

Polymer Identification During the Manufacturing Process with Raman Spectroscopy

The quality of plastics is largely influenced by the quality of the polymer used during the manufacturing process. Therefore, identification of the polymer material composition, during production, is key to product testing and a crucial part of the Quality Assurance procedure. The tec5USA Raman Process Spectrometer allows for validation of the polymer material such as HDPE, polypropylene and Nylon 6,6. In addition, the spectrometer system supports the identification of unknown materials and even the prediction of polymer performance.



Raman Spectrometer

The analysis of these polymer processes is possible with the MultiSpec® Raman (versatile R&D System) or CompactSpec II Process Raman Spectrometer. The process version of the Raman Spectrometer can be tailored for various process environment enclosures, such as the explosion proof CID1 enclosure. The Raman Spectrometer utilizes a temperature-stabilized 785 nm laser with tunable output from 50 – 500 mW. It contains a highly sensitive CCD array (1024 x 58 pixel) used in conjunction with VPH transmission gratings which allows for straylight reduction, highly efficient dispersion and a wide spectral range of 300 – 3100 cm^{-1} . The fiber-bundle cross-section converter optimizes light throughput by forming a linear arrangement of fibers to create the spectrometer entrance slit. When used in conjunction with the Tidus XP Raman Immersion probe or the tecRaman probe, the 600 μm diameter fiber allows for high optical throughput. The tec5USA calibration procedure assures both high peak accuracy and a reproducible intensity correction.



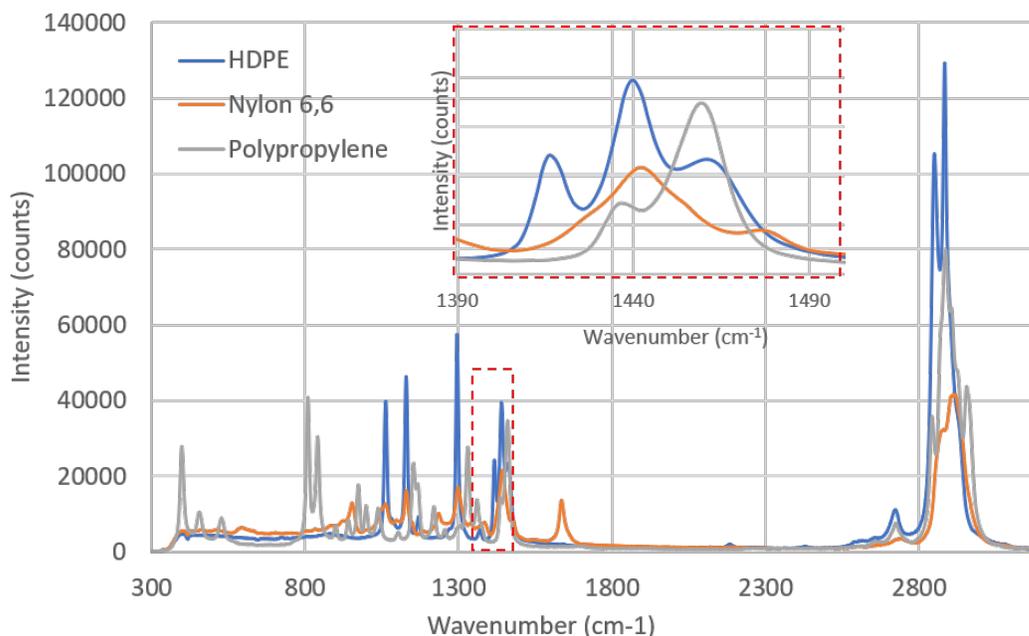
[MultiSpec® Raman Spectrometer – R&D System]



[Process Raman Spectrometer System]

Measurement

The MultiSpec® Raman Spectrometer system was used to identify 3 different polymer materials, where the vibrational bands of these polymers are observed by their Raman shift. Each polymer presented in this evaluation exhibit different spectroscopic features. For example, Nylon 6,6 shows a unique peak at 1635 cm^{-1} , polypropylene at 809 cm^{-1} and 842 cm^{-1} and HDPE at 1416 cm^{-1} . In addition, all three polymers show Raman features from 2800 cm^{-1} to 3000 cm^{-1} , which are attributed to $\nu(\text{C-H})$ vibrational bands. These individual vibrational bands are used to qualitatively and quantitatively identify each polymeric material.



tec5USA Spectroscopy Solutions

tec5USA offers tailored inline process spectrometers suitable for use in harsh industrial environments. Continuous monitoring enables true process verification, end-to-end supply chain optimization, consistent quality, yield maximization, and waste minimization. tec5USA offers optical multiplexers and switches up to 32 channels revealing significant cost-saving potential. High speed electronics allow for fast data acquisition and multiple averaging to increase measurement accuracy. MultiSpec®Pro II true process software incorporates various data acquisition modes, data processing and output options for full customizability. Various modules are offered including chemometric model prediction and a variety of process communication interfaces.

Conclusion

Raman spectroscopy is a powerful tool for analyzing polymers during production. The Raman Process Spectrometer allows for real-time identification of polymers during the manufacturing process.