

Rotational molding Tips for Processing ICORENE 1500 Series Cross-linkable Resins

When making plastic parts, maintaining a balance between high molecular weight product attributes and low molecular weight processing flow can be a challenge. Cross-linkable ICORENE high density polyethylene (HDPE) resins are unique materials that offer rotational molders the advantage of high-flow molding and high molecular weight part performance.

Key attributes related to high flow include:

- Rapid melting
- High part definition
- Design flexibility

Key attributes related to high molecular weight include:

- High-notched impact strength
- Outstanding ESCR
- Excellent thermal resistance

Critical indicators of properly molded parts include:

- Interior gloss development
- Ductile cold temperature impact performance
- Presence of off-gas odor confirming the chemical cross-linking reaction

Achieving the benefits of high-flow processing and of maximum molecular weight part toughness depends on the following:

Processing

Oven Temperature

Temperature differences within ovens, heat-transfer issues, and part thickness requirements contribute to a wide range of rotational molding temperature set points. Acceptable control set points can vary from 248.8 °C to 343.3 °C, depending on conditions.

Higher temperatures promote rapid curing, but part surface problems and bubbling are more common.

Lower temperatures promote smoother part surfaces and fewer bubbles, but molding cycle times increase.



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Off-Gassing

The molder should look carefully at handling the off-gassing characteristics of cross-linkable resins to ensure that the initial peroxide reactions start moderately to avoid bubble formation in the molded part.

Hygiene necessities must be met by following the ventilation, water-flushing and personal protective equipment requirements, as listed in the Materials Safety Data Sheets.

Due to chemical off-gassing of the peroxide cross-linking system, mold venting is critical with ICORENE XL resin. Minimum venting is 0.5 inch inside diameter per cubic yard. Typical venting allows for 50% more air flow than with conventional LLDPE resin.

Inert packing, such as glass wool, is required. Common vent packing materials, such as steel wool, offer the potential to ignite molding off-gasses. Direct-flame molding equipment should be avoided. Direct-flame equipment increases the risks of off-gas ignition and of part bubbling from early peroxide initiation.

Rotation Strategies

ICORENE XL rotation strategies are similar to molding with linear rotational molding resins. Common rotations range from 1:5 for cylinders and up to 8:1 for oblongs. A typical ratio for a medium part is 4:1.

Pigmentation

ICO Polymers offers more than a dozen colors of fully compounded, cross-linkable ICORENE XL series resins. These stock compounds ensure pigment compatibility with the cross-linking chemistry and ensure full developments of ESCR and cold impact strength with consistent processing characteristics.

Product blending and user-pigment modification of ICORENE XL resins are discouraged.

Experience shows that choices and variations in user specified pigment systems can cause unpredictable interactions with ICORENE XL cross-linking, thermal stabilisation and ultraviolet protection systems.

Additional problems develop as a result of non homogeneous mixing and localised temperature excursions during user-pigment incorporation procedures.

Quality molding

Properly molded cross-linked parts exhibit several characteristics that need to be monitored to ensure high quality performance:

Impact Performance

The most important impact characteristic is cold impact strength. Properly cross-linked parts show ductile mode failure when impacted to failure at -40°C. If parts show general tensile mode failure or if parts shatter with a brittle crack, adjustments in cycle conditions or in parts design are necessary.

Gloss Development

Properly cross-linked parts develop gloss on the interior surface. If the interior surface has a dull or a matte finish, the part is showing characteristics of low curing. The glossy surface should be apparent throughout the part. Reduced gloss in specific areas of the part is an indication of thermal shielding.

Backbend

Cross-linked parts have remarkable toughness. A quick method of confirming proper cross-linking is to test a molded coupon for repeated extension. Thinner cross-linked coupon sections can be flexed to full extension and flexed back almost to the point of a "living" hinge.

Gel Development

Gel development is a chemical testing method to confirm cross-linked molecular weight. Non-cross-linked polyethylene can be dissolved with excess solvent under extended reflux. Cross-linked resin dissolves to a partial extent under such solvent reflux conditions.

Typical gel levels for successful part performance range from mid-60's percent to high-80's percent gel.

ICO Polymers does not make a recommendation for final gel content of cross-linked parts. The molder should make an assessment of necessary part performance to be balanced with production cycle requirements.

Odors and vapours

The cross-linking mechanism produces off-gasses as part of the chemical reaction. There is noticeable odour and vapour development during cross-linkable resin molding. If odours and vapours diminish, the molder should look for evidence of contamination, resin substitution or heating failure.

Peak Internal Air Temperature

Temperature logging is a valuable tool to optimize production cycles for molding cross-linkable resins. Experience shows that most parts are cross-linked when the internal air temperature exceeds 210°C for more than a minute.

The molder can use temperature logging data to adjust molding conditions to ensure cross-linking while avoiding long extensions to the molding cycle. Internal air temperature is general evidence of thermal transfer to the plastic.

Specific areas of a part can be thermally shielded, and these areas may not be cross-linked even when the internal air temperature suggests adequate molding.

ICO Polymers does not specify a desired peak internal air temperature for ICORENE XL molding. Logging gives the molder insight into the possibilities of enhanced production cycles, but the responsibility of relating internal air temperature to part performance is the responsibility of the molder.

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