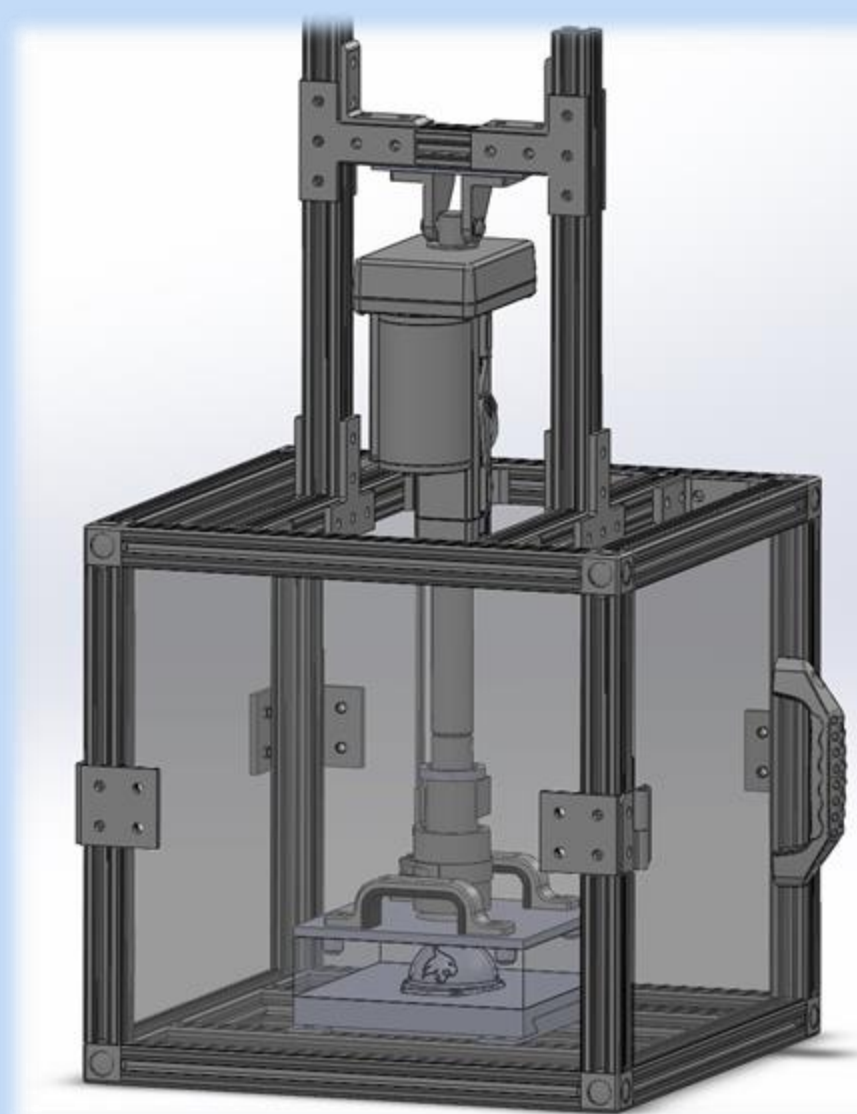


**Objective:** Our goal is to showcase how HDPE waste can be recycled using a low-pressure injection molding machine to produce durable and sustainable molded products.

## The Machine



### Machine Overview:

The low-pressure injection molding machine is designed as a compact system for processing materials efficiently.

It consists of five main subsystems:

- ❖ Heating System
- ❖ Electrical System
- ❖ Injection System
- ❖ Cooling System
- ❖ Assembly Structure

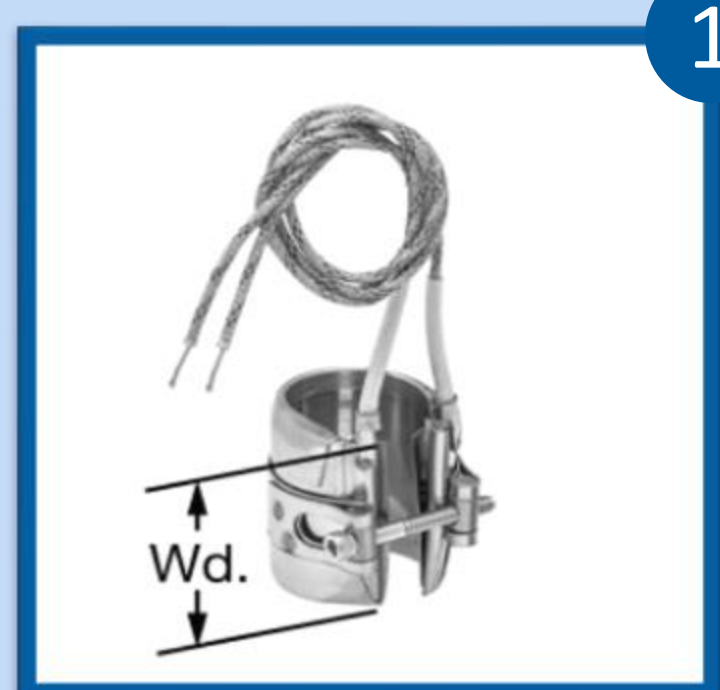
## Customer Needs

<b>Safety &amp; User-Friendly</b>	Ensuring intuitive operation and implementing designs prioritizing safety through optimization
<b>Encourage Public Engagement</b>	Creating an approachable system
<b>Low-Cost per use</b>	Delivering economic viability
<b>Mechanically Robust Design &amp; Non-Industrial Application/System Design</b>	Developing a mechanically reliable system without the complexities of industrial components

## Heating System

Responsible for achieving and maintaining the required processing temperatures for both the material and the mold.

**Band heater:** provides uniform and consistent heating of the cylinder to ensure proper material melting and flow (1)



**Cartridge heaters:** deliver localized and controlled heating to maintain consistent mold temperature (2)



**Band thermocouple:** continuously measures temperature and provides feedback for accurate monitoring and control of the heating process (3)



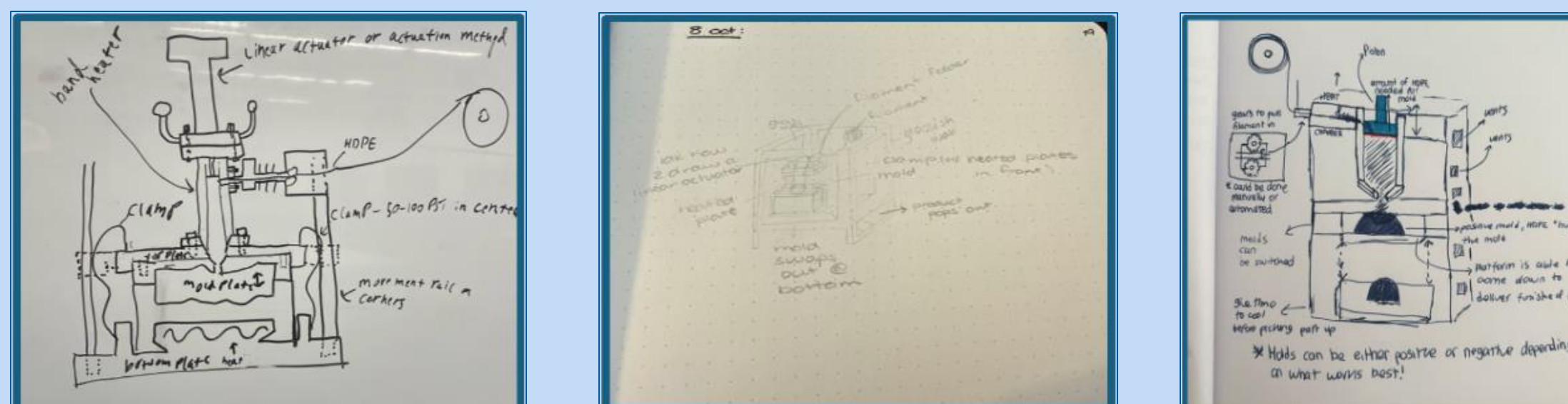
## Acknowledgements



We gratefully acknowledge the support of our project sponsor, Hunt & Hunt, whose contributions, and resources made this design possible. We would also like to say thank you to Dr. Talley, Dr. Ebrahimi, and Dr. Abdelkareem for their guidance

## Concept Generation & Safety

Preliminary sketches developed to explore multiple design concepts, evaluate alternatives, and guide selection of the final design.



### Safety Considerations:

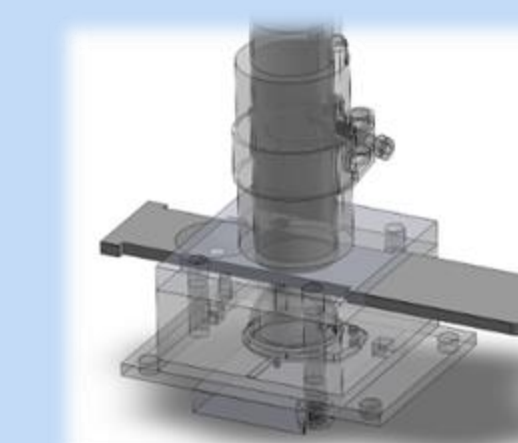
Thermal Protection, Enclosed Chamber, Electrical Safety, Actuator Motion Safety & Mold Pressure Safety

## Injection System

Responsible for controlling the flow of molten material into the mold and ensuring a consistent injection process.



**Linear actuator:** drives the plunger to inject material into the mold



**Gate mechanism:** blocks flow during heating and opens for injection, allowing clean cutoff of excess HDPE

## Electrical & Cooling

Controls heating, powers components, and maintains stable operation.



**Main PID controller:** regulates the band heater using feedback from the band thermocouple



**Secondary PID controller:** controls cartridge heaters for mold temperature regulation



**Solid State Relays (SSRs):** switch high-power heaters, with heat sinks for thermal management



**Power supply & wiring:** distribute power to the linear actuator and system components



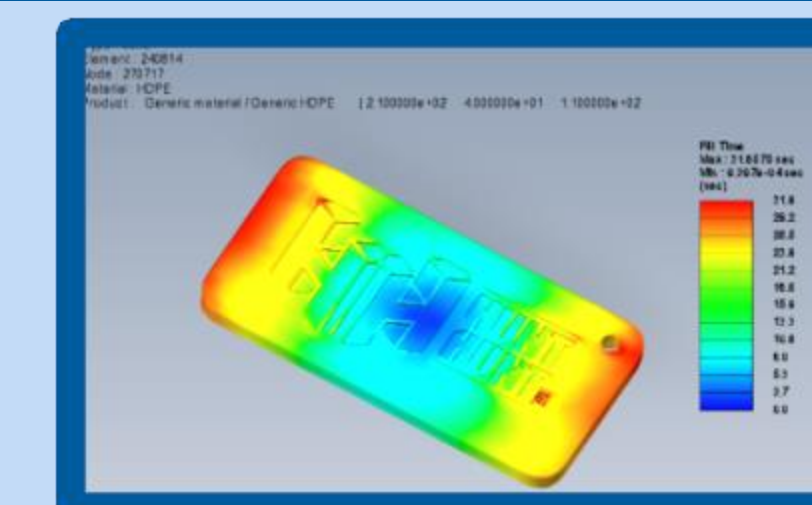
**Control interface:** enables user operation of the system such as switches, buttons, fuse, emergency stop



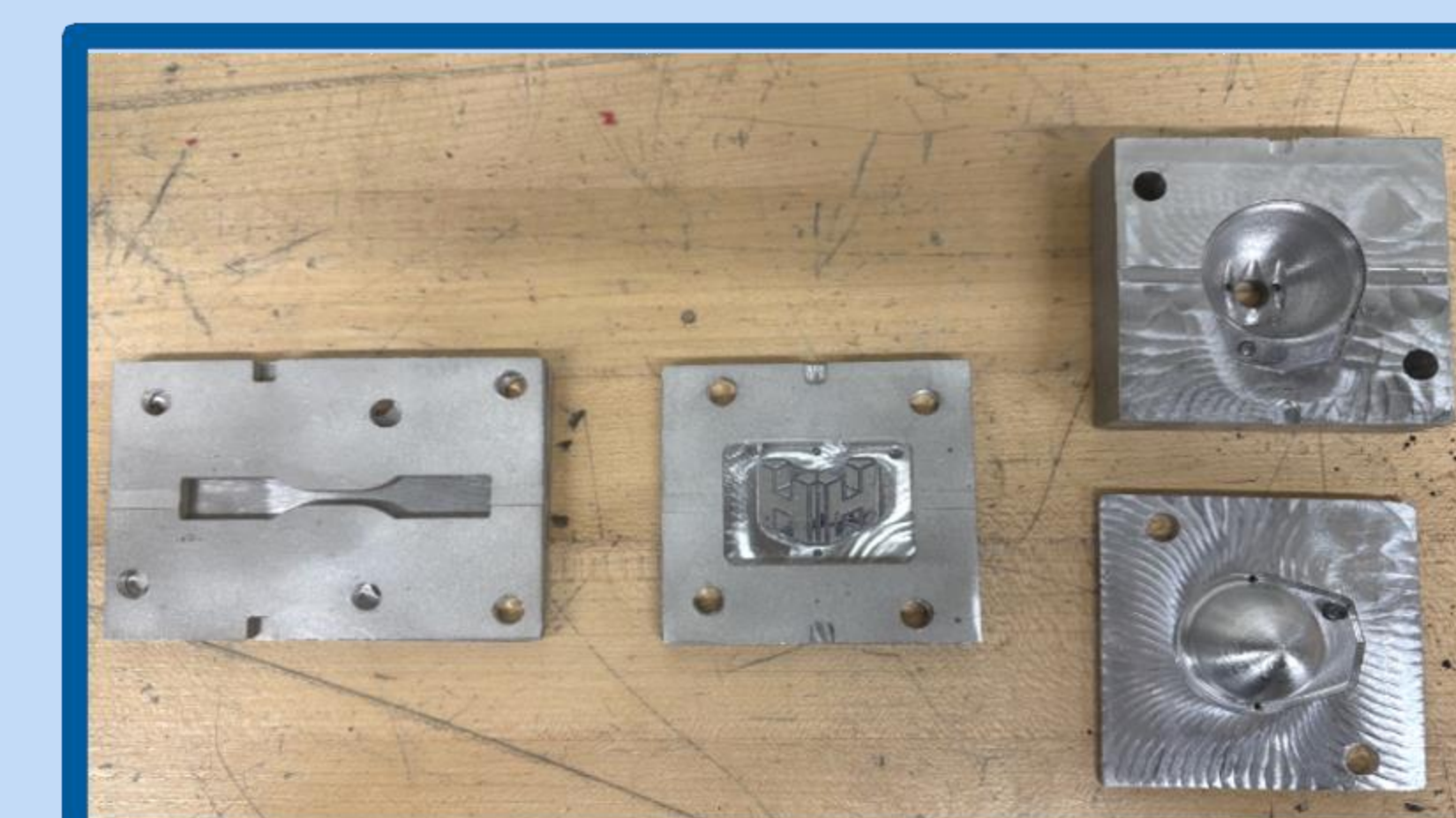
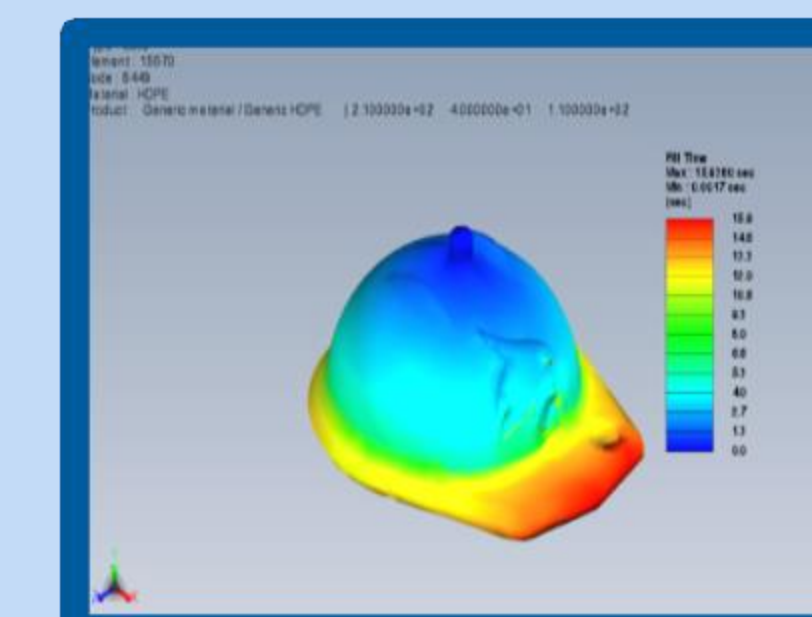
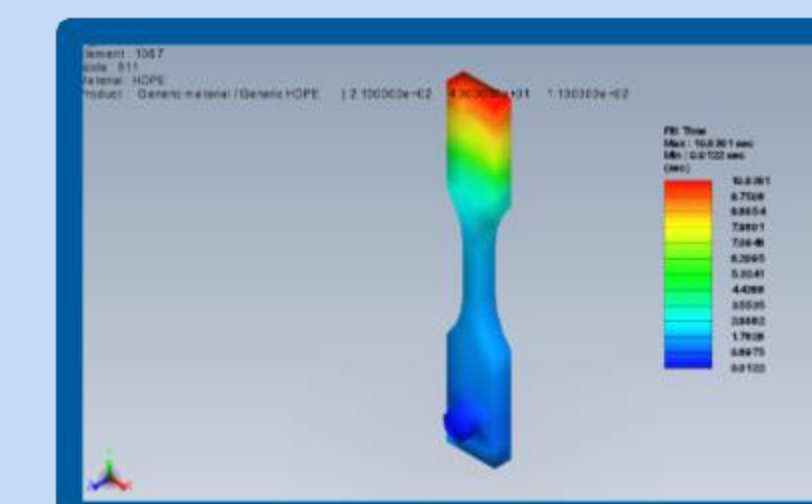
**Cooling fans:** provide airflow to cool down molds, helping maintain stable operating temperatures and reduce cycle time

## Molds, Target Process Parameters & Properties

- HDPE Properties:**
- Melting Temperature: 130°-140°
  - Density: 0.95 g/cm<sup>3</sup>
  - Tensile Strength: 25-35 MPa
  - Flexural Modulus: 800-1200 MPa
  - Thermal Conductivity: 0.45 - 0.52 W/mK
  - Shrinkage: 1.5 - 3.0%



- Process Parameters:**
- Heating Temperature (Malleability): 130°C -140°C
  - Melting Temperature ( Fully liquidized): 180°C - 200°C
  - Cycle Time: 10 – 15 minutes



### Current Molds:

- ❖ Hunt & Hunt Keychain
- ❖ Tensile Stress Specimen
- ❖ Hard Hat Keychain