Process Solutions

Optex Tips

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Dear Paul,

Welcome to the first edition of the Optex Tips newsletter. This is a quarterly publication that contains tips and hints to improve your process. We hope that you will find these tips useful and we welcome questions and suggestions for future issues. We will also keep you informed of any new information on Optex as well as seminars and shows that we are participating in.

Optex Process Solutions, LLC

Tip #1: Establish An Extrusion Baseline

We are frequently asked how often a client should pull a screw and inspect for wear. Of course this is dependent on the corrosiveness and abrasiveness of the materials run, the hours of operation, alignment, and many other factors but the bottom line is operations do not want to pull the screw. A good indication of wear is a baseline test. This test is also a potentially powerful tool for evaluating problems other than wear

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When your extruder is new (or today if you have never done so) take your most common frequently run material and establish a baseline set of run conditions. This could be a typical product set up. Select three run speeds. These should bracket your normal run speeds or 50, 75, and 100% of your maximum extruder speed. Run the extruder at each run speed for a period long enough to reach steady state conditions (typically 15 - 30 minutes depending on extruder size). The extruder barrel heater powers should no longer be cycling and the PV should be within 2°F of set point.

Under these steady state conditions perform a rate check. If you have a calibrated gravimetric feeder this can be recorded over a short run period. If you do not have an accurate gravimetric feeder you will have to collect the melt in a safe way. Typically pre-weigh a drool pan (tare weight). With the extruder running and with proper safety equipment (gloves and face shield) exchange the existing drool pan with the pre-weighed pan. Collect the melt in this pan for a measured time (I like 6 minutes because it is long enough to minimize error and makes for simple math). Cut of the melt and remove the pan. Weigh the pan and subtract the tare weight. If you used 6 minutes multiply by 10 and you have the extruder rate at that rpm in weight per hour (PPH). Record the extruder head pressure and average melt temperature. Repeat this procedure at the three selected speeds and record the results. For many extruders and materials the result may be nearly linear. Depending on material viscosities and system operating pressures there may be a significant reduction in specific output as rpm (and pressure and melt temperature) increase. Given consistent material and operating conditions however this rate check should repeat within an acceptable error (say ± 1.5%) provided there is no wear. If you repeat this test in one year and see no greater difference than the testing error you can conclude there is no significant overall extruder wear. Note this test will not allow a barrel alignment inspection and will not provide any indication of small local wear points (say chipped Colmonoy on a flight).

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Optex has teamed up with Circonix and Fulton Machinery at the NPE Show in Booth N60128 on June 22-25, 2009. Visit our booth and have your card swiped for a chance to win a laptop computer!!

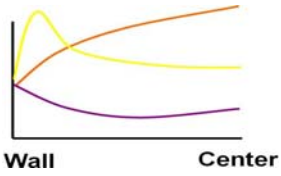
Upcoming Seminars & Shows

May 18-20 - TAPPI Europlace Conference, Budapest, Hungary
June 1-4 - CMM Show, Chicago, IL
June 22-25 - NPE Show, Chicago, IL
June 22-25 - ANTEC Conference, Chicago, IL
October 5-7 - CPP Expo, Las Vegas, NV
If you would like to meet with us at any of these events, send an e-mail to: andy@optexprocesssolutions.com or

What we like about this procedure is the additional power to evaluate overall screw performance. If in addition to recording rate you take the time at each steady state run condition to record some melt quality parameters it becomes even more powerful. Once the control system has stabilized record the variation of the head pressure. If the head pressure sensor is over the screw flight and there is another pressure sensor downstream this will provide data not influenced by the passing flight. Also record the melt temperature variation. Remember that melt temperature will vary by position in the melt flow as well as over time. An infrared camera or line scanner is the best way to capture this variation (make sure the sensor is coupled to the infrared frequency of the polymer run). Another accurate way to record the variation is with an adjustable depth melt thermocouple. If this has an exposed thermocouple junction it will be able to indicate both position dependent and time dependent variation. Remember to allow enough time at each position checked to see if there is time variation as well.

All processes have variation but what we are looking for is consistency and repeatability. The extruder is often like a "black box" and when we have a process problem we are all left scratching our head wondering if something has changed inside the extruder causing the problem. This baseline data provides us a "go / no go" test when this question arises. If we can go back to this standard conditions test and find repeatable consistent results we can often rule out the extruder suspect. Although this procedure will consume a significant amount of time and material to establish a baseline it can save many times more when chasing an unknown problem in the future.

Tip #2: Using Two Melt Thermocouples to Improve the Process



You have heard many times that a single spot temperature measurement is not a good indication of melt temperature. If you look at the potential patterns for the melt temperature above, you will see that a single probe at the wall will give the same readout for all three of the patterns shown. Each of these patterns is different and would changing process settings differently to improve the melt temperature uniformity.

The problem with using an adjustable depth thermocouple is that it can be difficult to adjust while running. If you move the probe into the melt and cool the extruder, you run the risk for bending the probe which is then difficult to remove. It also takes some time and effort to adjust and record temperature readings. Is there a simpler way to measure the melt temperature difference across the melt channel? The answer is yes. The method is to place two thermocouples in the pipe. The first is located either flush or 1/8" deep from the wall. The second is located ½" or centered in the pipe. The advantage to being ½" deep is that the probe will most likely not get bent when the polymer is cold.

Once both thermocouples are in the pipe and reading temperature, they can easily be used for process improvement. Compare the temperatures of both thermocouples. Adjust your process settings such as zone setpoints and pressure to get the two temperatures to match up as close as possible. If the different between the two is greater that 10F, you may want to investigate to see if you are experiencing screw wear or if the screw is not designed for the resin you are processing. The closer you can match your temperatures, the better your melt quality and product will be.