Melt Temperature Measurement

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I have found that melt temperature thermocouples (if we are fortunate to have them available) are often used incorrectly. The values obtained by a standard 3mm (1/ 8") immersion thermocouples are highly influenced by the temperature of the metal around it. This means that a thermocouple that is sitting in a melt pipe that is being controlled at a temperature below the 'true' melt temperature will tend to under predict the temperature of the polymer melt (and visa-versa). A variable depth melt probe (VDMP) is preferred because it can be used to measure the temperature across the melt stream, but these are not readily available in all plants.

Over the years, many process personnel have reported to me that a particular die is 'over heating' or 'over shearing' the material, causing the die temperature to exceed the set point temperature. This generally occurs in a retrofit situation where thermocouple positions and control settings have changed, due to equipment changes. While this may be possible under certain extreme situations, it is highly unlikely. It is more likely that the polymer melt temperature is actually higher than what is being indicated by the standard melt temperature probe. In general, the extruder screw design and conditions determine the polymer melt temperature and there is relatively little that can be done to influence it after the polymer leaves the extruder. In fact, an overriding temperature zone is a good indication that the melt temperature is higher than what the melt temperature probe indicates. Assuming, of course, that the heater control system is working properly.

The following procedure can be used to obtain a more accurate melt temperature using a standard probe. Record the set point and actual temperature for the melt pipe in which the melt temperature probe is installed and record the current melt temperature reading. If the melt pipe is set below the indicated melt temperature, raise the set point so that it is the same as the current melt temperature. if the 'true' melt temperature is indeed higher, you will notice that the melt temperature indicated by the melt probe will increase. Allow about 20-30 minutes for the system to stabilize and repeat the procedure. Continue to 'chase' the melt temperature until the indicated melt temperature is actually a few degrees lower than the set and actual temperature of the melt pipe. At this point, you have actually passed the 'true' melt temperature and melt pipe has an opposite effect on the thermocouple reading. The point to remember is that the standard 3mm immersion probes only provide a good reading if there is little difference between the melt temperature and the setting on the adaptor, assuming that there is not a large temperature gradient within the melt stream.

I prefer to have the melt pipes and the die set a few degrees higher than the 'true' melt temperature in order to minimize the possibility of creating melt temperature gradients within the melt stream. It also reduces the possibility of channeling; a condition where a large portion of the material near the wall actually stops flowing and the material only flows in the center of the flow channel.

- John Perdikoulias, Compuplast Canada Inc.

See also:

- Extrusion evaluation through pressure and melt temperature analysis
- Immersed thermocouples
- Interfacial instabilities during coextrusion of LDPEs
- Temperature control
- Thermocouple depth
- 30/30 melt temperature measuring method

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