

Blown Film Troubleshooting

Polyethylene Film Training Program

ExxonMobil
Chemical

Troubleshooting a Blown Film Line

This troubleshooting guide suggests a means for overcoming common problems that occur in the blown film extrusion process. Before using this guide the following is recommended:

1. Ask the question, “what has changed since the last time this product was run satisfactorily?” There will invariably be more than one answer; make a list and check each item independently.
2. Make certain equipment is operating satisfactorily. Check heater bands, temperature controllers, thermocouples, pressure gauges, machine alignment, motor speed regulation, etc.
3. Inspect feed resin for uniformity, contamination, moisture, excessive fines, regrind feed, etc.
4. Check resin transfer lines and make certain proper clean filters are used, especially when unloading a hopper car.
5. Select proper material for the application.

Remember:

Machine was running well before problem occurred, don't panic. Check - think before making adjustments - systematically make one adjustment at a time and allow time for adjustment to be effective. Suggested solutions will have noticeable effects with some resins and not others due to molecular characteristics such as molecular weight, molecular weight distribution and density of the resin.

ExxonMobil
Chemical

Introduction

- This troubleshooting guide suggests means for overcoming problems that occur in the blown film extrusion process. Before using this guide, it is recommended the following:
 - Ask the question - “What has changed since the last time this product was run satisfactorily?”
 - List and check each item independently
 - Proper production records are a tremendous help in dealing with extrusion problems
 - Check the working operation of all components from resin handling to motors to heater bands
 - Check the entire system for cleanliness
 - Be patient

Low Production rate

- Extruder line output not as fast as expected or desired
- What could be limiting output rate?
 - Extruder rpm at maximum?
 - Extruder power (motor load) at maximum?
 - Excessively high melt temperature?
 - Excessively high barrel pressure?
 - Bubble too instable?
 - Bubble cooling limited (frostline height too high)?
 - Take-off equipment at maximum line speed?

Low Production Rate

- Possible solutions
 - Lower resin stock temperature
 - Increase volume of air to air ring
 - Reduce back pressure in extruder
 - Replace dirty screen packs or use larger mesh screen pack
 - Increase die gap
 - Use larger die size
 - Eliminate water cooling of screw (if used)
 - Install refrigerated air or internal bubble cooling
 - Provide bubble enclosure to keep cooling air in contact with bubble longer
 - Increase tower height
 - Choose different resin grade
 - Use “hump” profile for barrier screws
 - Hotter compression zone, cooler metering zone

Extruder Surging

- Inconsistent output rate resulting in process instabilities
- Possible solutions
 - Check for problems in feed section
 - Bridging in feed throat
 - Blockage in feed section resulting in starve feeding
 - Check for variations in feed rate of recycle fluff or regrind
 - Reduce temperature in feed section
 - Check for cooling water flow to feed section
 - Reduce extruder barrel temperatures
 - Check pellet cut uniformity
 - Check screw design
 - Check die design

Melt Fracture

- Rough film appearance caused by excessive shear rates
- Possible solutions
 - Widen die gap
 - Increase extrusion melt temperatures
 - Increase temperatures of last zone (heat die lips)
 - Insulate air ring from die and die from surroundings
 - Use a processing aid
 - Use higher melt index resin
 - Blend with 5-10% LDPE
 - Lower output rate

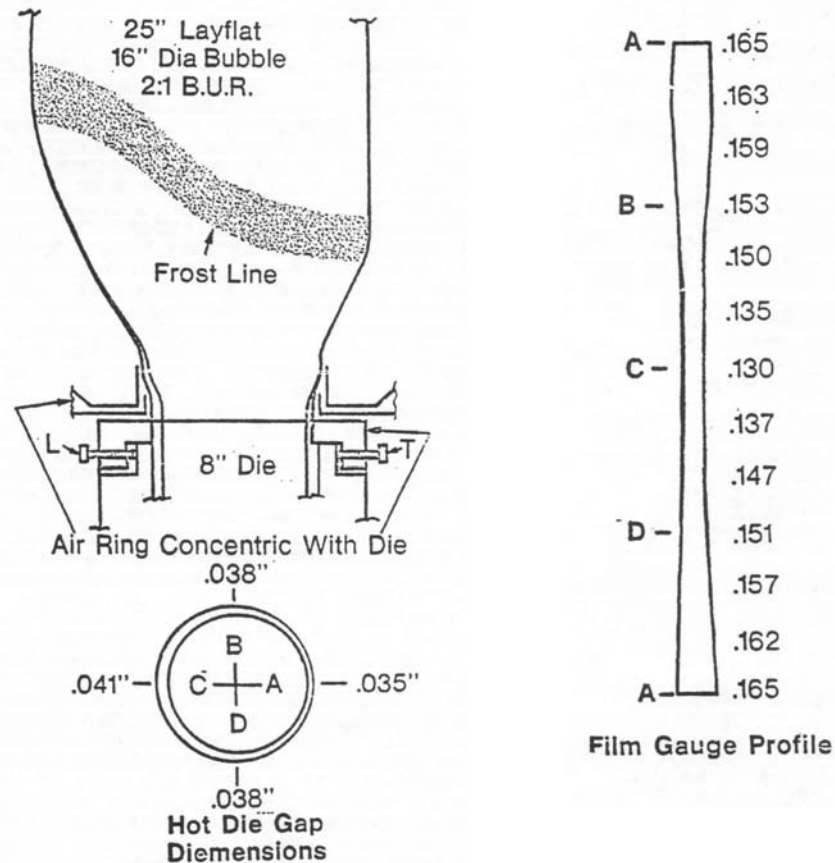
Bubble Instability

- Bubble moves excessively causing gauge variation and appearance problems
- Possible solutions
 - Reduce extrusion melt temperatures
 - Use refrigerated air
 - Install bubble stabilizers, check for excessive drag on stabilizer system
 - Check for blockage in air ring
 - Reduce frostline height
 - Change air ring
 - Reduce BUR or use larger die
 - Add 10-20% LDPE
 - Lower output rate
 - Eliminate room drafts, isolate bubble

Wide Gauge Variation

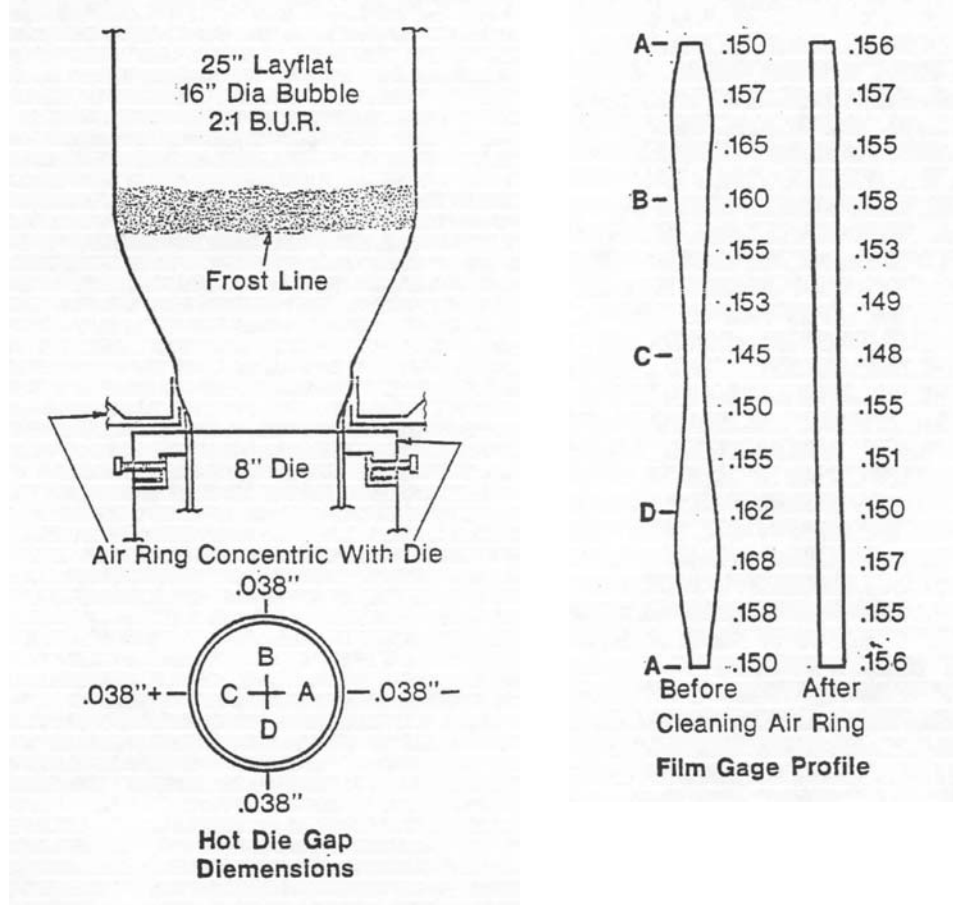
- Film has excessive variation in thickness causing roll appearance or mechanical property problems
- Possible solutions
 - Check die gap, clean die
 - Check air ring for problems
 - Alignment
 - Blockages
 - Non-uniform flow, leaky air supply line
 - Proper size for die
 - Lower frostline height, keep it level
 - Check melt uniformity of resin flowing to die
 - Check screw design for resin being run
 - Check alignment of die and tower

Effects of Poor Die Adjustment



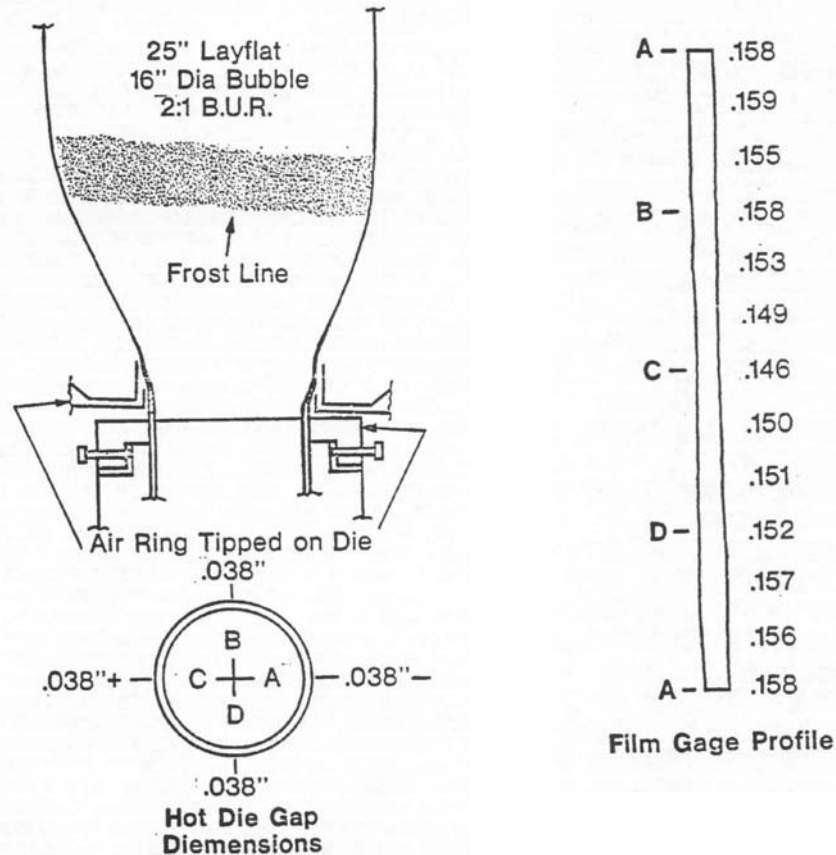
- Improperly centered die can result in significant gauge variation

Gauge Variation from Dirty Air Ring



- A dirt air ring can result in non-uniform air flow and significant gauge variance

Gauge Variation from Tipped Air Ring



- A tipped air ring can result in a non-horizontal FLH and gauge variation

ExxonMobil
Chemical

Inadequate Drawdown

- Film cannot be produced at desired thin gauge
- Possible solutions
 - Increase stock temperature
 - Rule of thumb, thin films use high melt temperature, thicker films use low melt temperature
 - Reduce die gap (if pressure allows)
 - Adjust extruder conditions to provide more uniform melt flow to die
 - Check for contamination in resin
 - Change to higher melt index resin

Poor Film Clarity

- Film is too hazy/cloudy for end use application
- Possible solutions
 - Increase stock temperature
 - Increase BUR
 - Reduce frostline height
 - Use refrigerated air
 - Decrease die gap
 - Blend 5-20% LDPE
 - Use less antiblock additive
 - Use lower density resin
 - Improve air ring design

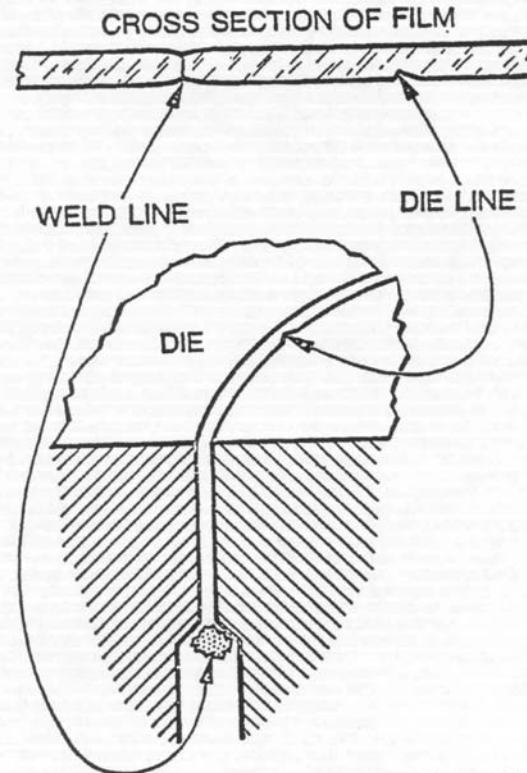
Streaks in Film

- Film has non-uniform appearance
- Possible solutions
 - Adjust extrusion conditions to improve mixing
 - Check for contamination
 - Check purging history of line, how well was it purged after last run?
 - Check for roughness on bubble guides, gussets, collapsing section, idler rollers, etc. as causes of scratches on film surface
 - Check for dirt on nip rolls, lay-on roll, etc, that may cause surface impressions
 - Clean die gap

Low Film Toughness

- Film does not meet performance criteria based on toughness
- Possible solutions
 - + Formulation changes
 - Increase LLDPE or mPE
 - + Process changes
 - Increase frostline height
 - Increase BUR
 - Decrease die gap
 - Clean die to eliminate die lines
 - Check gauge uniformity
 - Check for contaminants
 - Check resin stabilization (possible resin degradation)
 - Adjust extrusion parameters, e.g. output, melt temperature

Effects of Die Lines on Film

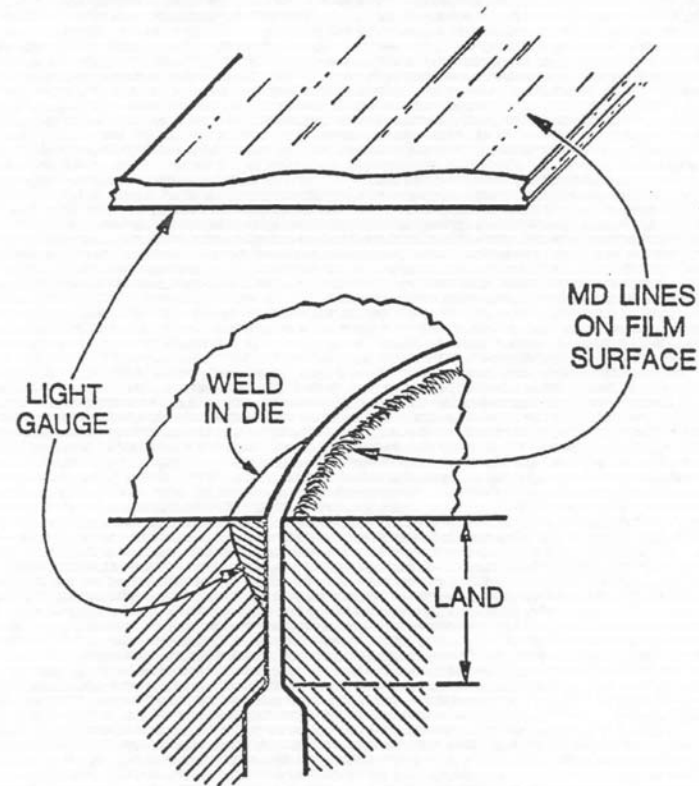


Weld Line in Film from Dirt Hung Up Below Die Lands. Die Line from Damaged Die Mandrel

- Die lines can significantly reduce film toughness properties

ExxonMobil
Chemical

Effects of Die Lines on Film



Gauge Band From Weld in Die Lip.
Build Up on Die Lip Drags and
Marks Film Surface.

- Die lines can also cause gauge bands

ExxonMobil
Chemical

Gels, Fisheyes, and Bubbles in Film

- Poor film visual quality due to contained imperfections
- Possible solutions for gels and fisheyes
 - Check for resin contamination (foreign particles, i.e. wood, metal)
 - Check for excessively hot temperature - degrading resin
 - Check for excessively cold temperature - unmelted resin
 - Check for problems in reclaim system
 - Change screen pack or filter cartridge
 - Change resin to one with better antioxidant package
 - Clean die
 - Eliminate or reduce dead spots (no/slow resin flow) in system
- Possible solutions for bubbles
 - Dry resin
 - Check for inadequate compression of unmelted pellets
 - Check for variable pellet size

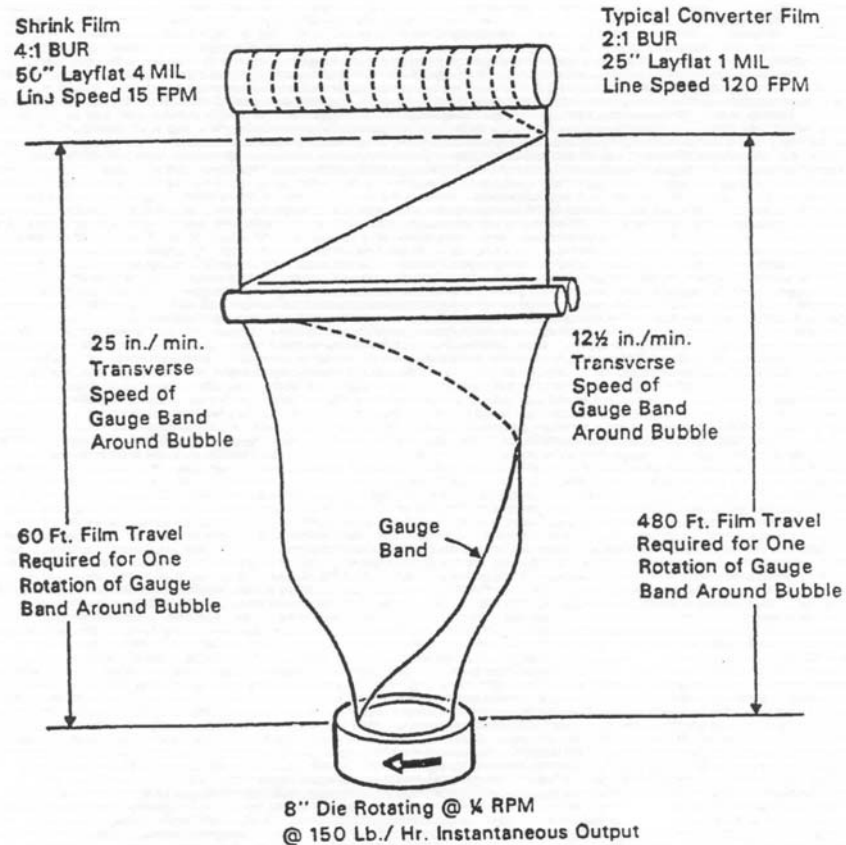
Wrinkles in Film

- Film has wrinkles which affect winding and film appearance
- Possible solutions
 - Eliminate gauge variations
 - Uneven gauge can cause film to track through winders unevenly
 - Change winding tension
 - Both too high and too low winding tension can cause wrinkles
 - Change slip level
 - Increase slip to minimize film tackiness
 - Check machine alignment
 - Improper alignment of nips and winder can cause wrinkles

Poor Roll Configuration

- Film roll has gauge bands or uneven edges
- Possible solutions
 - Minimize gauge variations
 - Use oscillating/rotating die to randomize gauge bands location
 - Make sure lay-on roll has uniform contact with film roll
 - Uneven pressure on lay-on roll can cause film to “wander”
 - Adjust winder tension
 - Tension too high can accentuate gauge bands, too low tension can allow film to “wander” resulting in poor edges
 - Wind cool film to minimize formed stresses when cooling
 - Use resin with less slip

Rotating Die

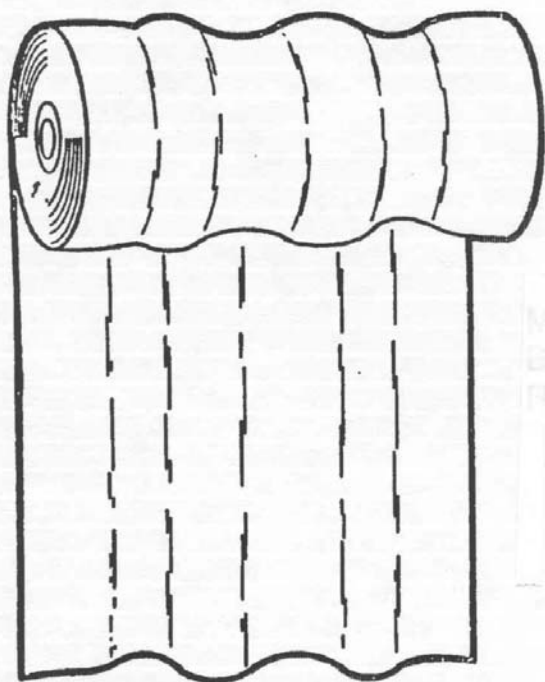


- Rotating die can change location of gauge bands making roll appearance much better

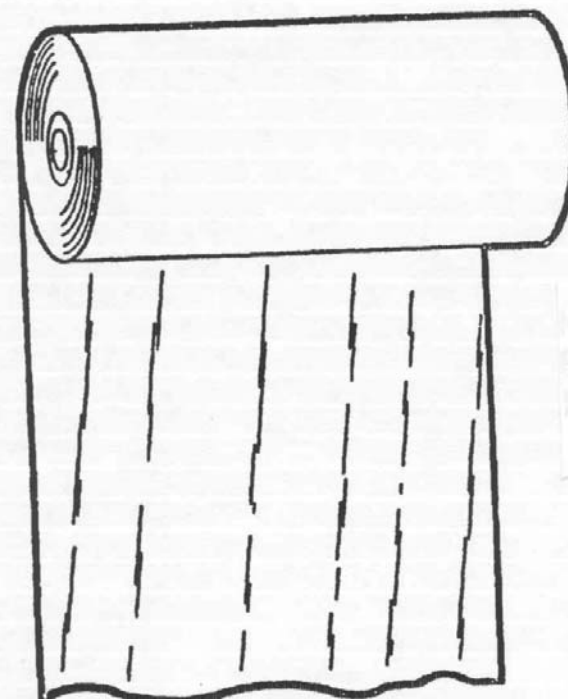
ExxonMobil
Chemical

Effects of Gauge Bands on Roll Appearance

Maximum distortion of roll appearance caused by gauge bands



Die rotation allows minimum roll distortion by moving location of gauge band



ExxonMobil
Chemical

Film Blocking

- Film blocks on roll causing unwinding and converting problems
- Possible solutions
 - Reduce film temperature - very warm film more likely to block
 - Reduce extrusion melt temperature
 - Increase volume of air to air ring
 - Inflate secondary bubble prior to winding
 - Add refrigerated air and/or internal bubble cooling
 - Add additional cooling rings above frostline
 - Raise nip roll height
 - Decrease machine line speed
 - Reduce nip roll pressure
 - Check treatment level
 - Excessive treatment can cause blocking
 - Use resin with higher antiblock loading

Printing Problems

- Film has poor ink adhesion
- Possible solutions
 - Treating issues
 - Treat film while still warm, preferably immediately after nip rolls as warm film treats easier and slip migration is less
 - Increase treater power for higher dyne level
 - Decrease gap between electrode and film
 - Check uniformity of gap
 - Check length of electrode - same length as film width?
 - Use resin with less slip
 - Excessive slip can negatively affect ink adhesion

Sealability Problems

- Film has poor sealability
- Possible solutions
 - Lower extrusion melt temperature
 - Excessive melt temperature can cause oxidation at die which can negatively affect sealing
 - Decrease treatment level of film
 - Excessive treatment or backside treating can negatively affect sealing
 - Change resin - lower slip, lower density, higher comonomer
 - Excessive slip concentration can negatively affect sealing
 - Lower density resin can improve sealing performance
 - Higher comonomer content (e.g. VA) can improve sealing performance

Don't Panic!

- Even when using quality resin from a reliable supplier, production problems relating to physical properties of the resin can occur. If a resin-related problem is suspected, the following guidelines are recommended:
 - Collect samples of good and bad resin
 - Save samples of good and bad film
 - Note all line procedures and conditions - date and initial
 - Make note of estimated downtime, scrap, etc. to help determine problem's magnitude
 - Try one solution at a time and let first solution settle before trying something else
 - If this doesn't work, contact your resin supplier

Summary

- There are many problems that can arise for the resin user
- Most problems will have a solution
- Suggested solutions might work for some resin families and not for others
- Proper production records are a tremendous help in dealing with extrusion problems
- When addressing a problem, it is important to change only one parameter at a time to judge effectiveness
- Contact the resin supply company for assistance when dealing with processing issues

- Troubleshooting guides are available from ExxonMobil and other major resin suppliers