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Troubleshooting your rotomolding operation from a shop floor perspective

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Introduction

- When resin properties and mold, machine, cook, cooling and environmental conditions are stable, the rotomolding process is extremely repeatable

- In most rotomolding operations, this does not occur for extended periods of time so knowing how to react and adjust the process is critical to maintaining part consistency and producing “within specification” parts

- The aim of this presentation is to increase your understanding of potential solutions to remedy your rotomolding problems when they occur
  - Linear polyethylene
  - Crosslinkable polyethylene

Linear polyethylene

Quality Characteristics – Linear Polyethylene

- Part cure
  - Impact strength
  - Stiffness
  - Fatigue
- Warpage and shrinkage
- Color consistency
- Graphics

Shop Floor Method to Tell if at Optimum Cure

<table>
<tr><th>STATE</th><th>UNDER</th><th>SLIGHT UNDER</th><th>CURED</th><th>SLIGHT OVER</th><th>OVER</th></tr>
<tr><td>INSIDE SURFACE COLOUR</td><td colspan="3"><---------- SAME AS ----------> OUTSIDE SURFACE</td><td>SLIGHT YELLOW</td><td>MORE YELLOW</td></tr>
<tr><td>INSIDE SURFACE GLOSS</td><td colspan="2"><------- DULL -------></td><td colspan="3"><---------- SHINY ----------></td></tr>
<tr><td rowspan="2">INSIDE SURFACE APPEARANCE</td><td rowspan="2">ROUGH</td><td colspan="4"><---------- SMOOTH ----------></td></tr>
<tr><td>WAXY</td><td>NOT STICKY</td><td>SLIGHT STICKY</td><td>STICKY</td></tr>
<tr><td>BUBBLES</td><td>MANY</td><td colspan="2"><------ FEW ------></td><td colspan="2"><------ NONE ------></td></tr>
<tr><td>FILL OF PART</td><td colspan="2">LESS THAN BEST TO BEST</td><td colspan="3"><---------- BEST ----------></td></tr>
<tr><td>TEAR RESISTANCE</td><td colspan="2">LESS THAN MAXIMUM</td><td colspan="3"><---------- MAXIMUM ----------></td></tr>
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Key Operator Responsibilities – Linear Polyethylene

- Mold condition and cleanliness
- Mold release
- Parting line and vent tube
- Resin identification and weight charged
- Heating, rotation and cooling logs
- Visual inspection of parts
- Molding cycles are typically set by the supervisor so outside of your direct control

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
1. Long-Term Part Failure	Part over-cured during molding	• Decrease oven temperature or heating cycle.
	Photodegradation of part caused by ultraviolet light from sun or internal lighting (fluorescent)	• Use a UV stabilized resin in application. • Add suitable U.V. stabilizer and/or pigment. • A fine, well dispersed carbon black with UV stabilizer affords the best protection.
	Stress-cracking due to multiaxial stresses in part; may have been accelerated by chemical environment and temperature.	• Use a stress-crack resistant polyethylene grade. • Do not store an environmental stress-crack solution in a container molded from a poor environmental stress-crack grade of polyethylene for a long period of time or at elevated temperatures.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
1. Long-Term Part Failure Cont'd		• Modify design around any area containing inserts.
		• Examine part in field use to determine adequacy of design and stress concentration points.
	Inadequate resin additive system	• Antioxidant type and level of inclusion may be insufficient.
		• Reduce level of internal mold release if used.
	Colour changes due to oxidation	• Reduce oven residence times. Ensure resin designed for rotational molding by supplier.
	Improper colorants or blending	• Use colorant that disperses well in base resin.
		• Compound resin and pigment for a homogeneous mixture before grinding.

Troubleshooting Guide – Linear Polyethylene

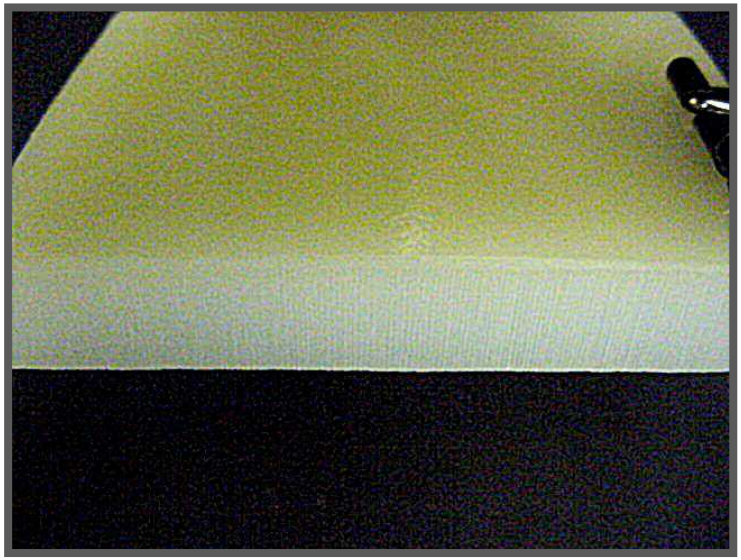
Problem	Possible Cause	Suggested Remedy
2. Speckled colour and lumps of color in dryblended colors	Insufficient blending	• Break up agglomerates of pigment before blending. Use high intensity mixer. If unable to achieve a desirable colour balance, use a colour compound.
"Swirling" effect in colored parts	a. Moisture in pigment or resin	a. If dry-blending, dry pigment, or use pigment from unopened containers. Dry resin completely or replace.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
2. Speckled colour and lumps of color in dryblended colors Cont'd	b. Static build-up	b. Add a small amount of mineral oil or commercially available anti-stat to resin. Wipe mold with antistatic cloth or spray mold powder with Static Guard or Bounce. Make certain that all mixing and molding equipment is adequately grounded with high surface copper cable. Slow initial rotation until powder tackified in mold.
	c. Pigment not properly ground	c. Use 100 mesh pigment or pulverize pigment prior to mixing. Use pre-compounded colours.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
3. Discoloration of inside surface of part.	Degradation of resin due to temperature and/or excessively long heating cycle.	• Decrease oven temperature or heating cycle, or purge part with inert gas (nitrogen). • Use resin containing the proper amount and type of antioxidant.
	Uneven heat transfer	• Check pigment for heat stability. • Mount mold to avoid hot spots.



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Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
4. Parts stick in mold	Insufficient amount of release agent, or release agent has deteriorated with use	• Reapply or use more release agent. • Old release may have to be removed and new one applied.
	Ineffective mold release, or release agent does not withstand elevated temperatures	• Use suitable mold release agent that is effective for resin and temperature used; apply according to supplier's instructions.
	Interference during part removal	• Relocate mold parting line undercut, or taper side walls of mold.
	Roughness and porosity of mold surface provide areas where resin may adhere	• Refinish damaged mold surfaces (plug weld smooth).

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
4. Parts stick in mold (Cont'd)	Presence of resin at parting line due to internal mold pressures which tend to force semi-molten resin through parting line	• Provide adequate venting, 10 to 13 mm (3/8" to 1/2") diameter vent per cubic foot of mold volume is suggested for thin-walled parts.
	Build-up of degraded resin in the mold may be caused by burning of thin-walled sections	• Clean the mold periodically. Check and clean parting line flanges.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
4. Parts stick in mold (Cont'd)	Shrinking onto large deep inserted areas	• Provide adequate taper. • Use very effective mold release on insert area. • Remove part warm. • Provide adequate provision for applying force to separate mold halves.
	Undercuts in mold	• Design mold to place undercuts at parting line so that mold has draft angle for part removal.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
5. Warped parts	Inadequate venting	• 10 to 13 mm (3/8" to 1/2") diameter vent per cu ft. of mold volume is suggested for thin-walled parts. Ensure end of vent not plugged.
	Non-uniform cooling of the mold caused by resin pulling away from the mold wall. (Note direction of warpage - convex or concave)	• Rotate mold during cooling cycle.
		• Provide adequate venting and make sure vents are not clogged.
		• Use less mold release. Excessive or too effective a mold release agent.
		• Avoid large, flat panels in part design if possible.

Warped tank wall

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
5. Warped Parts Cont'd		• Avoid large, flat panels in part design if possible. • Reduce cooling rate during initial part of cooling cycle. • Increase the cooling medium temperature - air cool, then water cool. • Apply air pressure through spindle during cooling.
	Non-uniform cooling caused by uneven part wall thickness	• See suggested remedies outlined in problem 15.
	Non-uniform cooling caused by shielding panels	• Mount mold to eliminate shielding.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
5. Warped Parts Cont'd	Uneven cooling caused by clogged water nozzles	• Check and clean nozzles on a periodic schedule. Watch spray pattern around mold during rotation. Should be light, enveloping and even.
	Over-cured part. Degradation of the resin due to high temperature and/or excessively long heating cyles	• Decrease oven temperature or heating cycle, or purge part with inert gas (nitrogen).
	Highly underfused part. Some degree of underfusion is advisable especially in the case of low melt index resins to prevent degradation. However, highly underfused parts can cause significant loss in impact strength	• Increase oven temperature or total heating cycle. • Increase heat-transfer rate by using thinner mold walls, or make the mold from material with greater heat-transfer coefficient, e.g. steel-aluminum-copper.

Troubleshooting Guide – Linear Polyethylene

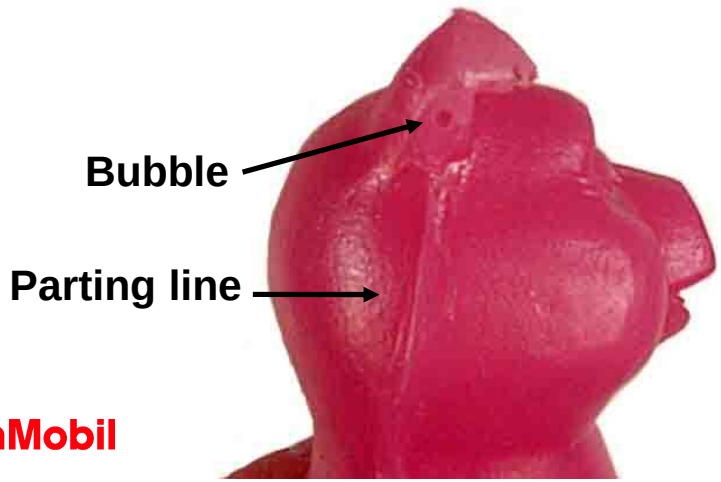
Problem	Possible Cause	Suggested Remedy
5. Warped Parts Cont'd	Improper colouring	• Select pigment and pigment loading that does not affect strength. • Use precoloured, compounded resin.
	Resin type	• Use proper resin having higher melt index and/or lower density. Ensure resin designed for rotational molding end use by supplier.
	Moisture on resin or pigment	• Only use dry powder and/or pigment.
	Too much mold release	• Reduce amount, apply evenly or change release to one having less release.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
6. Excessive flashing at mold parting line.	Internal mold pressure during heating cycle tends to force semi-molten resin out through the parting line	• Provide adequate venting and make sure vents are not clogged. • Remate mold parting line and adjust mold clamp pressure evenly. • Clean mold flange to prevent gapping and apply new mold release on flange. • Reduce internal air pressure if it is being used. • Use lower melt index resin.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
7. Bubbles on parting Line	During the first stage of cooling, there will be a rush of air into the part to fill the resultant partial vacuum. If there is inadequate venting, air will enter molten resin at the parting line and become trapped as the part wall solidifies Poor mold parting line	• Vent the mold to atmosphere pressure. • Relocate the vent to middle of mold. • Use glass wool in vent. • Use Teflon™ rather than metal as the material of construction for the vent tube. • Remate the parting line and adjust mold clamp pressure evenly. • Clean the mold flange to prevent gapping and apply new mold release on flange.



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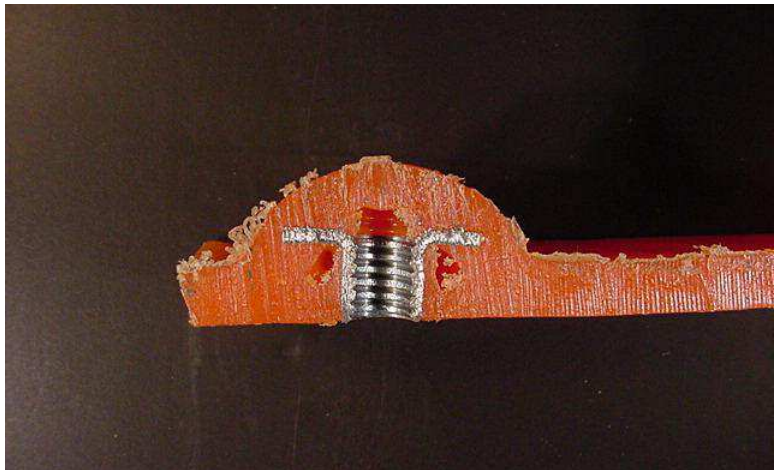
Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
8. Blow holes through part around inserts	Poor fit on inserts allowing moisture or vapours to be trapped around insert and expand, blowing a hole in the part	• Refit inserts and relieve to allow trapped gases to escape to the outside of the mold.
	Bridging of resin because of close dimensions	• Change insert dimensions or location to allow powder to flow without bridging.



Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
9. Poor impact resistance	Incorrect resin selection	• Use a lower density or lower melt index resin.
	Density increase during slow cooling	• Increase the cooling rate to maintain a lower density.
	Part design not appropriate	• Review and alter mold design if necessary, eliminating sharp corners and narrow passages.
	Insufficient fusion of resin	• Increase temperature or heat time.

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Troubleshooting Guide – Linear Polyethylene

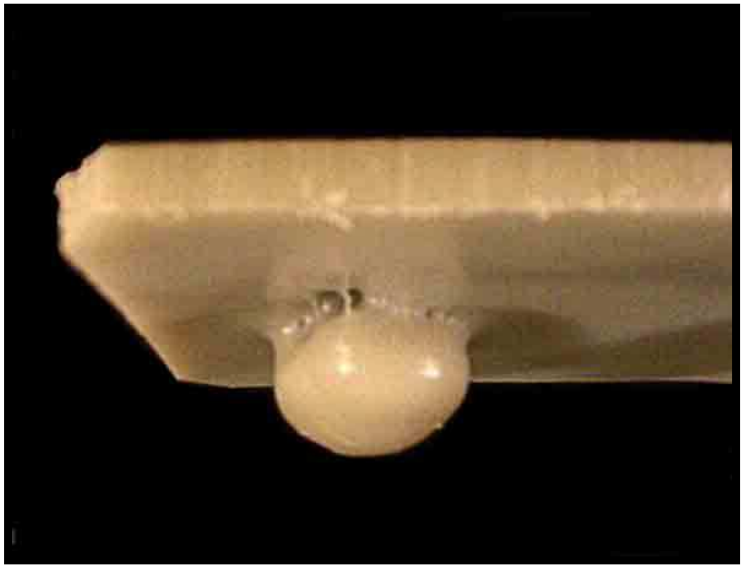
Problem	Possible Cause	Suggested Remedy
9. Poor impact Resistance Cont'd	Improper colouring	• Select pigment and pigment loading that does not affect impact. Check on natural, non-pigmented part. • Use precoloured compounds.
	Over-curing of resin Degradation of resin due to too high a temperature for too long	• Decrease oven temperature or heating cycle. • Reduce oxidation by purging with an inert gas such as nitrogen.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
10. Poor part stiffness.	Part wall too thin	• Add more powder to the initial charge.
	Resin selection not correct	• Use a resin of higher density.
	Part design not appropriate	• Review and alter mold design, if necessary.
	Underfused parts	• Increase oven temperature or total heating cycle. • Increase heat-transfer rate by using thinner mold walls, or make the mold from material with greater heat-transfer coefficient, e.g. steel-aluminum copper.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
11. Powder bridging or not filling narrow passages in mold.	Mold design incorrect	• Modify mold by increasing width-to-depth ratio across the mold opening. • Design corners of mold with more generous radii. Avoid ribs with width of less than 4x wall thickness.
	Poor pourability (dryflow) of powder	• Make sure powder has acceptable pourability and bulk density. Micropellets can help if deep recesses but no evaluated ribs.



Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
11. Powder bridging or not filling narrow passages in mold (Cont'd)	Powder does not melt or flow properly	• Use a finer mesh powder or a resin with a higher melt index.
	Cold spots on mold	• Avoid any shielded mold areas. • Check for mold wall thickness uniformity.
	Improper mold rotation	• Use correct ratio and rotation speed.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
12. Long oven cycles	Heat-transfer rate not adequate to melt all the resin, excessively thick mold	• Increase heat-transfer rate by using thinner mold walls, or make the mold from material with greater heat-transfer coefficient, e.g. steel-aluminum copper.
	Heat not efficient	• Increase air velocity around mold during heating cycle.
	Low oven temperature	• Increase oven temperature. • Recalibrate instruments as they may be reading high.

Troubleshooting Guide – Linear Polyethylene

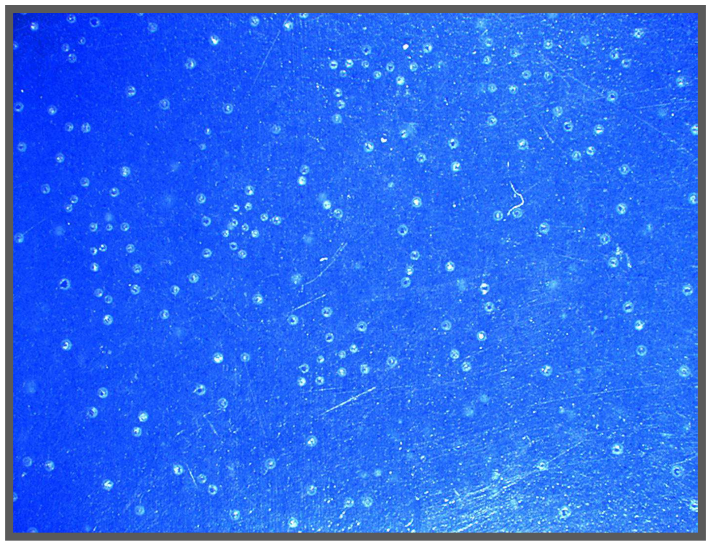
Problem	Possible Cause	Suggested Remedy
12. Long oven cycles (Cont'd)	Resin powder too coarse, or too fine	• Use a finer or coarser mesh powder. Usually 25 - 50 US mesh, size is optimum. If don't know, use 35. Ensure dry flow of resin adequate.
	Poor flow	• Use higher melt index resin.
	Extended cooling	• Reduce air-water cooling time ratio.
	Ambient temperature cooler	• Preheat powder or adjust oven time and/or temperature.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
13. Highly underfused parts with many small bubbles in wall or rough, powdery inside surface.	Oven temperature not high enough to drive air bubbles out of part walls	• Increase oven temperature or total heating cycle.
	Heat transfer rate not adequate to melt all the resin	• Increase heat-transfer rate by using thinner mold walls, or make mold from material with greater heat-transfer coefficient, e.g. steel-aluminum-copper.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
13. Highly underfused parts with many small bubbles in wall or rough, powdery inside surface. (Cont'd)	Resin powder too coarse	• Use a finer mesh powder.
	Moisture in mold	• Reduce moisture in mold by running with warm molds and dry mold before charging with powder.



Inside surface

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
14. Surface pinholes	Melt front moved through part too quickly	• Reduce oven set point initially.
	Powder too coarse	• Use finer grind.
	Al-cast mold porosity	• Repair by grinding out sub-surface voids in mold and weld in metal.

Tank surface pinholes

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
15. Uneven wall thickness of molded parts	Improper mold rotation	• Vary ratio and speed of rotating mold to obtain even coverage and adequate number of powder trackings.
	Mold shielded	• Mount mold to eliminate shielding. Infrared portable guns can find cold spots on molds.
	Uneven mold wall thickness	• Use care in designing molds to prevent excessive variations in mold wall thickness (thin spots attract more resin). • Air gain nozzles or flow vents can direct air to area requiring thickening.

Tank X-profile

Troubleshooting Guide – Linear Polyethylene

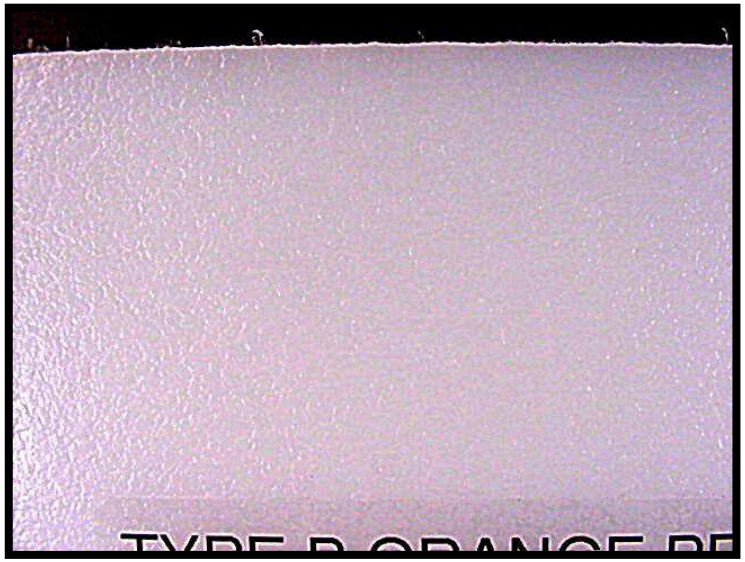
Problem	Possible Cause	Suggested Remedy
15. Uneven wall thickness of Molded Part (Cont'd)	Inadequate powder properties. Low bulk density, no powder pourability, large amount of fluff, particles have many tails which entangle into clumps during molding	Obtain an acceptable powder.
	Buffeting of air flow in deep dished areas	Avoid deep dished areas when possible. Reduce thickness of mold in dished areas. Open handles so that air can flow through kiss-off in mold.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
16. Blow holes through part or ringworm effect under outer part wall surface - other than parting line.	Porosity in cast aluminum mold	• Obtain better quality castings. • Drill through void and drive in pin or weld from inside. • Relieve from outside by drilling into void from side. • Remove parts from molds while mold is quite warm to touch. This helps drive moisture out of pores.
	Pores or holes in welds	• Use proper welding rod and procedure. Weld inside surface first to get good penetration.

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
17. Rippled surface inside, away from mold.	Polymer too hot	• Reduce temperature.
	Shaky rotation of arms	• Check arm rotation visually and correct.
	Underfused	• Increase time or temperature of cure.

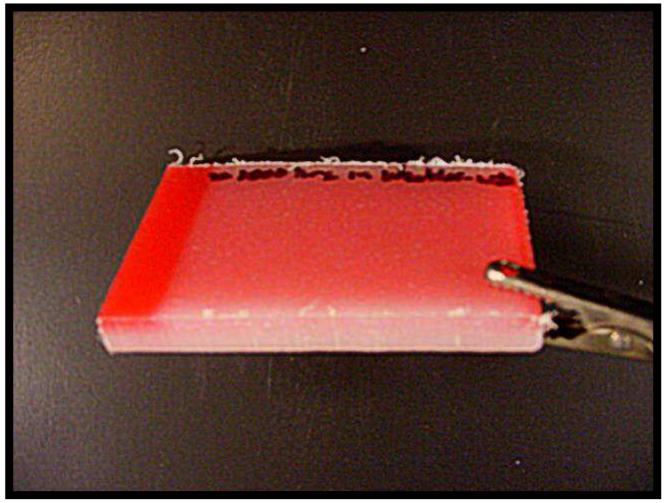


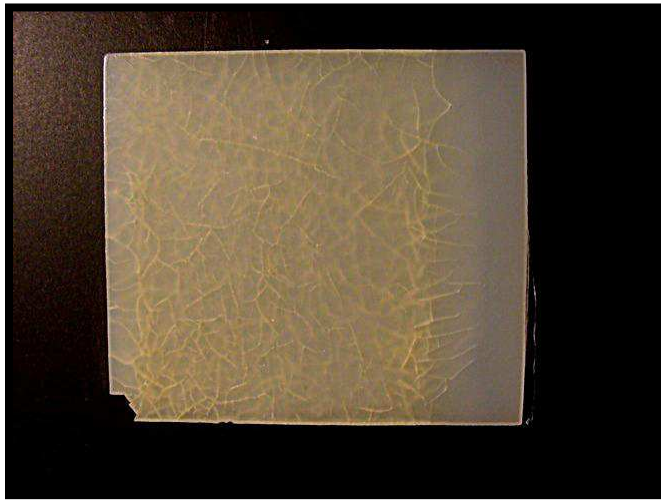
Orange peel

Troubleshooting Guide – Linear Polyethylene

Problem	Possible Cause	Suggested Remedy
18. Discoloration after exposure to UV.	Usually related to poor UV stability of the pigment itself. UV stabilized PE still may have not degraded. Degraded outside surfaces of PE may be seen by creation of a cross hatched pattern upon bending of the sample or by staining the surface with ink if still in field service.	• Use more UV stable pigment. Often pigment vendors don't know pigment required for outdoor exposures. Air gain nozzles or flow vents can direct air to area requiring thickening. • Ensure using well UV stabilized resin.

Poor UV stable pigment - deep red was under a label on the tank outer surface





Cross hatched pattern created upon UV embrittlement

Crosslinkable polyethylene

Quality Characteristics – Crosslinkable Polyethylene

- Confirm low temperature ductile impact response
- Good parts exhibit some inside surface gloss
- Medium and thinner parts can survive numerous bendbacks
- Adequately crosslinked parts have odor and color
- No bubbles in part cross section, on parting line or around inserts
- Adequately crosslinked parts develop high gel

Key Operator Responsibilities - Crosslinkable Polyethylene

- Parting line and vent tube
- Mold condition and cleanliness
- Mold release
- Resin identification and weight charged
- Heating, rotation and cooling logs
- Visual inspection of parts
- Molding cycles are typically set by the supervisor so outside of your direct control

Moldability – Crosslinkable Polyethylene

- A general starting points for molding XLPE is approximately 50°F lower oven set temperature versus HDPE and LLDPE
  - For example 1/4” parts:
    - 575°F oven set temperature and 21 minute oven cook time for HDPE/LLDPE
    - 525°F oven set temperature and 21 minute oven cook time for XLPE
    - Adjustments are made based on the linear resin MI, part design and equipment differences
- XLPE, HDPE and LLDPE must be molded within an acceptable window of time and temperature. Reaching cure is critical for XLPE processing, but over curing is a minimal issue with XLPE processing
- Parting line consistency, mold permeability, venting and mold heat sink issues require special attention for successful XLPE molding
- Owing to the high flow of the base resin, part definition and molding cycles are excellent with XLPE resin. Melt strength must be managed when molding XLPE in thick parts
- Hygiene issues require special attention with XLPE

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
1. Blow holes in parting line	a. Mold parting lines not clean	a. Clean parting lines and coat with suitable mold release.
	b. Poor mold parting line	b. Remate parting line and adjust mold clamp pressure evenly.
	c. Mold to large for oven	c. Move mold to larger oven. Mold rotates to close to burner outlet during cycle causing mold parting line or surface to get too hot.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
2. Blow holes not in parting line	a. Impurities in or on mold surface	a. Remove material imbedded in mold that oxidizes or causes outgassing.
	b. Pits or porosity in mold	b. Fill all nicks in mold and keep surface smooth. Blow holes in stainless steel or sheet metal molds can be caused by a bad weld. The mold can be dimpled to correct this or a hole drilled through the area as a temporary fix. A permanent solution would be to re-weld the problem area. In cast aluminum molds, peen porosity closed on the surface and back-drill to let trapped air escape.
	c. Improper mold fabrication techniques	c. Major welds of fabricated mold should be on inside of mold and then ground down to prevent void near surface of mold.
	d. Oven temperature to hot	d. Reduce oven temperature.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
3. Blow holes through part around inserts	a. Poor fit on inserts allowing moisture or vapors to be trapped around insert and expand, blowing a hole in the part	a. Refit inserts and relieve to allow trapped gases to escape to the outside of the mold. Drill a small hole through center of insert bolt to releave gas pressure.
	b. Bridging of resin because of close dimensions	b. Change insert dimensions or location to allow powder to flow without bridging.
	c. Insert temperature to hot during heating cycle	c. Provide shielding around insert.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
4. Pock marks	a. Improper heat cycle	a. Run part at a lower temperature and a longer heat time. Be sure to maintain proper gel % on molded parts.
	b. Improper heat cycle	b. Excessive cycle time -- overcure.
	c. Too effective mold release	c. Change to less effective release.
	d. Moisture or volatile on mold surface	d. Confirm mold surface is free of moisture or volatile components.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
5. Discoloration on molds or parts	a. Rust in molds	a. "Gas" and water combine to cause rust on cold rolled and hot rolled steel molds. This rust contamination may cause blow holes in parts. After each part, the mold needs to be wiped clean, using little or no water in the process. After each cycle, parts should be removed promptly and the mold cleaned out. Do not leave parts in the mold for an extended period of time. Could use stainless steel or aluminum molds.
	b. Parts over-cooked	b. Reduce oven heat, or shorten heat cycle.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
6. Mold explosion or bulging	a. Gas build-up in mold	a. Place vent end deep into center of mold to prevent powder flow over end. Lightly pack inside end with fiberglass. Use large or multiple vents to prevent build-up.
7. Low impact strength or lack of ductility	a. Parts inadequately crosslinked	a. Increase cook time and/or oven set temperature.
	b. Pigment type or loading	b. Confirm pigment type and loading is acceptable for XLPE. Use colour compounded material.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
8. Powder bridging or not filling narrow passages of mold	a. Mold design incorrect	a. Modify mold by increasing width to depth ratios across the mold opening. Design corners of mold with more generous radii. Avoid ribs with less width than 4 x wall thickness.
	b. Poor pourability (dry flow) of powder	b. Make sure powder has acceptable pourability and bulk density.
	c. Cold spots on mold	c. Avoid any shielded mold areas. Check for mold wall thickness uniformity.
	d. Improper mold rotation	d. Use correct ratio and rotation speed.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
9. Poor flow-out into mold recesses	a. Poor mold design	a. Design shallow recesses with generous radii on edges. Pre-heat recessed areas with torch for 30 seconds before charging. Add heat deflectors or thermal pins. b. Change ratio and/or speed of rotation.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
10. Long oven cycles	a. Heat-transfer rate not adequate to melt all the resin, excessively thick mold	a. Increase heat-transfer rate by using thinner mold walls, or make the mold from material with greater heat-transfer coefficient, e.g. steel or aluminum.
	b. Heating not efficient	b. Increase air velocity around mold during heating cycle. Check oven for air leaks.
	c. Low oven temperature	c. Increase oven set temperature. Recalibrate instruments on a regular schedule. Crosslinkable resins process best at moderate temperatures, 500 - 535ºF.
	d. Resin powder too coarse	d. Use a finer mesh of powder.
	e. Extended cooling	e. Reduce air-water cooling ratio.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
11. Excessive flashing at mold parting line.	a. Internal mold pressure during heating cycle tends to force semi-molten resin out through the parting line	a. Provide adequate venting and confirm vents are not clogged and replaced after each cycle. b. Use less dense vent packing material (i.e. glass wool) c. Remate mold parting line and adjust mold clamp pressure evenly. d. Clean mold flange to prevent gapping and apply new mold release on flange. e. Reduce internal air pressure if used or apply later in the heating cycle after crosslinking starts so resin will not flow. f. Relocate vent to middle of mold.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
12. Parts stick in mold.	a. Insufficient amount of mold release agent, or release agent has deteriorated with use	a. Reapply or use more release agent. Old release may have to be removed and new one applied.
	b. Ineffective release agent, or mold release does not withstand elevated temperatures	b. Use suitable mold release agent that is effective for resin and temperature used; apply according to supplier's instructions.
	c. Interference during part removal	c. Locate mold parting line at undercut, or taper side walls of mold.

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
12. Parts stick In Mold (Cont'd)	d. Roughness and porosity of mold surface provides areas where resin may adhere	d. Refinish damaged mold surfaces (plug, weld or sand smooth).
	e. Presence of resin at parting line due to internal mold pressures which tend to force semi-molten resin through parting line	e. Provide adequate venting (3/8"-1/2" diameter vent per cu.ft. or mold volume is suggested for thin-walled parts).

Troubleshooting Guide – Crosslinkable Polyethylene

Problem	Possible Cause	Suggested Remedy
12. Parts stick in Mold (Cont'd)	f. Build-up of degraded resin in the mold may be caused by burning of thin-walled sections	f. Clean the mold periodically.
	g. Shrinking onto large, deep inserted areas	g. Provide adequate taper to mold walls. Use very effective mold release on insert area. Remove part while warm. Provide adequate means for applying force to separate mold halves.
	h. Undercuts in mold	h. Design mold to place undercuts at parting line so that mold has draft angle for part removal.

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Problem	Possible Cause	Suggested Remedy
13. Warped parts	a. Inadequate venting	a. Provide adequate venting (3/8"-1/2" diameter vent per cu.ft. of mold volume is suggested for thin-walled parts).
	b. Non-uniform cooling of the part caused by resin pulling away from the mold wall	b. Rotate mold during cooling cycle. Provide adequate venting and make sure vents are not clogged. Use less mold release. Check for too effective a mold release agent. Avoid large, flat panels in part design if possible. Reduce cooling rate during initial part of cooling cycle. Increase the cooling medium temperature, air cool, then water cool. Apply air pressure through spindle during cooling.

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Problem	Possible Cause	Suggested Remedy
13. Warped Parts (Cont'd)	c. Non-uniform cooling caused by uneven wall thickness in the part	c. See suggested remedies under problem heading, "Uneven wall thickness of molded parts".
	d. Non-uniform cooling caused by sections of the mold being shielded from heat	d. Mount mold to eliminate shielding problem, add baffles to direct heat into recessed or shielded areas.
	e. Uneven cooling caused by clogged water nozzles	e. Check and clean nozzles on a periodic schedule.

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Problem	Possible Cause	Suggested Remedy
13. Warped Parts (Cont'd)	f. Over-cured part. Degradation of the resin due to high temperature and/or excessively long heating cycles	f. Decrease oven temperature or heating cycle.
	g. Improper coloring	g. Select pigment and pigment loading that does not effect strength. Use precolored, compounded resin.

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Problem	Possible Cause	Suggested Remedy
14. Poor part stiffness	a. Part wall too thin	a. Add more powder to the initial charge.
	b. Resin selection not correct	b. Re-evaluate resin selection.
	c. Part design not appropriate	c. Review and alter mold design, if necessary.
	d. Inadequately cross-linked parts	d. Increase oven temperature or time.

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Problem	Possible Cause	Suggested Remedy
15. Uneven wall thickness	a. Improper mold speed and rotation ratio	a. Adjust rotation speed and ratio.
	b. Uneven mold surface temperature	b. Reduce mold wall thickness in areas known to be shielded. Reposition molds or counter-weights on spider. Avoid when designing molds.
	c. Improper counter-balance	c. Re-balance arm.
	d. Shielded areas on mold	d. Add baffles, copper tubes or heat pins to shielded areas.

Conclusion

- Rotomolding is an extremely versatile process and when resin properties and mold, machine, cook, cooling and environmental conditions are stable, the rotomolding process is extremely repeatable
- Knowing how to react and adjust the process is critical to maintaining part consistency and producing “within specification” parts
- Hopefully this presentation increased your understanding of potential solutions to remedy your rotomolding problems when they occur

Disclaimer