

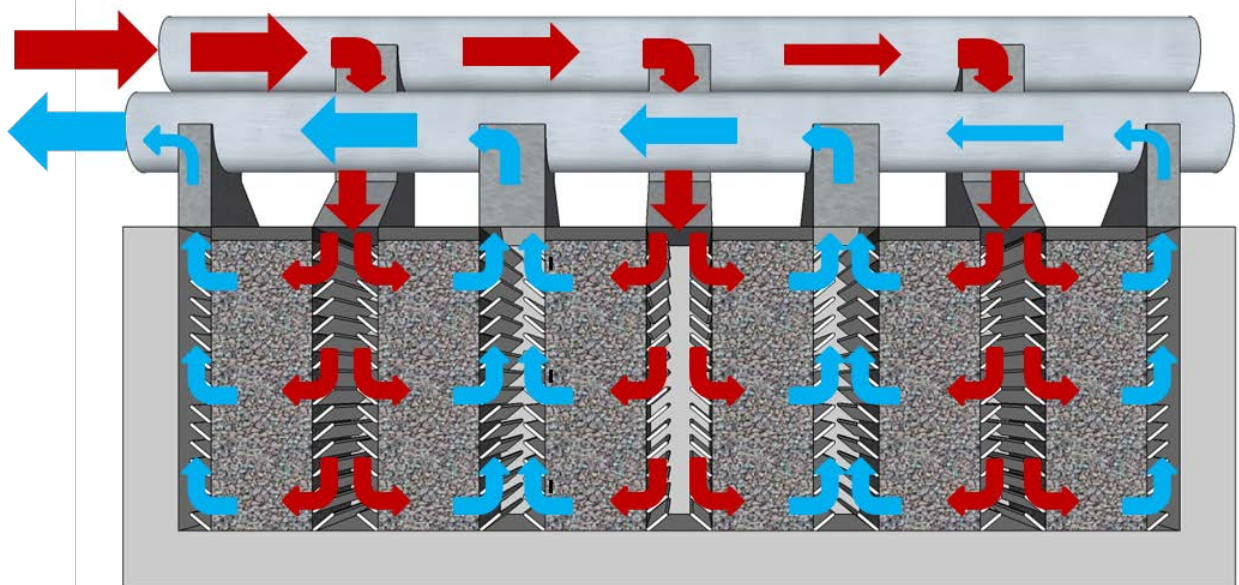
Use of thermal energy storage systems in industrial processes

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Thermal storage systems offer a wide range of possible applications including industrial waste heat and process applications. Thermal storage systems can be a key factor for the increase of energy efficiency in industrial processes. Furthermore cost effective storage solutions can help to protect the environment and enable energy (and cost) optimized production.

STORASOL-HTTES system

Enolcon and STORASOL developed a cost-effective high temperature thermal energy storage system (HTTES) based on several packed bed layers arranged in parallel. Small grained, natural, cheap and almost everywhere available silica sand is used as storage material. Hot air, provided by an industrial process, is used as heat transfer medium and directed horizontally through the packed bed layers. The following figure illustrates the storage module set up.



The system is able to store heat with temperature up to 600 °C, with variable volume flows. Due to the modular set-up, charging and discharging capacity as well as the storage capacity can be set individually, resulting in a highly flexible system.

Since 2015 the large scale demonstration plant ORCTES is in operation at the University of Bayreuth/Germany with a storage capacity of 1.5 MWh_{th}.

Application examples

There are enormous numbers of possible integration possibilities of a TES-system into new or existing production processes. In order to give a first insight, the possible applications are clustered into high-temperature to high-temperature (hT2hT) applications, high-temperature to low-temperature application (hT2lT) and mobile applications:

- **hT2hT:** With these applications, production processes with time shifted energy demand and waste heat production are connected via the TES-system. The main advantage of the STORASOL-HTTES is its flexibility in charging and discharging capacity. This allows, for example, the connection of a process with a high energy output for a short time period with a process with a low energy demand over a long time period by the TES-system or vice versa.
- **hT2lT:** Such applications connect the waste heat production of industrial processes with low temperature energy demand (e.g. heating, warm-water production, steam production < 10 bar). Similar to above, the main advantage of a TES-system is its ability to connect time shifted demands and production of heat and the connection of high power/short period with low power/long period.
- **Mobile applications:** Especially for hT2lT applications, energy source and sink are often too distant to allow a direct connection. There, mobile storage applications can be applied, using a modified STORASOL-HTTES solution. For mobile applications, energy density is crucial, one of the main advantages of the STORASOL-HTTES.

Although every production process is different, the modular design of the STORASOL-HTTES system offers an easy way to adopt the system to the process needs. Different storage modules can be placed in parallel (high charging capacity) or in serial arrangement (high storage capacity), etc. It is even possible to charge and discharge the system at the same time but with different capacity values.

Benefit

Obviously, a thermal storage system included in the production process reduces energy costs by using waste heat to serve energy demand. Moreover, the system increases the flexibility of the production process.