latest advances in thermal storage based thermocline are reviewed. The current project of solar collectors using thermocline storage thermal is reviewed. Enhancement of different parts of thermocline system is discussed. Theoretical models characterizing the storage performance are summarized.

Is thermocline storage a good solution? Thermocline storage on a solid bed is a promising solutionbut requires an adequate choice of the solid material used. In this literature review,it was found that vegetable oils have the same orders of magnitude in terms of thermal properties but their thermal stabilities allow them to be differentiated.

THERMOCLINE STORAGE SYSTEM BOLIVIA



Can thermocline system be integrated with CSP plant? There are many works , , , , , , , , , that investigated the integration of thermocline system with CSP plant, focusing the effect of such parameters like the porosity, the filler material conditions, the tank structure and size on the global performance of the thermal storage systems (TES).

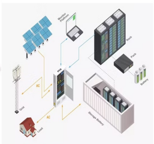
The TES effectiveness for a thermocline storage is the ratio of the usable portion in Figure 5 to the storage-fluid height, L. Because the thermocline effectiveness is relative to the detailed

One such thermal storage system, a thermocline, uses a single tank containing a fluid with a thermal gradient running vertically through the tank, where hotter fluid (lower density) is at the top

Presents optimum design of the thermal energy storage system. article info Article history: Received 17 May 2013 Received in revised form 2 August 2013 Accepted 19 August 2013 Keywords: Thermal energy storage Thermocline system Latent thermal energy storage Encapsulated phase change materials Concentrating solar power abstract

Thermal energy storage (TES) units use different fillers which can be stored at high-temperature within insulated storage tanks. When sunlight is not available, the heat release can then be utilized in CSP plants to meet electrical demands, thereby boosting and improving a plant's dispatchability [2, 3].As far as tank systems are concerned, the one-tank system with ???

THERMOCLINE STORAGE SYSTEM BOLIVIA

This work studies a new concept of thermocline-like storage device, which consists in combining different filler materials ???low-cost solid and different encapsulated PCM??? appropriately chosen ???


between two-tank and thermocline storage systems was carried out in Rodr?guez et al32 to evaluate the best sys-tem to integrate with a CSP-ORC system. The results rev-ealed the superior global attractiveness of the thermocline solutions, since they exhibited similar ther-mal performance but at a much lower cost of about 30%.


Thermocline storage is a relatively unproven TES method that has the potential to significantly reduce these costs. In a thermocline system, approximately 75% of the required storage medium is replaced with an inert quartzite rock, and only one storage tank is required instead of the two typically needed for high-temperature TES.


Yang and Garimella [10] presented a computational fluid dynamics model to analyze the performance of thermocline storage system filled with quartzite rocks for use in parabolic trough CSP plants, and more recently, Yang and Garimella [11] explored the cyclic behavior of sensible thermocline storage system. For a given mass flow rate of the HTF, the ???

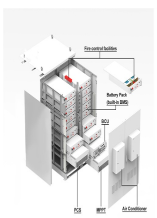

Thermocline is a cost efficient thermal storage system able to reduce capital costs up to 40%. The objective of NEWCLINE is to develop new thermocline concepts that can be applicable to different CSP plants (PT, CR, LF). Two different, but ???

THERMOCLINE STORAGE SYSTEM BOLIVIA

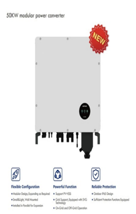
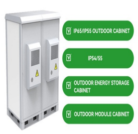

Due to the large physical scale of thermal energy storage systems, investigation of thermocline tank performance is of-ten conducted via numerical simulation. Bharathan and Glatz-maier [8] adopted a computational ???uid dynamics (CFD) ap-proach to simulate the thermal response of a quartzite sphere


One such thermal storage system, a thermocline, uses a single tank containing a fluid with a thermal gradient running vertically through the tank, where hotter fluid (lower density) is at the top


One such thermal storage system, a thermocline, uses a single tank containing a fluid with a thermal gradient running vertically through the tank, where hotter fluid (lower density) is at the top

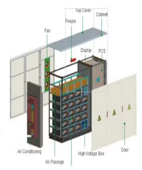
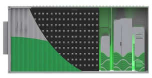


The influence of design parameters on the thermal performance of a packed bed thermocline thermal energy storage (TES) system was analyzed. Both one-dimensional (1D) and two-dimensional (2D) in-house codes were developed in MATLAB environment. The diameter of solid filler, height of storage tank, and fluid velocity were varied. The thermal performance of ???

The implementation of single-tank thermocline storage systems in concentrating solar power systems is a promising solution to improve their stability and continuity. However, flow uniformity

THERMOCLINE STORAGE SYSTEM BOLIVIA

of this paper is to present a new thermocline-like storage concept, which aims at circumventing this issue. The proposed concept consists of a storage tank lled with a combination of solid ???


The Master thesis hereby presented describes the modelling and implementation of a thermocline-like multi-layered single tank storage in a STPP. The research work presents a comprehensive methodology to determine under which market structures such devices can outperform the more conventional two tank storage systems.


Notably, despite the higher efficiency of two-tank energy storage systems, thermocline storage systems appear as a potentially preferable option for lowering energy supply costs in concentrated solar power (CSP) facilities . Several factors contribute to cost reduction in solar thermal power plants, including economies of scale in manufacturing and plant ???


In the present thermocline storage system, the rocks have a higher energy storage density, ?? r C r than that of fluid, ?? f C f as seen in Table 1 (Kearney et al., 2003, Van Lew et al., 2011). An ideal thermocline tank is a conceptual tank consisting of hot and cold fluid separated by a fictitious barrier without any filler material (?u = 1).


Thermocline thermal energy storage is one of the most promising solutions for recovering waste heat in industrial plants. This paper aims to optimise the shape of a thermal energy storage to ???

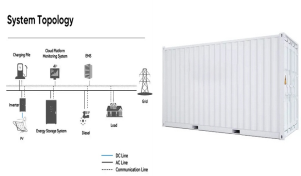

In this work, a series of three-dimensional unsteady numerical simulations are performed to study the stability and interface dynamics of a thermocline-based lab-scale single tank Thermal Energy

THERMOCLINE STORAGE SYSTEM BOLIVIA

An overall idea of the potential cost reduction can be highlighted by combining the facts that the conventional two-tank molten salt storage system [4] accounts for approximately 10-20% of the total investment of a CSP plant and that the thermocline TES is estimated to cost approximately 35% less [5].The expected cost reduction is achieved from the advantage of ???

focuses on the thermal and cyclic behaviour of a high temperature single-tank sensible thermocline storage tank. The thermocline thermal energy storage (TTES) system has the potential to reduce the overall cost of the plant since most of the expensive storage fluid can be replaced by low cost filler material (Gil et al. 2010; Brosseau et al. 2005).

The numerical code was developed to systematically investigate the behavior of different thermocline energy storage systems was extensively tested in terms of solution accuracy and mesh convergence [] addition, the code was compared with a version using a time explicit scheme; although the predictions are similar, the implicit version of the code shows a marked ???



A molten salt thermocline system has been developed that is lower cost than a two-tank molten salt system. ??? Isothermal and thermal cycling tests showed that silica sand and quartzite rock as well as taconite were compatible with nitrate salts. ??? The feasibility of a molten-salt thermocline system was proven on a pilot scale 2.3 MWh storage

A thermal energy storage (TES) approach is the primary technology for ensuring the continuous supply of electricity from solar power plants. In solar power research and development, selecting the best storage device in a two-tank TES system, the thermocline TES system is a more cost-effective alternative for storing sensible heat.

THERMOCLINE STORAGE SYSTEM BOLIVIA

Thermal storage improves the dispatchability and marketability of parabolic trough power plants allowing them to produce electricity on demand independent of solar collection. One such thermal storage system, a thermocline, uses a single tank containing a fluid with a thermal gradient running vertically through the tank, where hotter fluid (lower density) is ???

This work presents an optimized thermal energy storage (TES) system based on thermocline technology. A prototype of a single-medium (molten salt) thermocline storage system was built and tested at the ENEA Casaccia Research Center, which consists of a single tank equipped with an internal vertical channel to drive the salt motion by natural convection.

The installation is used to characterise TSAR (Thermocline Storage for Applied Research), a packed bed thermocline storage combining alumina spheres and Jarysol(R) oil, whose material properties are presented in Appendix B. Thermal oil was used because it does not require anti-freeze device and because its operating temperature range fits the one obtained ???

This work is a thorough review on the parameters influencing the performance of a dual-medium thermocline storage system for concentrated solar power plants. Thus, indicators such as efficiency