ANTEC® 2014

Poster #: 2014-U01

Efficiency and Consistency of Various Types of Mold Heating in LSR Injection Molding

Greg Murrer
Doug Natalie
Penn State Erie, The Behrend College

Abstract
A research study was performed to measure and analyze the efficiency and consistency of the heat transfer from a hot mold to a cold, two part Liquid Silicone Rubber (LSR) that has been injected into the mold. An 8-Run Design of Experiment (DOE) was used to find the most efficient and consistent heating source. The process parameters that were altered included: type of heating (oil, cartridge, and water), part thickness, and cycle time. After analyzing the results from the study, cartridge heaters were conclusively the most energy efficient out of the three heating methods. The water heating method was the easiest to set up, control and provided the most consistent mold temperature.

Introduction and Background

LSR material is gaining popularity in the medical field due to its chemical resistance and soft touch appeal. The production process has not been explored as much as the traditional injection molding process and is not common knowledge. Therefore the most efficient process methods are not well known.

The consistency and efficiency of heating an injection molding machine mold is very crucial to produce good quality parts and to save money. The purpose of the study is to determine which heating method (electric heaters, oil, or water) proves to be the most efficient while still imparting a consistent mold temperature. This could have a significant impact on energy consumption over a long production run or a high volume production floor.

In order to determine the most efficient process, different parameters and heating methods were altered to see which combination provided for the best results. In order to do this an 8-Run Design of Experiment (DOE) was conducted for each heating method (oil, water, cartridge). The process variables that were varied for this study include part thickness, cycle time, and mold temperatures.

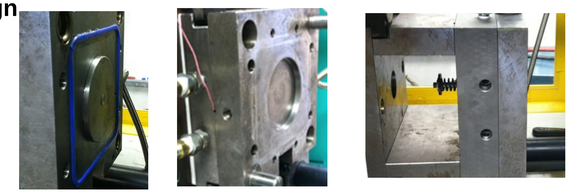
Description	MINUS (-)	PLUS (+)
Part Thickness (cm)	0.0762	0.254
Mold Temperature (°C)	150	160
Cycle Time (Sec)	47	57

Statement of Theory and Definition

The LSR material used contains an A and B component. When these components are mixed together they start to react. The LSR material is slightly exothermic, meaning that it releases energy in the form of heat. The material is releasing a small amount of energy when it enters the mold, but not enough to sustain the reaction. This is why additional heat is required for the material to fully cure.

From a thermal perspective the cartridge heaters have several advantages. They transfer heat through direct contact with the mold, additionally there is no line loses for heating and no energy expended to pump a heating fluid. Between the oil and the water methods most factors were kept consistent. Both fluids were turbulent and heat loss from other sources was consistent between the methods. Therefore the primary differences between the fluids is their material properties. Water should then outperform the oil.

Mold Design



Description of Major Equipment

Priamus data acquisition device, eDAQ 8102

The Regal Oil Temperature Controller, model number h50-1230hc-21d

The SC Standard Single temp hot water heater, model stw 200/1-6-25-ho.2

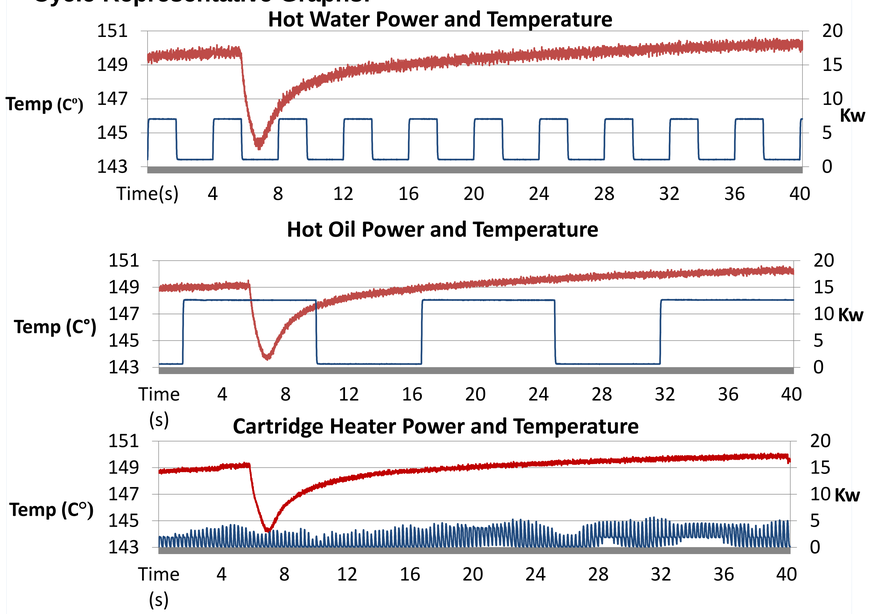
Eight 900 Watt Watlow cartridge heaters, model number g4a92

The Fast Response Universal Power Cell, produced by Load Controls Incorporated. The specific model number that was used was UPC-FR.

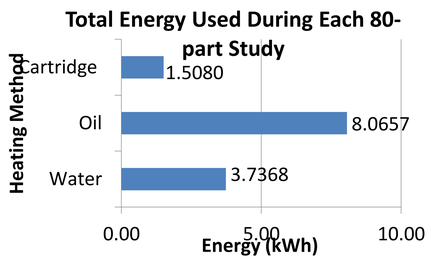
Artburg Allrounder 370 A injection molding machine, equipped with 622-1a meter=mixing dispensing unit.

Results

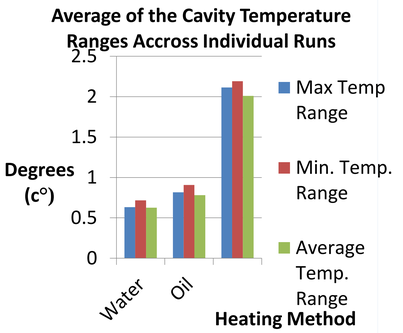
Cycle Representative Graphs:



Energy Cost per Thousand Parts:



Temperature Consistency:



Conclusion

After analyzing the results from the study, cartridge heaters used the least amount of energy of the three heating methods. There are some negatives to cartridge heaters though. A set of cartridge heaters needs to be designated for a specific mold, whereas water and oil can be used universally for any mold that has circuit lines already drilled. Also, once the cartridge heaters achieved their desired temperature they were not as stable as water and oil.

Acknowledgements

Penn State faculty, especially Brad Johnson
Rick Finnie, President of M.R. Mold and Engineering Corp.
Fluid Automation
Momentive Performance Materials
Priamus System Technologies