F I M M T E C H , I n c .

Frontier Injection Molding and Material Technologies, Inc.

www.fimmtech.com Suhas@fimmtech.com (760) 525 9053

ESTABLISHING A ROBUST INJECTION MOLDING PROCESS, PART 3: The Pressure Drop Study.

Introduction to Pressure Drop

As plastic flows through the different sections of the machine and the mold, because of drag and frictional effects there is a loss of the applied pressure at the flow front of the plastic. Additionally, as the plastic hits the walls of the mold, it begins to cool increasing the viscosity of the plastic requiring additional pressure to push the plastic. The skin of plastic that is formed at the walls decreases the cross sectional area of the plastic flow that also results in the pressure drop. The molding machine has a limited maximum amount of pressure available to push the screw at the set injection speed. The required pressure to push the screw at the set injection speed should never be more than the maximum available pressure. In this case the process becomes pressure limited. During process development, knowing the pressure loss in every section helps in determining the overall pressure loss and the sections where the pressure drops are high. The mold can then be modified to reduce this pressure drop and achieve a better consistent flow.

Procedure to determine Pressure Drop:

Consider the plastic flows through the following sections: The nozzle of the machine, the sprue, the primary runner, the secondary runner, the gate and the end of fill. The procedure to determine the pressure drop is as follows.

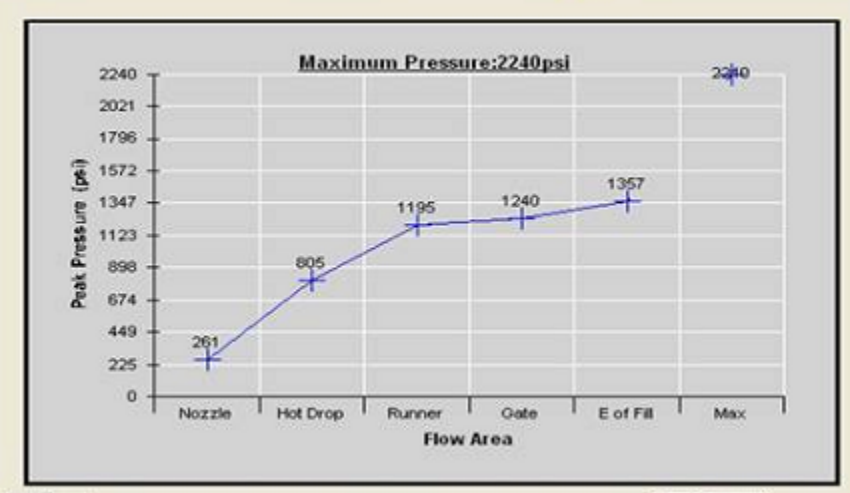
1. Set the machine to the maximum available pressure.
2. Build a shot on the molding machine and take an air shot. Note down the peak pressure required to do so.
3. Next start molding but mold only the sprue and note the peak pressure.
4. Mold the primary runner only and note the peak pressure.
5. Mold the secondary runner only and note the peak pressure.
6. Mold a shot such that it just enters the gate and note the peak pressure.

7. Mold a shot such that it just reaches the end of fill and note the peak pressure.

8. Generate a graph as shown and look for the sections that have a high pressure drop.

Note: Set a short screw recovery delay time. In doing so you will prevent immediate back flow into the cavity. If the gate is not frozen, the back pressure will influence the cavity fill.

Flow Area	Peak Pressure	% of Maximum	Delta P	% Delta P
Nozzle	261	11.7	261	11.7
Hot Drop	805	35.9	544	24.3
Runner	1195	53.3	390	17.4
Gate	1240	55.4	45	2.0
E of Fill	1357	60.6	117	5.2
Max	2240	100.0	883	39.4



How to use this information:

The maximum pressure used in the process should never be equal to the maximum available pressure at the machine. For example, if the maximum available hydraulic pressure is 2200 psi, then the end of fill pressure should not be equal to 2200. If this is the case, it means that the screw needs more pressure to move at the set injection speed and cannot do so because of the limited pressure. Such a condition is called 'Pressure Limited'. Typically, you should a maximum of about 90% of the maximum available pressure. Therefore in this case, where the maximum is 2200, the end of fill pressure should not be more than 1980 psi.
In the generated graph, if you are pressure limited or more than 90% of the maximum, look for steep increases in the pressure and try to reduce these. For example, If the secondary runner section shows a steep increase, then this means it takes a lot of force to move the plastic through this section. Increasing the diameter of the runner will help in reducing this pressure.

About FIMMTECH:

FIMMTECH is a consulting firm that provides services in the area of Injection Molding of Plastics. FIMMTECH is also in the process of developing products that will increase efficiency of the molding process, educate personnel and better manage the molding facility. One of the first products to be released is the software 'NAUTILUS' that helps in the development of robust and optimized processes. Suhas Kulkarni also teaches a course on Injection Molding at the University of California, San Diego that can be offered as In-House seminars. For more information please visit www.fimmtech.com

Thank You.

Sincerely

Suhas Kulkarni.