LA-UR-16-29392
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Title: Internship Progress Summary: Fall 2016

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Intended for: Report

Issued: 2016-12-13

Internship Progress Summary: Fall 2016

Presentation Abstract

Ralph Wiser
Matthew Valencia
A-3: Technology Applications

This fall I had the opportunity to work at Los Alamos National Laboratory for the Technology Applications engineering group. I assisted two main projects during my appointment, both related to the Lab's mission statement: "To solve national security challenges through scientific excellence."

My first project, a thermal source transfer unit, involved skills such as mechanical design, heat transfer simulation, and design analysis. The goal was to create a container that could protect a heat source and regulate its temperature during transit. I generated several designs, performed heat transfer simulations, and chose a design for prototyping.

The second project was a soil drying unit for use in post blast sample analysis. To ensure fast and accurate sample processing, agents in the field wanted a system that could process wet dirt and turn it into dry powder. We designed a system of commercially available parts, and we tested the systems to determine the best methods and processes.

This work was supported in part by the U.S. Department of Energy, Office of Science, Office of Workforce Development for Teachers and Scientists (WDTS) under the Science Undergraduate Laboratory Internships Program (SULI).

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INTERNSHIP PROGRESS SUMMARY: FALL 2016

RALPH WISER
A-3: TECHNOLOGY APPLICATIONS
MENTOR: MATT VALENCIA

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Introduction

- LANL mission statement: “To solve national security challenges through scientific excellence”
- SULI purpose: to engage undergraduate students in STEM work by providing opportunity to work at DOE facilities
- Bottom line up front:
  - Develop heat source transfer device
  - Develop post-blast soil sample drying system

Introduction

- A-3: Technology Applications.
  - Supports non-proliferation, counter terrorism, and emergency response missions
  - Specializes in tool design and prototyping
- Skills I developed
  - Mechanical engineering R&D
  - Product design and testing
  - Simulation and analysis

Two Projects

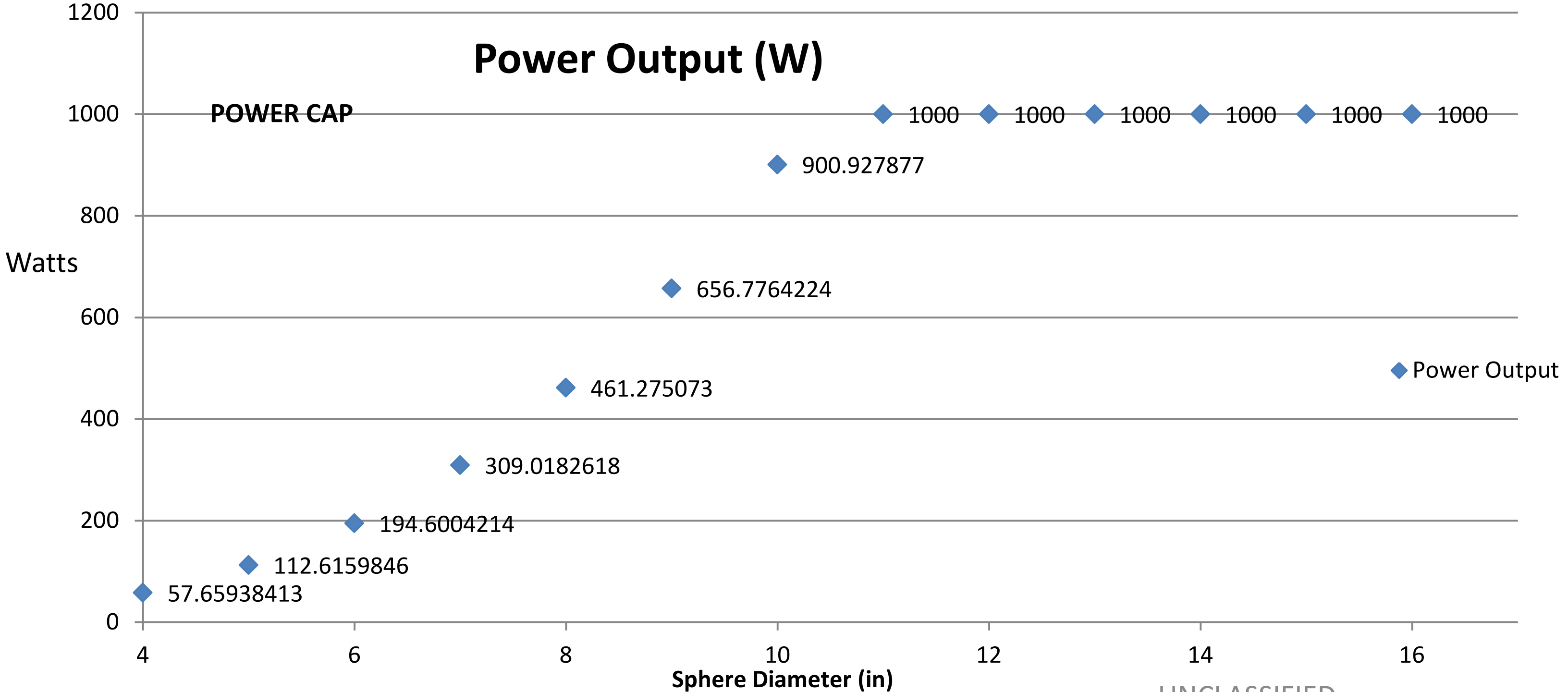
- Thermal Source Transfer Unit
  - Concept to design
    - Sponsor's idea is now ready to prototype
- Soil Drying system
  - Concept to prototype
    - Currently performing product tests

Thermal Source Transfer Unit

- Project Description
  - Transfer a nuclear thermal source in closed container
  - Maintain goal temperature (120°F) for at least 8 hours
  - Accommodate up to 16” diameter heat source
  - Filled with inert gas during transit
  - Collapsible for easy storage

Thermal Source Transfer Unit

- Project Description
  - Power density relationship of heat source: 30 W/kg
  - Assumptions: consistent material, spherical shape



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Thermal Source Transfer Unit

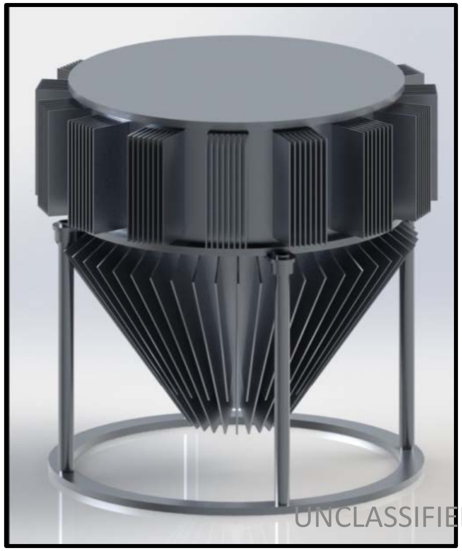
- Initial concept: Cubic Aluminum Box
  - Easy to disassemble/collapse
  - Would include active cooling system, such as AC unit
  - Ran simulations using SolidWorks Flow
    - Computational Fluid Dynamics ad-in for SolidWorks
  - Poor results: 10 inch heat source (900W) reached 412 K (282°F)

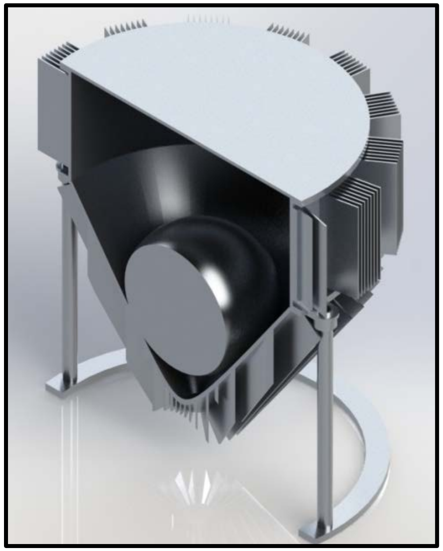
Thermal Source Transfer Unit

- Back to the drawing board
  - Passive cooling
    - Low maintenance
    - Consistent results
    - Long lasting
    - No moving parts and power source
  - Subsequent design ideas centered on passive cooling

Thermal Source Transfer Unit

- Final concept
  - Cone shape: diameter varies, accommodates multiple shapes and sizes
  - Enables contact with exterior at multiple points
    - Aided by aluminum foil packed around source



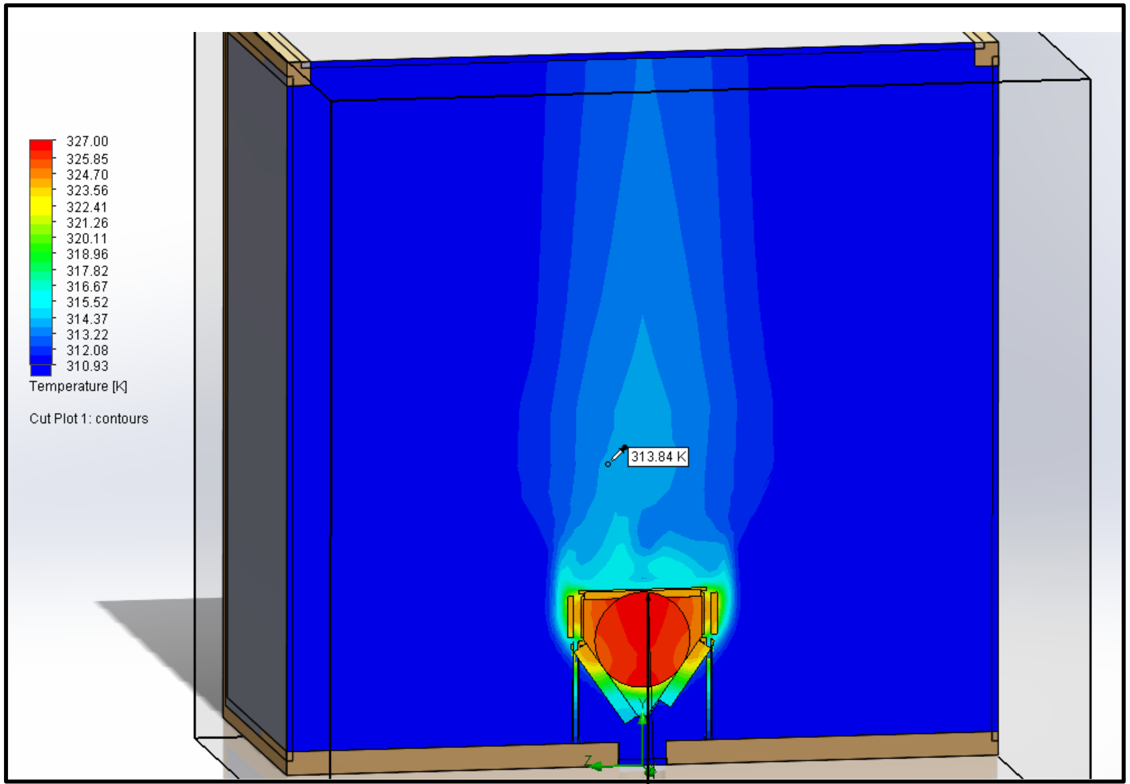


Thermal Source Transfer Unit

- Final concept (cont'd)
  - Heat fins on exterior enable rapid heat transfer
  - Item collapses; largest part is 12" x 20"
  - Automated process evacuates air, refills with He

Thermal Source Transfer Unit

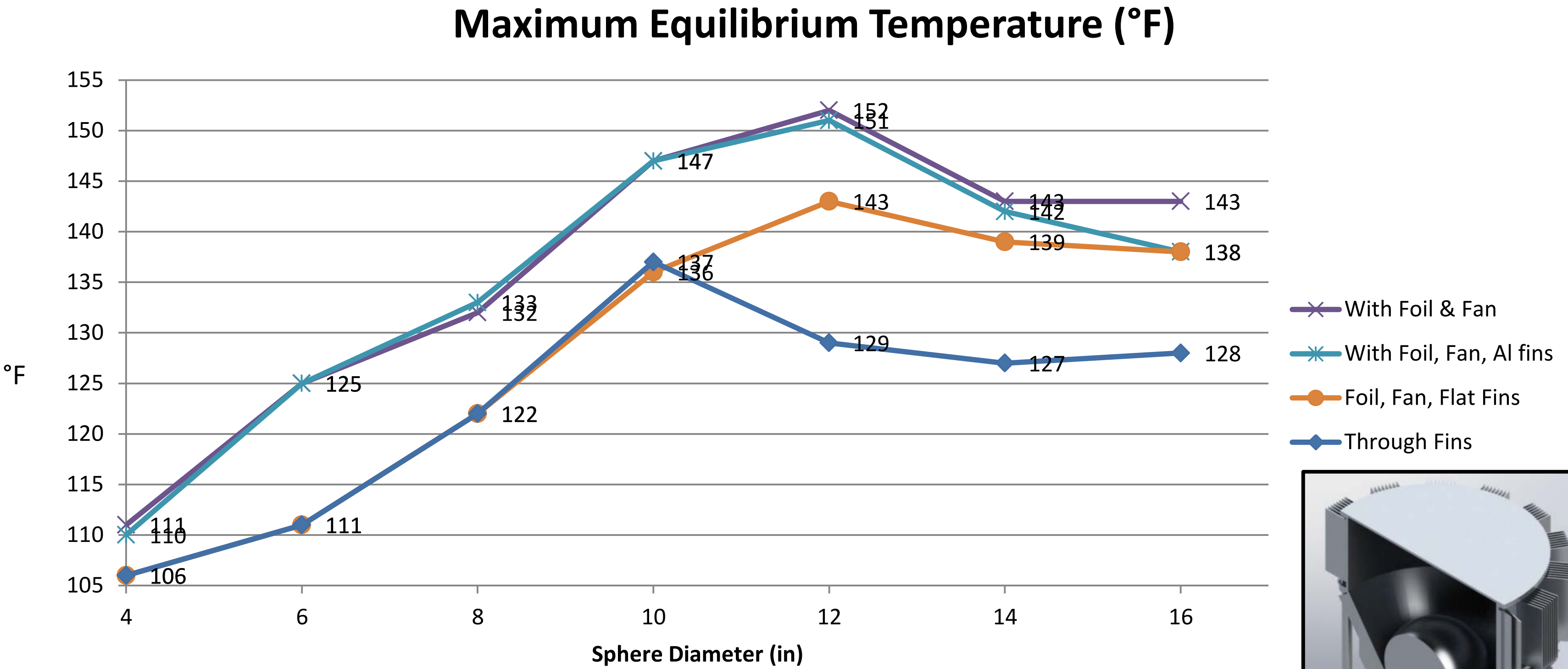
- Simulation Results
  - Hundreds of simulations on different sizes and configurations
  - 100°F ambient
  - 50% humidity

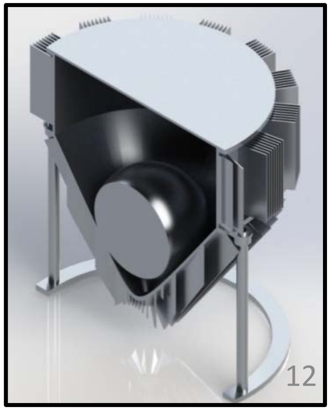


326.68 K

Thermal Source Transfer Unit

- Simulation Results: Four best configurations





Thermal Source Transfer Unit

- What we learned
  - Shape of curve
    - Power capping: decreasing wattage/unit surface area
    - Larger heat source can take advantage of more fins
  - Foil packing is important
  - He helps: 4°F

Thermal Source Transfer Unit

- Next Steps
  - Procure funding from program manager of A-NIR (Nuclear Incident Response)
  - Generate engineering drawings for prototype manufacturing
  - Test prototype

Soil Drying Unit

- Team project: Luca Maciucescu, Taurean Sullivan, Jacob Moore, Ralph Wiser
- Problem definition
  - Improve preparation of field samples collected during post-blast analysis missions
  - Previous field exercises have shown shortcomings of current soil sample collection system
  - Environmental interference: snow, rain, etc.

Soil Drying Unit

- Specifically, wet dirt samples are difficult to process
  - Sample analysis requirements:
    - Dry
    - Small grain size preferred
    - Homogenous

Bad

Good

Soil Drying Unit

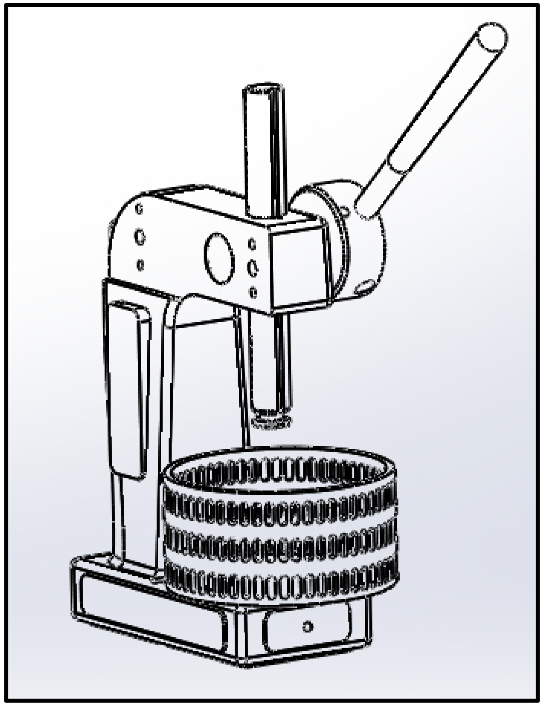
- Assignment: design soil drying system
  - 1 liter of soil
  - Short drying time
  - Sample should not clump or cake (i.e. should be powdery)
  - Small, light, simple system: 18” Pelican case
  - COTS: commercial off-the-shelf

Soil Drying Unit

- First ideas
  - Initial concept included dirt tumbler for drying process
  - Our research showed that commercially available units are large, heavy, complex

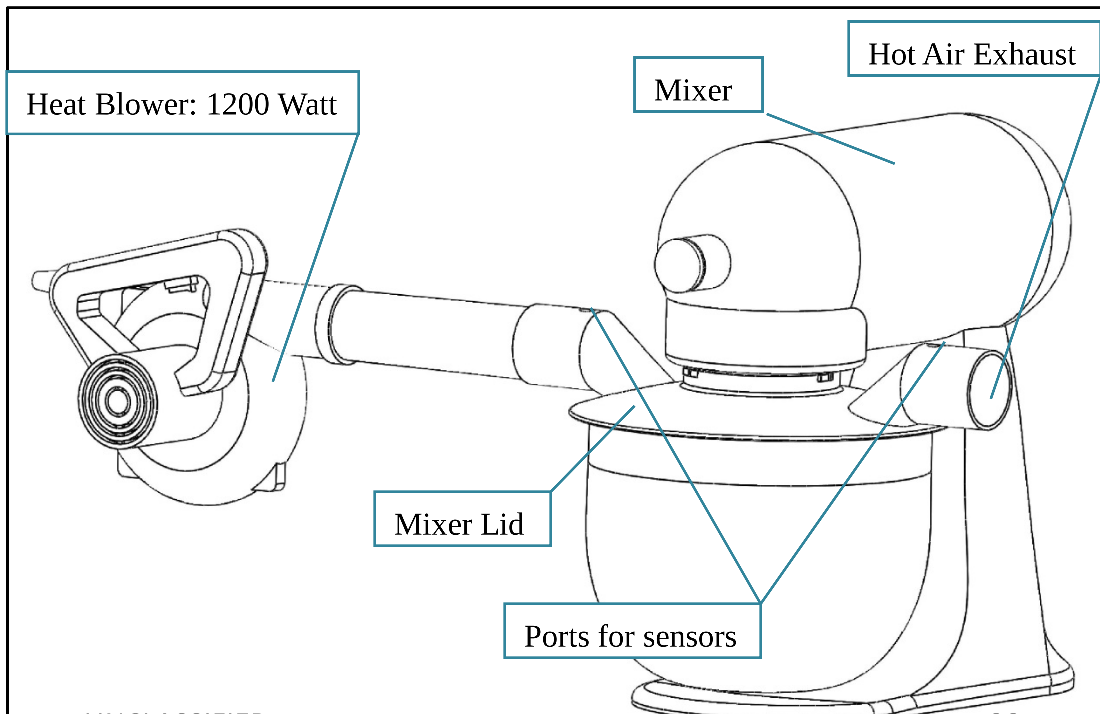
Soil Drying Unit

- Sample Pre-prep
  - Our student team added a process: soil press
    - Quickly removes water from mud
    - Time-saving



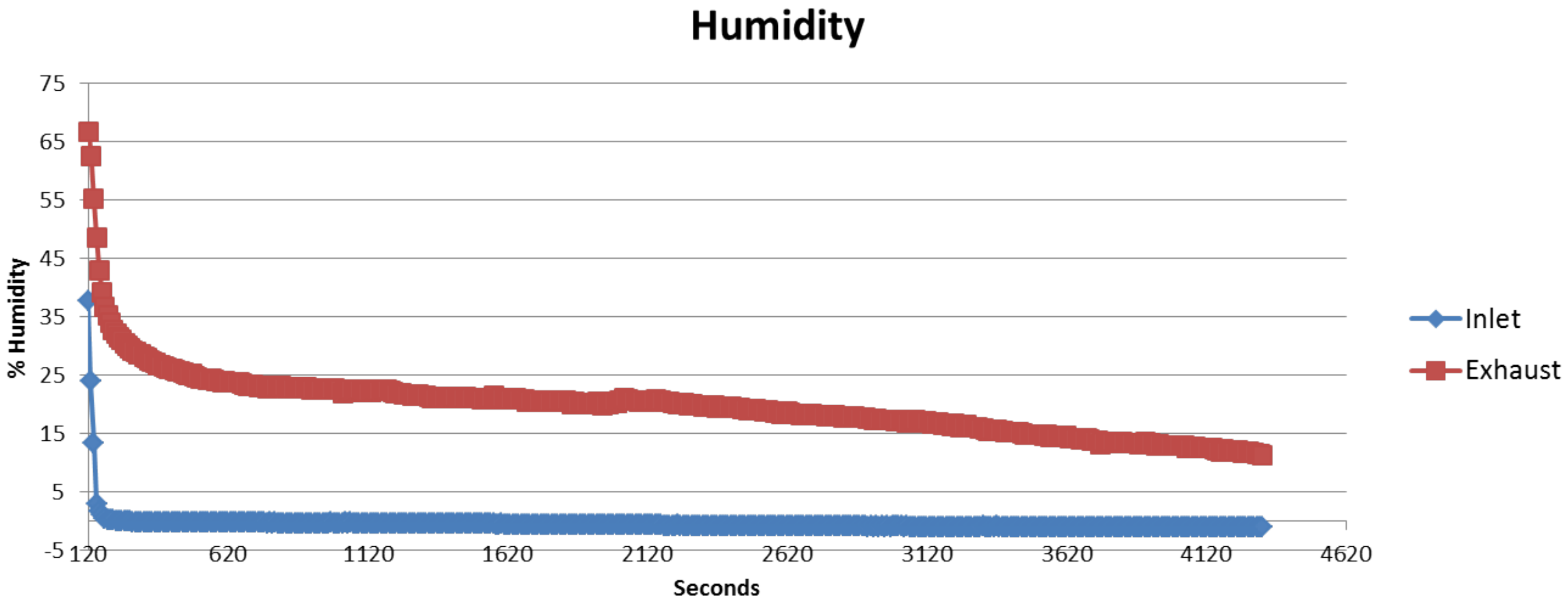
Soil Drying Unit

- Idea One
  - Kitchen mixer idea
    - Single process
    - Easy to monitor
    - Many moving parts



Soil Drying Unit

- Idea One
  - Sample data collection: humidity at inlet and outlet
  - Working on Arduino algorithm to automate



Soil Drying Unit

- Idea Two
  - Halogen oven idea:
    - 1450 Watt convection oven
    - Small, light, contained
    - Requires post-crushing

Soil Drying Unit

- Testing
  - Tests with saturated soil
  - Multiple types: sand, loam, clay
  - Preliminary results: mixer
    - Mixer: fast drying (30 minutes to dry, using clay sample)
    - Mixer shows signs of wear
  - Tests on oven need to be conducted
    - We expect shorter drying time
    - Will develop crushing process

Soil Drying Unit

- Next steps
  - Test oven, compare systems
  - Generate engineering drawings of final system for prototype manufacturing
  - Build it

Conclusion

- Two major projects: Thermal Source Transfer Unit and Soil Drying System
  - Both projects saw progress from concept to design

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