

Application Note: Polymer / Resin Reaction Endpoint

Determining reaction endpoint in polymer/resin reactors is critical to achieve desired product properties, such as molecular weight. Knowing exactly when the reaction is over saves residence time and batch conversion time, and lowers the overall manufacturing cost. Having real-time information leads to significant improvements in process control because you see activity with continuous readout that less frequent grab sampling may miss. Continuous monitoring allows you to go beyond “in-spec” to “on-target”!

Online monitoring delivers a number of benefits including:

- No need to increase grab samples near the end of the reaction.
- No need to pressure your analytical lab for faster turnaround of reference method results.

NIR (near-infrared) spectroscopy is effective in providing one of the key parameters used to determine molecular weight, acid value. Another key parameter is viscosity, also measured in the reactor. Both parameters are used together to monitor the path of the reaction and to accurately determine the end point. Different products can be distinguished by these paths, as shown for hypothetical products A and B in Figure 1.



Figure 1

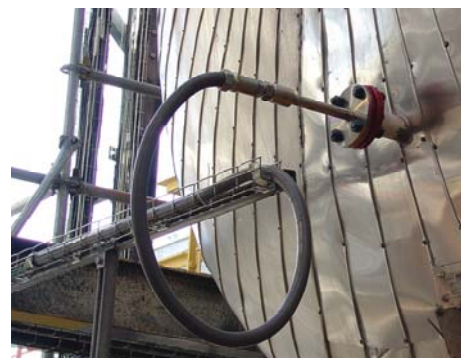
Isocyanate is commonly added near the end of the reaction to modify the final viscosity and as an end-blocker to achieve certain physical properties, such as wear resistance and electrical properties. Isocyanate may be measured accurately with a low cost ClearView® db photometer.

Color is a good indicator of oxidation where air might be brought into the reactor under vacuum from a leaky seal. Guided Wave’s ClearView db photometer is powerful in that it simultaneously analyzes chemical properties in the NIR range and color in the VIS range.

A fiber optic insertion probe may be directly inserted into the reactor. This is where light interacts with your sample. Guided Wave SST probes are designed to withstand the frequent heating/cooling cycles in batch reactors at temperatures up to 300°C. Insertion probes can also be placed in transfer pipes in continuous processes.

Insertion probes are not the only means to make continuous measurements. If your polymers/resins are routed through a bypass loop (side stream) at temperatures < 150°C, you can use one of our many flow cell designs. It is important that your material does not freeze up or solidify and block sample flow. The sample can be valved off from the cell and drained. The flow cell has a cleaning port that provides you with access to the optics for easy cleaning.

Our insertion probes and flow cells can be connected to our analyzers up to 100 meters away using reinforced process-ready optical fiber cables. Fiber optic cables are routed to the analyzer in the control room or to a suitable enclosure that meets your local safety requirements, such as ATEX.



Guided Wave Fiber Optic Insertion Probes Measure Directly in the Reactor



Guided Wave Probes and Flow Cells

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Guided Wave offers two types of analyzer technologies for these measurements; the ClearView® db photometer or the Model 412 process spectrometer.

For simple reaction systems the ClearView db photometer is a lower cost option. The ClearView db may be used when fewer than 6 wavelengths are required for analysis. Linear calibrations may be developed on the analyzer or absorbances may be output directly to a control system for analysis. For more complex systems requiring full spectrum data or multiple calibration models for significantly different reactions, a model 412 spectrometer offers more powerful data analysis and greater versatility.

Polymer Industry Proven Photometric Measurements

NIR	VISIBLE
Acid Value	Yellowness
Hydroxyl Number	Turbidity / Clarity
ppm Water	
Isocyanate	

Choose ClearView db Photometers

Our photometers are designed for less complicated online applications where only a few spectral wavelengths are needed for the analysis. Easy to calibrate and maintain, they are an economically attractive alternative to other platform analyzers.

- Monitor up to 6 wavelengths
- First true dual-beam process photometer
- Can monitor 1-2 sample points
- 450 – 2150 nm coverage
- TCP Modbus over ethernet or optional analog, 4-20mA data communication
- Compatible with an array of optical sample interfaces
- General Purpose, Z-purge and ExProof, ATEX enclosures available (see below)

Process Spectrometers

When you need complex chemical measurements delivered accurately and quickly, Guided Wave provides full spectrum fiber optic based spectroscopy as the complete solution.

- Can monitor up to 12 independent sample points
- Can measure multiple properties on each sample stream
- NIR (800-1700 nm) or XNIR (1000-2100 nm) survey range
- Dual-beam design for maximum long term stability
- Fiber optic system platform for remote sampling and flexible installation
- Delivers fast, reliable online analysis of complex



Model 412 Spectrometer



Zpurge Unit
Class I, Division 2

ExProof Unit
Class I, Division 1

General Purpose Unit

ClearView db Enclosure Options