Outline 4-Day Extrusion Course by Chris Rauwendaal

Day 1, Morning, Introduction and Hardware
- Basic components
- Review of terminology

* <u>Hardware components of an extruder</u>
- Screw and barrel
- Screw drive
- Heating and cooling
- Instrumentation & control

Day 1, Afternoon, Polymer properties
- Melt flow properties
- Thermal properties
- Viscous heat generation
- How to improve extrusion

Day 2, Morning, Functional aspects
- Solids conveying
- Plasticating
- Melt conveying
- Devolatilization
- Mixing

Day 2, Afternoon, Screw Design
- Standard extruder screw
- Variations on std. screw
- Mixing screws
- Barrier screws
- Multi-stage screws

Day 3, Morning, Twin screw extruders
- Twin vs. single screw
- Co-rotating twin screw
- Counter-rotating twins
- Co- versus counter-rotating
- Non-intermeshing twins

* <u>Die Design</u>
- Rules and guidelines
- Analysis of dies
- Die flow problems
  - Die drool
  - Melt fracture
  - Concentricity
  - Die lines

- Tubing and pipe dies
- Sheet and film dies
- Profile dies
- Wire coating dies
- Coextrusion dies

Day 3, Afternoon, Troubleshooting
- Methodology
- Requirements for troubleshooting
  - Instrumentation and DAS
  - Condition of equipment
  - Information on feedstock
- Importance of data acquisition
- Common mistakes in companies
- Machine related problems
  - Wear
  - Poor screw design
  - Poor die design

Day 4, Morning, Troubleshooting cont'd
- Functional problems
  - Conveying
  - Melting
  - Mixing
- Polymer degradation
  - Types of degradation
  - Solving degradation problems
- Extrusion instabilities
- Mechanics of surging
- Fast Fourier Transform analysis
- Melt fracture and shark skin

Day 4, Afternoon, Troubleshooting cont'd
- Gel problems
  - Gels formed in polymerization
  - Gels formed in the extruder
  - How to eliminate gels
- Air entrapment
- Shrink voids
- Optimizing barrel temperatures
- Practical examples/case studies
  - Wear problems
  - Surging
  - Degradation, etc.

Understanding, Optimizing and Troubleshooting the Extrusion Process by REE, Inc.