Scenarios:

Waste:

Every business produces waste, whether it be organic or industrial. Most of the time, non-recyclable material either ends in landfill, or in the case of organic material, turned into low value compost or animal feed. With the world population ever increasing, along with its thirst for resources, Goterra seeks to transform common organic waste into high value protein and oils through the use of breeding black soldier fly larvae.

Insect:

The insect that Goterra specializes in is known as the Black Soldier Fly. Low capital costs to breed, and completely safe to house and transport, Goterra seeks to innovate the way society currently breeds and harvests what is an efficient and sustainable protein source. By utilizing **mobile insect breeding plants**, transporting them to areas where there is high organic waste output, Goterra allows on site production of larvae, eliminating the need for material transportation or infrastructure.

Rendering:

The project our team has been tasked is to conduct feasibility analysis and design of a **mobile insect rendering plant** that contained in one (or more) containers can accompany the mobile farming plant from site to site. Rendering being the process of turning the insect larvae into protein meal and natural oils, the shared vision of the design is to take in organic waste, process into insects, then process those into high value meal, used for animal feed or human consumption, while also producing oils for everything from the heavy industries, to cosmetics.

Impact:

- As mentioned before, with rising populations across the globe, and with arable land finite, the search for more efficient food generation methods are becoming more and more valuable.
- A large barrier to market currently for manufacturers seeking to enter the insect farming industry, is high capital expenditure, without secure knowledge of the industry's profitability.
- With Goterras design, industrial partners would be able to lease or buy fully automated plants, that take organic waste and produce meal and tallow. They would be able to do it for a fraction of the costs, while also allowing flexibility, as they would not be liable to liquidating any standing capital infrastructure.
- The produced meal and oils are of extremely high quality. The meal could be used in anything from chicken feed to high protein supplements for mass consumption. The oils, while still crude once separated from the meal, has an infinite number of uses, in anything from industrial use, to (in its more processed form) cosmetics and medicines.
- By also allowing more players to produce in the market, enlarging the manufacturing base, and therefore allowing a larger market to be serviced, the use of insects moves from an outside practice, to a normalized one, attracting not just more investment but societal recognition, and therefore the beneficial economic and environmental impacts that the process brings with it.

Future:

1. The main goal of this project was to design a mobile rendering plant capable of being transported from location to location along with its farming counterpart. It was designed however to be able to handle not just insect material but other animal materials as well, namely animal offal and fish. The adding of a breaker machine to turn any incoming material into much smaller pieces for the cooking process would potentially allow the user to potentially turn other animal materials into the associated meal and tallow. Future projects could look into this conversion, adjusting the design to be able to handle other proposed material.
2. The design presented above is built out of currently available equipment from manufacturers in both Australia and China. Some of the pieces of equipment however are designed for much higher capacity than this project was seeking. A large part of the future, or continuation of this project, will be looking into the redesign of certain components and processes to first of all make them more appropriate to our needs, therefore reducing energy and water consumption, as well as reducing the volume of each piece of equipment, possibly reducing the need for multiple containers, making the system easier to transport.
3. The final area where future development will be focused is enhancing the level of synergy between the farming and rendering modules. A lot of heat and waste water is produced by the rendering process. At the moment, the material is cooled through a condensing process where waste heat is removed through the use of circulating water through the system. One current idea is to use this waste heat in the farming process, saving hugely in energy costs. The waste water extracted from the insects needs to be further treated, but can also be looked at being further used, depending on its mineral and bacterial properties. There are many areas where the waste products of the process can possibly be reused, and presents an opportunity for a future project to build on the work presented here.

System Introduction:

Insects are moved into the Cooker post death, their moisture content at this point being 70-75% water, and 20-25% dry matter. For the first 2 hours, it is only the Continuous Cooker working, evaporating the water into the contained chamber. After this the chamber is opened to the rest of the system, the vapour being extracted as the material is then “dried” for 3 hours. Once dry, the material is then moved through the Screw conveyer into the Fat press, where the tallow and meal are separated, moving into storage containers outside of the crates themselves. During the drying process, the vapour travels through the “dust collector”, which essentially removes any impurities or residual particles from the vapour, before it moves into the Condenser. The Condenser then runs cooler, outside water in pipes through the chamber, to condense the much hotter vapour coming in from the dust collector and continuous cooker. The “waste water” (condensed vapour from cooker) then flows out of the system (probably into an outside tank nearby) to be treated separately, and the cooling water that helped in the condensing process, flows into the Cooling Tower and then into the water Storage tank.

1. Insects move into Continuous Cooker
2. Cooked for 2 hours, then dried for 3, vapour is extracted into Dust Collector, and meal into Fat Press (through screw conveyer)
3. Fat Press separates Meal from liquid tallow, both of which is then ejected into outside storage

4. Dust Collector removes any solids from the vapour, which is then condensed in the Condenser.
5. Waste water pumped outside, stored before treated further.
6. Cooling tower and Water tanks used in the Condensing process

System component functionality introduction

Fat Press:

- Function: Once the material has been cooked and dried, it is moved through the conveyer into the fat press, where through a rotational device (as shown to the left) forces the solids from the liquid tallow, and then ejecting the two quantities separately.

Screw Conveyer:

- Meant for transporting the cooked material from the cooker to Fat Press.

Batch Cooker:

- The term “batch cooker” refers to the process by which the cooker processes the material. Cooked in batches, for a period to releases all water contained in the larvae, and then dried for another period to remove it, the material is the n transported out of it, dehydrated and ready to be further processed.

Condenser:

- Used to cool the removed vapor from the cooker into waste water that is removed at the end, and stored for further processing.

Dust Collector

- Removes solid particles from the vapor, as well as other impurities.

Cooling tower

- Cools water used by the condenser in the condensing process (not the waste water that condenses from the vapor from the cooker)

Water Storage:

- Stores water from the cooling tower, ready to be used by the condenser again.

PROJECT

SCOPE MOTIVATION

Every business produces waste, whether it be organic or industrial. With the world population ever increasing, along with its thirst for resources, Goterra seeks to transform common organic waste into high value protein and oils through the use of breeding Black Soldier Fly Larvae. By utilizing mobile insect breeding plants, transporting them to areas where there is high organic waste output, Goterra allows on site production of larvae, eliminating the need for material transportation or infrastructure. The project our team has been tasked is to conduct feasibility analysis and design of a mobile insect rendering plant that contained in one (or more) containers can accompany the mobile farming plant from site to site.

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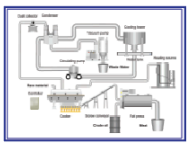

Andre Olivier Derek Tan Jiaying Ying Minghui Zhang

Australian National University

MOBILE RENDERING PLANT DESIGN

Fat Press

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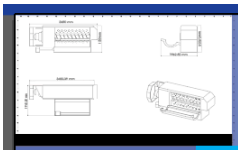

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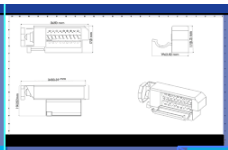
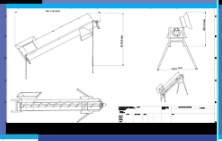
Used to cool the removed vapor from the cooker into waste water that is removed at the end, and stored for further processing.



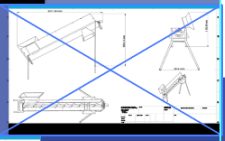
Screw Covenyor

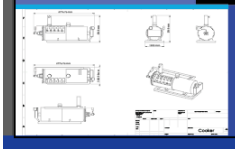
Meant for transporting the cooked material from the cooker to Fat Press.



Dust Collector

Removes solid particles from the vapor, as well as other impurities.





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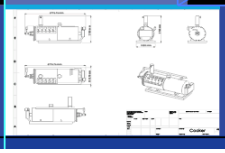

Cooling Tower

Cools water used by the condenser in the condensing process (not the waste water that condenses from the vapor from the cooker)

Impact

Addresses Barrier to Market
Low Capital Expenditure enables players to enter market

Generates High Value Products
Widely usable protein meal and oils from low value waste

Environmentally Sustainable
Significantly more efficient than current agricultural practices

Popularizes Insect Protein as a Food Source
Helping increase production, insect protein becomes normalized

The Future

1. **Expanding Rendering into Other Animal Materials**
While currently able to process insects only, future projects will seek to expand the designs capability to process animal offal and fish.
2. **Redesigning Process Equipment**
Currently most of the equipment sourced for the design is over capacity. As this project is continued, specific equipment can be design ed to be smaller and more efficient for Goterra.
3. **Increasing Synergy between Farming and Rendering Modules**
Can waste heat from rendering be used in the farming module? Is the waste water extracted of any value in the rest of the process? These questions and others will be sough to be answered.