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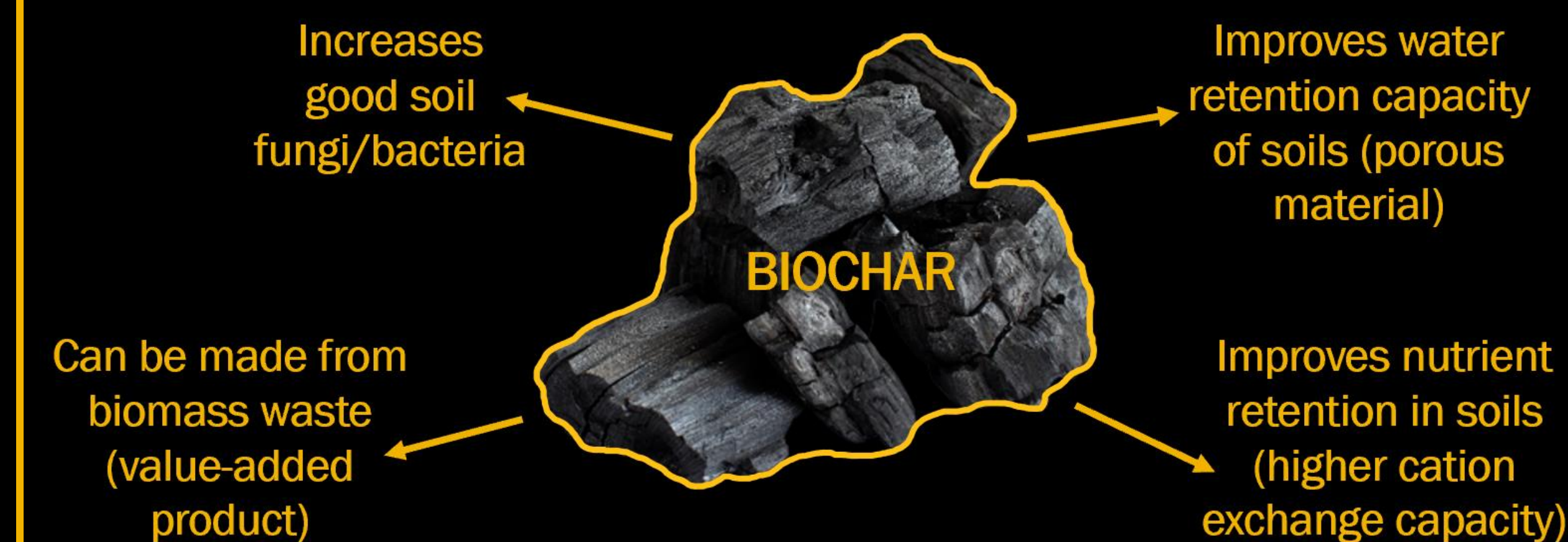
Client/Sponsor: Joe Stanley, Stanley Solutions | Lead Instructor: Dr. Russell Qualls | Shop Mentor: Jack Gonzales

Objective

Develop a fully-functioning, continuously producing, and modifiable biochar reactor.

Background

- Palouse topography presents challenges with water distribution and nutrient retention in crops
- Nearly 2 million tons of biomass waste (from milling, etc.) accumulates in the 150 miles surrounding the Palouse each year
- Biochar is a charcoal-like substance that is created by heating biomass in a low-oxygen process called pyrolysis



Value Proposition

The development of a biochar reactor would provide a meaningful way to use biomass waste (i.e. woodchips from lumber mills) and add value to a normally underutilized product, as well as potentially mitigate challenging topographic effects experienced on the Palouse.

Key Requirements

- Exterior temperature of reactor must be 60°C (140°F) or less
- Heating chamber reaches at least 450°C
- Able to produce biochar
- Controls that will:
 - Manually turn the system on and off
 - Turn the heater and motor on (independently)
 - Reverse motor direction

Concept Development

Initial Design Considerations:

- Low-oxygen environment
- Reactor shape
 - Auger vs. rotary kiln
- Heating source
 - Electric vs biodiesel



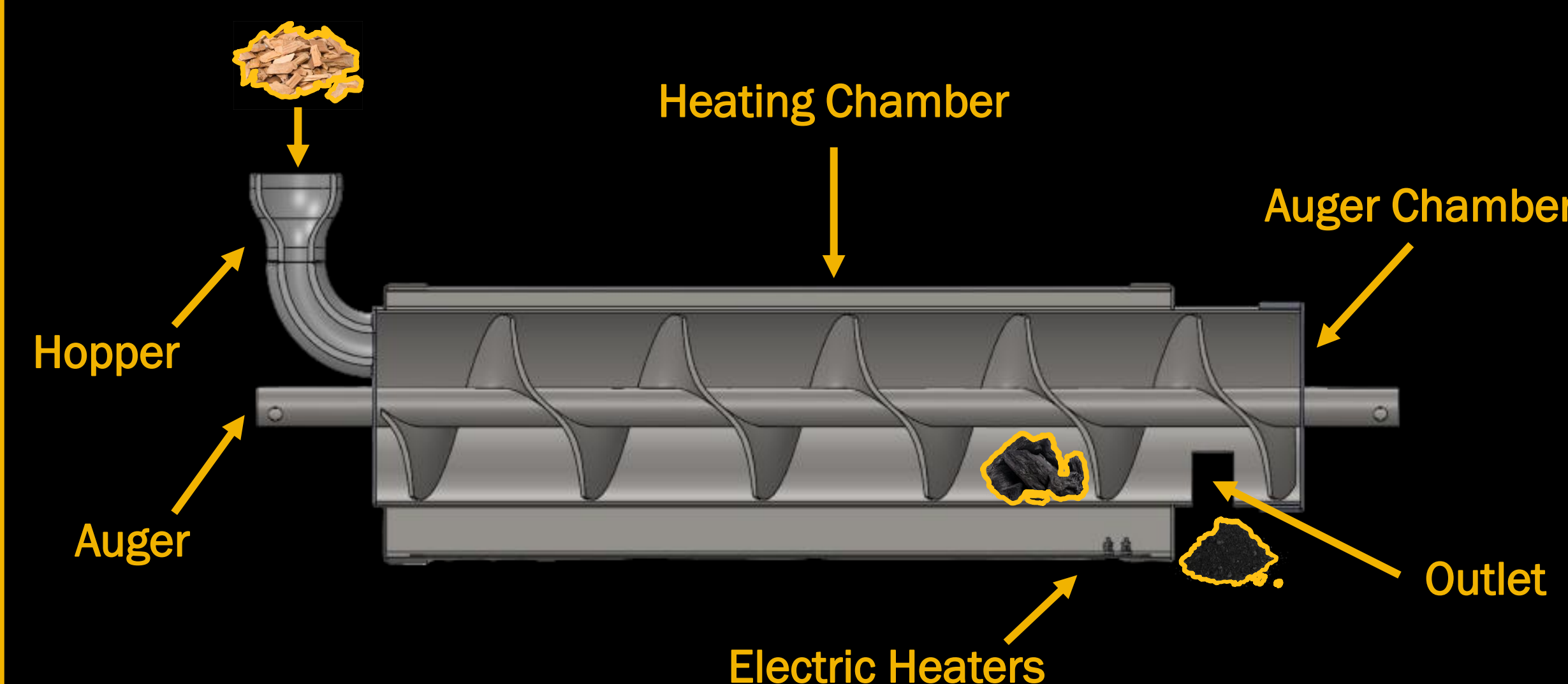
Reactor Design

Final Design Characteristics:

- Constructed from black steel
- Re-designed inlet chute and hopper
- Square heating chamber and round auger chamber
- Electric heating source

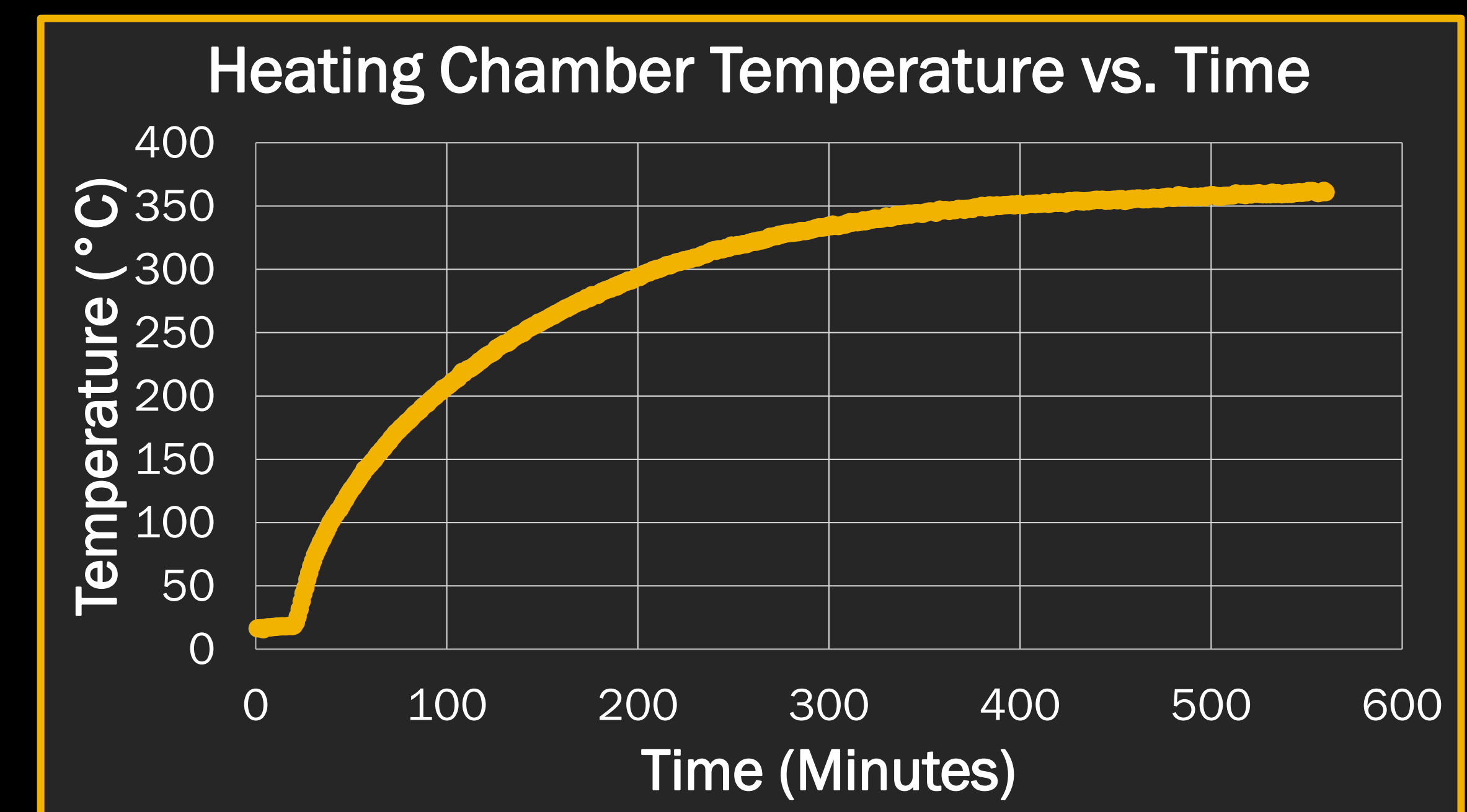


Completed Project Build (left) and PLC (right)



Breakdown of the Reactor and Components

Results and Conclusions



Heating chamber reaches maximum temperature of 362°C



Small pieces not picked up by auger or cause auger to bind (left), medium-sized pieces pass through without issue (right)

Future Directions

- Add heat exchanger to reheat system using by-product gas
- Implement fully-autonomous control system
- Improve heat retention (create a more closed system)
- Add safety guards around pulleys and moving components
- Analyze and determine chemical properties of the biochar

Acknowledgements

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