There are two general classes of plastic foams: Thermosetting foams such as polyurethane where the foam is generated by volatilizing a foaming agent during the chemical reaction of two pre-polymers and Thermoplastic foams such as polystyrene where the foam is generated by incorporating a foaming agent into the molten plastic under pressure and lowering the pressure to allow the dissolved foaming gas to expand the plastic.

Thermoplastic foams have density ranges from 90% to less than 5% of the solid plastic. There are many ways of foaming thermoplastics including injection molding, rotational molding, extrusion and steam expansion. Low-density extruded foams dominate the thermoplastic foams market. Foaming agents are of two general types - physical foaming agents such as hydrocarbons and atmospheric gases and chemical foaming agents such as sodium bicarbonate and thermally unstable hydrazines. The keys to successful foaming are temperature and pressure. The foaming agent must be soluble in the plastic at elevated temperature and pressure but must come out of solution at lower temperature and pressure. Ideally, there should be good compatibility between the characteristics of the foaming agent and the temperature-dependent rheological characteristics of the plastic.

The equipment needed to achieve quality foam is unique to the specific process. The mechanical characteristics of the produced foam depend on the mechanical characteristics of the solid polymer and the foam density. The thermal characteristics depend on the time-dependent thermal diffusivity of the cell gas, the extent of unbroken cell walls and the foam density. This program explores in depth these and other aspects.

**Course Topics:**

- Typical Foam products
- Basic principles
  - Mechanical properties of foams
    - Standard time behavior
    - Long term behavior
    - Short term behavior
    - Time-dependent thermal conductivity
    - Time-dependent compression strength
  - Melt temp gradient/distribution
  - Secondary foam expansion
  - Alternative mat’ls v. quality
  - Additives
  - Cell stabilizers
  - Other agents
  - Foaming agents
  - Rheology of gas-laden melts
    - Bubble mechanics
    - Why does foam stop growing?
    - Why does it shrink?
- Foaming agents
  - Nature of foaming agents
    - Chemicals
    - Physicals
    - Role of nucleant
    - Foaming agent compatibility
    - Solubility
    - Diffusivity
    - Fugitive foaming agents
    - What about alcohols?
    - CO2?
    - N2?
    - What about time-dependent TK?

- Hardware
  - High-density foam
    - Extrusion
      - Injection molding
    - Medium-density foam – extrusion
    - Low-density foam – extrusion
    - Other foaming technologies
      - Blowing
      - Rotational molding
      - Expanded bead foam
  - Hardware, extrusion
    - Twin v. long single screw
    - Tandem v. long single screw
    - Primary screw design
    - Gas dispersion issues
    - Secondary screw design
    - Thermal flowing issues
    - Metering
      - Coupling to screw speed - practical?
      - Transfer pipe issues
      - Screen packs, breaker plates?
      - Gear pump?
      - Extruder to die issues
    - General flat sheet die design
    - What about annular dies?
    - The role of cap sheet
      - Cost v. performance
    - Calibration, sizing
      - Constrained shaping of extrudate
      - Free expansion
    - Control of extrudate dimensions
    - Sheet surface quality
  - Secondary processes
    - Thermoforming

**Registration Fee/ Person**

- 950 US$/Person (register before 5 Aug 17)
- 1,050 US$/Person (register before 25 Aug 17)
- 1,200 US$/Person (register after 25 Aug 17)

The registration fee includes documentation, lunch and refreshments.

**Group Discount:** If 3 or more than 3 delegates join from the same organization, 10% discount will be offered on total registration fee.

**Program Schedule:** 8.30am to 4.30pm

**Venue & Accommodation**

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**To register,** please download registration form at [www.plastics-industry.org](http://www.plastics-industry.org) and send to Mr. Len Czuba

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