TECHNICAL SERVICE REPORT Number 71

Geon® Rigid Vinyl Molding Compounds Processing Guide

Introduction

This guide will assist you in setting up your press for molding Geon® Rigid Vinyl molding compounds. For more specific information or if you have any other question, please contact the Technical Service Department for Molding by calling 1-800-438-4366 and ask for Molding Tech Service.

Warning

It is important that vinyl compounds and acetal or acetal copolymers (such as Delrin or Celcon)[1] never come in contact with each other at processing temperatures. At processing temperatures, the two materials are mutually destructive and involve rapid degradation of the products.

If possible, avoid processing these two materials in the same equipment. If this is not possible, then thoroughly purge the equipment with general purpose ABS followed by a thorough mechanical cleaning of the equipment.

Equipment

Presses designed to run engineering thermoplastic materials are usually well suited for running Geon® CIM Vinyls. Ideally the barrel is bimetallic. The compression ratio of the screw is in the range of 2:0:1 to 2:6:1. A free-flow sliding check ring is recommended. Smeartips and ball check valves are not recommended.

A nozzle length in the 1-inch to 8-inch range is suggested. Longer nozzle lengths may lead to shear burning. The minimum recommended exit diameter of the nozzle is 1/4 inch (6- to 8-oz. shot). As the shot size is increased, the nozzle exit diameter also needs to be increased. Full-taper or reverse-taper nozzles are preferred, although straight-bore nozzles are acceptable for shorter-length nozzles.

Starting Molding Parameters

The following represent typical starting parameters for molding vinyl. On most equipment designed for engineering thermoplastics, the starting parameters will give a melt temperature close to the recommended temperature range of 390°F-405°F.

Clamp Tonnage

2 tons to 2.5 tons per square inch of projected area is typical. Thinner walls or long flow lengths require higher clamp tonnage.

Barrel Capacity

A shot weight which uses 50%-80% of the barrel capacity is recommended for rigid vinyl. A shot weight using 30%-90% of the barrel capacity may be possible. A long cycle time using a low shot weight percentage may lead to slight degradation of the material in the barrel.

[1] Delrin is a product of E.I. duPont de Nemours & Co. Celcon is a product of Celanese Plastics and Specialties Co.

Melt Temperature

The ideal melt temperature range for rigid CIM vinyl is 390°F-405°F. The temperature is measured by taking an "air shot" and measuring the temperature of the melt with a needle probe pyrometer. In addition, the melt should look smooth and glossy. A dull-looking melt indicates too low of a temperature. A rough surface melt indicates too hot of a melt or moisture in the compound.

STARTING SCREW RPMS

75- to 150-Ton Press ---------- 50-75 RPMs
175- to 350-Ton Press ---------- 50-75 RPMs
375- to 500-Ton Press ---------- 30-50 RPMs
500- to 1000-Ton Press ---------- 20-30 RPMs
1100- to 2500-Ton Press --------- 10-15 RPMs

BACK PRESSURE

50 to 150 Psi

Screw RPMs and back-pressure settings will depend on the screw compression ratio and screw configuration. The more severe the screw, the lower the screw RPM and back-pressure settings.

PRESSURES

Injection Pressure ------- 800-1500 Psi
Pack Pressure ---------- 400-800 Psi
Hold Pressure ---------- 300-600 Psi

Injection Velocity

The injection speed is dependent on the nozzle and sprue bushing diameters as well as the gate size and wall thickness. Initial settings in the 0.75 inch per second to 1.0 inch per second are reasonable. If shear burning is present in the part, reduce the injection speed. If no shear burning is present in the part, increase the injection speed until shear burning is observed and then reduce injection speed until no shear burning is present. On presses capable of variable injection speeds, it is sometimes helpful to use lower injection speeds until the material has filled the runner and gates.

Mold Temperature

The temperature of the inlet water can be in the range of 40°F-150°F. For most applications, inlet water temperature in the range of 70°F-90°F is normal. Parts with wall thicknesses greater than .150 inches may use cooler water. Thin wall parts may require warmer water. The temperature of the water to the core side of the mold should be 5°F-10°F cooler than the cavity side.

Cooling Cycle Time

Part cooling time is dependent on melt temperature, cooling water temperature, wall thickness, and tool design. The following table lists suggested cooling cycle times for different wall thicknesses.

Wall Thickness	80°F Cooling Water	40° F Cooling Water
0.040	< 15 seconds	Not recommended
0.060	< 20 seconds	Not recommended
0.080	< 25 seconds	Not recommended
0.100	< 30 seconds	< 15 seconds
0.125	< 40 seconds	< 20 seconds
0.150	< 50 seconds	< 30 seconds
0.180	< 70 seconds	< 55 seconds

Regrind

Runners, trim, short shots, and other sources of clean vinyl compound can be reground and mixed with virgin material. A regrind range of 10%-25% is recommended. Higher regrind percentages up to 100% are being used in non-UL applications. It is important to maintain sharp grinding blades. Grinding generates significant heat. The regrind vinyl should be cooled to below 150°F before storing to prevent degradation of the material.

Tooling Considerations for Geon CIM Rigid Vinyls

Stainless steel is recommended for tools being built for rigid vinyl molding compounds. Stainless steel protects the tool from potential damage if for some reason the vinyl is allowed to degrade.

Tool Design

Designing a mold for use with vinyl follows standard mold-building practices. All sharp corners should be radiused. Full round runners are preferred. All types of gates may be used provided the gate size is proper for vinyl. The following tables are a guide for selecting starting values for sprues, runners, and gates. Since each mold is unique, these values can only be considered as starting points.

CENTER SPRUE GATE

Avg. Wall Thickness	Part Weight	Sprue Diameter "RO" Dimension
0.100 in	10 oz or less	0.250 in
0.125 in	16 oz or less	0.250 in
0.125 in	16-32 oz	0.375 in
0.125 in	32-48 oz	0.4375 in
0.140 in	32 oz or less	0.375 in

Avg. Wall Thickness	Part Weight	Number of Cavities	Sprue Diameter "RO" Dimension	Runner Size	Gate Size
0.090 in	4 oz or less	2	0.250 in	0.3125 in	0.090" x 0.312" - 1 gate each
0.100 in	8 oz or less	2	0.375 in	0.375 in	0.100" x 0.375" - 1 gate each
0.125 in	8 oz or less	2	0.375 in	0.375 in	0.125" x 0.375" - 1 gate each
0.140 in	16 oz or less	2	0.40265 in	0.375 in	0.140" x 0.375" - 2 gates each

Avg. Wall Thickness	Part Weight	Sprue Diameter "RO" Dimension	Full Round Runner Size	Half Flat Ejector Pin Diameter	Gate Size	Number of Gates
0.110 in	8 oz or less	0.250 in	0.250 in	0.250 in	0.125 in	1
0.125 in	8 oz to 16 oz	0.250 in	0.250 in	0.3125 in	0.125 in	2
0.125 in	16 oz to 3 oz	0.375 in	0.375 in	0.3125 in	0.125 in	4
0.140 in	32 oz or less	0.375 in	0.375 in	0.375 in	0.140 in	4

Purging

For color changes, clean screw, barrel, end cap, and nozzle of black specs during production processing runs with:

- CylaPurge by Cylatec. This is a granular blowing agent which comes in individual packets to be mixed with the rigid PVC to clean out the injection unit. This method does not introduce any other polymer into the injection unit. The blowing/foaming action cleans the screw, barrel, end cap, adapter, nozzle, and nozzle tip.

CYLATEC
3711 Whipple Avenue, N.W. - Canton, Ohio 44718
Phone: (216) 492-2854 - Fax: (216) 492-3956

- DynaPurge "Elite" or "Magna" works well for cold runner systems, especially to purge out the injection unit for shutdown. The press is started back up on the DynaPurge, which remains in the barrel. It can also be used for color changes and cleaning, bur requires a greater number of purging shots (compared to CylaPurge) to remove it from the injection unit.

DynaPurge "Pulsar" works best for hot runner and hot sprue bushing molds where the sprue bushing, hot runner manifold, and drops are purged to clean out the rigid PVC during processing, production, or shift shutdown.

SHUMAN PLASTICS
35 Neoga Street - Depew, New York 14043
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- If commercial purge compounds are not available, natural T-Grade ABS, which is free of flame-retardant additives, or Styrene can be used as purge materials.

Natural ABS does an excellent job of purging PVC from the injection unit. The ABS must, however, be completely purged from the injection unit which may require repeated purge shots to ensure complete ABS removal. **(NOTE: When purging with natural ABS, increase the front barrel heats to lower the viscosity of the ABS to help it flow out of the injection unit.)**

- Chemical purges such as Rapid Purge and Z-Purge have been successfully used to purge out rigid PVC. These chemical purges range from $8 to $20 per pound. They are generally used at the end of a long production run to chemically clean out the injection unit for changing over to higher-melt temperature polymers.
- Each injection molding shop has a particular purge that is optimal for them. The choice includes the cost per pound of purge compound and the efficiency of the purge for a shop's color change or cleaning/purging application. **(NOTE: The above purging compounds are typical of practices of PVC molders and represent preferred practices of internal Geon testing.)**

TROUBLESHOOTING

Defect: Short shots
Possible Causes:
Shot size too small
Material melt temperature too low
Injection pressure too low
Injection velocity too slow
Mold temperature too low
Sprue, runners, and/or gates too small

Defect: Sink marks
Possible Causes:
Shot size too small
Injection pressure too low
Hold pressure too low
Hold time too short
Cooling time too short
Mold temperature too high

Defect: Poor knit lines
Possible Causes:
Mold temperature too cold
Injection speed too slow
Melt temperature too low
Poor venting

Defect: Blush marks at gate
Possible Causes:
Mold temperature too cold
Injection speed too fast
Sprue and nozzle diameter too small
Insufficient cold slug well
Moisture in compound

Defect: Silver streaks on part
Possible Causes:
Injection pressure too high
Injection speed too fast
Melt temperature too high
Poor venting

Defect: Dull streaks, flow lines
Possible Causes:
Melt temperature too low
Runners too small
Inadequate cold slug well
Mold temperature too low
Injection speed to slow

Defect: Warpage
Possible Causes:
Mold temperature too high
Melt temperature too high
Insufficient hold time
Injection speed too fast
Insufficient cooling time

Defect: Lamination
Possible Causes:
Purging compound left in barrel
Mold temperature too low
Melt temperature too low
Injection speed too fast
Gate size too small

Defect: Burn streaks in center of sprue
Possible Causes:
Front zone temperature too high
Screw speed too high
Excessive back pressure
Compression ratio too high

Defect: Burn streaks at gate
Possible Causes:
Injection speed too fast
Injection pressure too high
Gates and/or nozzle too small
Shear burning due to low melt temperature

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