

Design Build and Test a working demonstration unit of a Sand Battery

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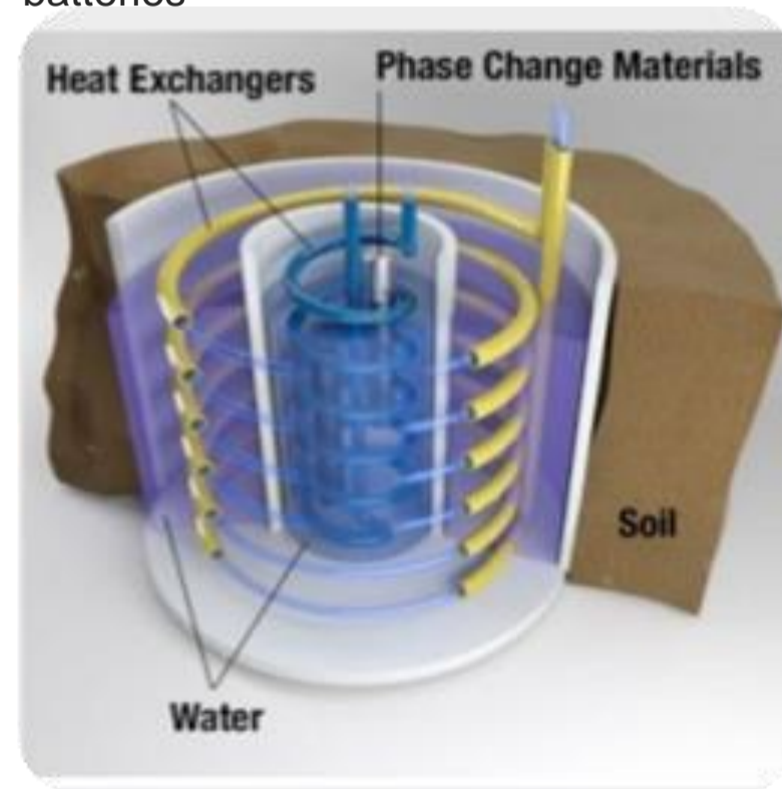
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Aim of the Project

Design a demonstration unit for lab, that shows the ability of sand battery to store heat energy and distribute over time.

What is a sand battery?

- Type of thermal energy reservoir that uses a renewable energy source to power a heating element and in turn heat up the sand which will store the heat energy
- First produced in Kankaanpää, Western Finland to combat rising cost of gas from Ukraine war
- Sand Stored at up to 500-600° C in large insulated silo's
- Stores enough energy to power residential towns and other facilities
- Much more cost effective than alternative "batteries"



Why use a sand battery

- Renewable energy source makes it much more environmentally friendly than Fossil fueled energy sources and reservoirs
- While the initial manufacturing cost is expensive the maintenance and upkeep is relatively cheap

Concept designs

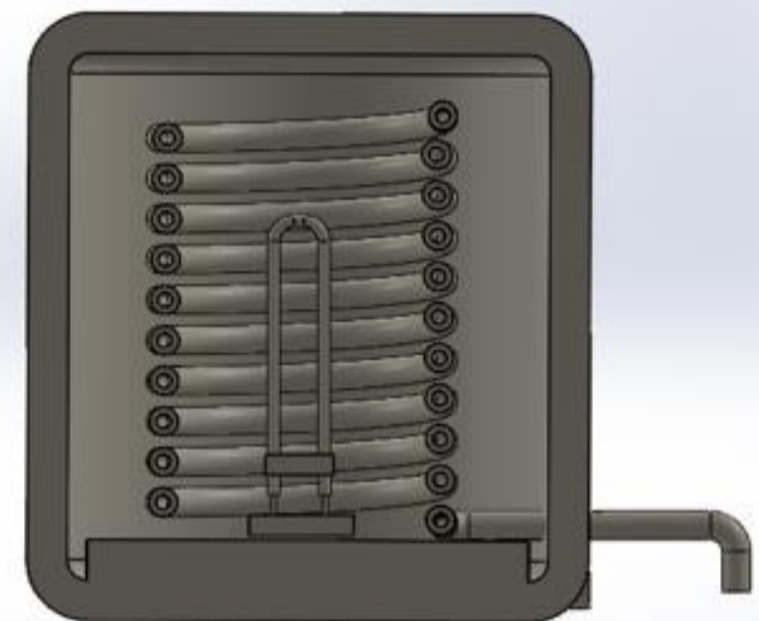


Figure 2: Concept Design 1

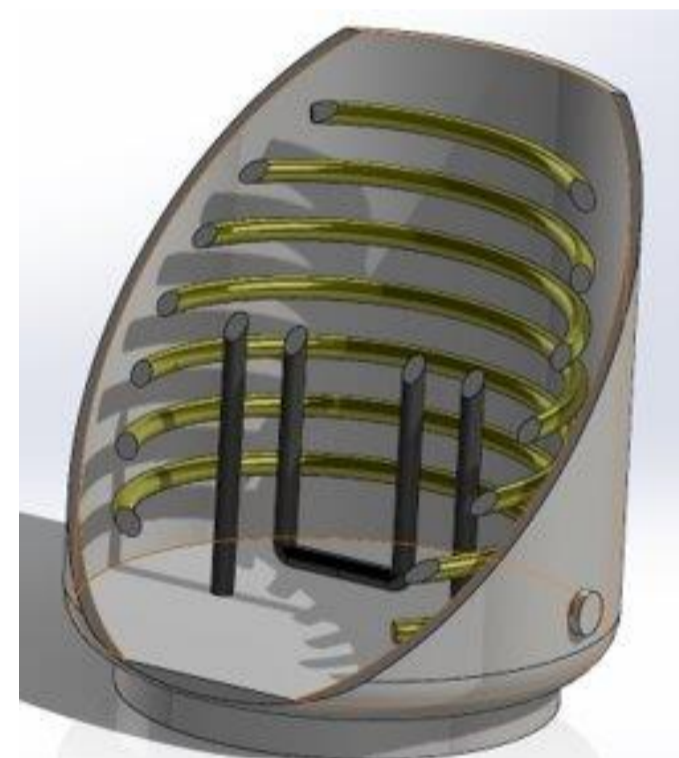


Figure 3: Concept Design 2

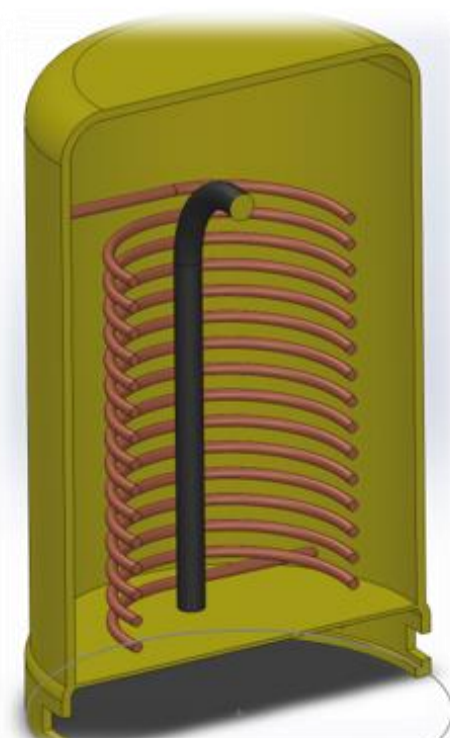
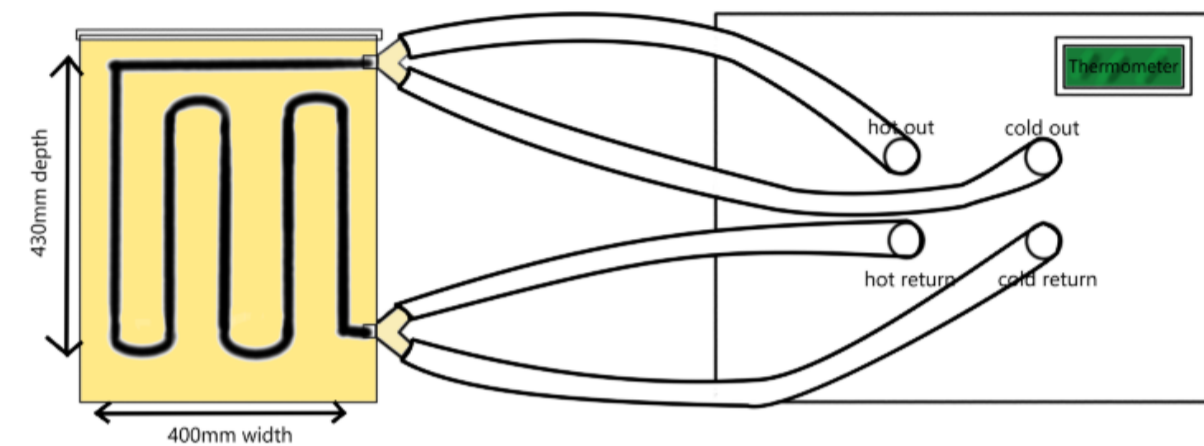


Figure 4: Concept design 3

Final concept



Under floor heating pipes - connecting using three-way-taps to a heat exchanger
---hot water will be used to heat the sand, cold water will then be fed in to absorb the heat(read off thermometer)
Sand with a high silica content used for its high thermal conductivity
Boiler unit made of aluminium

Figure 5: Final Concept

Using a Burko Boiler as the tank and heat exchanger apparatus from the lab was used as the heating element We used a Thermo wrap LDPE bubble membrane with an aluminum reflection as the insulation.

We inserted the piping using a heat resistant sealant and attached the insulation using a simple grab adhesive.

We used a low grain sand as the storage medium as this had the best conductivity and was readily available to us

Testing

To test the effectiveness of the sand battery the piping was connected to the inlets for cold and warm water in the heat exchanger.

It was then left over the course of 2 days with warm water flowing through the sand to heat up and store the heat energy, then after disconnecting the hot water letting the battery sit for a day to prove the sand has acted as an energy reservoir we ran room temperature water through the battery and would measure the inlet temperature and minus it from the outlet temperature to find the effectiveness of the sand battery using the heat transfer rate equation

Photo of: Electrical, Plumbing and HVAC systems using BIM

Conclusion

Over the last twelve weeks, this project has given us the opportunity to not only learn about Sand Batteries and vastly improve our collective knowledge on them, but has allowed us to create our own functioning "scaled down" version of a Sand battery that we produced as a result of working as a team.

Our project also allowed us to upcycle important components of the Sand Battery such as the Burko Boiler and the associated piping which was originally "left over" underfloor heating piping.

Working as a team and identifying individual roles and responsibilities within our group held extreme importance, especially in a group of five members. This allowed for clear and consistent progress while taking all group members ideas and opinions into account. Taking all this into account, the project was an absolute success.

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References

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