

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.

Process

Assembly:

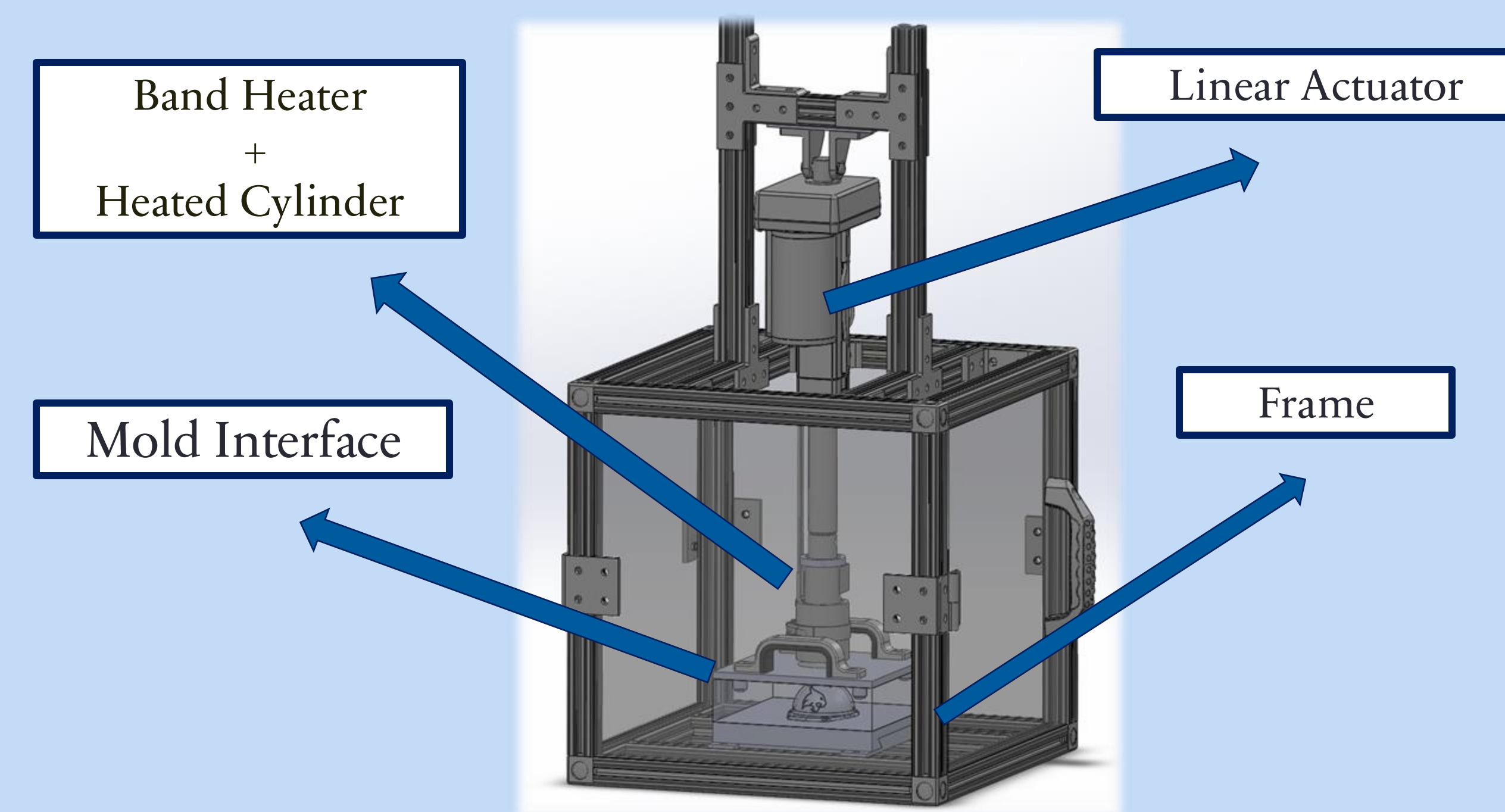
- Use HDPE for low-pressure injection molding
- PID-controlled band heaters for consistent temperature
- Simple, modular mold setup for easier part changes
- Linear Actuator to drive piston
- Enclosed Chamber to reduce heat loss and improve safety

Initial Testing Concerns:

- Temperature inconsistencies causing poor melt flow
- Minor leakage at the mold interface
- Longer than expected heating/cooling times
- Incomplete filling of molds

Customer Needs: Easy to use, Recycles HDPE, Safe, Low-cost Operation, Reliable & Durable

The Machine



Team Members, Advisors & Sponsor

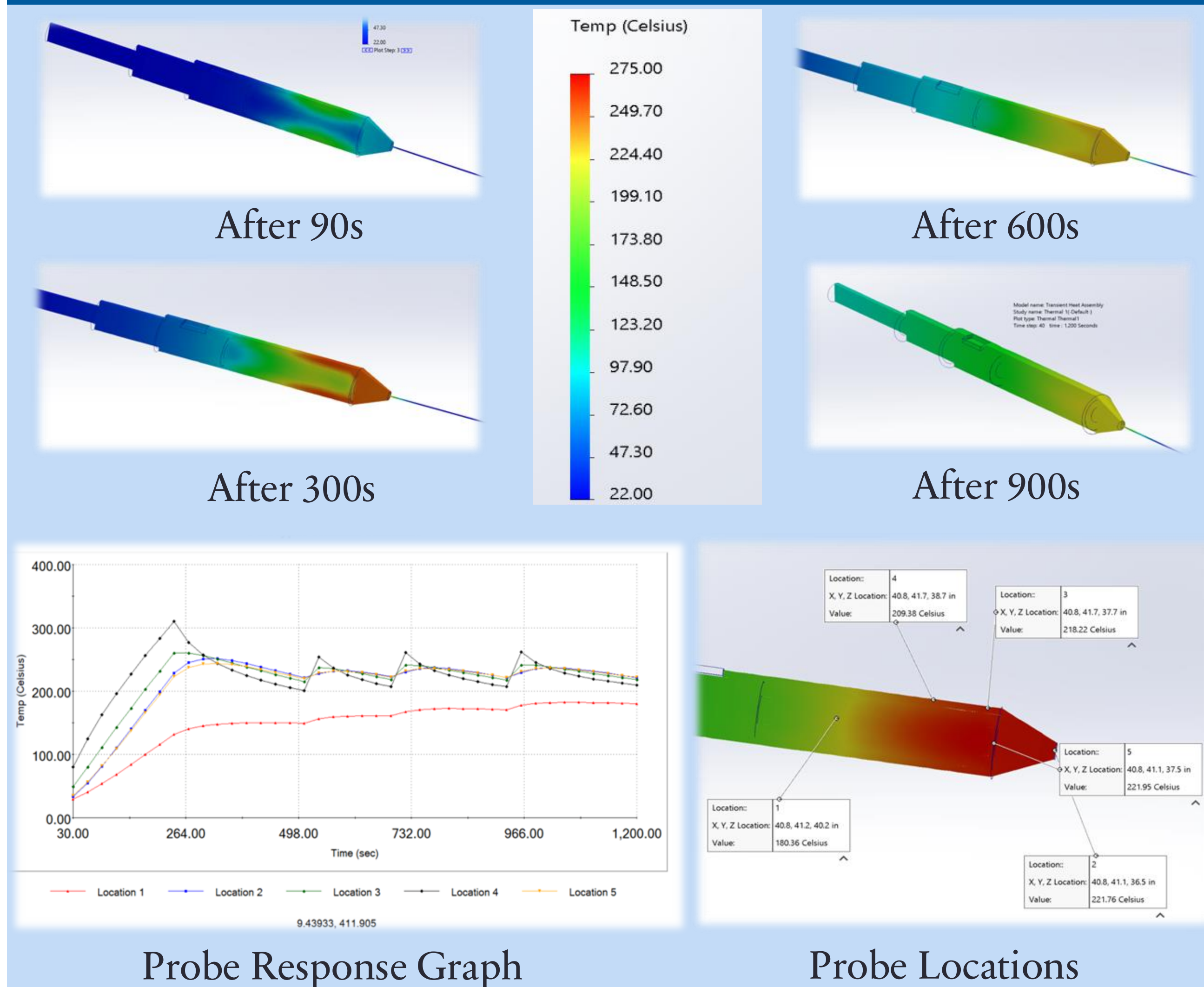
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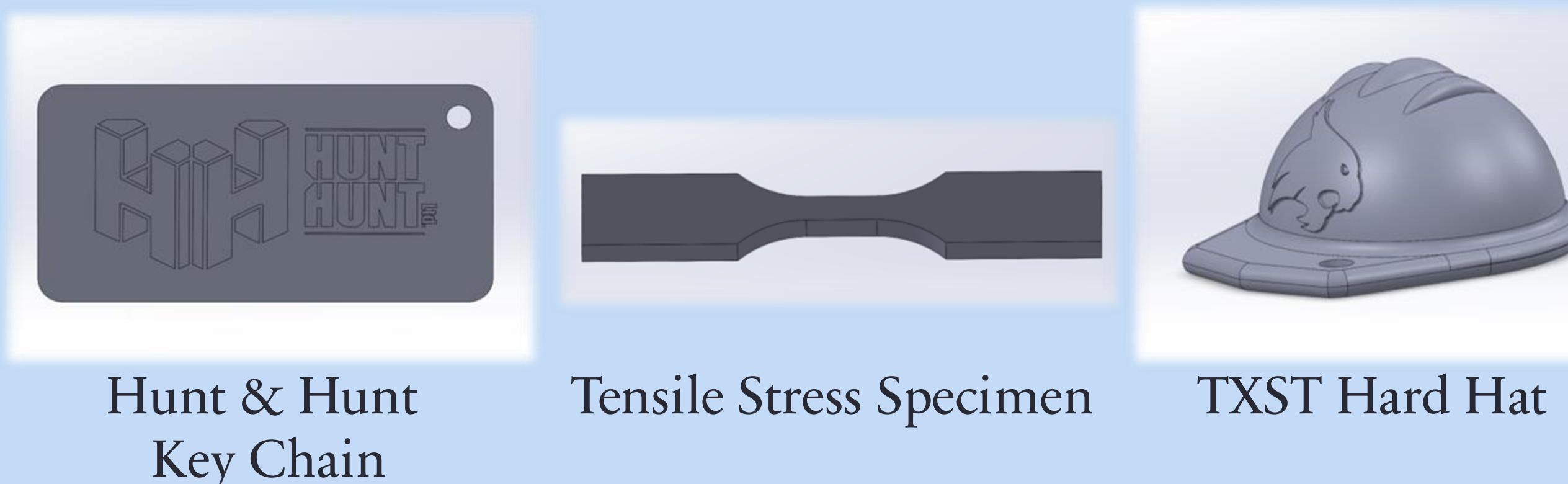
Acknowledgements

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Thermal Simulation



Molds



Main Concerns

- Air Bubbles / Voids
- Material Shrinkage
- Incomplete Fills
- Leakage
- Warping / Distorsion
- Cycle Time

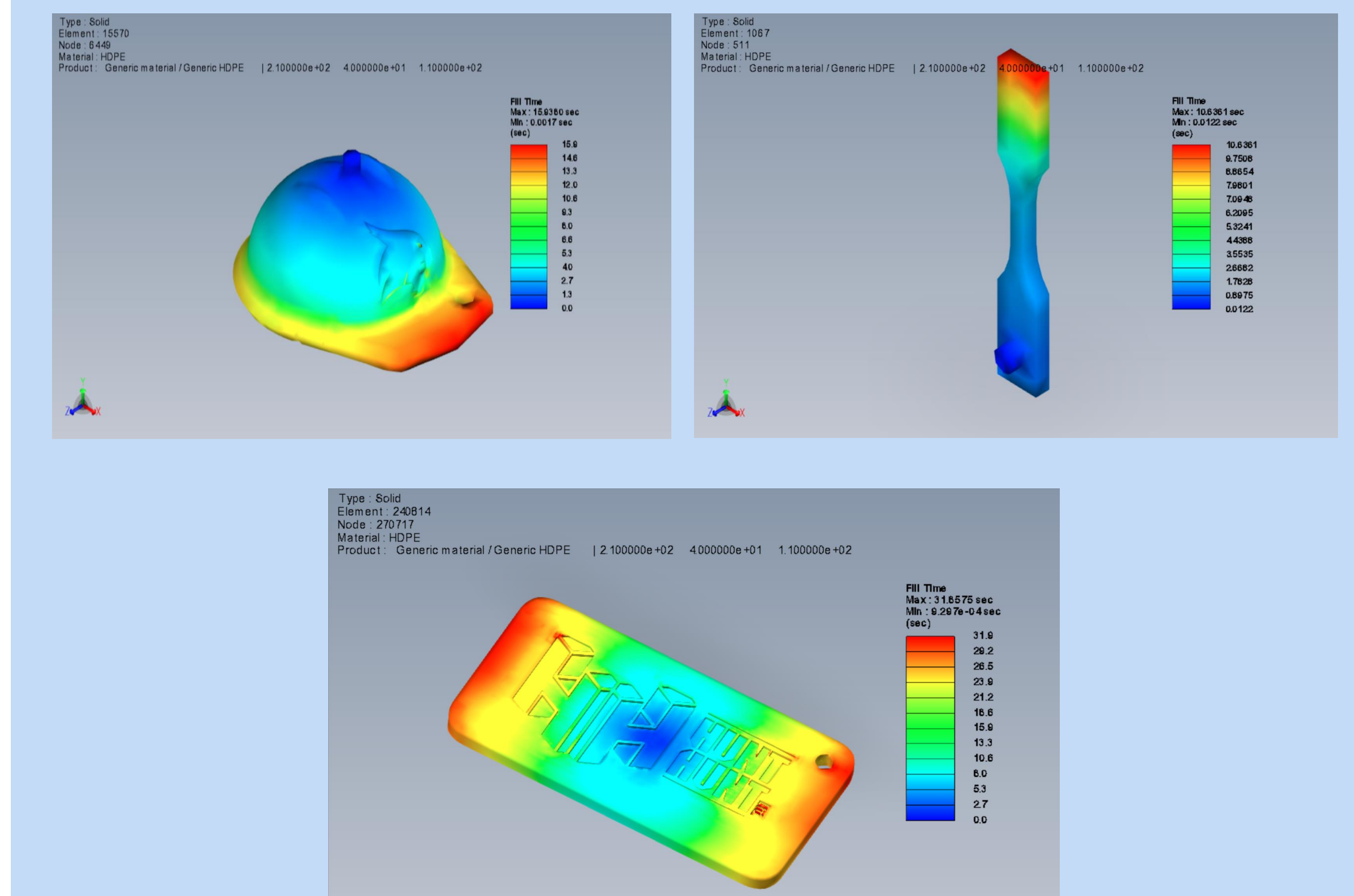
Safety Considerations

Thermal Protection
Enclosed Chamber
Electrical Safety

Actuator Motion Safety
Pressure & Mold Safety
Maintenance Safety

Mold Fill Simulation

Analysis of melt progression and air traps to understand areas at risk of incomplete fill



Material, Properties & Target Process Parameters

HDPE Properties:

- Melting Temperature: 130°C - 140 °C
- Density: 0.95 g/cm²
- 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
- Heating Temperature (Complete Melting): 180°C - 220°C
- Heating Duration: 0 – 15 minutes
- Cooling Duration: 0 – 15 minutes
- Extrusion Pressure: 60 – 80 psi



Future Plans

- ❖ Improve Melt Uniformity and reduce Thermal Gradients
- ❖ Pressure & Force Monitoring for better consistency
 - ❖ System Automation
 - ❖ Enhance Control System
 - ❖ Structural Optimization
 - ❖ Improve Cycle Time
 - ❖ Improve Mold Surface Finish