Injection molding machine measurements with a Fluke 190 Series II ScopeMeter®

Application Note

The trend towards automation to reduce labor content while improving product quality is a strong driving force in the industrial electronics world, especially in process control instrumentation. In this Application Note, several sensors and their use in injection molding machines are discussed. Easy capturing of proces parameters is described for adjusting and finetuning of molding machines at the start-up phase and measurements to verify correct operation for maintenance.

Sensors

To monitor or control a process, parameters of the process have to be measured. This is normally done by what is called a sensor. In order to control the process, a sensor giving an electrical output is preferred. In fact, in most cases the sensor is also a transducer. Such sensors are used for the measurement of many physical quantities such as:

- temperature
- flow
- pressure
- acidity (pH)
- conductance
- velocity
- acceleration
- dimension
- rotation and in "guided vehicle" environments determining
- identification
- position
- direction

Process tuning and maintenance

Plastic injection molding machines make use of servo-hydraulic control systems. For a perfect reproduction process, the system first needs to be "tuned" and then the optimum process needs to be maintained. The primary parameters involved are:

- material (injection) flow
- cavity pressure
- melting temperature
- mold temperature, see figure 1

The most dynamic part of these parameters are flow and pressure. In the production of lenses for compact disc players, for example, a typical molding cycle takes less than ten seconds.

A regular and constant material flow is maintained by controlling

- the position of the feed-scroll
- the hydraulic pressure

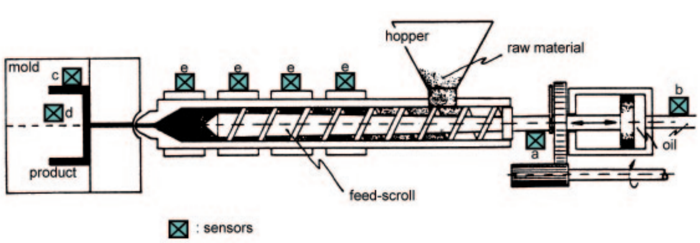

Figure 1: A schematic picture of a plastic molding machine. Indicated are the sensors for feed scroll position (a), hydraulic pressure (b), cavity pressure (c), mold temperature (d) and melting temperature (e).

Figure 2: An example of an injection-molding product is the laser pick-up for compact disc players. It consists of an aspherical optical lens with a diameter of 4 mm whose conformity to the mold is within 0.1 thousandth of a millimeter. When this component leaves the mold it is ready for final assembly.

Both position and hydraulic pressure are registered with the ScopeMeter, as shown in figure 3. In order to achieve constant flow, the linear displacement of the feed-scroll (around 10 mm, trace A red) causes a non-linear increase of the hydraulic pressure up to about 100 bars. (trace B blue).

Cavity pressure build-up behavior, which goes up to a level of 1000 bars is shown in figure 4 together with position of the feed-scroll.

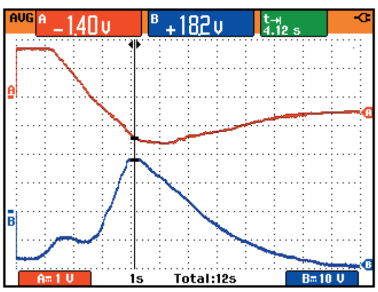

Figure 3 – *The position of the feed-scroll (trace A red) and behavior of the hydraulic pressure (trace B blue) shown as a function of time (Fluke 190 Series II).*

In practice, technicians responsible for the production control of these plastic CD-lenses can't do their jobs properly without the visual representations shown above.

The oscilloscope is a primary tool at the start-up period of the molding process, or in cases of malfunction. Owing to the low repetition rate of the process, a ScopeMeter with Scope Record mode is required.

The need for adjusting the molding machine to a preferred setting makes reference curves of the parameters as shown in figures 3 and 4 very desirable, drastically reducing the set-up time.

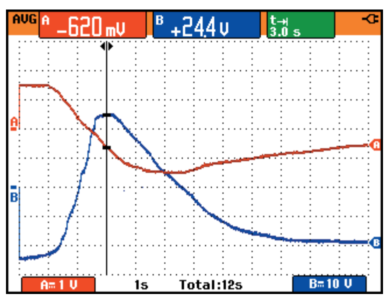

Figure 4 – *The position of the feed-scroll (trace A red) and course of the cavity pressure in the mold (trace B blue) shown as a function of time (Fluke 190 Series II).*

Conclusion

Fluke 190 Series II ScopeMeter oscilloscopes with their rugged, battery-powered capabilities are ideal for use in an environment where many machines need to be set up, often in dirty conditions. With the ScopeRecord mode process parameters can be captured easily, even these slow processes can be measured accurately with cursor reading and kept for future reference.

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Fluke Corporation
PO Box 9090, Everett, WA 98206 U.S.A.

Fluke Europe B.V.
PO Box 1186, 5602 BD
Eindhoven, The Netherlands

For more information call:
In the U.S.A. (800) 443-5853 or
Fax (425) 446-5116
In Europe/M-East/Africa +31 (0) 40 2675 200 or
Fax +31 (0) 40 2675 222
In Canada (800)-36-FLUKE or
Fax (905) 890-6866
From other countries +1 (425) 446-5500 or
Fax +1 (425) 446-5116
Web access: http://www.fluke.com

Printed in U.S.A. 3/2011 2543347B A-EN-N
Pub_ID: 10165-eng, rev 01