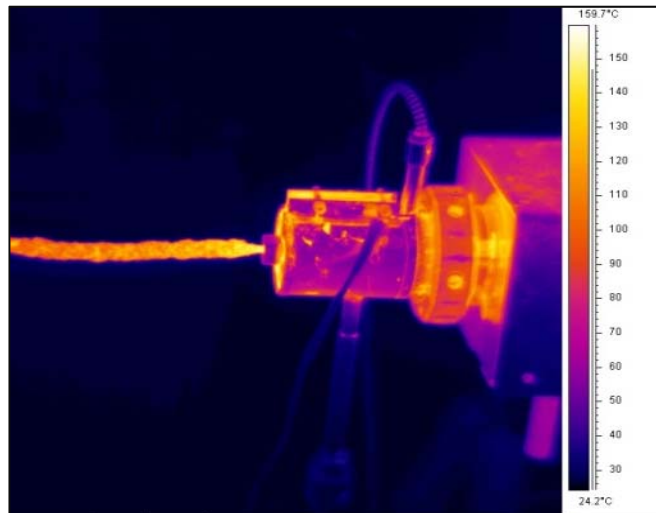
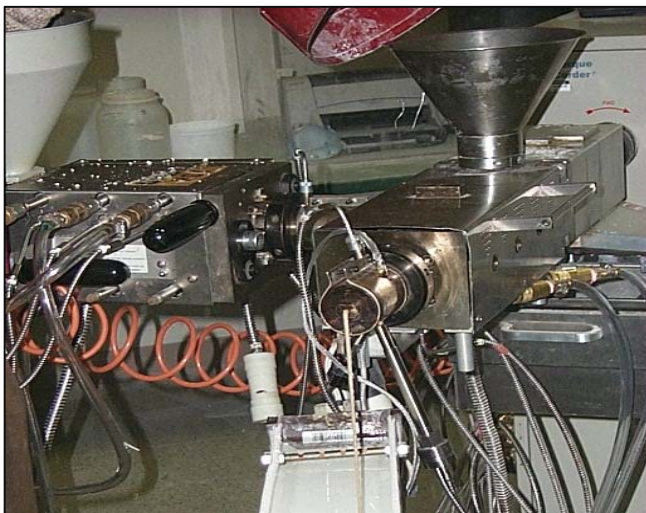
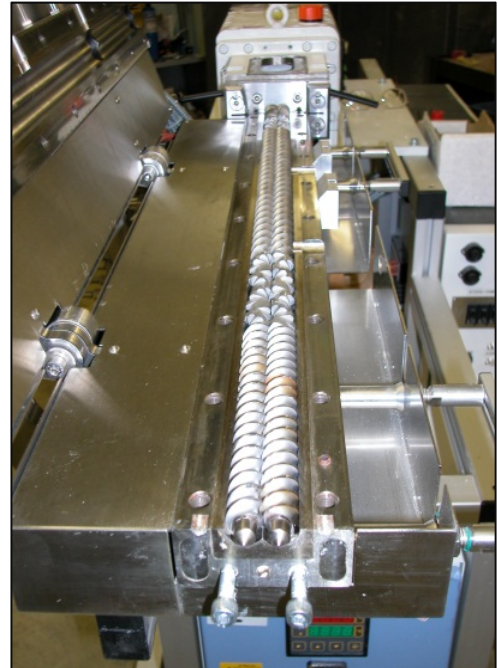


## Extrusion Services

The University of Nebraska - Industrial Agricultural Product Center extrusion facility is equipped for reactive, compounding, film, sheet and collett extrusion processes on a laboratory scale. The extrusion equipment was purchased from C. W. Brabender Instruments Inc. of South Hackensack, New Jersey ([www.cwbrabender.com](http://www.cwbrabender.com)). The equipment available includes:

- An Intelli-torque drive system. This system has a 7.5 hp variable speed motor (0 to 225 rpm) and allows real time torque and speed monitoring. System pressure and temperature can be monitored at up to 4 points.
- A single screw extruder (20:1 L/D, 19 mm) with screw configurations of 1.5 and 3 to 1 compression ratios and single and double pineapple mixing zones with a 3 to 1 compression ratio. This extruder attaches to the Intelli-torque drive system.
- A conical twin screw extruder with intermeshing co-rotating screws. Screw configurations available are conveying, venting and mixing (cut flight zone). This extruder attaches to the Intelli-torque drive system.
- A twin screw extruder (19 mm) with segmented screws allowing for a wide variety of screw configurations. This system has its own drive system which can monitor speed (0 to 225 rpm), pressure and temperature of the process. The barrel can be configured to have 10:1, 20:1, 30:1 or 40:1 L:D ratios.
- Numerous dies: rod dies with nozzles from 2 mm to 7 mm, 1 inch adjustable ribbon die, 6 inch flex lip sheeting die, film blowing die, annular dies, 60 mm slit die, and co-extrusion die.
- Supporting equipment: flex wall volumetric feeder, pelletizer, face cutter, blender, grinders and halogen moisture analyzer.



## Extrusion Services

The resulting extruded products can be analyzed for mechanical strength, physical characteristics, degradation characteristics and heat stability.

- To determine the mechanical strength and physical characteristics a wide variety of equipment is available. To measure irregular low density shapes a procedure has been developed utilizing glass beads to accurately measure the volume of small objects. That along with a laboratory balance provides accurate density information on irregular shaped products. An Instron 5566 is equipped with Instron Bluehill software to accurately control the crosshead rate of the universal testing machine. It allows accurate measurement of the energy applied to bend, shear, pull apart, crush or puncture products.
- Degradation and heat stabilization are important to understand how long the product will last or react in specific conditions.
  - Degradation chambers have been built to operate with compost. The chambers are maintained at a prescribed temperature and air can be pumped through them to maintain an aerobic state. Periodically the compost is rotated and gases collected and analyzed with gas chromatography to determine the rate of degradation.
  - Heat stability is evaluated by differential scanning calorimetry (DSC). The DSC can operate between -145°C to 500°C at prescribed rates of temperature change.
- Water vapor and air transmission rates for films can be determined at specific environmental conditions. By using environmental chambers and transmission cups, the films can be tested for transmission rates.
- The University of Nebraska maintains and operates core facilities of expensive equipment that would be cost prohibitive for individual laboratories to own and operate. Equipment available to University researchers is outlined at (<http://research.unl.edu/facultyresources/corefac.shtml>). Core facilities regularly used by Industrial Agricultural Products Center researchers include scanning electron microscopy, X-ray diffraction, and nuclear magnetic resonance spectroscopy (NMR), and Fourier transform infrared spectrometry (FTIR).

