INLINE NEAR INFRARED (NIR) SPECTROSCOPY FOR PROCESS CONTROL IN POLYMER EXTRUSION

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Extrusion is one of the most important processes in polymer industry. The characterisation of the polymer melt during processing will improve this process noticeably. One possibility of characterising the actual processed polymer melt is the inline near infrared (NIR) spectroscopy. With this method several polymer properties can be observed during processing, e.g. composition, moisture ormechanical properties of the melt.

For this purpose probes for transmission and reflection measurements have been developed, withstanding the high temperatures and pressures appearing during extrusion process (tested up to 300°C and 10 MPa). For the transmission system an optical bypass was developed to eliminate disturbing spectral influences and hence increase the long term stability, which is the prerequisite for an industrial application. Measurements in transmission and reflection produced comparable results for blending processes, where the prediction error was less than 1%. An optimum RMSEP of only 0.24% was found for preprocessed polymer blends measured in transmission on a laboratory extruder.

A transflection measurement allowed for the first time the recording of relevant NIR-spectra in the screw area of an extruder. The application to a (PE+PP) blending process delivered promising results. This new measurement mode allows the observation of the ongoing processes within the screw area, which is of maximum interest for reactive extrusion processes.

Due to economic reasons the calibration transfer between different extrusion systems is also of high importance. Investigations on simulated and real-world spectra showed that a calibration transfer is possible. A new method alternatively to the well-known direct standardization procedures was developed, which is based on an automatic data pretreatment. This procedure delivers comparable results for the calibration transfer.

Overall this paper presents concepts, components and algorithms for the inline near infrared (NIR) spectroscopy for polymer extrusion, which allows the use of it in a real industrial extrusion process.