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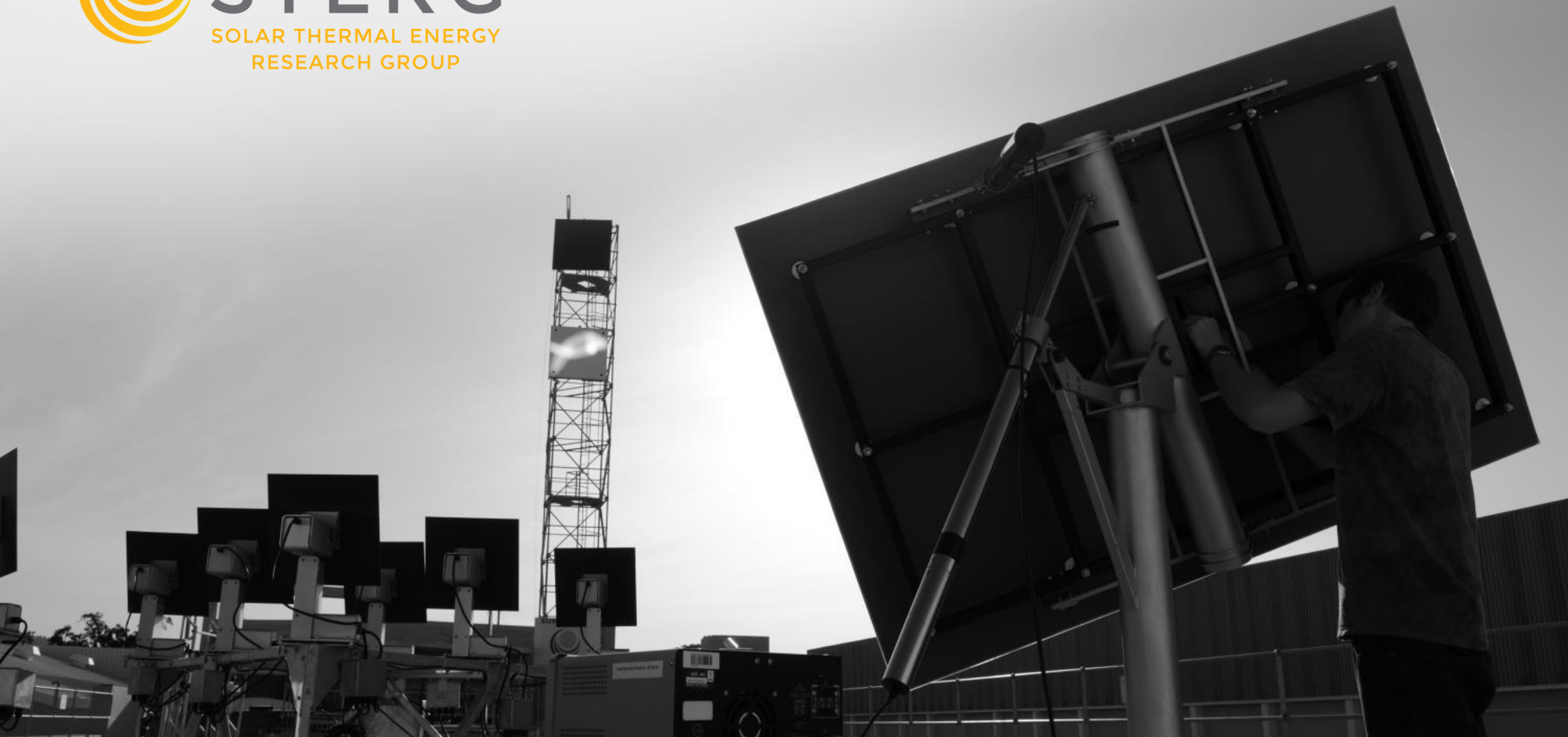

Low Cost Thermal Energy Storage in Packed Bed of Rocks

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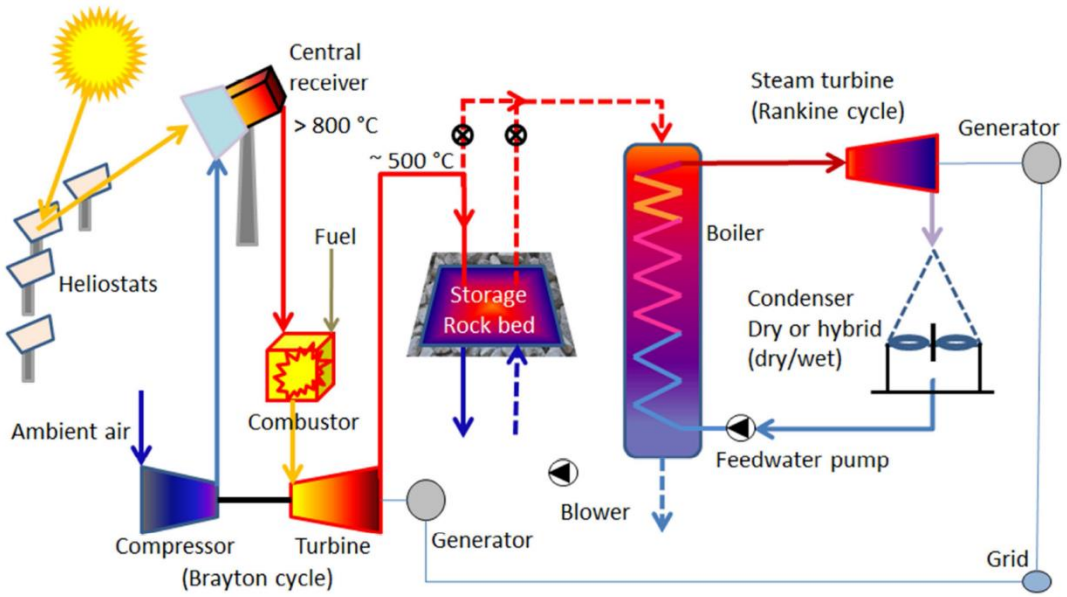
Introduction

- Thermal Energy Storage System (TESS)

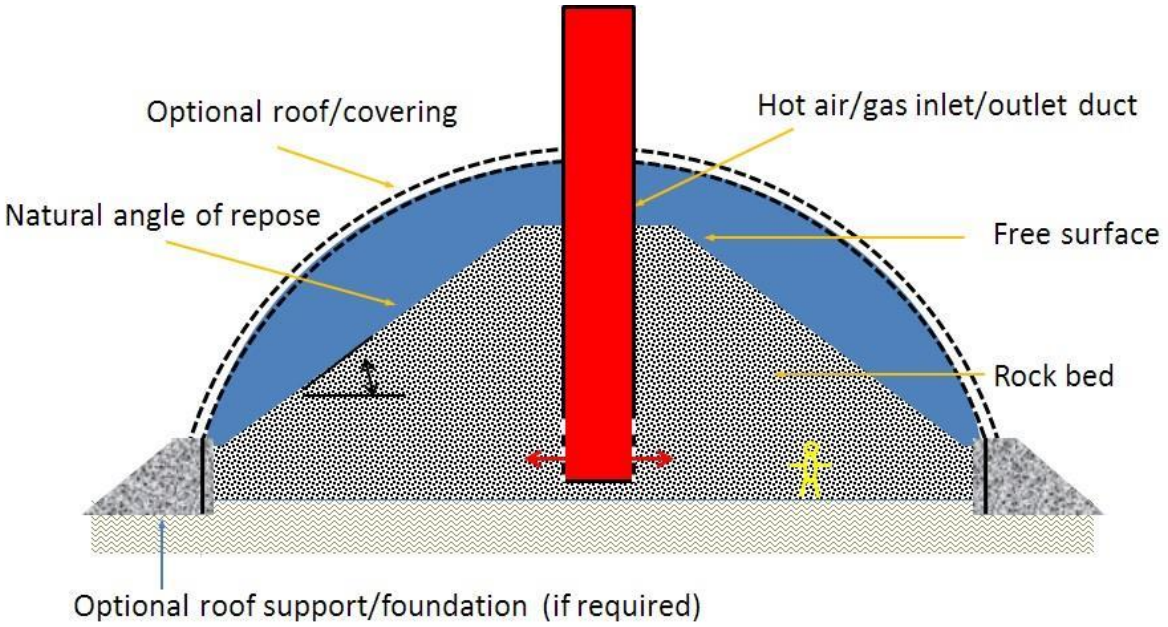
  – Packed bed vs Molten Salt?

  – Packed Bed of Rocks: Is it cheaper?

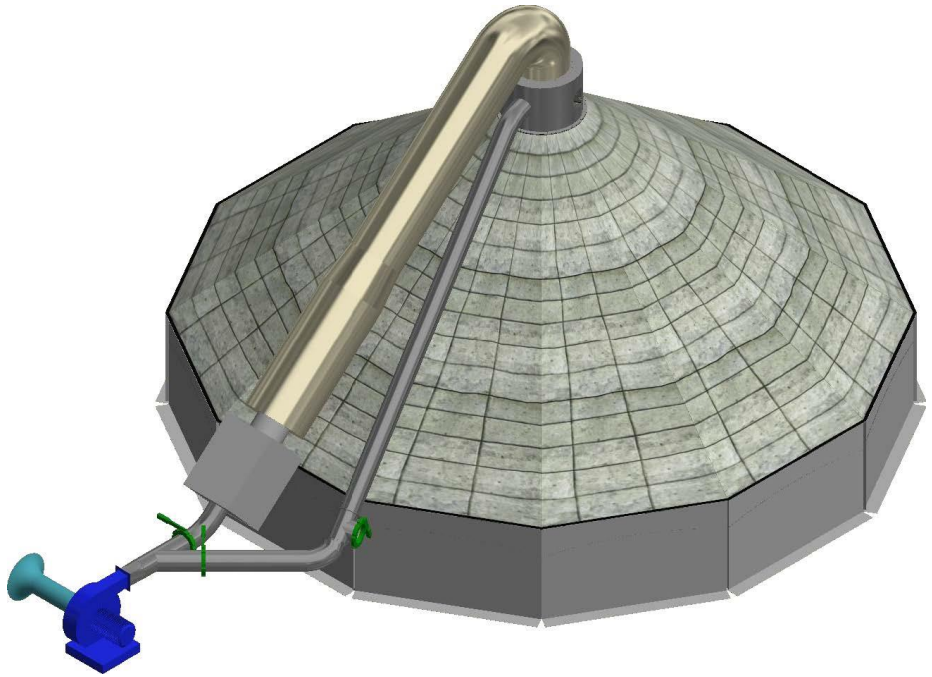


SUNSPOT Cycle (Kröger 2012)

Thermal energy storage project



Rock Bed Thermal Storage: conceptual layout (Gauché, 2014)



Rock Bed Thermal Storage: experimental

Overview

- Motivation and drive
- Objectives of the study
- Research method
- Experimental work and design
- Results and Conclusion

Motivation

- More stable electricity generation from renewables
- Supply base load electricity on demand
- Why specific rocks as storage medium?
- Potential for Cost reduction in CSP
- Clean and abundant resource available (dolerite rocks)
- Investment in STERG research facility

Objectives

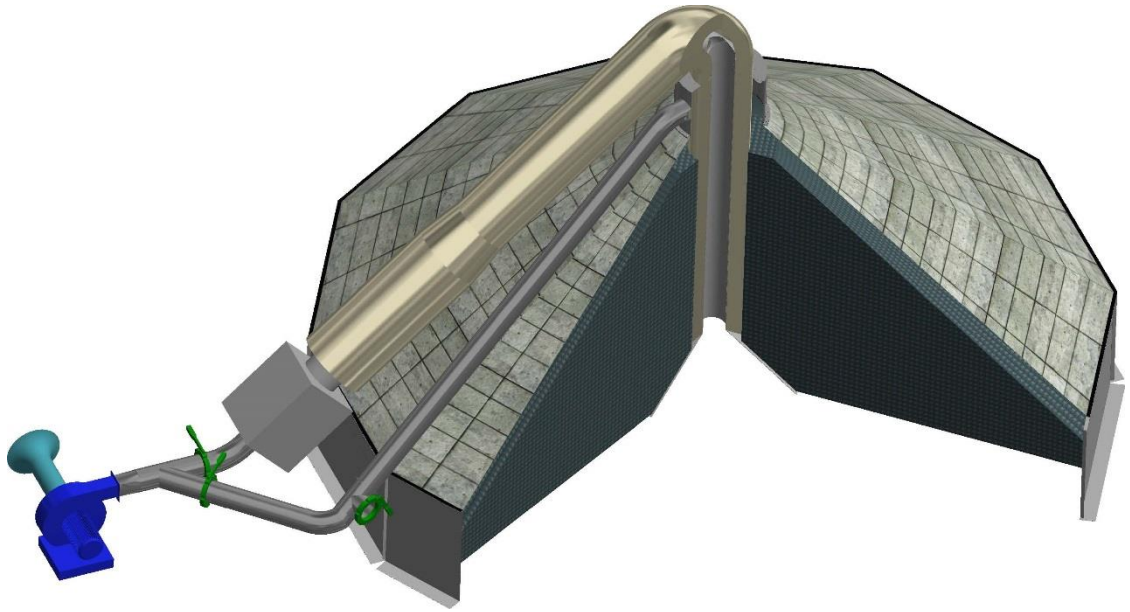
- Design and construct experimental setup
- Gather experimental results
- Numerical simulation
  - CFD (ANSYS Fluent)
  - Theoretical calculation (analytic)
- Comparison between CFD, analytic and experimental results
- Conclude if method is viable at large scale

Method

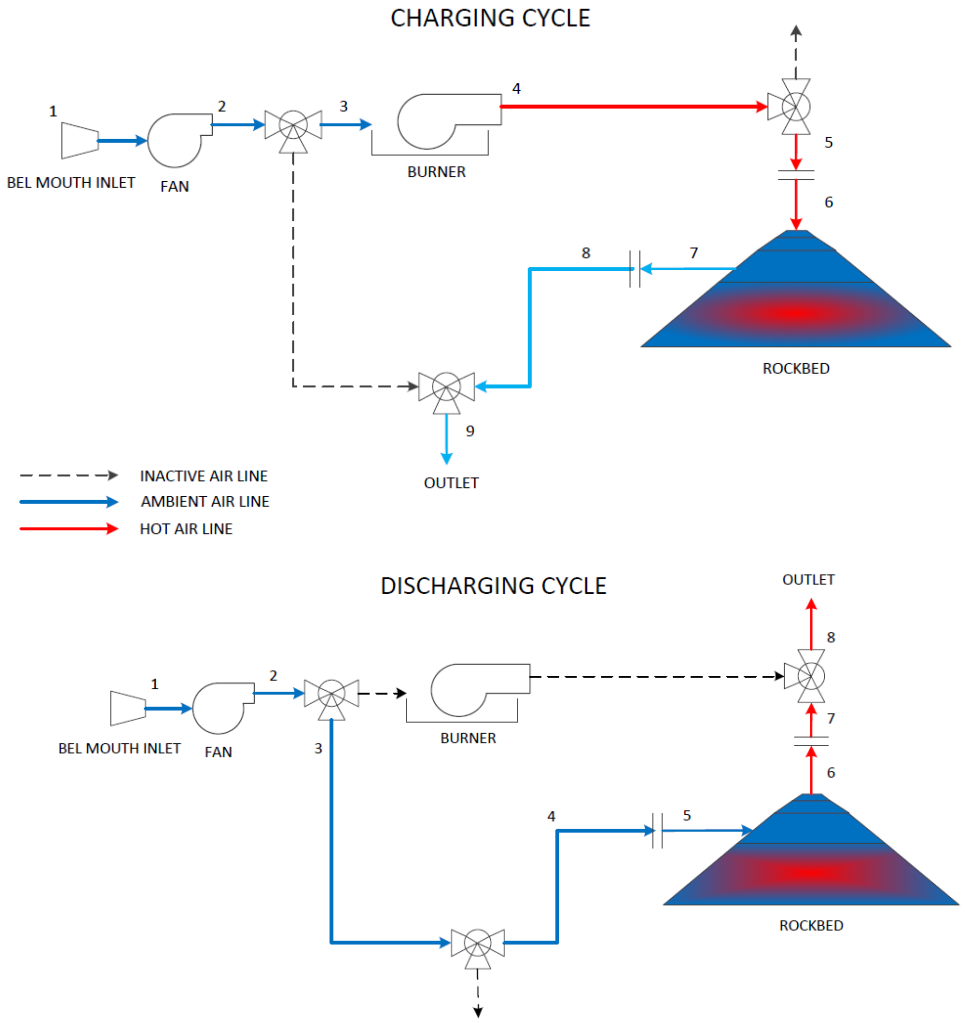
- Design for industry readiness and scalability
- CFD analysis via use of porous model
- Experimental data gathered from tests
- Refine/validate CFD model with experimental results
  - Adapt model to simulate reality more accurate according to measurements

Experimental work

Experimental layout for thermal energy storage system



Rock Bed Thermal Storage experimental layout

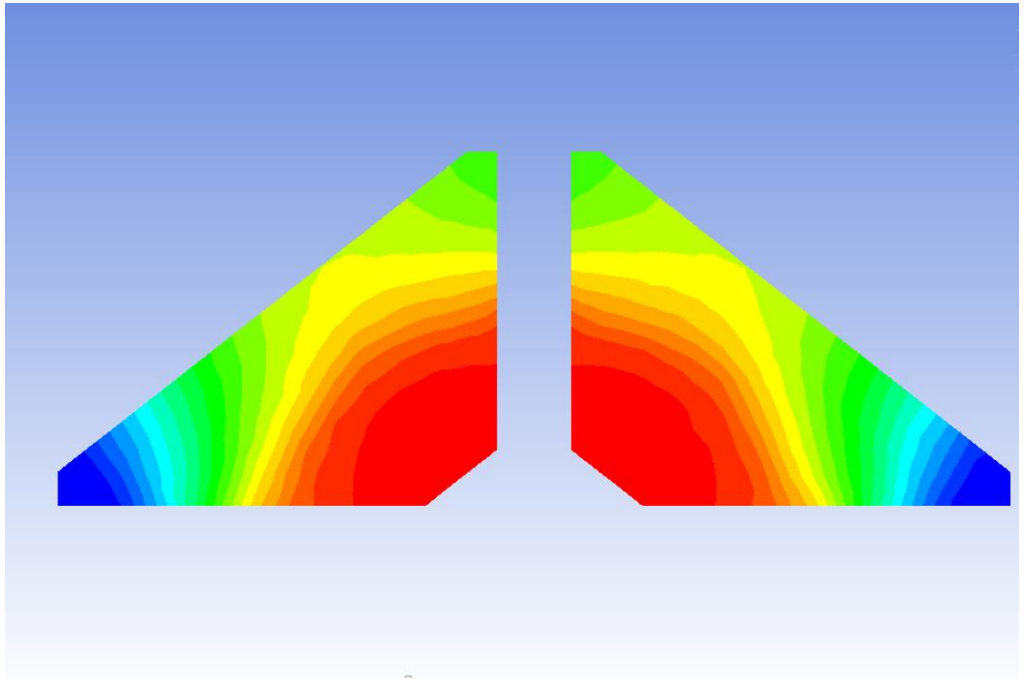


Experimental work and design

- Measurements
  - Thermocline measurement
  - Pressure drop over porous media
  - Round-the-clock cycle efficiency of the system
- Design for future projects
  - Three times heating capacity of Helio100
  - Air-receiver, biogas co-firing, process heat for agricultural application

Results

Temperature distribution from ANSYS Fluent simulation



Simulated temperature profile in cross sectional plane

Conclusions

- High enough cycle efficiency would make compatible in the market
- Measured thermocline would give good design guidelines for future design of a containment structure
- If thermal storage could work effectively without insulation, it would be major breakthrough in cost reduction

Thank you

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