

# Thermoplastic Foams & Foam Extrusion

**15-16 OCTOBER 2018, TAMPA, FLORIDA**

**CROWNE PLAZA, TAMPA WESTSHORE**

## Course Overview:

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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 foam markets. 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
  - Blow molding
  - 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 pooling 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



## Trainer:

Dr. Jim Throne is a Well-Known & Well-Experienced Plastics Processing Consultant from Dunedin Florida with more than 45+ years experience. His consultancy focuses on advanced plastics processing technologies, including thermoforming, foam processing and rotational molding. He was a Fellow of the SPE, Fellow of IoM3 (England), and Chartered Scientist (England). He was SPE Thermoformer of the Year 2000. He received the first Lifetime Achievement Award from the SPE European Thermoforming Division in 2004 for his technical contributions to the international thermoforming industry. In 2004, he was inducted into the Plastic Pioneers Association. He has published ten books in polymer processing, including four in thermoforming and two in thermoplastic foam processing. He holds nine US patents, including two in thermoplastic foams and a fundamental one in thermoforming CPET. He has written more than a dozen technical book chapters and has published and presented nearly 200 technical papers. He was Technical Editor of SPE Thermoforming Quarterly and Editor of SPE Rotational Molding Division Newsletter. His BS is in Chemical Engineering from Case Institute of Technology. His MChE and PhD in Chemical Engineering are from University of Delaware.

## Registration Fee

**1,200 US\$/Person**

The registration fee includes documentation, lunch and refreshments

**Earlybird Discount:** 15% discount for registrations before 29 August 2018 / 10% discount for registrations before 20 Sept 2018 / 5% discount for registrations before 4 Oct 2018

**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

CROWNE PLAZA TAMPA WESTSHORE  
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Direct 813.405.1181 | Fax 813.288-7343 | [www.cptampawestshore.com](http://www.cptampawestshore.com)

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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