

Uniloy is proud to introduce this month's web posting which showcases mold cooling upgrades now available for your Uniloy blowmolding equipment. Mold cooling is highly important for efficient production of quality blow molded products. Improving your machines mold cooling capacity will help provide:

- ◆ Shorter Machine Cycle Times
- ◆ Improved Finished Container Quality
- ◆ Reduced Distortion to Finished Container Dimensions
- ◆ Reduced Finished Container Shrinkage

### **This is why it's important!**

Molds absorb heat from the plastic each cycle as the parison is blown against the mold cavity. This heat must be removed at the same rate or quicker than it is absorbed or else the molds heat up and lose their ability to cool the product. Quite often a machines cycle time is limited by insufficient mold cooling capacity. This is because product run with poor cooling comes out of the mold too hot and as the product cools to room temperature it shrinks and distorts from its intended shape. If cooling is not improved, the only choice left is to slow the machine down, reducing the rate heat is absorbed by the molds.

### **So How Much Cooling do I Need?**

#### **Step 1: Calculate the heat transferred each cycle from the plastic to the mold**

The heat transferred from a plastic parison to an aluminum mold can be calculated using the specific heat of the plastic and the mold, and knowing the weight and change in temperature of the plastic. The answer can be shown in Degrees F and represents the increase in mold temperature.

$$\Delta T_m = \frac{C_p \times M_p \times \Delta T_p}{C_m \times M_m}$$

*Where*

C<sub>p</sub> is the specific heat of the plastic = .75 BTU/lbm deg F for HDPE

C<sub>m</sub> is the specific heat of aluminum = .215 BTU / lbm deg F

Delta T<sub>p</sub> is the average change in temperature of the plastic = 185 deg F (typically)

For an illustration of this calculation, lets use a gallon mold with a finished container weight of 60 grams and a flash factor of 1.5. Therefore:

M<sub>m</sub> is the weight of the mold = 66.7 lbm

M<sub>p</sub> is the weight of the plastic (bottle plus flash) = 90 grams = .198 lbm

$$\Delta T_m = \frac{.75 \times .198 \times 185}{.215 \times 66.7} = \boxed{1.92 \text{ deg F}}$$

**This mold temperature increase is from the heat absorbed from one parison during one machine cycle!** This illustrates the importance of sufficient mold cooling. It is the job of the mold cooling system to remove this heat every cycle.

## **Step 2: Calculate the volume of cooling fluid required per cycle**

Now let's calculate the volume of cooling fluid required to remove 1.92 deg F from the mold above.

$$M_f = \frac{C_m \times M_m \times \Delta T_m}{C_f \times \Delta T_f \times D_g}$$

Where

C<sub>f</sub> is the specific heat of the cooling fluid = .879 BTU / lbm deg F

Delta T<sub>f</sub> is the ideal change in temperature of the cooling fluid = 4 deg F

C<sub>m</sub> is the specific heat of aluminum = .215 BTU / lbm deg F

M<sub>m</sub> is the weight of the mold = 66.7 lbm

Delta T<sub>m</sub> is the change in temperature of the plastic = 1.92 deg F

D<sub>g</sub> is the density of 30% ethylene glycol = 8.7 lbs / gal

$$M_f = \frac{.215 \times 66.7 \times 1.92}{.879 \times 4 \times 8.7} = \boxed{.90 \text{ gallons per cycle}}$$

This means the amount of cooling fluid needed to reduce the temperature of the mold 1.92 deg F is .90 gallons/cycle.

## **Step 3: Calculate the volume of cooling fluid required per minute**

If the machine were running at 6 seconds/cycle, our mold requires:

$$.9 \text{ gallons/cycle} \times 60 \text{ seconds/minute} / 6 \text{ seconds/cycle} = \boxed{9.0 \text{ gallons/min}}$$

This is the amount of cooling fluid needed to cool one mold producing a 60 gram bottle with a 1.5 flash factor at a 6 second cycle time.

**If the mold cooling system cannot supply 9.0 gallons/min per mold, then the machine cycle time will need to be lengthened!**

**Don't Compromise Optimize!!**

## **Cooling System Optimization**

There are two areas of focus when it comes to cooling system optimization:

- ◆ Machine Cooling Fluid Delivery
- ◆ Mold Design

## **Cooling Fluid Delivery**

There are two ways to improve your machines mold cooling capacity:

- ◆ Minimize the pressure drop in the machines cooling fluid piping.
- ◆ Boost the pressure and flow of the cooling fluid supplied to the machine.

### **Cooling fluid piping improvements:**

Uniloy has designed the following 4 retrofit packages to improve your machines existing mold cooling capacity. These packages are designed to allow flexibility and the option to retrofit the contents of package A alone, or add the other packages for a complete system optimization. Please consult your Uniloy sales representative to ensure that your machine/mold configuration is eligible for these packages.

As a comparison to the packages below, a standard dairy gallon mold (without the benefit of any of the packages below) with 3/8" NPT ports will flow **8.5** GPM @ 50 psi. This is when it is plumbed with 3/8" to 1/2" CTX fittings and 1/2" Hose, and supplied by platens ported at 3/8" NPT and return manifolds ported at 3/8" NPT.

### **Package A – Increase the mold port size**

With Package A, you can choose to rework molds or buy new molds and that's all. By not upgrading the water manifold(s) or platens, the full benefit will not be realized. By changing the molds alone, the maximum GPM increases to **9.1**. Package A includes:

- ◆ New or Refurbished 1/2" ported molds
- ◆ 1/2" Hose (8 ft per mold)
- ◆ 1/2" Push on fittings (4 per mold)
- ◆ 8-8 CTX (2 per mold)
- ◆ 8 CTX (2 per mold)

### **Package B (Add to package A) – Change the water manifolds too**

With Package B, you add new return manifold(s) but don't change the platens. When this is done; the maximum GPM increases to **9.7**. Package B includes:

- ◆ Return water manifold LH (1 for all clamps)
- ◆ Return water manifold RH (1 for clamps with split water)
- ◆ 8-8 CTX (1 per mold)
- ◆ 8 CTX (-1 per mold)

### **Package C (Add to package B) – Change the platen too**

With Package C, the platens are also upsized to 1/2" NPT and plumbed with 1/2" to 1/2" CTX fittings. This increase in water flow translates into a maximum GPM of **10.3**. Package C includes:

- ◆ New platens (34x15 Platens only can be refurbished)
- ◆ 8-8 CTX (1 per mold)
- ◆ 8 CTX (-1 per mold)

### **Package D – Hybrid Molds**

Hybrid molds are available for most classic reciprocating screw blowmolding machines. A hybrid mold is similar to the molds in a UR series machine in that they are capable of two zone cooling with two inlet and two outlets fed directly from the platens. The difference is that they are mounted to the platens using individual mounting plates. These plates allow individual mold adjustment and direct transfer of cooling fluid from platen to mold. The Hybrid gallon mold is capable of flowing **18.0** GPM at 50 psi.

The hybrid mold package includes:

- ◆ Hybrid molds
- ◆ New front and center platens
- ◆ New longer tie bars
- ◆ New rotac bracket
- ◆ New clamp piping
- ◆ Platen rails
- ◆ Platen shoes

### **Boosting the Pressure and Flow of the Cooling Fluid**

#### ***Booster Pump***

The cooling fluid supplied to the machine is recommended to be 90 gallons per minute and 65 psi at the inlet to the machine. If the supply to the machine is less than this in flow or pressure, or if the flow divided by the number of molds in the machine is less than the target described in packages A thru D, a booster pump can be retrofitted. The benefits a booster pump include:

- ◆ Increased Fluid Pressure at Mold Inlet
- ◆ Increased Fluid Flow Through Molds
- ◆ Improved Mold Cooling Capacity

The booster pump package is good for 250R1, 350R, and 400R machines and can be plumbed into existing single or double clamp plumbing with or without split water. Package includes:

- ◆ Centrifugal pump
- ◆ 7 1/2 Horsepower motor
- ◆ Mounting bracket
- ◆ Hoses and fittings
- ◆ Motor starter

### **A Word about Mold Design**

Mold design is a challenge which is successfully achieved only through the mastery of a number of overlapping disciplines. At Uniloy; Metallurgy, Fluids, and Thermodynamics are mixed with the practical arts of sound machining practice and product design to develop the most functional and optimal mold designs in the world. Today's mold designs take into account several key design features such as:

- ◆ The number of internal cooling lines
- ◆ The size and placement of cooling lines
- ◆ The use of channels in high heat areas
- ◆ Size of inlet and outlet ports
- ◆ The number of cooling zones

### **Sales and Service**

For more information on molds or machine upgrades, please contact your local Uniloy Representative. Trained Uniloy Service Representatives are available to assist in the installation of these packages at your facility.