

## International Training Program (TechnoBiz)

# Plastic Extrusion

## *Understanding, Optimization & Troubleshooting*

1-3 October 2009, Hotel Borobudur, Jakarta, Indonesia



This 3-day training program is designed to enhance skills of extrusion personnel related to optimization and troubleshooting of extrusion process. Extrusion problems can be very costly and it is important to troubleshoot these problems quickly, efficiently, and systematically. This program instructor is **Dr. Chris Rauwendaal**, the world-renowned extrusion expert.

### Program Outline

#### **1. Introduction**

- Basic extruder components
- Screw, barrel, and feed system
- Grooved feed extruders
- High speed extruders
- Screw drive systems
- Breaker plate and screens
- Gear pumps
- Heating and cooling
- Instrumentation and control

#### **2. Important Polymer Properties**

- Melt flow properties
- Thermal properties
- Viscous heat generation
- Optimizing process conditions
- How to set process conditions

#### **3. Requirements for efficient extrusion**

- Efficient machinery
- Efficient operation
- Efficient changeover
- Maintenance
- Resin quality
- Training
- Statistical process control

- Design of experiments
- Data acquisition system
- Instrumentation and control

#### **4. Functional aspects**

- Solids conveying
  - Flood feeding
  - Crammer feeding
  - Starve feeding
  - Gravity induced conveying
  - Drag induced conveying
  - How to improve solids conveying
- Plasticating
  - Contiguous solids melting
  - Dispersed solids melting
  - How to improve melting
- Melt conveying
  - Drag flow
  - Pressure flow
  - Leakage flow
- Degassing
  - Bubble controlled degassing
  - Diffusion controlled degassing
  - How to improve degassing
- Mixing
  - Basic mechanism of mixing
  - Distributive mixing

- Dispersive mixing
- How to improve mixing
- Energy efficiency
  - Measuring energy efficiency
  - Preheating the resin
  - Starve feeding
  - Screw design

### **5. Screw Design**

- Standard extruder screw
- Barrier type extruder screws
- Multi-stage screws for venting
- Mixing screws
- Screw manufacturing
  - Screw materials
  - Coatings and surface treatment
  - Rebuilding extruder screw

### **6. Die Design**

- General rules and guidelines
- Methods of flow balancing
- Types of extrusion dies
  - Sheet and film dies
  - Blown film dies
  - Pipe and tubing dies
  - Profile dies
- Analysis of dies
- Coextrusion dies
- Case studies of die design

### **7. Twin Screw Extruders**

- Twin vs. single screw extruders
- Co-rotating twin screw extruders
- Counter-rotating twin screw extruders
- Co- vs. counter-rotating extruder
- Non-intermeshing twin screw extruders
- Screw design for twin screw extruders
- Analysis of twin screw extruders

### **8. Troubleshooting**

- Requirements
  - Instrumentation
  - Understanding the process
  - Collection of historical data

- Condition of equipment
- Information on feedstock
- Tools for troubleshooting
  - Temperature measurement devices
  - Data acquisition systems
  - Microscopy
  - Thermochromic materials
  - Thermal analysis
- Systematic troubleshooting
  - Upset vs. development problem
  - Troubleshooting techniques
  - Machine related problems
- Polymer degradation
  - Thermal degradation
  - Mechanical degradation
  - Chemical degradation
  - Solving degradation problems
- Purging
  - Mechanics of purging
  - Effect of shear thinning
  - Effect of viscosity
  - Effect of machine design
  - Purging techniques
  - Purging compounds
- Extrusion instabilities
  - Frequency of instability
  - Mechanism of instabilities
  - Solids conveying problems
  - Melting problems
  - Melt temperature variation
  - Melt fracture
  - Draw resonance
  - Solving extrusion instabilities
- Other extrusion problems
  - Air entrapment
  - Gel problems
  - Die flow problems
  - Wear problems
- Case studies
  - Wear
  - Degradation
  - Die lines
  - Students are encouraged to bring actual extrusion problems to the seminar

## Course Instructor – Dr. Chris Rauwendaal

**Dr. Chris Rauwendaal** - President of Rauwendaal Extrusion Engineering, Inc. since 1990; previously with American Enka Company and Raychem Corporation. *Chris* received a M.Sc. from Delft University and a Doctorate in Polymer Processing from Twente University in the Netherlands. Chris is a well-known author, lecturer, entrepreneur, and consultant in the field of extrusion. He holds numerous patents and has written more than 200 articles and seven books related to extrusion, mixing, injection molding, and statistical process control. Chris has developed video training courses and interactive training programs on extrusion, injection molding, and SPC. He has been involved in technical meetings of the SPE and PPS for many years as a speaker as well as a technical program chairman. Chris is a Fellow of the Society of Plastics Engineers. *Chris* is the developer of the CRD and VIP mixing technology that utilizes strong elongational flow to improve mixing in extrusion and molding. CRD mixing devices are successfully used in many extrusion operations. VIP mixers were recently introduced to the plastics processing industry and are gaining rapid acceptance. Work is ongoing to extend this technology to a new generation of extruders and injection molding machines. The most recent development is the HHT (high heat transfer) extruder screw developed to improve cooling in foam tandem extrusion operations.

### Course Registration Fee

- Registration Fee / Person : 750 US\$ (before 15 August 2009)
- Registration Fee / Person : 900 US\$ (after 15 August 2009)

*Course fee includes training documentation and refreshments.*

### **Group Registration:** (must register before 15 August 2009) (Limited Copies Available)

	<b>Books (FREE)</b>
Every Delegate	1 Copy of “ <b>Plastic Extrusion Asia 2008</b> ” Proceedings
Two Delegates from the Same Company	1 Copy of “ <b>Polymer Extrusion</b> ” Handbook
Three Delegates from the Same Company	1 Copy of “ <b>Polymer Extrusion Handbook</b> + 1 Copy of “ <b>Troubleshooting Extrusion Process</b> ”

**Course Timing:** 09.00 am – 17.00 pm (Each Day)

**Course Language:** ENGLISH

### Organizer

**TechnoBiz Communications Co., Ltd.**  
300/53, Soi Lardprao 35/1, Lardprao Road, Chandrakasem, Bangkok 10900 Thailand  
Tel: 66-2-938 2315 Fax: 66-2-513 1301 Email : [training@technobiz-asia.com](mailto:training@technobiz-asia.com)  
Contact Person : Ms. Saowalak, Training Coordinator

**International Training Program (TechnoBiz)**

**Plastic Extrusion**

**1-3 October 2009, Hotel Borobudur, Jakarta, Indonesia**

---

**Registration Form**

*Instruction: Please fill all the information in English only*

Organization Name .....

Address .....

.....

Tel ..... Fax ..... Email .....

Contact Person ..... Tel ..... Email .....

**Participant Names :**

Participant 1: ..... Position ..... Email .....

Participant 2: ..... Position ..... Email .....

Participant 3: ..... Position ..... Email .....

**Registration Fee per Participant:**     750 US\$ (before 15 Aug '09)     900 US\$ (after 15 Aug'09)

**Payment Method**

Bank Transfer to    Bangkok Bank, Ratchada-Latphrao Road Branch, A/C No: 177-0-70727-9  
A/C Name: TechnoBiz Communications Co., Ltd., Swift Code: BKKBTHBK  
*(Kindly make payment for all bank charges)*

Credit Card             Visa             Master Card            *(5% credit card fee applies for processing)*

Card Number .....

Cardholder Name .....

Last 3 digits on signature panel .....Card Expiry Date .....

Signature of Cardholder .....

Date .....

---

**Please send completed registration form to**

**TechnoBiz Communications Co., Ltd.**

No. 300/53, Lardprao Soi 35/1, Lardprao Road, Chandrakasem, Chatuchak, Bangkok 10900 THAILAND

Tel: 66-2-938 2315 Mobile: 66-84-658 1444 Fax: 66-2-513 1301 Email: [training@technobiz-asia.com](mailto:training@technobiz-asia.com)

Website: [www.technobiz-asia.com](http://www.technobiz-asia.com) Contact Person: Khun Saowalak, Coordinator

**W**