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Report No. B1011EV1

ZEONOR1020R INJECTION MOLDING GUIDE

1. Selection of Injection Molding Machine

1-1 Capacity of the Machine

Capacity, including cavity, runner and sprue, should correspond to the capacity of the cylinder. Although general-purpose polystyrene is frequently used as a benchmark unit for injection capacity standards, injection capacity for ZEONOR should be selected according to official injection capacity standards, since the specific gravity of ZEONOR is 1.01 (compared to the 1.05 specific gravity of polystyrene). Ideal molding is within 60 to 70% of official injection capacity.

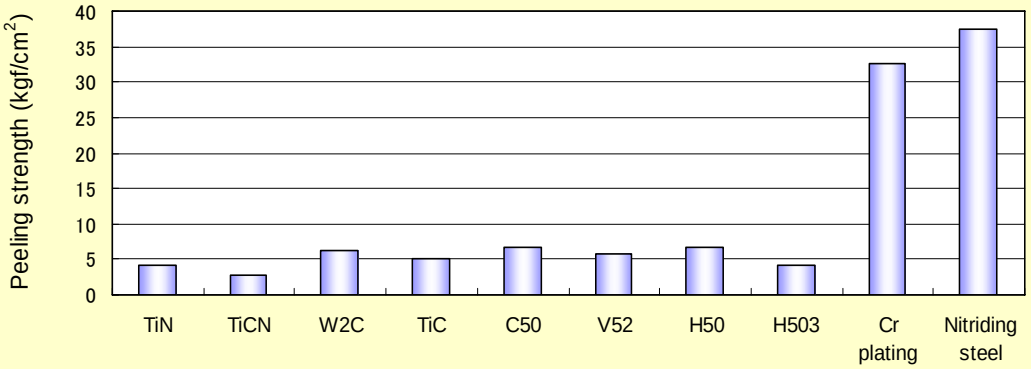
1-2 Screw Design

Since the melt viscosity of ZEONOR is low during molding, a screw design with large compression ratio is suitable for stability and degassing. However, large compressibility may result in the occurrence of noise in the plasticizing region and high temperatures at shearing resistance. The proper compression ratio is 2.0 to 2.5.

1-3 Surface Material of Screw and Cylinder

To prevent carbide from mixing with molded articles, the surface of screw and cylinder should be made from materials that have good releasing properties with ZEONOR. Figure 1-1 shows the releasing property of metallic materials with ZEONOR.

Fig.1-1 Peeling strength between metal surfaces and ZEONOR



- Cylinder material
  H503 (H-alloy steel, made by Hitachi Metals Ltd.) is more suitable than ordinary nitriding steels.
- Screw material
  Coatings such as TiN, TiCN and W_2C are preferable.

1-4 Nozzle

Commonly available open nozzles can be used with ZEONOR.

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2. Mold Design

2-1 Materials

SUS 420J2 (for example STAVAX CD manufactured by Uddeholm) is recommended when it is necessary to prevent molded articles from carbides or discoloring or to produce highly precise mirrored surface.

2-2 Draft

Since the molding shrinkage of ZEONOR1020R is small (0.1 to 0.3%), draft of at least 2 to 3 degree is required to make the release easier and prevent damage to molded articles.

2-3 Undercut

Since crack or deformation occurs because of ejecting stress, avoid undercut design.

2-4 Venting

The gas generated during injection molding is vented from knock pins and parting lines. If the gas does not vent properly, full perimeter with groove depth of 0.02 to 0.03mm should be provided.

2-5 Sprue and runner

Specially shaped sprues and runners are not required. The standard shape is shown in Fig.2-1.

Circle runner is most suitable.

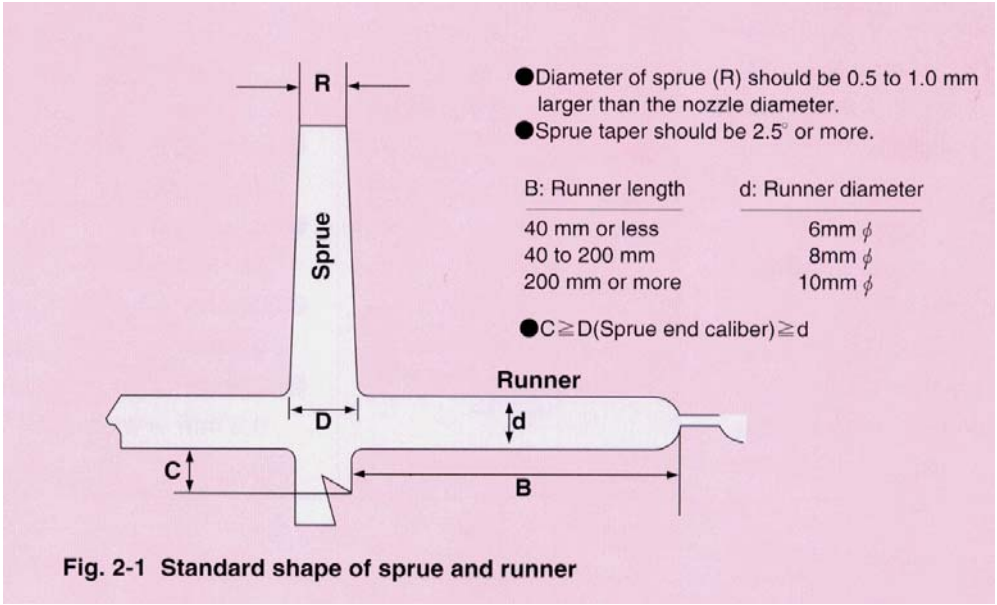

Fig. 2-1 Standard shape of sprue and runner

2-6 Gates

Various design like direct, side and pinpoint gate can be used. If gate size is small, silver streak and defective packing may occur.

2-7 Mold Release

Since ZEONOR1020R has low molding shrinkage, sufficient attention is needed to get good mold release. The thickness of molded article should be as even as possible and it should have appropriate draft angle and curvature of the corner. The mold should have sufficient ejector pins. These treatments enable continuous molding without mold release agent.

If draft cannot be designed, surface treatment (see 1-3) of the mold is effective.

3. Molding Preparation and Stoppage

3-1 Predrying (Heating)

Air(oxygen) dissolved in ZEONOR1020R pellets can cause discoloration, carbide and void, ZEONOR1020R should be dried(heated) to remove air in the pellets for 4 to 24 hours at 85℃ before molding. Drying too long period may cause heat deterioration, and possibly discoloration in the molded articles.

3-2 Replacing resin

When using ZEONOR, the injection molding machine should be prepared only for ZEONOR and replacing resin is not recommended. If it is necessary to replace the resin, purge with approximately 3kg of ZEONOR (for 100t-class molding machines) followed by purging with approximately 3kg of commercial cleaning pellets (for processing temperatures of around 280℃). Be sure that the resin is thoroughly changed to prevent impurities and deterioration in the strength of the molded articles. Cleaning by pulling out the screw is very effective in preventing contamination.

Similar process should be implemented when changing from ZEONOR to other resins.

3-3 Nitrogen Sealing

a) Necessity of Nitrogen Sealing

ZEONOR is stable even at 280℃ for 30 hours when oxygen is not present, so defects such as carbonization, burning and discoloration do not occur in products. Since these problems will arise in the presence of oxygen, nitrogen sealing should be used to prevent oxygen from entering into the injection molding process. Nitrogen sealing is very effective for general product molding to prevent molding deficiencies which result from resin decomposition.

b) Nitrogen Sealing Method

Fig.3-1 shows the method for nitrogen sealing, and Fig.3-2 shows a simplified nitrogen sealing method.

1) As shown below, feeding nitrogen to the lower part of the hopper prevents mixture with air. This is also effective when air is used for transport.
2) Before increasing the cylinder temperature, nitrogen is introduced in order to purge air from inside of the cylinder. After this, the resin can be poured.
3) The flow rate of nitrogen depends on the capacity of the molding machine. For example, nitrogen flow rate 3 l/min (cylinder diameter: 15 to 30mm).

*when a nitrogen sealing is applied, carefully monitor the increase in nitrogen density in the molding room and be sure to provide periodical ventilation.

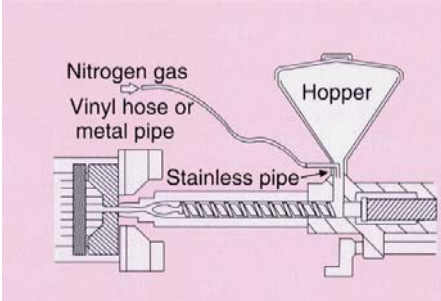

Fig.3-1 Nitrogen sealing method

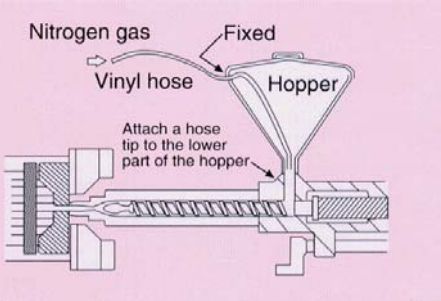

Fig.3-2 Simplified nitrogen sealing method

3-4 Start up and Stoppage

a) Start up

1) Nitrogen sealing is implemented prior to raising the cylinder temperature.
2) Do not increase the cylinder temperature all at once. After attaining a temperature of about 220℃, steadily increase it to the set molding temperature.

b) Stoppage

1) Short term (overnight to weekend setting)

The entire cylinder should be kept warm at 115℃ while the nitrogen sealing is applied and the cylinder is filled with resin (when not injected after measurement).Oxidation and burning are thus prevented. These measures will not be effective if the cylinder temperature is below ZEONOR1020R glass transition temperature (105℃).

2) Long term

Turn off the heater power as the nitrogen sealing is applied and the cylinder is filled with resin (when not injected after measurement). Turn off the main power to stop the nitrogen sealing when the temperature drops to about 100℃.

4. Molding Condition

4-1 Cylinder Temperature: 240 to 300℃

- To prevent oxidation at the nozzle, nozzle temperature should be 230 to 290℃, approximately 10℃ lower than the cylinder temperature.
- In general, fluidity is improved, molding distortion reduced and transcription improved when cylinder temperature is raised. Pay careful attention to setting conditions since decomposition, discoloration, burning and other resin defects tend to occur under high resin temperature and long molding cycle.

4-2 Mold Temperature: 70 to 100℃

- Oil and electric heaters can be used for adjustment of the mold, but specially-pressurized water temperature adjustment machines should be used due to their superior adjustment performance.
- The higher mold temperature, the better ZEONOR1020R flows within the mold, thereby molded articles with less distortion. However, when the mold temperature exceeds the glass transition temperature (105℃), Failure in mold release occurs, making it difficult to secure the surface accuracy of molded articles.
- Mold release improves when the mold temperature is low, but distortion may occur in molded articles with insufficient transcription. In particular, large stress distortions may occur in molded articles, possibly generating cracks.

4-3 Injection and Holding Pressure: 500 to 1500kgf/cm^2

- The higher the holding pressure, the fewer the sink marks or air bubbles will be produced and the better the dimensional accuracy of the molded articles. However, if holding pressure is too high, residual stress in molded articles remain too high, with a risk of causing cracks and deformation. Be careful to set the pressure as low as possible within the parameters of the required dimensional accuracy of the molded articles.

4-4 Injection speed: 30 to 80cm^3/s

- Since ZEONOR tend to be decomposed by share stress and silver streaks occur, lower injection speed is better.

4-5 Screw Speed: 20 to 40rpm

- In general, screw speed should be lower to degas and prevent decomposition.
- High screw speed can result in noise, bubble, silver streak and other problems. If this is the case, screw speed should be lower.

4-6 Back Pressure: 50 to 100kgf/cm^2

- With higher back pressure, the kneading level of resin and degassing improve, reducing the occurrence of bubble and silver streak in the molded article.