The Centre for Industrial Application of Microcellular Plastics (CIAMP) is a state-of-the-art R&D centre with industry-scale facilities for developing innovative, commercially viable plastic foaming and composite technologies. CIAMP is an integral extension to the Microcellular Plastics Manufacturing Laboratory (MPML), which is the international leader in plastic foaming research since its inception in 1993. Industry-scale experimentation and optimization of these technologies is conducted. This is the main goal of the CIAMP. The CIAMP is equipped with state-of-the-art plastic foaming resources, such as industry-scale foam extrusion and foam injection molding systems. In addition, the CIAMP is supported by substantial industry expertise from the Consortium of Cellular and Microcellular Plastics (CCMCP), a network comprising of more than 20 leading plastics companies around the world. With this extensive research network and infrastructure, we are dedicated to bridging science and technology and providing solutions to enable our partners to succeed in their foaming and composite technologies.

The objective of the CIAMP is to collaborate with industries to develop innovative microcellular plastic products and commercially viable processing technologies. The CIAMP is an integral part of a world-leading research network and infrastructure directed by Dr. Chul B. Park focusing on the science and technology of plastic foaming. The investigation on the science of plastic foaming is undertaken by the NSERC Network for Innovative Plastic Materials and Manufacturing Processes (NIPMMP), a $5-million research initiative bringing together 21 leading academic researchers across Canada. To enable effective technology transfer and commercialization, it is imperative that industry researchers and companies work together to advance the field of plastic foaming.

“Industry-scale experimentation and optimization is imperative to enable effective technology transfer”

“Dedicated to bridging science and technology and providing solutions to enable our partners to succeed in their foaming and composite technologies.”

“Our vision is to collaborate with industries for innovation, with a focus on scientific understanding and technological development” - Chul B. Park
Maag-Automatik Underwater Pelletizer

**Description:** The SPHERO® 50 underwater pelletizing system has been designed to produce spherical pellets. This highly flexible system can be applied in the manufacturing of raw materials, compounds, master-batches, engineering plastics, thermoplastics elastomers, hot-melt adhesives, and recycling. The system can also be used to produce pre-impregnated thermoplastic beads with varying expansion ratios.

**Capabilities:**
- Ideal for lab applications and production lines for master-batches, compounds
- Process stability due to quick and reliable start-up function

**Specifications:**
- 10 kg/hr of maximum throughput
- 0.6 ~ 2.5 mm pellet diameters
- 60 °C of maximum pellet temperature

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**Pre-Expander from Erlenbach GmbH**

**Description:** The batch-type pre-expansion has a discontinuous operation with maximum operational pressure from 0.5 to 2.5 bar for pre-expanding EPS bead foams. Additionally, a pressure filling system for attainment of required bulk density in EPP beads is also available.

**Capabilities:**
- Short adjustment periods when changing processing conditions
- Precise density control
- Efficient steam exit and blowing agent suction
- Economical utilization of steam-condensate for heating

**Specifications:**
- 2.5 bar of maximum operating pressure
- 150 liter of expansion chamber
- 70 kg/hr (for 15 g/l), 140 kg/hr (for 20 g/l), and 160 kg/hr (25 g/l) of production capability
- 40-50 kg/hr of steam consumption

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1300 ton KraussMaffei Injection Molding Compounder (IMC)

**Description:** This injection molding machine is capable of a continuous plasticization and efficient mixing of directly fed long fibers. The customizable twin-screw provides the manufacturing flexibility to accommodate numerous applications. Furthermore, its foaming capability offers competitive edges such as material cost savings and improved dimensional stabilities in today’s plastics industry.

**Capabilities:**
- Single step manufacturing (twin-screw compounding + injection molding)
- Fully continuous process for maximum plasticization and mixing
- Direct injection and accurate control of physical blowing agent for foaming technology
- Flexible and highly customizable manufacturing process (modular screw configuration)
- Direct and continuous feeding of long fibers to maximize their aspect ratios
- High filler contents possible
- Superior dimensional stabilities against shrinkage and warpage
- Significant material cost savings via foaming and reduction in amount of additives needed.

**Specifications:**
- Specially designed to accommodate physical foaming technology
- 13,000 KN of maximum clamping force
- 8588 cm³ of maximum stroke volume
- 6.2 kg for PP or 8.0 kg for 30% glass-filled PP of maximum shot weight
- 1,200 cm³/s for maximum injection flow rate
- 60 mm for twin-screw diameter and 42 L/D ratio
- 8 heating zones for hot runner system

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**On-Line Feeding of Long Glass Fiber**

**Description:** The batch-type pre-expansion has a discontinuous operation with maximum operational pressure from 0.5 to 2.5 bar for pre-expanding EPS bead foams. Additionally, a pressure filling system for attainment of required bulk density in EPP beads is also available.

**Capabilities:**
- Short adjustment periods when changing processing conditions
- Precise density control
- Efficient steam exit and blowing agent suction
- Economical utilization of steam-condensate for heating

**Specifications:**
- 2.5 bar of maximum operating pressure
- 150 liter of expansion chamber
- 70 kg/hr (for 15 g/l), 140 kg/hr (for 20 g/l), and 160 kg/hr (25 g/l) of production capability
- 40-50 kg/hr of steam consumption
We have a strong commitment and interest in the fundamental studies of plastic foaming, because we believe that science will lead us to technological breakthrough in industries.

**Pilot-Scale Tandem Extrusion System**

**Description:** This tandem extrusion system (comprising of a single-screw extruder for plastization and a single-screw extruder for cooling) is the most versatile extrusion system in CIAMP. One or two more extruders can be added to this tandem system to produce co-extrusion applications. It can accommodate polystyrene, polypropylene, polyethylene, polycarbonate, and other commercial resins for applications such as foam sheets, foam boards, profile foams, and co-axial cable foams.

**Capabilities:**
- Manufacturing flexibility for various applications
- Direct injection and accurate control of physical blowing agent(s) for foaming technology

**Specifications:**
- 20-80 kg/hr of maximum throughput
- 2 on-line drying hoppers (45 kg/hr and 90 kg/hr)

**Recycling Machine**

**Description:** This extrusion system is to recycle a wide variety of foam samples in order to minimize the environmental impact of our research at CIAMP.

**Capabilities:**
- Significant reduction of environmental foot-print of research activities at CIAMP
- Capable of recycling various commercial foams such as EPP, EPS, EPE, and etc.
- Complete processing from foam samples to solid pellets
- Opportunities for research utilizing recycled plastics

**Specifications:**
- Tandem extrusion set up (two single-screw extruders)
- 200 kg/hr of maximum throughput

**KraussMaffei Berstorff XPS Tandem Extrusion System**

**Description:** This tandem extrusion system consists of a twin-screw extruder for compounding and a single-screw extruder for cooling. This configuration can provide efficient mixing as well as high throughput for foaming applications. Further, high processing flexibility can be achieved because of customizable screw configurations of the twin-screw extruder.

**Capabilities:**
- Excellent size-output ratio
- Outstanding mixing capability
- Direct and accurate injection of liquid or gaseous physical blowing agent(s) into the twin-screw extruder
- Flexible and highly customized process flexibility (modular screw elements and barrels)
- Excellent cooling of single-screw extruder through “wet” liners of barrels and pressurized water
- Utilization of patented active melt seal

**Specifications:**
- 450 kg/hr of maximum throughput
- 65 mm for twin-screw diameter and 30 L/D ratio
- 150 mm for single-screw diameter and 30 L/D ratio
- On-line drying hopper with 450 kg/hr of maximum throughput
- 600 mm width of foam board with variable thickness
- Various types of physical blowing agents (CO2, n-butane, n-pentane, etc)
Microcellular Plastics Manufacturing Laboratory (MPML) is the premier research laboratory for innovative plastic foaming technology in the Department of Mechanical and Industrial Engineering, University of Toronto. The focus in MPML is fundamental knowledge and technology development using the analytical and lab-scale equipment. Laboratory currently supports 22 PhD, 3 Post-Doc and 4 Master students. The key research areas include the processing of plastic foams and composites through novel injection molding techniques and extrusion processing, involving both physical and chemical blowing agents. Additional information can be obtained at:

http://mpml.mie.utoronto.ca

NSERC Network for Innovative Plastic Materials and Manufacturing Processes (NIPMMP) is an academic network between 20 Professors from 11 Universities and 15 Industrial Partners. The objective of the NSERC NIPMMP is to develop a wide range of novel polymer materials and technologies that will make Canada a prominent innovator in original, high-value-added plastic products and related manufacturing processes. Additional information can be obtained at:

http://nipmmp.mie.utoronto.ca

Centre for Industrial Application of Microcellular Plastics (CIAMP) focuses on developing new products and processing technologies for microcellular foams. The overall goal of CIAMP is to facilitate technology transfer to the industry. We will mobilize the knowledge and lab-technology for improving and building up on the current industrial technology. Additional information can be obtained at:

http://ciamp.mie.utoronto.ca

Consortium for Cellular and Microcellular Plastics (CCMCP) was formed to facilitate the access of processors, equipment designers, resin suppliers, and foaming agent suppliers to highly qualified research personnel. It also established a network for training young engineers in the areas of technologies for processing cellular plastics. CCMCP currently comprises of 23 industrial partners from around the world. Additional information can be obtained at:

http://ccmcp.mie.utoronto.ca