Develop alternative heat exchanger design based on calculations

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Aim of the Project

Design a model on an improvement of the inner tube work, increasing CSA, or the outer surface area, using heat transfer principles.

History of a Sand Battery

The world's first working sand battery was created on the 5th of July 2022 in Finland, it can hold up to around 500C which can be used during Winter when heating in houses is used the most.

The 1st operational sand battery is accredited to Polar Night Energy. The two Engineers, Markku Ylönen and Tommi Eronen, were two of the main Engineers on the project in Finland.

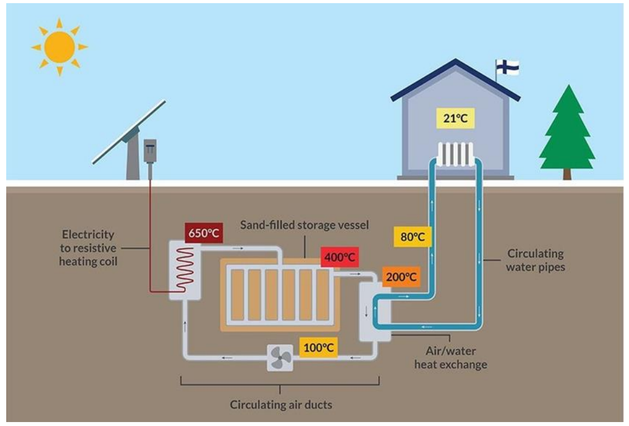
Concept Design

Many different concepts were designed for the purpose of this project. These concepts mainly revolved around the inner pipework design. The final design consisted of a tank which was a Burco boiler and multi-layer pipe in a spiral shape to allow for the most sand to pipe contact.

Background

What is a Sand Battery?

A “sand battery” is used for storage of a high temperature thermal energy by using sand as a storage medium. Typically, low-grade sand is used in sand batteries, the sand retains energy in the form of heat. It's used as a high-capacity reservoir for excess power. This energy is stored as heat which in return can be used for providing home-heating and steam and heat energy to fossil fuel operated industries. The sand battery increases the efficiency for these industries that use renewable energy because of the large excess of heat energy the sand battery can hold.

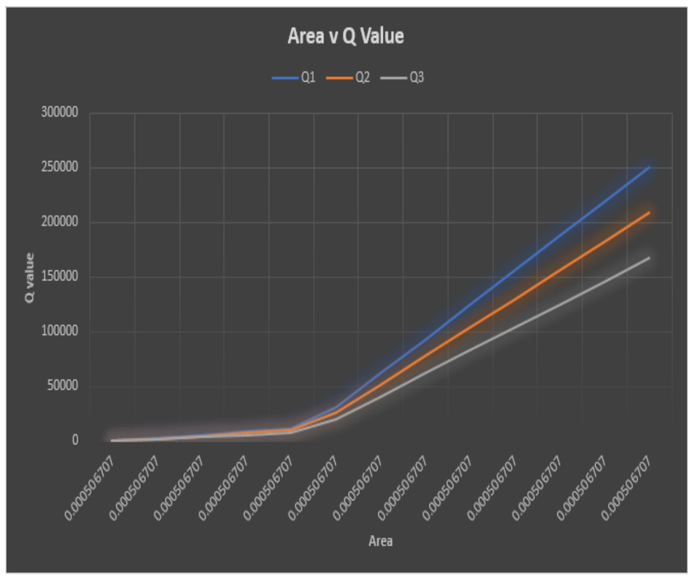


Advantages of A Sand Battery?

The sand battery is roughly eight to ten times cheaper to run than the lithium battery alternative. Due to low amount and simplicity of resources required to produce a sand battery, they have a lifespan of tens of years

Calculations

For the purpose of the calculations a series of heat transfer calculations were carried out. From a large quantity of calculations, the graph below was made. The graph below has the cross-sectional area on the X-axis while having the Q-Value on the Y-axis. This graph displays that the greater the area the large the Q value.



Testing

In the basic of terms, the testing of the sand battery involves heating the sand for 12 hours. Leaving the sand battery sit idle for 24 hours before pumping in cold water. The temperature in and temperature out is monitored for both the heating of the sand and the heat extraction stage of the procedure.

To pump the heated water into the sand the P. Hilton heat exchanger is used. This heat exchanger is also used to pump in the cool water and extract the heat.

Conclusion

From carrying out this project it is clear t that the concept of a sand battery is a very viable method of storing energy. It has both advantages and disadvantages but would be suitable for many large towns and cities and if developed further, possibly the future of energy storage.