

One Part™ Liquid Silicone in Conventional High Consistency Silicone Applications

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Abstract

Liquid silicone can replace certain high consistency applications thus having substantial resource savings. These savings come from reductions in processing time and waste. Processing time can to be reduced up to 70% while waste reduction can be greater than 50%. These figures are highly dependant on which molding process is used and the part that is being manufactured.

Introduction

High consistency silicone molding has been performed for decades. The main forms, in which molding is achieved, are compression, transfer and injection¹.

Compression molding is labor intensive. The silicone is typically supplied in bulk, calendered or preformed into some shape. Compression molding the material in whatever form it arrives is achieved by measuring, perhaps shaping then placing the material into the mold. The mold is closed, pressed and heated until the material is cured.

The part is then removed and any flash is removed from the part and mold. The cycle is then repeated.

The process efficiency and economics can be improved upon by replacing a high consistency silicone rubber (HCR) with a One Part™ liquid silicone. Recent literature also suggests that this change from HCR to liquid silicone to achieve the benefits of liquid silicone is possible². Reductions in the time required for the steps involved can result in significant savings. The handling necessary to prepare the measured and formed HCR is a significantly labor intensive step. Utilizing a One Part™ liquid silicone, the efficiency of this measuring and forming step can be dramatically increased. The molding time required for the One Part™ liquid silicone is another benefit, thus increasing the efficiency of the manufacturing process. Molding times are highly dependant on the part being molded, but a molding time reduction of 50% or more is possible. Flash and mold cleaning will remain fairly constant. The mold design and manufacture will determine whether this step will be more efficient with the One Part™ liquid silicone.

In transfer molding of a HCR, material is placed into a transfer pot and the material is subsequently transferred into the mold. The time to prepare the material can be minimized using the One Part™ liquid silicone. The molding time will also be reduced while the flash and flash removal reductions remain mold design determined.

Achieving Improvements in Efficiency

One Part™ liquid silicone can be supplied fully compounded. Historically, liquid silicones have come as two part systems that must be mixed together and colored if necessary. Although this can be performed, the manufacturer must have the appropriate

equipment. One Part™ liquid silicone is supplied ready to use and is available in color. Since the One Part™ liquid silicone has a long pot life (see Chart 1: 1 Year Stability Testing) and is thermally stable, the material is ready to dispense when needed³.

One Part™ liquid silicone, being fully compounded, can be supplied in various containers increasing the manufacturer's options for dispensing the material. The material can be supplied in several forms, including 1/10-gallon tubes (caulk type), other pneumatically operated tubes in various sizes, 20-liter pails or 200-liter drums. The choice of container is dependent on the final use.

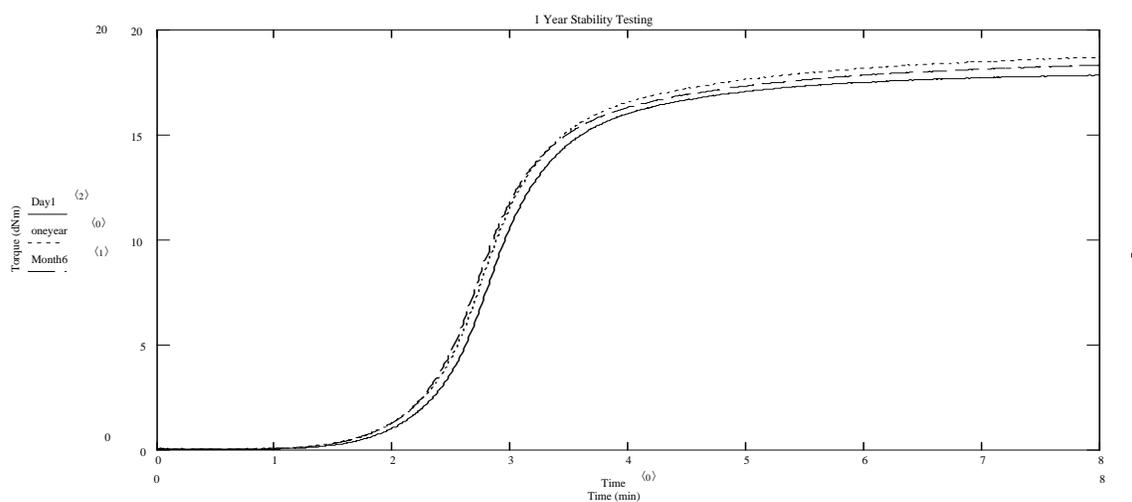


Chart 1: 1 Year Stability Testing

The dispensing options depend on the supplied container. These options include: a common caulk gun, automatic tube guns, pneumatic pressure pots, pneumatic or hydraulic ram assisted pumps, or typical two part liquid silicone dispensing systems. A calibrated dispensing mechanism in conjunction with the dispensing options could also be utilized to dispense a measured shot.

Several methods have been explored for the molding process. For filling a compression mold, manual and pneumatic tube guns have been used with good results. The equipment

necessary is inexpensive and easy to store until the next run. A pneumatic pressure pot using a 20-liter pail has also provided good results when used for filling molds due to the relatively low viscosity of the fully compounded One Part™ liquid silicone. This is another inexpensive method of dispensing the One Part™ liquid silicone. The pails can be easily changed if a different material is required. A pneumatic ram assisted pump will allow faster flow rates of the material, which may be beneficial if small runs of various colors with a constant durometer are necessary. This method does not provide quick change out of material, but colors can be changed quickly. The typical liquid silicone dispensing system is the most versatile system allowing additive stream changing and potentially durometer changes. It is also the most expensive option.

In a practical application, the time necessary for material handling and mold filling using the One Part™ liquid silicone has been significantly reduced. An example is a current HCR molding operation. Each part requires approximately 2.1 pounds of material and currently takes approximately 3.5 hours per cycle. Using a One Part™ liquid silicone, the total cycle time has been reduced to approximately 45 minutes.

Problems associated with filling this mold include material preparation and the mold filling process itself. The material preparation is time consuming. The stock must be cut into pieces that will easily fit into the mold. The amount of material placed into the mold is variable because the molder is dependant on the form of the supplied material. Since the material is a HCR, the material cannot be quickly formed into a shape that lends itself to filling the mold. Because the HCR would often stick to the mold and the time required for filling the mold is relatively long, the mold needs to be cooled prior to mold release application and reloading. Because of the above reasons, the efficiency of the

process was improved using the One Part™ liquid silicone. The One Part™ liquid silicone can be quickly dispensed into the mold using any of the dispensing methods. Waste of raw material is reduced because of the ability to dispense only what is needed to fill the mold. Due to the One Part™ liquid silicone's robust curing profile, meaning a relatively long scorch time, and the release characteristics of the One Part™ liquid silicone the mold no longer needs to be cooled to the extent that it does in the current operation. Mold release was required only at the beginning of a manufacturing run. The curing profile and release characteristics of the One Part™ liquid silicone are significant in that they are key components in reducing the cycle time for this part. Curing time for this part was reduced from 2.5 hours to 25 minutes.

Transfer molding using a conventional manually loaded transfer pot could process a One Part™ liquid silicone using any of the dispensing methods previously described to fill the transfer pot.

Injection molding using One Part™ liquid silicone can also be achieved using the described dispensing methods, but the dispensing method will depend on the current configuration and operation of the screw or plunger. For example, in a Boy injection molding machine, a simple pneumatic pressure tube filled the barrel when required without difficulty.

Molds

The molds used with conventional HCR will need to be modified due to the low viscosity of liquid silicone. Some molds may need to be rebuilt, while others may only need modifications to achieve quality parts. Cost and part finishing steps will determine which method is most economical. In this particular molding application, the flash ports

needed to be closed and the mold better sealed to minimize the liquid silicone flash and create consistently usable parts. Mold manufacturers can assist in modifying or manufacturing a mold that is appropriate for liquid silicone molding.

Summary

Liquid silicone can replace some high consistency silicone applications. The savings potential is dependant on the part and the current manufacturing process. The use of One Part™ liquid silicone can greatly decrease the capital expenditures to start or transfer a current HCR operation to a liquid silicone operation. The ease of application and the time necessary to handle the material can be significantly reduced when using a liquid silicone when compared to a HCR. Mold modification is necessary when transferring a HCR mold to a liquid silicone because of viscosity differences. Overall, the use of a One Part™ liquid silicone is an excellent choice for changing a current HCR molding operation to an efficient liquid silicone molding operation. It is also a good choice for molding new molding applications.

¹ Johnson, PS, Rubber Processing an Introduction. Hanser Gardner Publications, Inc., Cincinnati, OH. 2001 pp. 119-124.

² Curtis et al., Liquid injection molding versus compression molding: Effect on LSR elastomer mechanical properties? *Rubber World* January 2005; Vol. 231 (No. 4): 16-20.

³ Kehl, P, Heat Cured One Part™ Liquid Silicone Rubber. *International Silicone Conference*, May 2004, pp. 5-7.