

ANTI-DROOL COLD DECK FOR HIGH CONSISTENCY SILICONE RUBBER

FIELD OF INVENTION

The present invention relates to the use of customised shuttle gate to prevent the high consistency silicone rubber material which is a viscous paste like elastomeric material from oozing or drooling out from the cold deck open tip nozzle during a vertical compression injection molding process.

BACKGROUND OF THE INVENTION

In the compressed injection moulding of high consistency silicone rubber, it is quite common to have some form of silicone rubber drooling or oozing out from the cold deck open tip nozzle of the mold due to the back pressure from the injection unit. This drooling or oozing occurrence is commonly found in vertical silicone rubber compression injection moulding machine as compared to using horizontal LSR injection moulding machine which has an in-line valve pin to stop the silicone rubber from drooling. As the viscosity of high consistency silicone rubber is much higher compared to liquid silicone rubber, an in-line valve pin mechanism would get jammed and cannot retract to allow the high consistency rubber to flow through

Drooling builds up at the nozzle leading to material wastage, typically in the range of approximately three (3) per cent. The contaminated and degraded silicone rubber material gets injected into the subsequent shots, hence causing moulding defects and parts to be rejected. Due to drooling, the shot size varies, hence causing the molded parts to be short molded. Short molding accounts for about 8 to 10% of the total rejects. Having silicone drooling can also lead to subsequent problems on the molded elastomeric part. The excess contaminated silicone rubber material from the drooling causes defects like black dots and cold flow in the molded plastic part. It can also

cause bubble traps and tearing due to the degraded elastomeric material flowing into the molded plastic part. All these related defects account for about 6 to 9 per cent of the total rejects.

To mitigate the drooling occurrence, there are some solutions in the prior art out there that are being designed to mitigate or prevent drooling. Many of such solutions are applicable for the horizontal type of injection molding. Hence there exists a need to develop a solution that is able to prevent high consistency silicone rubber or elastomeric materials with similar nature from drooling for vertical type injection molding machine.

The present invention disclosed an anti-drool mechanism that utilises the use of the customised shuttle gate assembly. Essentially the shutter gate assembly is part of the cold nozzle assembly consisting of the shuttle sleeve with grooves at one end of the shuttle sleeve body and an opening at the other end of the shuttle sleeve for material to flow through. It also includes a nozzle holder section customised at one end to be able to fit with the grooves of the shuttle sleeves. The other end of the nozzle holder section has a specially customised slot that leads to the interior of the nozzle holder, whereby this slot is for the cold nozzle to be encapsulated within the cooling jacket. The entire set of the nozzle holder with the shuttle sleeve forms part of the cold nozzle assembly that is located on one side of the mold plate. The operation of the shuttle gate assembly plays a key role in preventing drooling from the mold, especially for a vertical compression injection molding process.

According to the present invention, the shuttle gate assembly is incorporated inside the vertical compression injection moulding process for high consistency silicone rubber material, with the process comprising of the following steps:

1. Firstly, the mold is closed.

2. Next, the mold is transferred to the compression molding platen.
3. Heater plate moves up, activating the shuttle gate mechanism. As the plate moves up, the cold nozzle will engage the heater plate that has a cam groove inside it. The cam pin on the shuttle gate housing will slide in the cam groove to rotate the housing, thus it forces the shuttle sleeve to rotate anti-clockwise and align the shuttle opening to nozzle. The high consistency silicone rubber material is then being able to flow through when the injection cycle starts.
4. Compression mold platen then moves up, sandwiching the cold deck with the shuttle gate, heater plate and mold.
5. High consistency silicone rubber is then injected into the mold cavity.
6. After injection, high consistency silicone rubber is then left to cure.
7. Compression platen then moves down, releasing the mold from the cold deck and heater plate.
8. Heater plate then moves down, activating the shuttle gate mechanism.
9. As the heater plate moves down, it forces the shuttle sleeve to rotate clockwise and offset shuttle opening, thus closing and preventing the high consistency rubber material to flow through. Drooling is prevented due to injection back pressure. The closing action results in cleaning the nozzle for subsequent shots. By closing the opening, the nozzle back pressure in the manifold equalises, hence resulting in better shot control. Since there is no drooling, there is no exposed drool material building up on the nozzle, hence minimizing the contamination from the molding shop-floor environment that may affect the part to be shot out. Moreover, as the shuttle gate functions simultaneously with the molding process, i.e. it is at "0" cycle time, and thus does not affect the overall production cycle time.
10. Mold is then transferred out of the compression molding platen.
11. Subsequently, the mold is then open and the molded high consistency silicone rubber part is then de-molded and removed from the mold.

12. The entire molding cycle is then repeated.

Hence to summarise, the present invention disclosed is able to offer the following advantages for high consistency rubber vertical compression injection molding process:

1. Key important advantage is that it prevents oozing or drooling from the nozzle of the molding machine.
2. Since drooling is prevented, there is no contamination on the silicone rubber material that is being injected into the mold.
3. Without any silicone rubber contamination, there would not be any variation in the shot size that might lead to short-molding, thus minimising rejects.
4. Without any silicone rubber contamination, it will reduce the cosmetic defects on the elastomeric part, whereby such defects would include:
 - a. Black dots;
 - b. Cold flow;
 - c. Bubble traps, tearing and
 - d. Short mold
5. Overall, it does not affect the production cycle time, thus improving the overall productivity of the process, production yield and operator visual inspection fatigue manning the high consistency silicone rubber vertical compression injection moulding operation.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings attached here are to aid comprehension of the description of the invention here. The drawings are not to scale and they are to be used for merely illustrating the principles and concepts of the invention only.

To aid in comprehension of the invention, the drawings are separated into the various Figures as described below:

Figure 1 illustrates an overall perspective view of the various key components and functions for the embodiment of the present invention.

Figure 2 illustrates a cross-sectional view of the various key components of the present invention.

Figure 3A and 3B illustrates another view of the present invention highlighted the key components in operation.

Reference numbers

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|----|--------------------------------|
| 1 | Shuttle Gate Exploded Assembly |
| 2 | Cold Nozzle |
| 3 | Cooling Jacket |
| 4 | Cold Nozzle Holder |
| 5 | Shuttle Sleeve |
| 6 | Shuttle Gate Assembly |
| 7 | Cam Groove |
| 8 | Mold Plate |
| 9 | Nozzle Position (Closed) |
| 10 | Nozzle Position (Open) |

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT OF THE PRESENT INVENTION

In the following description, details and drawings are provided to describe the embodiment of the application.

The present invention is applicable for vertical compression injection molding process whereby it involves the use of customised shuttle gate to prevent oozing or drooling of the high consistency silicone rubber material which is a viscous paste like elastomeric material from the cold deck open tip nozzle.

Figure 1 illustrates an overall perspective view of the various key components and functions for the embodiment of the present invention. It illustrates the exploded view of the shutter gate assembly **1**. Essentially the key components for the shuttle gate assembly **1** includes the cold nozzle **2**, the cooling jacket **3** as well as the cold nozzle holder **4** for holding the cold nozzle **2** and the cooling jacket **3** in place, as well as the shuttle sleeve **5**. All these key components mentioned formed the shuttle gate assembly **6** as illustrated in **Figure 1**.

The shuttle gate assembly **6** is being applied to be used on the vertical compression injection molding process. The shutter sleeve **5** has grooves at one end of the shuttle sleeve body and an opening at the other end of the shuttle sleeve **5** for the high consistency silicone rubber material to flow through. This high consistency silicone rubber material is a viscous paste like elastomeric material that will be injected from the cold deck open tip nozzle of the vertical compression injection molding machine. As illustrated in **Figure 1**, the grooves at one end of the shuttle sleeve body **5** is customised to fit one end of the cold nozzle holder **4**. The other end of the cold nozzle holder **4** has a specially customised slot that leads to the interior of the nozzle holder

4, whereby this slot is for the cold nozzle 2 that is to be encapsulated within the cooling jacket 3.

The entire set of the nozzle holder 4 with the shuttle sleeve 5 forms part of the shuttle gate assembly 6 that is located on one side of the mold plate 8, as illustrated in **Figure 2**. The operation of the shuttle gate assembly 6 plays a key role in preventing drooling from the mold, especially for vertical compression injection molding process. **Figure 2** and **3** illustrates the different movement of the shuttle gate assembly 6 depending on whether the mold plate (which can be heated) moves up or down. For illustration purposes in **Figure 2** and **3A/3B**, when the mold closes, the heater plate moves up as depicted in numeral 8 in **Figure 3A**, it will activate the shuttle gate mechanism. As the plate 8 moves up as shown in **Figure 3A**, the cold nozzle 2 will engage the heater plate that has a cam groove 7 (as shown in **Figure 2**) inside it. The cam pin on the shuttle gate housing 6 will slide in the cam groove 7 to rotate the housing 6, thus it forces the shuttle sleeve 5 to rotate anti-clockwise (illustrated in **Figure 3A**) and align the shuttle opening to nozzle, hence the nozzle position is at the open position as depicted in numeral 10 in **Figure 2**. The high consistency silicone rubber material is then being able to flow through when the injection cycle starts.

Conversely when the mold opens, the heater plate moves down as shown in **Figure 3B**. It forces the shuttle sleeve 5 to rotate clockwise and offset shuttle opening, thus closing the nozzle as shown in **Figure 2**, numeral 9, thus preventing the high consistency rubber material to flow through. Drooling is prevented due to injection back pressure. The closing action results in cleaning the nozzle for subsequent shots. By closing the opening, the nozzle back pressure in the manifold equalises, hence resulting in better shot control. Since there is no drooling, there is no exposed drool material building up on the nozzle, hence minimizing the contamination from the molding environment that may affect the part to be shot out. Moreover, as the shuttle

gate functions simultaneously with the molding process, i.e. it is at "0" cycle time, and thus does not affect the overall production cycle time.

While what has been described hereinabove is the preferred embodiment of the invention, those skilled in the art will understand that numerous modifications may be made without departing from the spirit and scope of the invention. The embodiments described herein are meant to be illustrative only and should not be taken as limiting the invention, which can be expressly set forth in the following claims.

CLAIMS

What is claimed is:

1. An anti-drool mechanism for high consistency silicone rubber vertical compression injection molding, said anti-drool assembly comprising of:
a shuttle gate assembly having
 - (a) a shuttle sleeve with grooves at one end of the shuttle sleeve body and an opening at the other end of the shuttle sleeve body for high consistency silicone rubber material to flow through;
 - (b) a nozzle holder section customised at one end to be able to fit with the grooves of the shuttle sleeve;
 - (c) the other end of the nozzle holder section has a specially customised slot that leads to the interior of the nozzle holder, whereby this slot is for the cold nozzle to be encapsulated within the cooling jacket, and wherein
 - (d) the entire set of the nozzle holder with the shuttle sleeve forms part of the cold nozzle assembly that is located on one side of the mold plate, and wherein
 - (e) depending on the movement of the mold plate, it will cause the cold nozzle to go through the heater plate that has a cam groove inside it, and wherein
 - (f) the activating pin on the shuttle gate housing will then slide in the cam groove to rotate the shuttle gate housing, thus
 - (i) forcing the shuttle sleeve to rotate anti-clockwise and align the shuttle opening to nozzle, allowing the high consistency silicone rubber material to flow through, or
 - (j) forcing the shuttle sleeve to rotate clockwise and seal off the shuttle opening to nozzle, thus preventing the high consistency silicone rubber material to flow through.