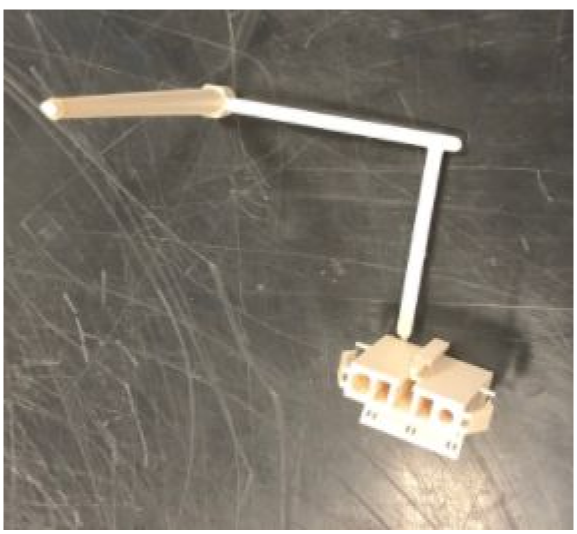
Case Study Shows How Melt Temperature Fluctuations Affect Part Quality

You can't manage what you can't control, and you can't control what you can't measure. That's a derivative of the popular quote "You can't manage what you can't measure", which is commonly attributed to either W. Edwards Deming or Peter Drucker. It's also the reason why the Melt Profiler™ System was developed. Michael Durina, the founder of Md Plastics, realized that the single most important data point in the injection molding process was not being collected – namely the temperature of the melt inside the barrel. Variances in melt temperature cause variances in viscosity, which can lead to wild fluctuations in injection pressure. The end result is an unstable process and inconsistent part quality. The following is a case study that shows how melt temperature fluctuations affect part quality.

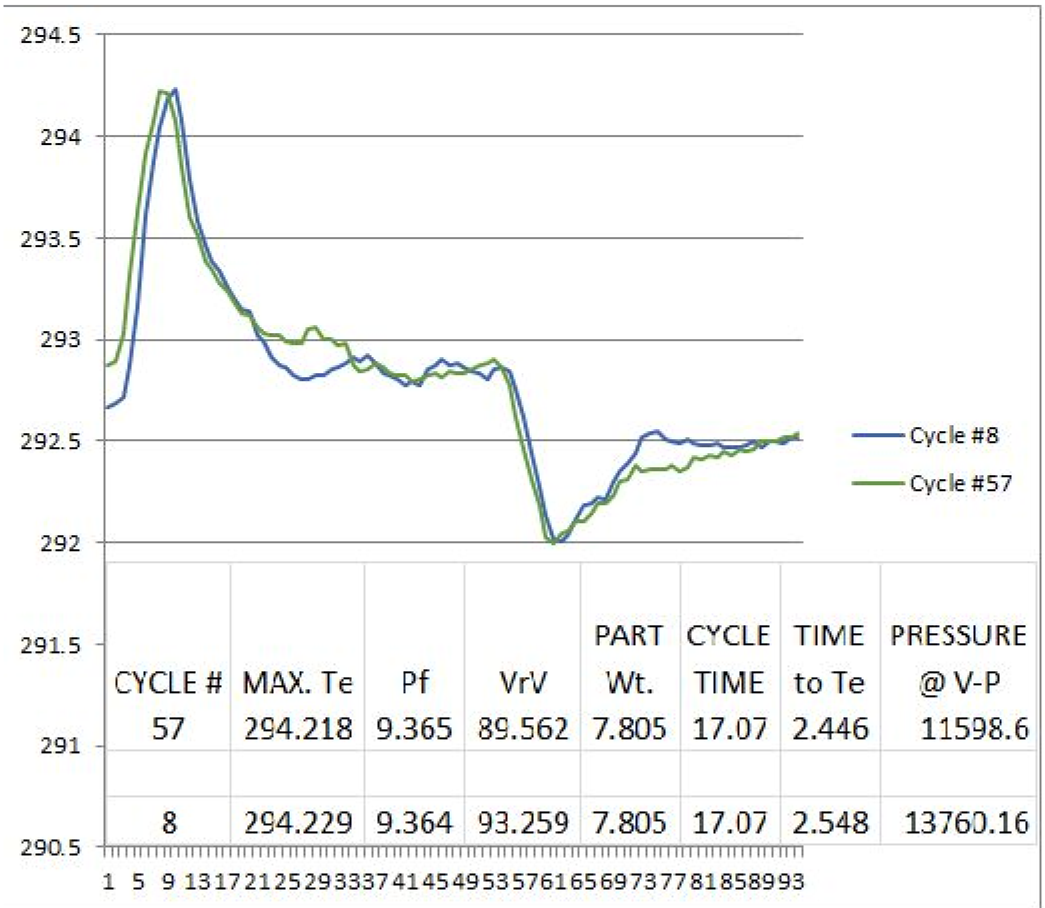
Below is information gathered via a Melt Profiler™ VII system on 100 consecutive shots of the part shown in figure 1. The parts were molded using a brand new Sumitomo molding machine and the mold shown in figure 2.



(Figure 1)

(Figure 2)

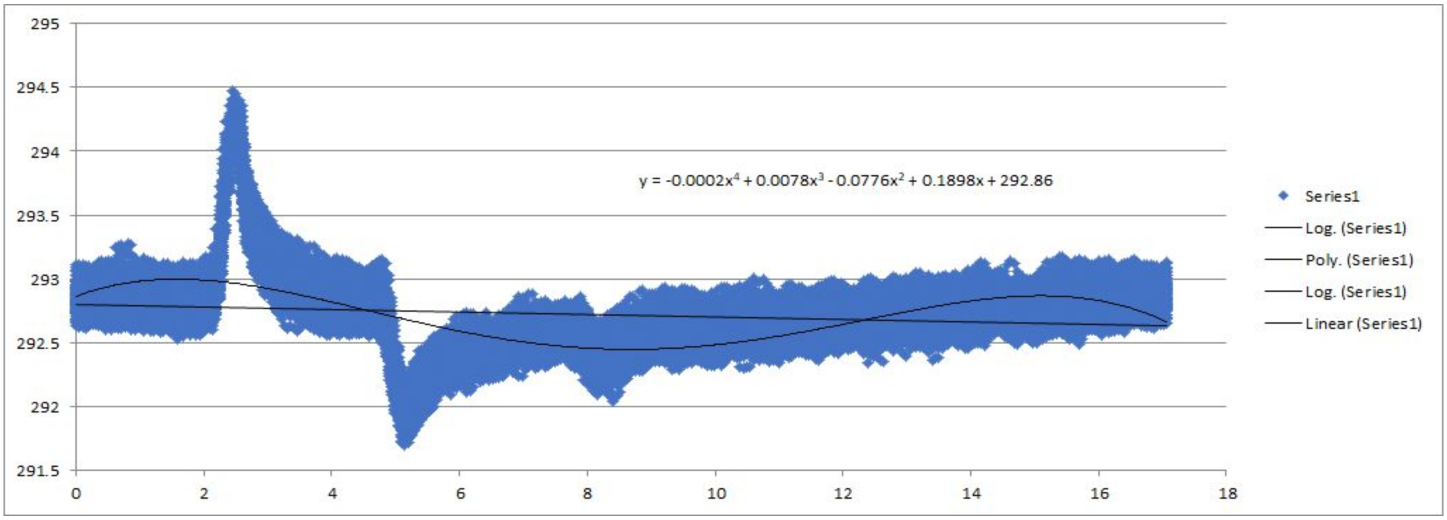
The graph below (figure 3) shows the processing data collected on shots 8 and 57. These two shots represent the greatest variance in injection pressure out of all 100 shots.



CYCLE #	MAX. Te	Pf	VrV	PART Wt.	CYCLE TIME	TIME to Te	PRESSURE @ V-P
57	294.218	9.365	89.562	7.805	17.07	2.446	11598.6
8	294.229	9.364	93.259	7.805	17.07	2.548	13760.16

(Figure 3)

The important thing to notice is that there was a pressure difference of 2162 psi. needed to fill the part and the only variable that can be attributed to the higher V-P was the melt temperature/total heat content just before injection. As you can see, the difference in melt temperature resulted in a significant difference in the injection pressure needed to fill the cavity. So in order to reduce injection pressure variances you must control melt temperature, which in turn controls viscosity and the more homogeneous the melt pool the more uniform the polymer will flow into the mold.



(Figure 4)

The graph above (figure 4) shows the melt temperature data formatted in a stacked scatter chart for all 100 shots with the vertical axis representing melt temperature and the horizontal axis cycle time. The temperature spike during the fill stage represents the fill slope (temperature over time) and you can see that each slope is straight which indicates that the screw tip closure is consistent. But notice the temperature variance during the rest of the process, which is when the melt is being prepared for the next shot. That variance is much greater. Why? We believe it is because of a poorly designed plasticating screw. Other possible explanations could be malfunctioning heater bands or screw/barrel wear, but these parts were molded on a brand new state-of-the-art molding machine, so that rules out those possibilities. This “LOOK” inside the barrel reveals an insight that was not possible before and can reveal the root cause for part rejects.

Conclusion: In many cases (most cases in our opinion) general purpose screws are unable to prepare a homogeneous melt within a tightly controlled temperature range. This problem causes large injection pressure fluctuations that some machines cannot overcome. The end result is an unstable process, which lessens the probability of molding high quality parts. The moral of the story: Our Melt-Profiler™ product line solves the “mystery” of the state of the polymer and can help in identifying the root cause for part rejects and DO NOT SETTLE FOR GENERAL PURPOSE SCREWS. Rely instead on Posi-Melt™ screw designs developed by one of the world’s foremost experts in polymer melt preparation dynamics.

For better plasticating screw performance and the only inline melt monitoring solution in the plastics world, call us today at 330-482-5100 or visit us at www.mdplastics.com.