

Quality Control of PVC foils

Easy and robust determination of PVDC layer thickness

Summary

PVC (polyvinyl chloride) foils with a PVDC (polyvinylidene chloride) coating are often used for high performance packaging films like pharmaceutical blister packs or in food packaging. In multi-layer blister films, the PVC serves as the thermoformable backbone structure, whereas the PVDC coating acts as a barrier against moisture and oxygen. The Water Vapor Transmission Rate (WVTR) and Oxygen Transmission Rate (OTR) are influenced by the composition and the thickness of the coating.

A fast way to monitor PVDC coating thickness is with near-infrared spectroscopy. Results are provided **in a few seconds**, indicating when adjustments in the polymer production process are necessary.

Experimental equipment



Figure 1. DS2500 Solid Analyzer

Several 250 m PVC foils coated with a PVDC layer of varying thickness (40 g/m^2 , 60 g/m^2 , 90 g/m^2) were measured on the DS2500 Solid Analyzer. The measurements were carried out in transfection mode using the NIRS gold diffuse reflector with 1 mm pathlength. This ensures that the spectral pathlength is constant while enhancing the spectral signal. The Metrohm software package Vision Air Complete was used for all data acquisition and prediction model development.

Table 1. Hardware and software equipment overview

Equipment	Metrohm number
NIRS DS2500 Solid Analyzer	2.922.0010
Vision Air 2.0 Complete	6.6072.208
NIRS gold diffuse reflector, 1 mm	6.7420.000
NIRS mini sample cup	6.7402.030



2.922.0010 - DS2500 Solid Analyzer

Robust near-infrared spectroscopy for quality control, not only in laboratories but also in production environments. The NIRS DS2500 Analyzer is the tried and tested, flexible solution for routine analysis of solids, creams, and optionally also liquids along the entire production chain. Its robust design makes the NIRS DS2500 Analyzer resistant to dust, moisture, vibrations, and temperature fluctuations, which means that it is eminently suited for use in harsh production environments. The NIRS DS2500 covers the full spectral range from 400 to 2500 nm and delivers accurate, reproducible results in less than one minute. The NIRS DS2500 Analyzer meets the demands of the pharmaceutical industry and supports users in their day-to-day routine tasks thanks to its simple operation. Thanks to accessories tailored perfectly to the instrument, optimum results are achieved with every sample type, no matter how challenging it is, e.g. coarse-grained solids such as granulates or semi-solid samples such as creams. The MultiSample Cup can help improve productivity when measuring solids, as it enables automated measurements of series containing up to nine samples.



6.6072.208 - Vision Air 2.0 Complete

Vision Air - Universal spectroscopy software. Vision Air Complete is a modern and simple-to-operate software solution for use in a regulated environment. Overview of the advantages of Vision Air: Individual software applications with adapted user interfaces ensure intuitive and simple operation; Simple creation and maintenance of operating procedures; SQL database for secure and simple data management; The Vision Air Complete version (66072208) includes all applications for quality assurance using Vis-NIR spectroscopy: Application for instrument and data management; Application for method development; Application for routine analysis; Additional Vision Air Complete solutions: 66072207 (Vision Air Network Complete); 66072209 (Vision Air Pharma Complete); 66072210 (Vision Air Pharma Network Complete);



6.7420.000 - NIRS gold diffuse reflector, 1 mm total pathlength

Gold diffuse reflector for the transfection measurement of liquids. Can be used in combination with the following instruments: NIRS DS2500 Analyzer (order number: 2.922.0010); NIRS XDS MasterLab Analyzer (order number: 2.921.1310); NIRS XDS MultiVial Analyzer (order number: 2.921.1120); NIRS XDS RapidContent Analyzer (order number: 2.921.1110); NIRS XDS RapidContent Analyzer - Solids (order number: 2.921.1210);



6.7402.030 - NIRS mini sample cups, 10 pcs. including 100 disposable backs

Mini sample cup for the spectral recording of powders and granulates in reflection. The sample cup can be sealed with disposable backs in order to avoid sample loss and for the uniform distribution of the powder or granulate in the sample cup. The sample cups are used with the following instruments: NIRS DS2500 Analyzer (order number: 2.922.0010); NIRS XDS MasterLab Analyzer (order number: 2.921.1310); NIRS XDS MultiVial Analyzer (order number: 2.921.1120); NIRS XDS RapidContent Analyzer (order number: 2.921.1110); NIRS XDS RapidContent Analyzer - Solids (order number: 2.921.1210);

Result

All 68 measured Vis-NIR spectra (**Figure 2**) were used to create a prediction model for quantification of PVDC layer thickness. The quality of the prediction model was evaluated using correlation diagrams, which display a very high correlation between Vis-NIR prediction and the reference values. The respective figures of merit (FOM) display the expected precision of a prediction during routine analysis.

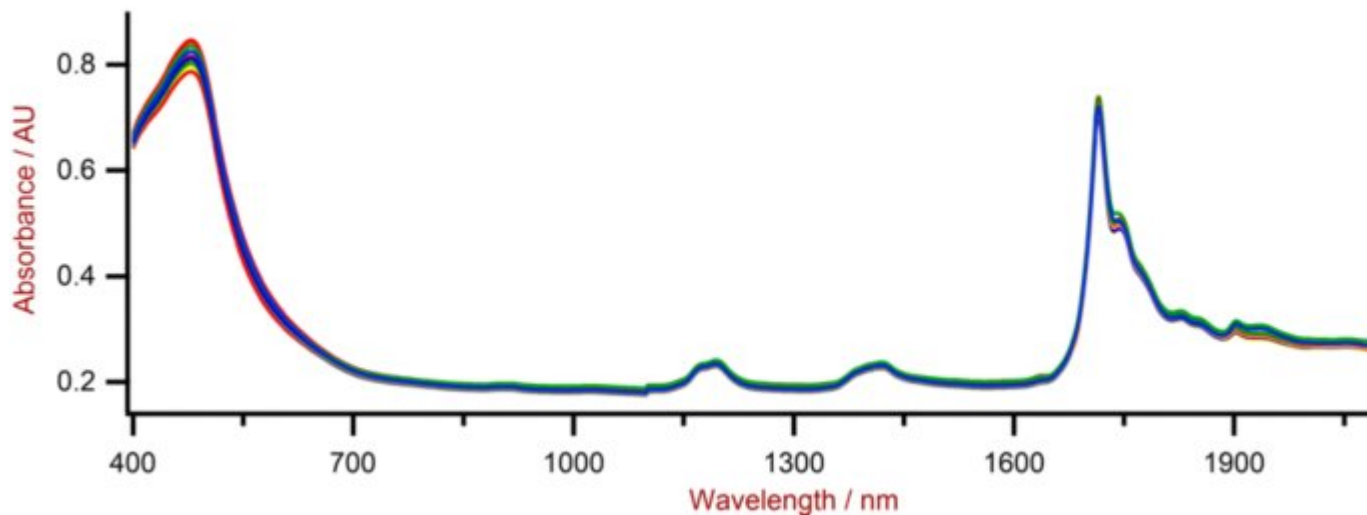


Figure 2. Vis-NIR spectra of PVC foils with different PVDC layer thicknesses measured on a DS2500 Solid Analyzer.

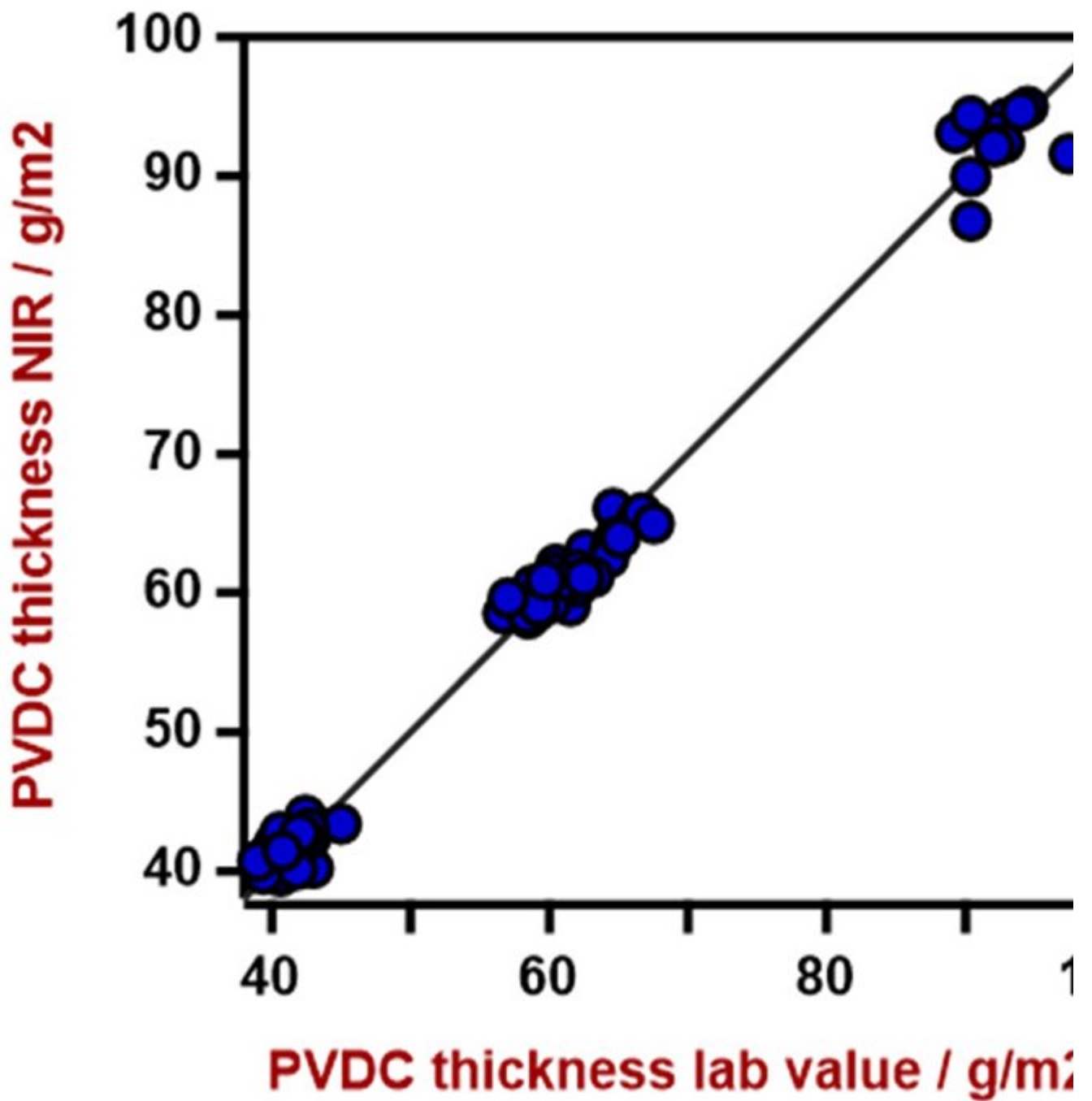


Figure 3. Correlation diagram for the prediction of PVDC layer thickness using a DS2500 Solid Analyzer.

Table 2. Figures of merit for the prediction of PVDC layer thickness using a DS2500 Solid Analyzer.

Figures of merit	Value
R ²	0.992
Standard error of calibration	1.7 g/m ²
Standard error of cross-validation	1.9 g/m ²

Conclusion

This application note demonstrates the feasibility of differentiating PVC foils coated with different PVDC layer thickness (40, 60, 90 g/m² PVDC on 250 µm PVC foils). The thickness of the PVDC layer could be successfully determined with NIR spectroscopy with an average difference with respect to the reference data of 2%. Vis-NIR spectroscopy enables a fast determination without any sample preparation, and therefore represents a suitable method to measure PVDC layer thickness.

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