INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*BASF Corporation*	**Date Submitted**	*4/29/26*
Project Title	*Design & Construction of an IR/Forced Air Belt Oven for Laboratory Testing (BASF_BELT)*	**Planned Starting Semester**	*Fall 2026*

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	4	Electrical	1
Computer	2	Systems	

Company and Project Overview:

BASF is one of the world's largest chemical companies, focused on delivering innovative and sustainable chemical solutions. The North American Dispersions business, based in Charlotte, North Carolina, supports a wide range of industries including construction materials, adhesives, architectural coatings, nonwovens, and infrastructure.

BASF laboratories frequently evaluate coatings, adhesives, and functional materials under controlled thermal conditions to understand curing behavior, activation mechanisms, and performance in customer-relevant manufacturing processes. Currently, some laboratory evaluations rely on repurposed equipment such as small pizza ovens, which limit temperature uniformity, airflow control, heating modality, process repeatability, and data logging.

This Senior Design project will focus on designing and constructing a programmable benchtop belt oven that better mimics the industrial conveyor ovens used by BASF customers. The system will be capable of infrared (IR) heating, forced-air impingement heating, or combined operation to enable realistic and repeatable laboratory thermal processing. The belt oven will provide precise control over temperature, airflow, heating modality, and sample residence time, with residence time controlled through adjustable conveyor belt speed and defined by the effective heated zone length. The design shall allow flexibility in heated zone length to support residence times ranging from approximately 10 seconds to 1 hour. This

project will be done as a two phase project. Phase 1 will start in Fall 2026 and extend until May 2027. Phase 2 will overlap with Phase 1 with a Spring 2027 start and will complete the project in December of 2027.

Project Requirements:

- Benchtop continuous belt oven suitable for indoor laboratory use; unit may be mounted on a wheeled table.
- Operating temperature range of approximately 250–600 °F (120–315 °C).
- Infrared (IR) heating capability (ability to tune IR wavelength or swap out different bulbs of varying IR wavelengths).
- Forced-air impingement heating capability with adjustable airflow ranging from approximately 100 to 5,000 CFM (can discuss further on upper limits of airflow). Airflow shall be configurable to impinge on the sample from the top, bottom, or both directions. The system shall also include a means to securely hold or restrain samples during transport through the oven to ensure positional stability during processing.
- Optional/exploratory feature: integration of a UV-C light source for limited laboratory-scale curing or surface treatment studies
- Ability to operate IR heating and impingement heating singularly or simultaneously.
- Belt should be programmable to move forward and reverse direction. Belt design should allow flexibility to have a sample resonance exposure time of 10 seconds up to 1 hour.
- Programmable control platform (PLC or microcontroller-based) to manage temperature, conveyor speed, airflow, and heating mode.
- Touchscreen human–machine interface (HMI) for programming and storing test profiles.
- Must be able to store a minimum of 50 different test profiles.
- Continuous temperature monitoring at multiple locations within the oven chamber and ability to map heat profiles and log heat traces over the curing process.
- Vent or exhaust port for removal of water vapor generated during processing of water-based coatings.
- Basic laboratory safety features include over-temperature protection, emergency stop capability, and safety interlocks.
- The device must be easy to operate & maintain to achieve reproducible results
- Compliance with applicable BASF laboratory safety standards.
- A manual that covers the operation and maintenance of the unit

- Phase 1 will develop the architecture of the project and define the design parts for Phase 1 and what the Phase 2 team will be responsible for starting in Jan 2027. The two teams will interface and handoff the design and build during the Spring 2027 semester and the Phase 2 team will complete the total project and handover to BASF.

Expected Deliverables/Results:

- Fully functional programmable laboratory belt oven.
- Demonstration of IR heating, forced-air impingement heating, and combined operation.
- User interface capable of saving and recalling multiple processing profiles.
- Demonstration testing using BASF-provided materials.
- Operation and maintenance manual.
- Design documentation covering mechanical, electrical, controls, and safety considerations.
- On-site demonstration at the BASF Charlotte Technical Center.

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. It is also a mandatory part of this Program that the Industry supporter attend the 2 expos to grade their team's performance. 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):

- The following will be provided by BASF in an Orientation to the student team as scheduled after Kickoff:
    - BASF company overview
    - BASF overview of product portfolio and water-based dispersions
    - Review of current curing methods utilized by BASF laboratories
- BASF may require its own NDA from the students
- An interest in machine design