

IN-LINE COLOR MEASUREMENT OF VINYL SIDING

Color values not only are an indicator for product quality but are also useful as an excellent insight for process monitoring. All parameters in the production process (temperature, pressure, production speed, feeders, pumps etc.) have an impact directly on the color values. It is now possible to make measurements directly in the molten polymer. Immediate adjustments of the process parameters are therefore possible through immediate 'off-specification' detection.

INTRODUCTION

Color measurement is a well-accepted technology to check the quality of the color values in the production process. Usually these measurements are performed 'off-line'.

The typical procedure for off-line measurements:

- Manually take a sample from the process
- Send/take the sample to the laboratory
- Perform 'off-line' measurement in the lab
- Report the results to production
- Make a decision then on a process adjustment
- Repeat the above five steps if necessary, to obtain another measurement e.g. color corrections or after change of process parameters

The delay between sampling and obtaining the results from the laboratory can be time consuming. A significant disadvantage is that only a single measurement is generated in this time period and the quality of the color during, before and after the sampling point is unknown.

With the in-line color measurements taking place directly in the vinyl polymer, not only is complete documentation possible, but when color variations occur, immediate intervention can take place. This method eliminates many steps of the offline method and the measured results are available in real time.

INNOVATION

This technology deploys a probe directly in the molten polymer. The Reflection Polymer Melt Probe (RPMP, photo 1) is installed on the exit (adapter) of the extruder by using ½"-20 UNF thread (typ. Dynisco®). As illustrated in photo 2, it is screwed into position in the adapter. The RPMP consists of the threaded body and optical fibers. The sapphire lens on the tip of the probe is the observation window and is very well suited to the harsh conditions in the extruder (temperature, pressure, and friction through flowing material). The self-cleaning function of the sapphire is ensured by the shear force of the material flow. Ideal installation is directly into the melt stream in the adapter.



Photo 1 : RPMP with Sapphire window w/thread 1/2"-20 UNF

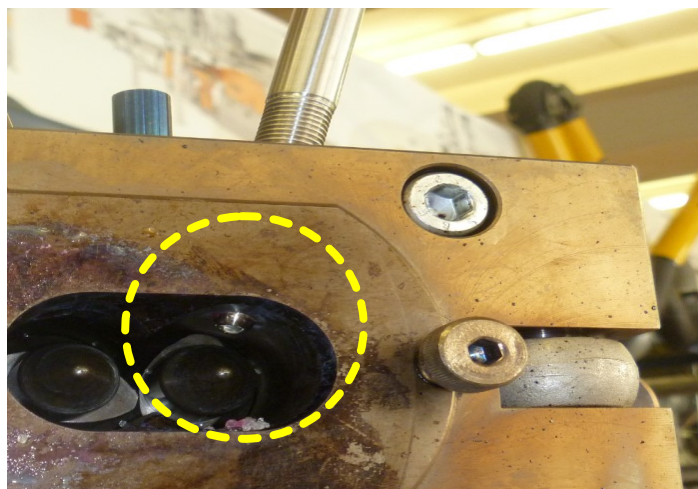


Photo 2: Reflection Polymer Melt Probe installed in the adapter

COLOR MEASUREMENT

Illumination of the polymer through the sapphire window is achieved by 6 circumferentially positioned glass fibers which convey the light of a xenon flash lamp. The reflection from the illuminated surface is detected by one center-positioned optical fiber. This reflected light is then interpreted by the spectrophotometer. Color values such as L^* , a^* , $b^* C^*$, h are calculated from this spectral curve, and displayed as trend charts, (see photo 3).



Photo 3: Trend charts of EquiColor™ Software

For a continuous process monitoring, 10 to 60 seconds is recommended as the measurement interval. Intervals as fast as 1 to 2 seconds are possible. The calibration of the spectrophotometer is designed specifically for the demands of the production process. Calibration can be done without interruption of the process.



Photo 4: Stainless Steel NEMA4 box with touch-screen

The spectrophotometer is integrated in a NEMA4 box with an industrial computer and touch-screen (see photo 4). The appropriate spectral range is 380-780 nm (resolution 1 nm). The NEMA4 box is made from stainless steel. It is designed and equipped specifically for use in the production environment where the ambient conditions can be dusty, vary in temperature, subject to vibration etc. The box also contains a thermoelectric cooling and heating device to eliminate the influences from ambient temperature by keeping the temperature inside the box at a constant level.

PROCESS MONITORING

Extrusion of Vinyl Siding is a very complex process subject to influence by various factors. Such factors can be process parameters e.g. temperature, pressure, production speed. Other factors come from the extruder and its components i.e. pumps, feeders, blenders, combination of the screws, cooling, and vacuum. In addition, raw material can influence the result, reflecting different lots, ratio of mixtures etc. All these factors, either singly or in combination result in modification to the color of the produced material during the extrusion process.

USER BENEFITS

- Real-time information about process stability & quality
- Impact of speed changes on the quality of the extrusion
- Controlled color changes: start phase, end of run
- Avoid off-specification batches & waste production
- Detection of dosage elevations
- Optimized recipe formulation & process design
- Available feedback loop for L^* closed loop control via feeder
- Comprehensive quality audit trail customer documentation of the quality of the delivered product
- Reduced costs – higher ROI

For more information or to discuss your vinyl siding application in detail,

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