Abnormal Transfer Pressure Detection by APC - Howe See Ban

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Abstract

The compression molding process is using a ram plunger to force molten plastic material into a mold cavity. This module is called mold die. By mean of transfer motor, the plunger pushes up along the sleeve until the top position will create the force require to fill up the cavity. Too high force will result in excess material in thin layer exceeding normal part geometry. For this reason, there is a need to measure & control the force (transfer pressure) acting on the molten plastic material (mold compound). It is necessary to have a system to monitor when there is an abnormal Transfer Pressure readout occurs, and stop the machine from continuous running products of bad quality. In order to have the real-time monitoring, it is required to have a system which can transform the transfer pressure data from the equipment, to a form of trending, and enable to activate tool stop when there is a limit violation. APC Trend is Infineons in-house system which provides the required features. By tapping the data of the transfer pressure from a load cell mounted on the transfer beam, APC Trend is able to provide a real-time transfer pressure reading, which is useful for engineers to analyse and provide countermeasure to prevent abnormal transfer pressure reading.

Transfer Pressure Trend # 1 – Comparing multiple tools on same system

Data trends for multiple tools can be viewed at APC Trend simultaneously with same timeframe. This enables comparison of individual tool behavior at particular duration. Referring to Figure 1, the data show transfer pressure trends of 2 different mold dies which are fixed on transfer module #1 and #2. They clearly show that one of the mold dies is behaving differently compared to another mold die on the same system.

There are 2 possibilities for the root causes, the transfer module comprising of the motor & load-cell attached to the transfer beam is faulty or the mold die itself is in bad condition. Without APC Trend, this variation will not be noticed, and the mold machine will be running with 50% of the product will be at potential quality risk.

APC Trend makes troubleshooting easier, the problem can be isolated to the actual root cause by swapping the tools, in this case is mold die.

The result of the action, as shown in Figure 2, clearly monitors that the problem is due to the mold die and not the transfer module.

Transfer Pressure # 2 – Identify root cause in a tool

Since the abnormal transfer pressure is isolated to one of the mold die, further analysis required to determine why the 2 same design mold dies are behaving differently.

By looking into the cross-section of the mold die and understanding the molding process, the abnormal transfer pressure is due to higher friction between sleeve & plunger. When the plunger is pushing up the mold compound, under normal condition, transfer pressure reading should be +/- 10% of setting at the transfer end position. If the sleeve and plunger are in bad condition, this phenomenon will cause unnecessary transfer pressure built in order for the plunger to reach transfer end position. Refer to Figure 3.

By replacing the bad sleeve and plunger, the result from APC Trend monitor both mold dies after corrective action show similar behavior, no major different in transfer pressure reading at transfer end position. Refer Fig 4.

Conclusion and Outlook

APC Trend is a good analysis system for identifying potential root causes of abnormalities in manufacturing equipment or tool. It is able to show the changing behavior of multiple tools or single tool over time. Before APC Trend, reaction on abnormalities was usually based on data from product quality. The automatic data acquisition allows proactive actions, preventive and predictive maintenance easier to achieve with this system.
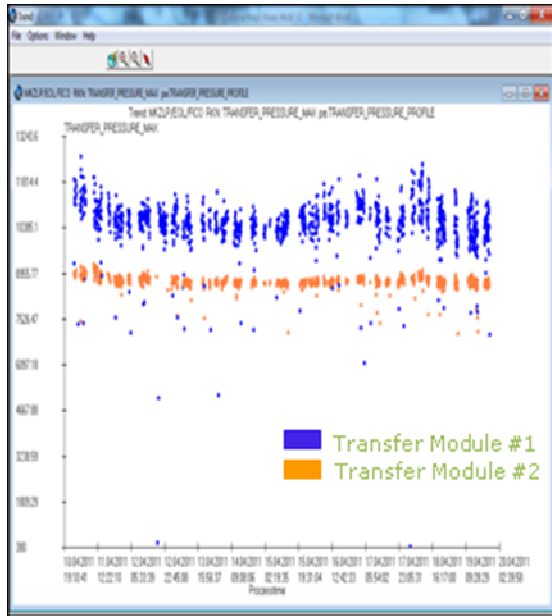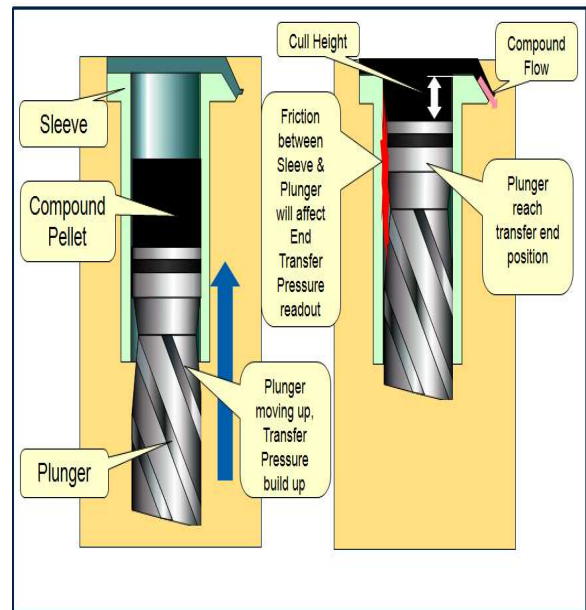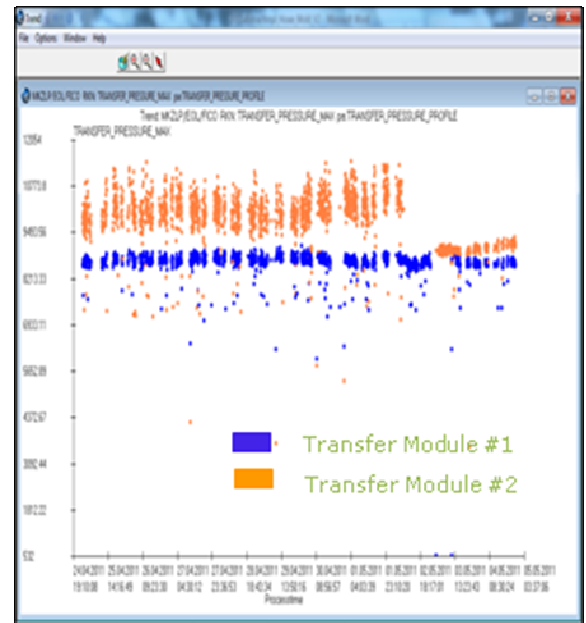
Figure 1

Figure 3

Figure 2

Figure 4