

Senior Design Project Description

Company Name	<i>The Polymer Technology Center</i>	Date Submitted	<i>11/10/202</i>
Project Title	<i>Cooling System for Extruder Filament</i> (PTC FILAMENT)	Planned Starting Semester	Spring 2021

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	4	Electrical	1
Computer		Systems	
Other ()			

Company and Project Overview:

The State of North Carolina chartered The Polymer Center in October, 1998, and was initially located on the UNC Charlotte campus. By 2000, PEP moved off of the UNC Charlotte campus to a nearby office park and became today's Polymers Center of Excellence (PCE). In 2012, Polymers Technology Center (PTC) was added for small scale production for compounding. Since then, the Polymers Center has continued to impact economic development through education, research and development, and trial production.

Polymers Technology Center supplies compounds to a variety of industries including automotive, textiles, home goods and recreation. Compounding is a process of melt blending plastics with other additives. The resulting polymer blend will provide a specific physical, thermal, electrical, etc. characteristic that is desired by the customer. Compounding is accomplished by feeding the resins and additives into an extruder. The material exits the extruder and is pelletized and packaged for shipment. From 500 pound orders to truck load orders, PTC has a broad capability for various compounding needs. In some cases, PTC will produce filaments from an extrusion machine and the filaments will be cut into small pieces for delivery to their customer. This project is related to the extrusion operation.

Project Requirements:

In plastic extrusion, a polymer melt is compressed to flow through a die orifice. For strand lines, the orifice is small and the filament is extended beyond the die and spooled or cut. Before the spooling or cutting can occur, the strands must be cooled so they do not melt together or

agglomerate during the cooling or cutting phase. To speed this process up, it is common to pull the strands through a water trough at the exit of the extrusion die. See the photo below:



The water temperature, the speed of the line through the water and the length of the tray are all elements to be designed based on the size and chemical composition. Some materials are hydrophilic and the absorption of too much water can ruin their composition.

PTC sometimes runs into this situation and currently does not have a solution to cover this situation. This project will be to design, build, test and verify a strand cooling mechanism that cools the strands in a short (less than ten feet) area after the extrusion machine exit. The student team will need to gather data on the range of material and sizes that need this solution and design a system that can cool the strands from the extrusion exit temperature to a temperature where the strands can be cut. Heat transfer calculations will be required to develop the analytical basis for the design that will be built in the second semester. Water can be used, for those materials that do not absorb it, but alternative cooling methods that would expose hydrophilic materials to excessive absorption must form part of the solution. Speed of strand movement, must be adjustable. Sensors with displays will be part of the design, so the operator and be aware of all operating parameters.

PTC has various conveyer lines and extrusion trays that are available to the student team that can be repurposed for this project. See photos below:



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Expected Deliverables/Results:

- Design idea for how to cool the molten exudate to the proper handling temperature in minimal section[PS1]
- Heat transfer calculations that provide the analysis of the design idea to achieve the goal.
- Build, test and validate an apparatus that achieves the project goal.
- The system must include a “closed loop” water treatment section that involves a heat exchanger that is run off plant tower water.

Disposition of Deliverables at the End of the Project:

Hardware developed is the property of the Industry Supporter. The work product will be displayed at the last Expo then immediately handed over to the supporter unless arrangements have been made to deliver at a future date.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Travel to PTC to understand process requirements, evaluate available equipment and test solutions.
- Interest in heat transfer analysis and machine building.