Measurement of Plastic Coatings in Automotive Components

PROZESS TECHNOLOGIE

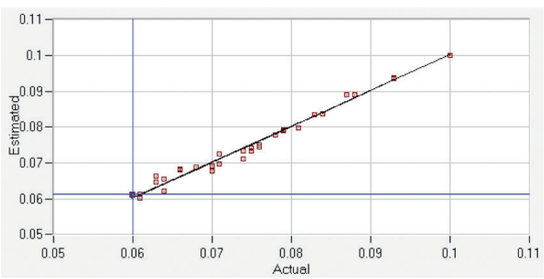
APPLICATION NOTES

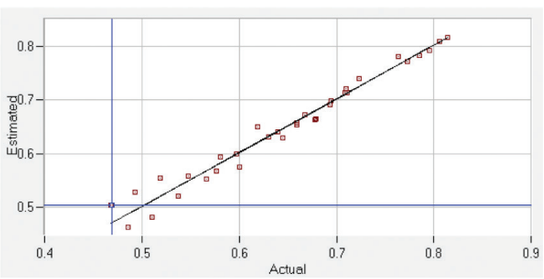
Detector: Reveal XNIR (Extended Near Infrared 1100–2100 nm)

HIGHLIGHTS

- Millisecond measurement times
- Internal referencing, wavelength and linearity validation for stable, continuous operation
- WiFi, Ethernet, OPC, ModBus, Ethernet/IP communications standard
- Hazardous area enclosure options
- Various sampling options

REGRESSION ANALYSIS





Summary

Plastics have become ubiquitous in the automotive industry, supplanting manufacturing materials like steel and aluminum. These plastics are not only used in the vehicle's interior, but also are seeing more prevalence in mechanical components, where the structural integrity is of the utmost importance. While the plastic materials reduce the overall weight of the vehicle, it is imperative that their performance mimics the material being replaced.

Coating Analysis

The Prozess XNIR analyzer was used to quantify several different plastic coatings. *Figure 1* demonstrates the ability to detect changes in the spectral features, as the samples are diluted.

While some spectral changes scaled with dilution factor linearly, some peaks revealed shifts in wavelength with changing concentration. Because of this, a partial least squares (PLS) regression model was developed, and the power of this technique is exemplified in *Figure 2*, where polymethyl methacrylate (PMMA) solids are quantified at concentrations anticipated in this specific production process. Strong linearity ($R^2 > 0.98$) was measured both for the analysis of the solids, as well as when evaluating solvents 1-methyl-2-propanol (*Figure 3*), and diacetone alcohol (*Figure 4*), which are employed for diluting the plastic during production.

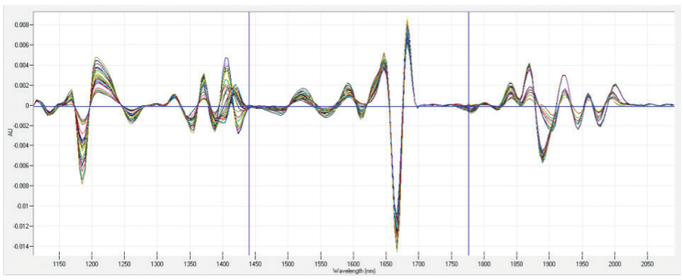


Figure 1: Dilutions of production samples after data processing show shape changes and peak shifts for several features (1350–1450 nm range, 1850–1930 peak).

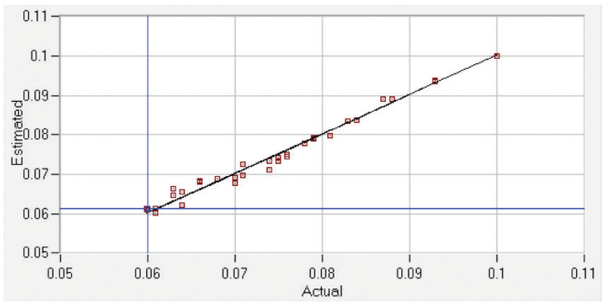


Figure 2: Partial least squares indicates strong correlation (R^2>0.98) to reported polymethyl methacrylate solids concentration over the tested range with a standard predictive error of ±0.1% wt.

Reveal

The Prozess Technologie Reveal XNIR instrument provides millisecond measurements, a variety of sample interfaces, and rugged system designs for the manufacturing environment, enabling users to acquire data in real-time, and make modifications during their process to ensure proper quality control and efficiency.

The Reveal contains integrated light sources and dispersive spectrometers utilizing linear diode array detectors, with no moving parts for high throughput and maximum stability. The Reveal contains automated internal hardware for lamp referencing and for wavelength and photometric linearity validation, all of which can be performed at user-defined intervals. Standard communications in the system include WiFi, Ethernet, OPC, ModBus and Ethernet/IP

for upstream and downstream interface with distributed control systems, computers, or tablets. Sampling options range from flow cells with selectable path lengths, to measuring heads that mate to sight glasses in vessels, to fiber probes for contact or non-contact measurement in various insertion points.

Prozess provides a myriad of engineering solutions to integrate into customers' process streams. Hazardous area enclosures, additional analog and digital inputs and outputs, and sample head integration are just a few of Prozess' competencies to ensure a turnkey and trouble-free implementation. With high stability and genuine real-time measurement, the Reveal is a dependable device for monitoring moisture content in both continuous and batch processes.

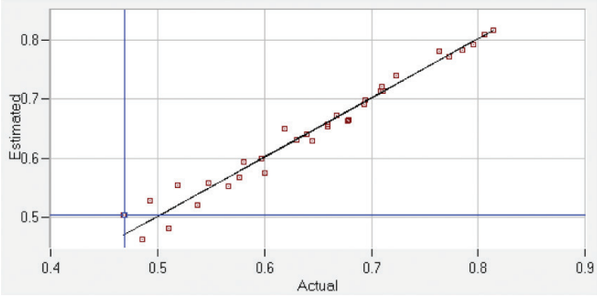


Figure 3: Partial least squares indicates strong correlation (R^2>0.97) to reported 1-methoxy-2-propanol concentration over the tested range with a standard predictive error of ±1.66% wt.

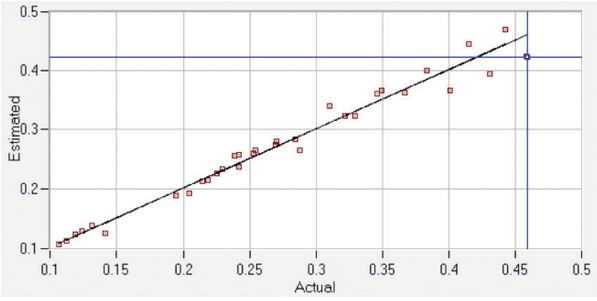


Figure 4: Partial least squares demonstrates a >97% correlation to the reported diacetone alcohol concentration over the tested range.

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