Thermal Energy

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Objectives

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1. To develop a thermal conductivity measurement device with integrated mobile application.
2. Innovative plaster-air thermal insulation material.

Motivation

While there are a few thermal analyzers available on the market, none of them have the capability to transmit data and results wirelessly to a smart phone application. We believe that such combination would expedite the communication process in either industrial or laboratory environment.

Meanwhile, the current insulations used in TES systems are firebricks as the direct contact to solar salts. The firebricks are covered in concrete in order to meet the required thermal insulation R- value and structural capacity. We are inspired to develop an air-cell type insulation that maintains the roughness of plaster, yet has competitive cost over concrete.

Innovation

Thermal Analyzer

- First thermal analyzer available with smart phone app integration.

Thermal Insulation

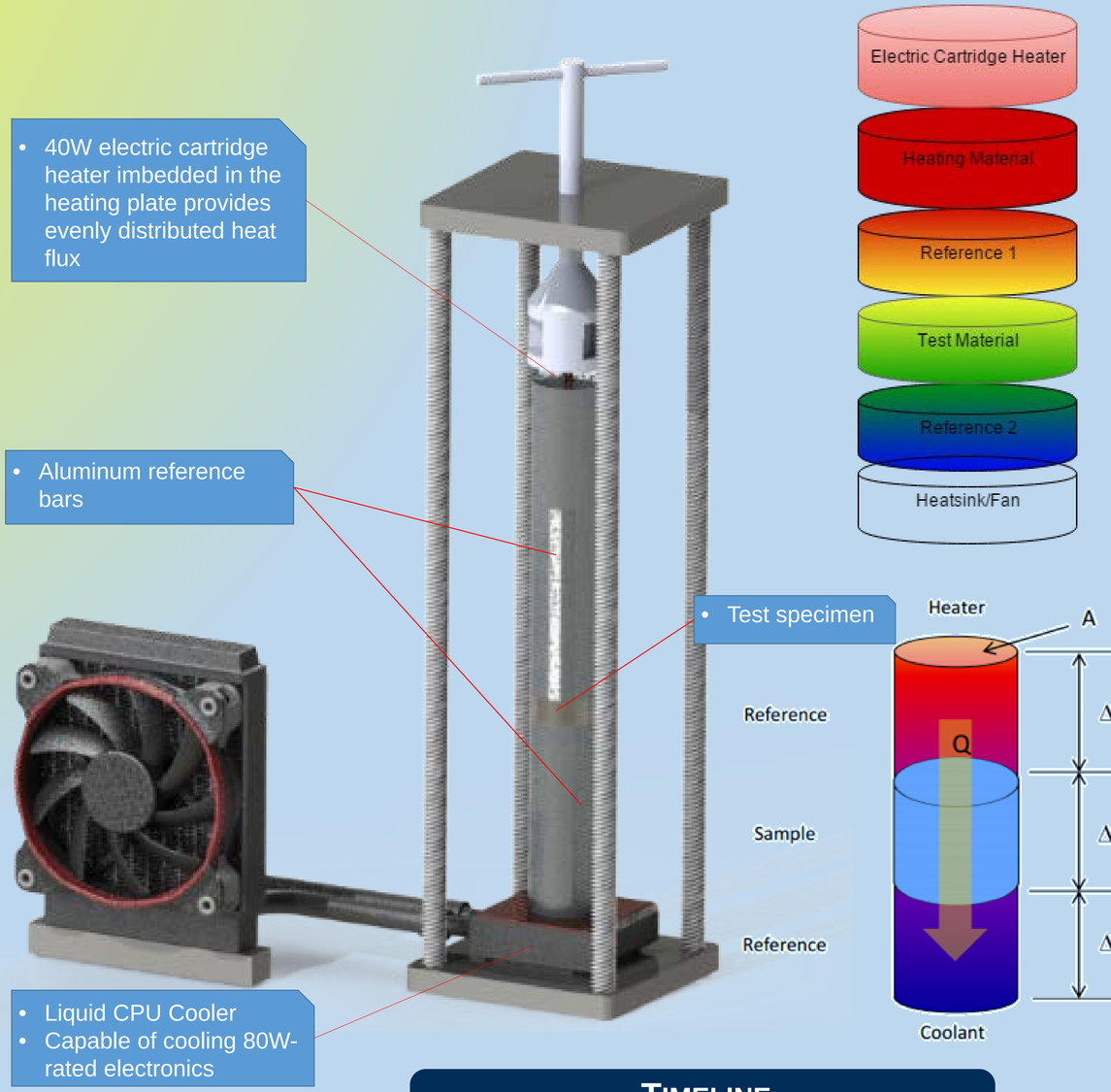
- 150% air by volume yet maintain toughness.
- Heat capacity: 13 times less than concrete
- Cost: 14 times less than firebricks
- Air that is in pockets small enough for convection to not occur will give the most effective insulation characteristics.

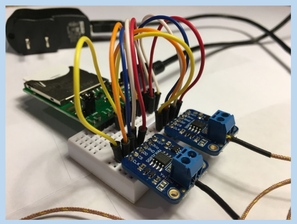
Current Status

- General design completed
- CAD model completed
- Mobile app coding in progress
- Two fabrications for insulation completed, two tests completed

Next Step

- Fabrication and assembly of thermal analyzer
- More tests for insulation



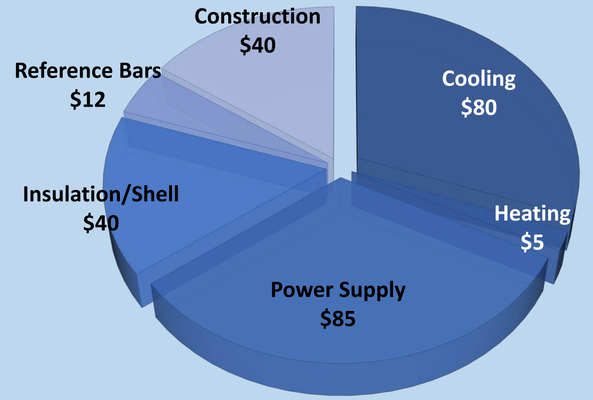


Thermocouple Assembly

Timeline

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
General Design	■	■	■					
CAD	■	■	■					
Insulation Fabrication		■	■	■				
Insulation Test				■	■			
Thermal Analyzer Fabrication						■	■	
Field Test and Finallization							■	■

Thermal Analyzer Estimated Cost



Prototype Total Cost: $262

The Innovative Insulation

Our insulation is innovative because the world does not have many insulations that use air while maintaining toughness. By mixing plaster with air, we hope to create an insulation that is nearly as efficient as Styrofoam but maintains the toughness of plaster. When we started our plaster insulation, we first used a combination of H2O2 and KI to trap the air in the plaster.

We started at 10mL H2O2 with increasing increments of 5mL and discovered that the more H2O2 we used, the lighter and weaker the plaster became. At 20 mL H2O2, the plaster combination was three times the volume of the original plaster, but was very soft and crumbled when touched. Because of this, we could not do an accurate test of the thermal conductivity of the plaster combination.

To strengthen the plaster combination, we added borax into our solution. We kept the amount of borax at 15mL and started at 5 mL H2O2 with increasing increments of 2.5 mL H2O2. We discovered that a mixture of 7.5 mL H2O2 with 15 mL of borax had the lowest thermal conductivity, while the 15 mL H2O2 had the highest thermal conductivity.

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