Charcoal Briquette Compactor

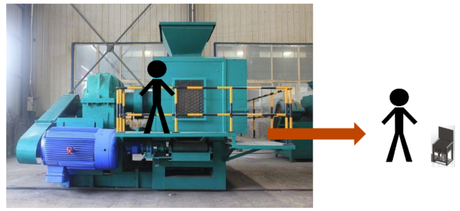
2023-2024 Mechanical Engineering Senior Design - Team 33

Advisor: Dr. Bob West **Sponsor:** Virginia Tech College of Engineering

Team Members: Alyssa Martinez, Junyeong Ahn, Marlon Delp, Nicholas Lamb, Shane Rue, Tyler Rutkowski

Problem Statement

- 80% of wood use in Ghana is for charcoal.
- Dependency on wood leads to mass deforestation of Ghana's natural forests.
- Existing biomass waste can be broken down, carbonized, and compacted into energy dense briquettes.
- Current briquette compactors are industrial, making them large, intricate and expensive.

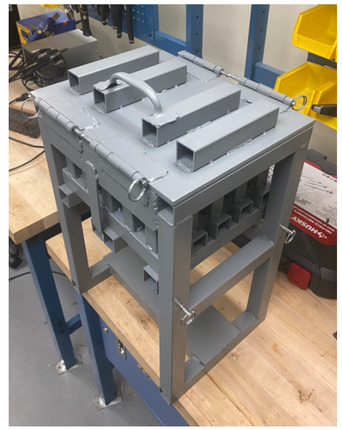


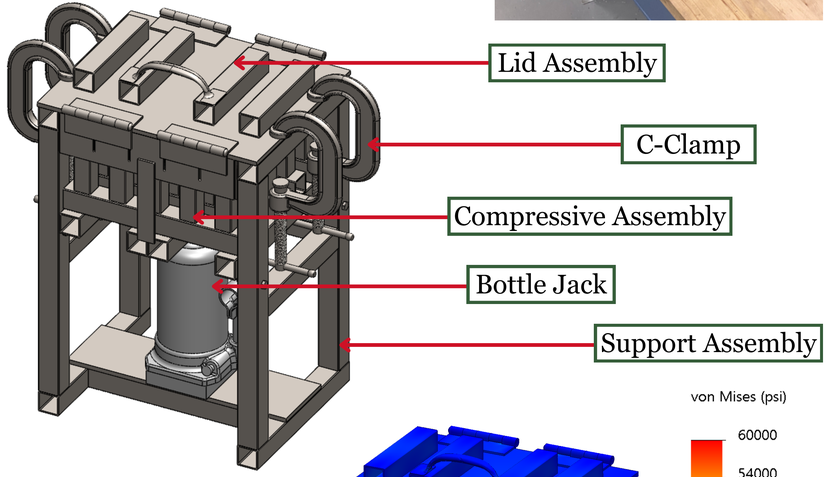
Objectives

- **Purely Mechanical**
- **Simple to Use**
- **Easily Sourced**
- **Affordable**
- **Reliable**
- **Durable**
- **Productive**
- **Portable**

Final Design

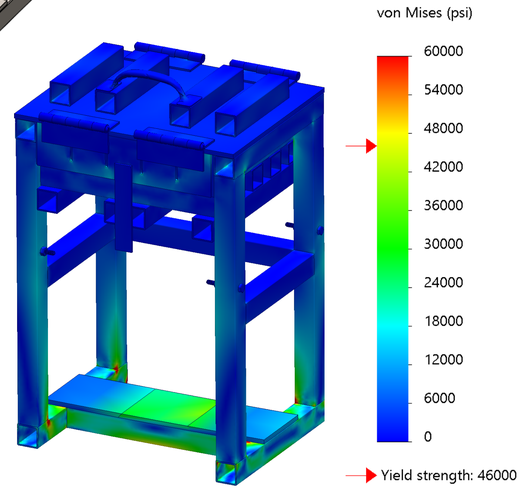
- 25 briquettes per cycle.
- Low-Carbon Steel construction.
- Completely welded assembly process.
- Operated by a bottle jack (min. 8-ton).
- Requires 12,500 lbf to produce briquettes.
- Removable Lid and Compressive Assembly.
- Unit Cost = $231.50





FEA Data

- Maximum Deflection
  - Lid: 1/100 inch
  - Comp: 1/50 inch
  - Support: 1/32 inch
- Fatigue Life
  - Lid: 61 years
  - Comp: 34 years
  - Support: 34 years



Testing and Results

Briquette Testing

- Fall testing with Carver Press provided inconclusive force results.
- Spring testing with Instron and test cell determined chamber height, expected density and required loading.

Deflection Testing

- A Linear Variable Differential Transformer (LVDT) and a QuantumX MX840B Universal amplifier measures and outputs deflection.

Test	Objective	Threshold	Expected	Actual
Weight (lbf)	50	100	93	88.5
Footprint (in x in)	18 x 18	24 x 24	13.25 x 10.75	13.25 x 10.5
Height (in)	30	48	20.75	21.79
Cycle Time (sec)	60	90	80	89
Density (lb/in^3)	0.018	0.007	0.015	0.010
Deflection (in)	0.1	0.2	0.01	0.04
Energy Density (J/in^3)	131,000	90,000	174,000	TBD

Conclusions

- All threshold specifications and team objectives met.
- Anticipated cost is half of the objective ($500).
- Per day productivity exceeds the needs of a family, more than ample for a business.
- Design process is iterative. Product should be investigated and tested further to produce optimal design for charcoal briquette compaction.

Future Work

- Compactor to be tested in Ghana, Summer 2024.
  - Corrections/Improvements made as needed following consumer use.
- Improved rust preventative measures/coatings.
- Smaller/Larger Compactors.
- Quicker and easier biochar production/feedstock mixing.
- Production of different sized and shaped briquettes.