COFFEE MATES

ROASTER FILTRATION SYSTEM

Sponsored by:

DIEDRICH™ ROASTERS

Team Members: Adam Niemet, William Overstreet, Patrick Paulus, and Samantha Peters

Advisors: Dr. Steven Beyerlein, Melissa Bogert

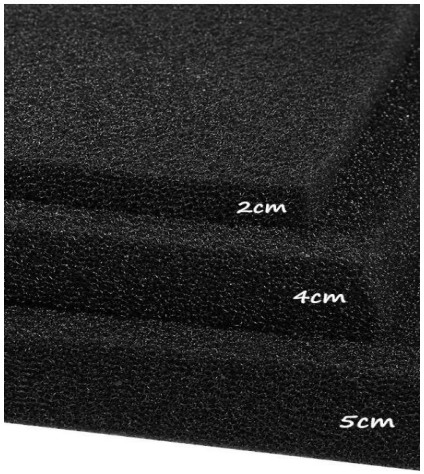
DESIGN REVIEW SLIDES

PROBLEM STATEMENT

Coffee roasting releases smoke, particulate and unfriendly odors. Current air treatment systems that mitigate these emissions are typically expensive and excessive for small-scale roasters. Diedrich Roasters, our client, desires an affordable alternative for these smaller operations to allow small-scale roasters to be good neighbors.

DESIGN SPECIFICATIONS

Specifications	Constraints	Deliverables
Standalone system	Dimensions: 4x4x6 ft	Innovative design
95%smoke reduction	Backpressure: -.15 - .25 inH20	Marketable product
Odor removal	Material Cost: < $3300	3D model and drawing package
40-hr minor/6-year major maintenance interval minimum	Weight: < 1000 lbs	Operable proof-of-concept
Indefinite operational lifespan	Sustained operation at 450 °F intake temperature	Measurement equipment to quantify smoke attenuation

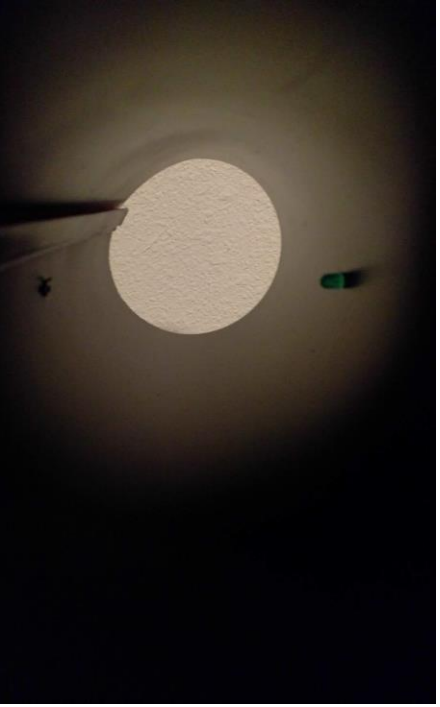


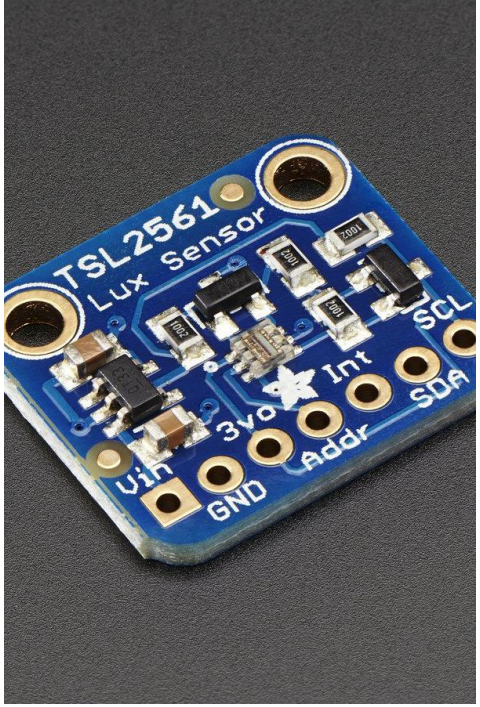
WET SCRUBBER

- Very effective at removing substantial amounts of particulates in an exhaust stream.
- Cools exhaust gases allowing for efficient implementation of electrostatic post-treatment.
- Smoke abatement specific nozzles.
- Filtration of large particles through

Creation of a system that allows for simulation of smoke conditions present in various roasters

SMOKE GENERATOR





SENSOR

Smoke Meter

Measures light using a lux sensor – will determine how much light is present

COMPLICATIONS

Wastewater removal

- Filter generates liquid waste that must be accounted for
- Solution: additional line to septic or to waste storage container

Packaging

- Filtration package must be clean for display purposes on "show" roasters

PROJECT SCHEDULE

- Procedural testing completion – March 31
- Finalized prototype design – April 15
- Design EXPO - April 28

SMOKE GENERATION

Coffee Mates
Roaster Filtration System

Team Members: Adam Niemet, William Overstreet, Patrick Paulus, and Samantha Peters

Advisor: Dr. Steven Beyerlein **Mentor**: Melissa Bogert

DIEDRICH™ ROASTERS

Problem Statement

Coffee Roasting

- Smoke emissions
- Unfriendly odors

Goal

- ‘good neighbor’
- Reduce noticeable emissions by 95%

DIEDRICH™ ROASTERS

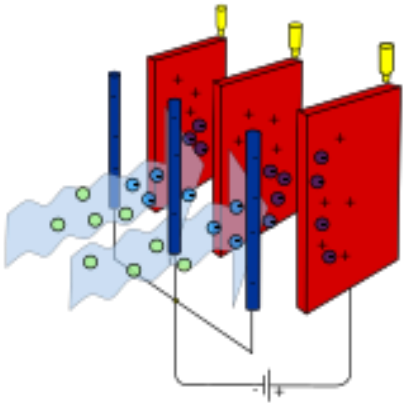
Design Specifications

Specifications	Constraints	Deliverables
Standalone system	Dimensions: 4x4x6 ft	Innovative design
95%smoke reduction	Backpressure: -.15 -.25 inH20	Portfolio and report
Odor removal	Material Cost: < $3300	3D model and drawing package
40-hr minor/6-year major maintenance interval minimum	Weight: < 1000 lbs	Operable proof-of-concept
Indefinite operational lifespan	Sustained operation at 450 °F intake temperature	Measurement equipment to quantify smoke attenuation

Alternative Concepts

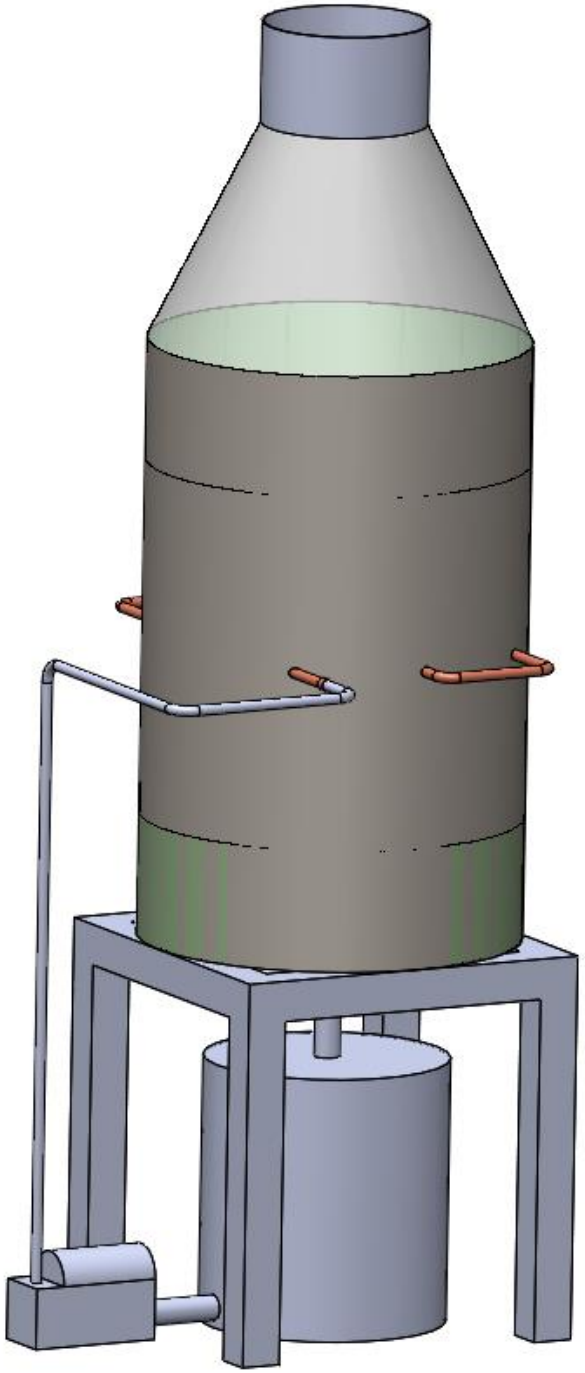
- Thermal Oxidizer

- Electrostatic Precipitator



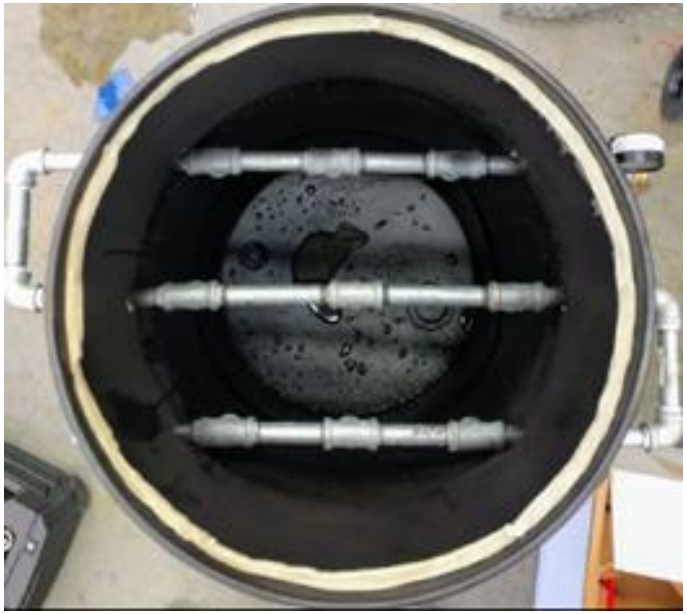
- Electrostatic Filter

DIEDRICH™ ROASTERS



Wet Scrubber

- 9 high-pressure water injectors
- Recirculation pump with water filtration



DIEDRICH™
ROASTERS

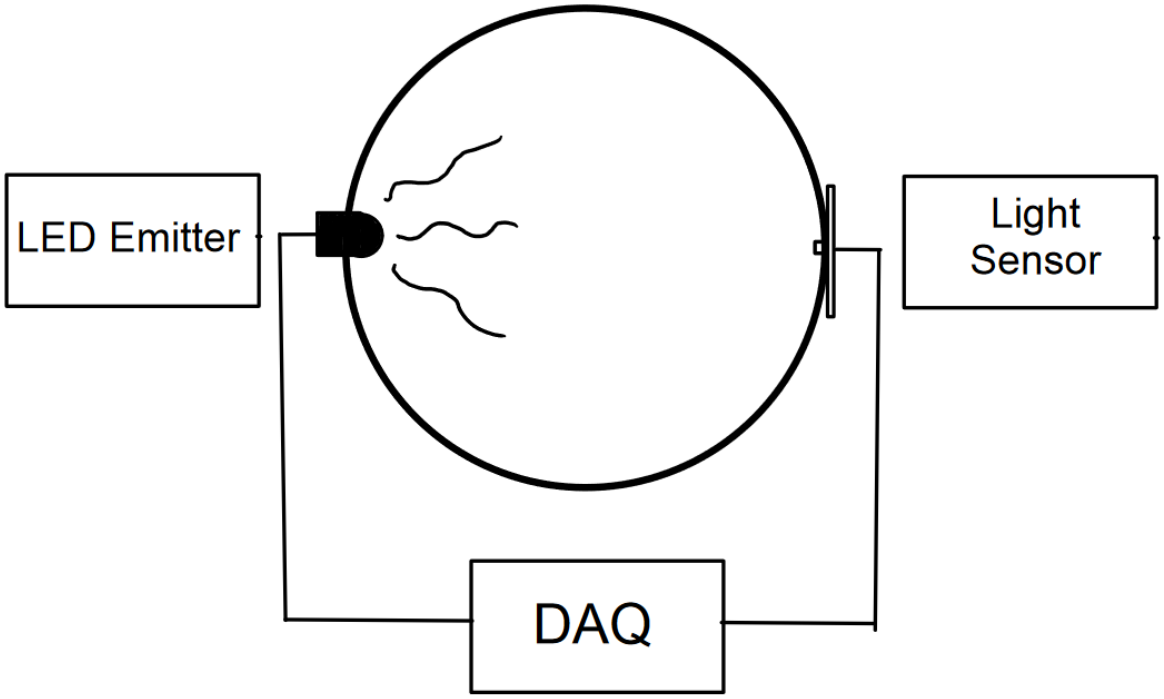
SYSTEM DESIGN

DIEDRICH™
ROASTERS

COMPONENTS

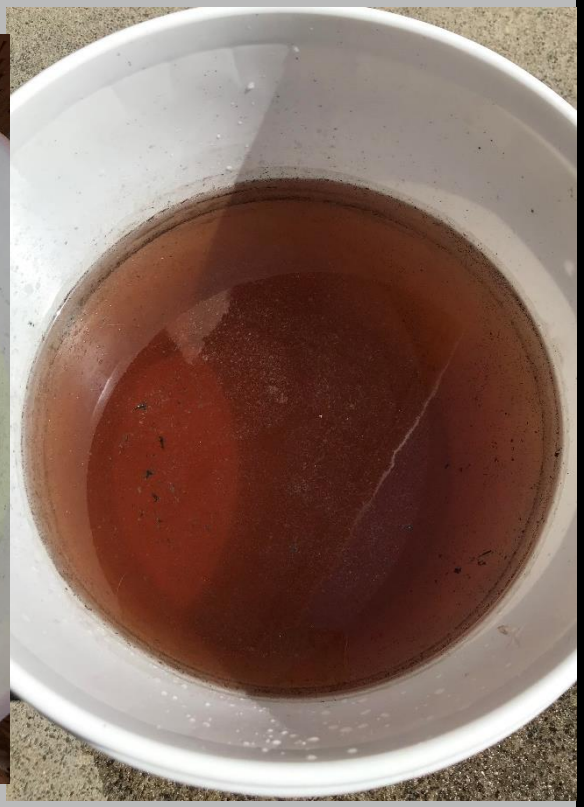
DIEDRICH™
ROASTERS

TESTING



DIEDRICH™
ROASTERS

Before Test



After 5 Minutes

TEST RESULTS

DIEDRICH™
ROASTERS

Recommended Future Work

- Larger-diameter nozzles
- Specified pump
- Unified scrubber casing
  - Proper hosing and connector selection
  - Corrosion-resistant materials
- Testing with coffee roaster
- Improved testing procedures and equipment

DIEDRICH™ ROASTERS

Questions?

Thank you to our sponsor:

DFMEA

System:	Coffee Roaster Filtration System	**Prepared by:**	Patrick Paulus, Samantha Peters
Design Team:	Diedrich Roasters	**DFMEA Date:**	2/13/2018
Team Members:	Adam Niemet, William Overstreet, Patrick Paulus, Samantha Peters	**Revision Date:**	4/16/2018

Item/Function	Potential Failure Mode	Potential Effect(s) of Failure	SEV	Potential Failure causes/mechanisms	OCC	Current Design/Process Controls	DET	RPN	Recommended Action(s)
Nozzle: Particulate trapping, temperature reduction	Uneven spray	Reduced smoke abatement	2	Contaminants in recirculation loop	3	Use chemical cleaner on nozzles	3	18	Higher pressure, add cleaner to water
Scrubber casing	Seal leak	Excess smoke release	1	Use, high temperature/pressure	2	Add more sealant	1	2	Implement unified housing
	No airflow	Damage to internal components	3	Excess backpressure, objects in exhaust path	1	Visual inspection prior to test	1	3	n/a
Exhaust fan: Push air from roaster to scrubber	Fan overheat	Damage to internal components	4	Excess roasting temperature/time, current overdraw	1	Limite constant operation time, regulate temperature	3	12	Implement temperature measurements
Opacity meter: Measure smoke levels	Sensor power loss	Poor smoke measurements	2	Sensor overheating, improper wiring	2	Regulate temperature	2	8	Improve sensor robustness
Sponge filter: Absorb large partculate	Inadequate porousity	Scrubber water pooling, insufficient water to pump	2	Filter overuse	1	Use new filter	3	6	Check filter once per week
Recirculation loop	Insufficient water to pump	Cavitation/damage to pump	4	Water leaks, evaporation, insufficient water in reservoir	1	Fill reservoir before tests	5	20	Implement water replacement/check schedule
	Water leakage	Eventual loss of water; system pressure loss	2	Improperly connected fittings	3	Check fittings regularly	1	6	Use proper hose and fittings
Recirculation pump	Insufficient water pressure	Reduced smoke abatement	5	Insufficient power to pump/pump size	1	High-powered pump	2	10	Model pump for specifications
	Excessive water pressure	Damage to recirculation loop	4	Overpowered pump, regulator failure	1	None	2	8	Model pump for specifications
Smoke generator: Simulate roaster output	No smoke in flow	Poor smoke measurements	1	Flameout in smoke generator	3	Visual inspection during test	1	3	Use a real coffee roaster
	Flames in generator	Damage to internal components	4	Excess heat to pellets	3	Reduce heat/oxygen	1	12	Use a real coffee roaster