Processing guide

Celanese

Rotational molding Hostaform® POM RF

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1. INTRODUCTION

Celanese Corporation is a global specialty materials leader in producing differentiated chemistry solutions and specialty materials used in most major industries and consumer applications.

Hostaform® POM RF is an impact-modified acetal copolymer (POM) specially designed for rotomolding. The material is available in pre-colored black or natural. Hostaform® (polyacetal copolymer) POM RF developed in Florence, KY (USA) is a single-layer solution for fuel tanks, known for its unique characteristics:

- Low fuel permeation
- Does not require fluorination
- Tested for EPA & CARB regulations

The roto-moldable grades of Hostaform® acetal are formulated to withstand the long hot cycle times unique to the roto-molding process. Additionally, these grades of acetal have been formulated to take the abuses that rotomolded parts are asked to perform. Celanese has carefully balanced these levels of impact and heat resistance with one of the most attractive aspects of the Hostaform® acetal, which is its naturally low permeation of a wide variety of fuels.

Hostaform® POM RF provides a good balance of mechanical properties with low fuel permeation for a single-layer tank solution. The resin has been designed to use standard rotomolding equipment at typical cycle times.

Hostaform® POM RF provides a high-temperature resin well-suited for hydraulic tanks with improved processing and reduced yield loss.

Table 1 Hostaform® POM RF 2162

PROPERTY	VALUE	UNIT	TEST STANDARD
Density	1350	kg/cm_3	ISO 1183
Melt flow rate, MFR	3,1	g/10min	ISO 1133
Melting point, 20 °C/min	165	°C	ISO 11357-1/-3
	329	°F	

2. GENERAL GUIDELINES

STORAGE AND HANDLING

Hostaform® POM should be stored in its original container on pallets in a dry place. Open containers should be carefully resealed before returning to storage. In the winter, containers of resin should be brought into the warm processing area at least 24 hours before use and allowed to come to room temperature before opening. If this is not done, moisture in the air may condense on the surface of the pellets and lead to surface effects on molded plastic parts.

Every effort should be made to avoid pellet or powder spills or loss. Spilled pellets or powders can be very slippery and may result in employee accidents. Loss to the environment could lead to fines or other penalties under Storm Water Regulations issued by the Environmental Protection Agency. Celanese Polymers supports the Society of the Plastics Industry Operation "Clean Sweep" program.

SAFETY AND HEALTH INFORMATION

The usual precautions must be observed when processing any hot and molten thermoplastic.

Caution

Normal processing and internal air temperatures (IAT)* should not be exceeded. Hostaform® POM RF should never be heated above 405° F IAT nor be allowed to exceed 450° F outside mold surface temperature. Excessively high temperatures or long residence time in a heated chamber can cause the resin to discolor and, in time, degrade, which can release formaldehyde, a colorless and irritating gas. This gas can be harmful in high concentrations, so proper ventilation is essential.

*See the description of IAT in the process parameters section.

Consult the current Hostaform® POM RF material safety data sheets (MSDS) for health and safety data before processing or handling these products. Copies are available by calling your local Celanese sales office or Customer Services at 1-800-526-4960.

FLAMMABILITY

When ignited, Hostaform® POM burns with little or no smoke and a barely visible blue flame. Combustion products are carbon dioxide and water. If Hostaform® POM burns with a muffled flame and combustion is incomplete, carbon monoxide and some formaldehyde may be released. Exposure to high concentrations, especially in a poorly ventilated area, can be harmful. For more detailed information on worker exposure limits for formaldehyde, refer to the material safety data sheet for Hostaform® POM.

DRYING

Hostaform® POM does not readily absorb moisture and can usually be fed to the pulverizer or molding machine without drying. However, drying may be necessary to prevent splay and odor problems during processing if the material has adsorbed moisture due to improper handling or storage. Hostaform® POM should be dried in a dehumidifying oven or a hopper dryer. For oven drying, the Hostaform® POM pellets or powder should be spread evenly in less than one-inch-deep layers on trays and placed in the oven for three to four hours at 82° C (180° F).

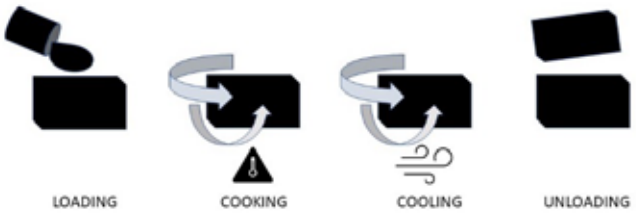
Warning – Avoid PVC

Hostaform® POM RF copolymer and polyvinyl chloride (PVC) can chemically react and must never be allowed to mix, even in trace quantities in the melt. PVC forms acidic decomposition products when heated, which can rapidly degrade Hostaform® at processing temperatures. If possible, Hostaform® POM and PVC should not be processed in the same equipment.

3. ROTOMOLDING HOSTAFORM® POM RF

The rotational molding process utilizes high temperatures, thin-walled metals, biaxial rotation, finely grounded resin and air or mist for cooling. The four critical stages of the rotomolding process are shown in **Figure 1.**

Figure 1 The four stages in the rotomolding process



- Standard attrition mills are suitable, cryogrinding is not required, and pre-drying powder is unnecessary.
- Do not allow the operating temperature of the mill to exceed 190° F; higher temperatures may cause the melting of pellets around the mill housing.
- Overs (powder less than 35 mesh) from the process can be passed through the mill again to achieve the desired particle size.
- ARM 2.1 flowability and bulk density funnels are suitable for test powder. 35 mesh RF 2162 typically flows between 15 and 19 seconds.

Table 2 Typical particle distribution for RF2162

MESH	30	35	40	60	80	100	PAN
RETAINED WT%	0	1	1	48	29	9	12

MOLD RELEASE

Mold release is typically unnecessary; however, olefinic and water-based mold sprays have shown good results in hard-to-fill areas. Contact Celanese for recommendations.

PROCESS PARAMETERS OF HOSTAFORM® POM RF

Cooking

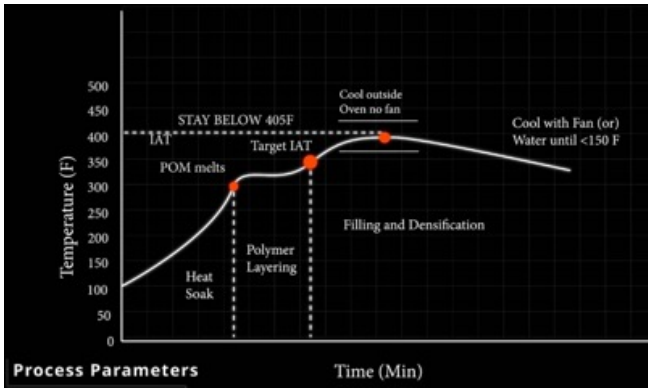
Monitoring the IAT is key in setting an ideal process recipe. The following points are important to take into consideration when creating a recipe for Hostaform® POM RF rotomolding:

- POM melts around 330° F.
- Target IAT is between 360° F – 400° F. Allow IAT to reach at least 360° F but no more than 400° F before the mold exits the oven.
- For best results, we recommend allowing the IAT to be above 375° F for 5 to 10 minutes.
- Do not allow outside wall temp to exceed 450° F (use temperature tape to monitor outside wall temp). POM begins to decompose and volatilize at 450° F.
- A major-minor ratio of 6:1.5 is recommended.
- Nitrogen can be used during cooking if needed.

Cooling

Uniform cooling of mold is required to produce a good quality part. Controlling the rate of cooling has a higher density part. The following points should be considered when creating a cooling recipe for Hostaform® POM RF:

- A two-stage cooling is recommended.
- In the first stage, allow the mold to rotate in ambient air for 5-to-10 minutes.
- Cooling fans at full speed can cool down the mold in the second stage.



Two-stage cooking

A two-stage cooking process is recommended to roto mold parts with large complex shapes or heavy walls. In this process, IAT is allowed to reach up to 375° F, and heat is cut off, but mold rotates inside the oven for at least 10 minutes with burners off. This allows IAT and outside mold surface temperature to be within the recommended range.

Density Check

To validate the process recipe, check the final part density. The recommended final part density is above 96% of the density value in **Table 1.**

4. DESIGN RECOMMENDATIONS

Standard rotomolding industry principles for good molding design and construction apply to the design of molds to process Hostaform® POM RF. Existing molds used with other materials are usually suitable. Cast aluminum and fabricated aluminum molds with 0.25" or 5/16" wall thicknesses are recommended. Molding shrinkage of 1.5 - 2% is recommended for POM.

- Drafts are not needed.
- 0.5" radius or greater is recommended.
- Molded-in inserts and threads for fuel tank caps can be molded in. Use polyethylene/water-based flow promoters around threads and inserts to enhance flow.
- Typical wall thickness of 3 mm – 6 mm is recommended

SHOT WEIGHT CALCULATION

When calculating shot weight with mold surface area, use 96% of density from Table 1 for POM. Shot weight correction is needed with a change in wall thickness requirements.

5. TROUBLESHOOTING GUIDE

Table 3 Troubleshooting guide

PROBLEM	CAUSE	RECOMMENDATION
The final part density is low	Overcooking/high oven temperature for excessive time	Do not allow IAT to exceed 400° F; monitor IAT using a thermocouple or temperature-monitoring adhesive
Outside wall discolored	Excessive oven cycle	
Excessive surface porosity	Excessive oven cycle time/temperature	
	Contamination	Ensure mold is clean before each run
	Improper venting	Clear vents of any debris/ increase vent size
	Wall thickness uneven	Use localized insulation for heat and thickness control
Webbing around the corners on the inside wall	Undercooked/not enough time in the oven	Two-stage cooking/allow IAT to be above 375° F for 5 to 10 minutes
	Part design	Revisit part design
Mold deposit	Tool condition	Wipe inside mold/ sandblast mold surface
Uneven molded in threads/improper flow around metal inserts		Use water-based mold spray around threads and metal inserts
Pinholes	Dirty parting lines	Clean parting lines

6. HOSTAFORM® POM RF 2162 PROPERTIES

Table 4 Mechanical properties

PROPERTY	TEST METHOD	VALUE
Multiaxial impact at 23º C mean failure energy (ft-lbs.), t = 3 mm	ARM low-temperature impact test (V4)	7.5-10.0
Multiaxial impact at 0º C mean failure energy (ft-lbs.), t = 3 mm	ARM low-temperature impact test (V4)	2.5-5.0
Tensile modulus	ISO 527-1, -2	1400 Mpa
Tensile stress at yield, 50 mm/min	ISO 527-1, -2	42 Mpa
Tensile strain at yield, 50 mm/min	ISO 527-1, -2	20%
Tensile stress at break, 50 mm/min	ISO 527-1, -2	32 Mpa
Tensile strain at break, 50 mm/min	ISO 527-1, -2	>50%
Flexural modulus, 23° C	ISO 178	1350 Mpa
Fuel permeation EPA testing (CE10 Fuel, g/m^2/day)	USEPA 40 CFR Part 1060.520	0.60
Fuel permeation CARB testing for SORE and marine standards	TP-901 (40° C test temperature)	1.13

For more information, including safety and technical sheets, visit www.celanese.com and contact us.

NOTICE TO USERS

Values shown are based on testing of laboratory test specimens and represent data that fall within the standard range of properties for natural material. These values alone do not represent a sufficient basis for any part design and are not intended for use in establishing maximum, minimum, or ranges of values for specification purposes. Colorants or other additives may cause significant variations in data values. Properties of molded parts can be influenced by a wide variety of factors including, but not limited to, material selection, additives, part design, processing conditions and environmental exposure. Any determination of the suitability of a particular material and part design for any use contemplated by the users and the manner of such use is the sole responsibility of the users, who must assure themselves that the material, as subsequently processed, meets the needs of their particular product or use.

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