(POSTER) Design of an Extruder Cooling Line

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Extruder Cooling Line Team
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Design Engineering Technology
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ABSTRACT
Trine University’s School of Engineering and Technology offers a plastics minor with machines and tools for the students to gain experience with in a lab environment. One machine is a plastic extruder which mixes plastic pellets and any filler the students wish to add and extrudes the hot material through a die forming a 2D profile part.

CUSTOMER NEEDS

<table>
<thead>
<tr>
<th>Customer Needs</th>
<th>Specifications</th>
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<tbody>
<tr>
<td>Cool polymer for safe to touch</td>
<td>Trough length 3-4 feet</td>
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<tr>
<td>Pulverizer system speed matches the extruder</td>
<td>Max temp. 450°F</td>
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<tr>
<td>Motor runs off standard wall outlet</td>
<td>Cool polymers ≤25°F</td>
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<tr>
<td>Corrosion resistant</td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>120 dB</td>
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<tr>
<td>Product looks neat and professional</td>
<td>Motor 1/4 HP max</td>
</tr>
</tbody>
</table>

DESIGN CONCEPTS

The team came up with a number of different designs for the shape of the trough. The different designs for the trough are shown in Figures 2-4.

TEST RESULTS

The team performed finite element analysis on the complete design to verify frame structural stability and that the trough design and shape would hold the weight of the water. Each test had a simulated water weight of 50 lbf and another 50 lbf to simulate a student leaning in on the side. The tests were done with two fixed constraints and two rolling constraints to represent being on casters. The factor of safety for teams design was 3.294 as seen in Figure 7. The displacement was 1.855 mm as seen in Figure 8. These met design requirements.

FINAL DESIGN

After consulting with the sponsor and Design Engineering Department regarding the test results and design concepts, the panel proposed changes based on the design concepts. The design was chosen for ease of accessibility, lighter weight, and improved stability. Based on the teams analysis and testing, as well as the extruder specifications, Figures 9 and 10 show the final design.

PROBLEM STATEMENT

The Trine University plastics lab has a polymer extrusion machine with no effective way to cool the material being extruded and used for testing. The design team must create a cooling line for the extruder to make the cooling process more effective, efficient, and safe for the operators. This new machine must be cost effective and allow students to operate the entire process with limited training and faculty oversight. Both the extruder, Figure 1, and the cooling unit must work independent of each other but in unison.

ABSTRACT

The current setup has no cooling unit at the die end, so when the hot plastic is extruded, it falls straight down into a bucket making achieving a standard sample difficult. The design team is tasked with designing a simple cooling system that catches the extruded plastic upon emerging from the die and cools it to a temperature which is safe to handle. A mechanism to pull and guide the plastic is required and must match the speed of the extruder. With these requirements, the design team came up with the design of a water trough system supported by a frame with a mechanical puller device to guide the extruded plastic and provide sufficient cooling. The two main factors of the project were cost and overall size.

The team decided to go with stainless steel for the trough with a foam edging, based on corrosion resistance and professional look. The team considered two different materials for the frame: 1-inch 8020 aluminum and 1-inch stock tubing. The team went with stock tubing for the frame to reduce cost, but still used 80/20 for the puller device.

LENSSES LEARNED

Throughout this project, the team learned:
- The design process is always changing.
- Paying attention to detail in every aspect of the project is crucial.
- Test and then test again.
- The importance of time management.
- Communication is essential to the success of any team based project.

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