



Company Information

Company Name	<i>Polymer Center of Excellence</i>	Date Submitted	<i>03/26/2022</i>
Project Title	<i>Design and Build of a Bench-Top PET Crystallizer for Lab Usage (PCE_CRYSTAL)</i>	Planned Starting Semester	<i>Fall 2022</i>

Senior Design Project Description

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	3	Electrical	1
Computer	1	Systems	

Company and Project Overview:

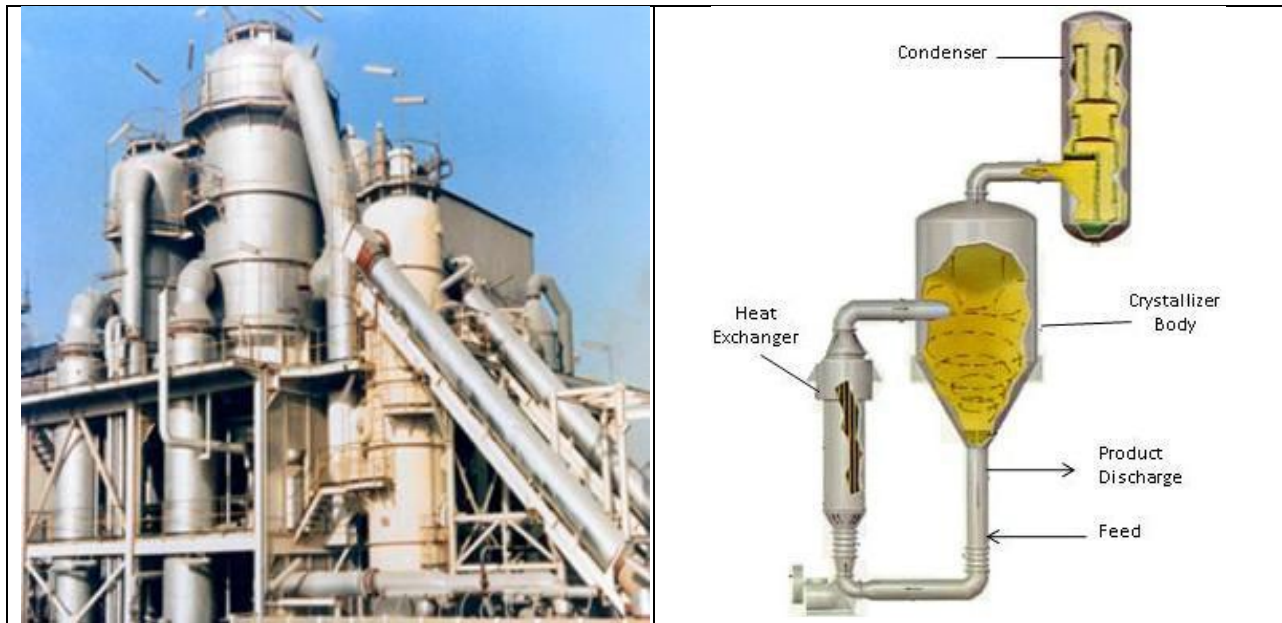
The Polymer Center was founded in 1972 when the State of North Carolina funded plastics specialists in the Industrial Extension Service program at UNCC. The center, located at that time on the UNCC campus, expanded in 1994 when a joint venture was entered into with NCSU to form PEP (Polymers Extension Program). By 1999, PEP moved off of the UNCC campus (to the close by University Research Park) and became today's Polymers Center of Excellence (PCE). In 2012, Polymers Technology Center (PTC) was added for small scale production for plastic injection molding and compounding plastics. Since then, the Polymers Center has continued to impact economic development through education, research and development, and trial production.

This project will be focused on developing a lab scale version of a production piece of equipment

Project Requirements:

Crystallizers are used in industry to achieve liquid-solid separation. They are an important piece of chemical processing equipment because they are capable of generating high purity products with a relatively low energy input.

Equipment Design: The feed slurry is first heated in a heat exchanger, then pumped to the main body of the crystallizer. Vaporization occurs at the top surface of the slurry, while nucleation occurs near the bottom of the crystallizer body. The crystals are removed and vaporized solvent is condensed and returned to the crystallizer body.



(Source:

<https://encyclopedia.che.engin.umich.edu/Pages/SeparationsChemical/Crystallizers/Crystallizers.html>

The Polymer Center desires a simple bench-top version of a PET Crystallizer. The project will design and build a small scale device which performs similar functionality to a production scale version similar in functionality to this device: <https://www.cometpe.com/products/pet-closed-loop-crystallizer/>

PET crystallizer is **used to re-crystallize PET amorphous materials before drying**, thus preventing the formation of clumps. After re-crystallized, PET materials will be conveyed to the material storage bin or directly to the drying hopper.

A crystallizer heats granulated amorphous PET to a temperature greater than its glass transition temperature, but just below its melting temperature. When the heated PET material reaches its “crystallization” temperature, the molecules of the amorphous PET rapidly change state: Crystalline structures grow and align within the molecules and the material changes from an amorphous state to a semi-crystalline state.



When the change is complete, this “crystallized” PET is ready for drying (if necessary) and processing, just like virgin material. Without crystallization, amorphous materials tend to agglomerate when they are heated up during drying. Agglomerated materials cause several problems: 1) They disrupt smooth mass flow through a drying hopper, causing some material to have insufficient residence time. 2) The large size of agglomerated clumps makes them difficult to dry and likely to retain unacceptable levels of moisture. 3) Agglomerated clumps can get stuck or bridged in downstream processes, causing a myriad of other material handling issues.

Crystallization can be done as a continuous or a batch process, depending on the capabilities of your crystallizer equipment. Typically, crystallizers are sized according to the volume of material that can be crystallized per hour. (source: [What's the role of a crystallizer? - Conair \(conairgroup.com\)](http://www.conairgroup.com))

Expected Deliverables/Results:

- Bench top PET Crystallizer no larger than 36” wide x 30” tall x 30” deep
- Weight – no more than 70 lbs
- Power – 110vac, with built in circuit breaker
- Needs to be portable / mobile
- Accurate Temperature control

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team’s work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter’s location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

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

- Control circuitry
- Heat Transfer