Polymer Compounding Basics
Continuous Process Melt Extrusion Polymer Compounding

Definition
Upgrading or adding value of polymers or polymer systems through melt blending & mixing of additives into a polymer matrix or melt mixing two or more polymers together to make an alloy

Purpose
Tailor properties to satisfy a specific applications requirements
Compounding Line

drying
feeding system(s)
extruder
Screw(s)
barrel
motor
die
cooling
size reduction and segregation
Traditional Process Sequence

Pellets

Powders/Fillers

Fibers

Liquids

Twin Screw Extruder

Pellets
Twin Screw Extruder

Controls: screw rpm, temp’s, vacuum
Readouts: melt pressure, melt temp., motor amps/torque, vacuum level
What Happens in a Hot Melt Extrusion Compounding Operation

- Preparation of inputs
- Feeding of inputs

Compounding
- Conveying
- Plasticizing/melting
- Mixing
- Homogenizing
- Dispersing
- Devolitizing
- Reacting
- Heating/cooling
- Viscosity breakdown
- Cooking/pressurizing

Cooling
Size reduction and packaging
Screw Geometry v Function
Conical Twin Screw Extruder
Pressure Profile in Twin Screw Extruder
Example of Compounding

Conceptual representation of components prior to compounding

Example dispersive mixing

Homogenous compound

Example distributive mixing
Mixing

**Distributive**
uniformly distributes ingredients without using high-shear stresses

**Dispersive**
intense process that employs high stress techniques to break up cohesive agglomerated solids

**Twin Screw Extrusion Achieves Both**
Screws and Barrels are Modular

Screws are assembled on high-torque splined shafts

Flanged barrels, electrically heated and liquid cooled
Single Kneading Element

BROAD

LOBAL POOL CAPTURE (DISPERSIVE)

NARROW

MELT DIVISION (DISTRIBUTIVE)

Wider disk = increased elongational acceleration/dispersive mixing

Narrower disk = melt divisions/distributive mixing
Multiple Downstream Feeding
High Distributive “Combing” Elements
Feeding Section
Melt/Mix Section
Section for Adding Filler/Mixing
Foster Compounding Lines

Production Machines
   27mm – 53mm
   all co-rotating twin screws
   dry and liquid feed capabilities
   side stuffers on some machines

R & D
   Counter-rotating conical twin screw

Screw Technology
   distributive and dispersive mixing
   programmable screw configurations

Feeders
   volumetric
   loss-in-weight
   ability to feed powder, pellet, and some liquids
Foster Compounding Lines

Pre & Post Blending
- high intensity mixers
- deaglomerating V-blender
- cross-tumbler

Size Reduction
- strand and underwater pelletizers
- sifters/classifiers
- die face cutting

Driers
- dehumidifying hopper
- dehumidifying tray
- non-dehumidifying tray

Cooling
- water bath
- air
- none

Other
- melt filtering