



Application Note AN-NIR-112

近外光法定回收PET的特性粘度(IV)

Simple, chemical-free analysis with results in seconds

Determination of the intrinsic viscosity of recycled polyethylene terephthalate (rPET) is a time-consuming and challenging process. This is especially true if the sample is highly crystalline and needs to be dried before the analysis with the glass capillary as mentioned in the ASTM norm (ASTM D4603). The drying process often takes several hours until a constant weight is reached, and high crystallinity hinders solubility.

Near-infrared (NIR) spectroscopy is able to determine the intrinsic viscosity of rPET in less than one minute without any sample preparation. This Application Note demonstrates that the Metrohm DS2500 Solid Analyzer operating in the visible and near-infrared spectral region (Vis-NIR) offers users an easier way to perform this analysis without the use of toxic chemicals.

EXPERIMENTAL EQUIPMENT

48 different recycled PET samples with varying IV were measured on the Metrohm DS2500 Solid Analyzer, as well as with a glass capillary viscometer. All measurements on the DS2500 Solid Analyzer were performed in rotation to average the subsample spectra. This setup with

the large sample cup reduces the influence of the particle size distribution of the polymer pellets (**Figure 1**). Data acquisition and prediction model development was performed with the software package Vision Air Complete.



Figure 1. Metrohm DS2500 Solid Analyzer with the DS2500 large sample cup for measuring the intrinsic viscosity of recycled polyethylene terephthalate (rPET).

Table 1. Hardware and software equipment overview.

Equipment	Article number
DS2500 Solid Analyzer	2.922.0010
DS2500 large sample cup	6.7402.050
Vision Air 2.0 Complete	6.6072.208

RESULT

All 48 measured Vis-NIR spectra (**Figure 2**) were used to create a prediction model for quantification of intrinsic viscosity. The quality of the prediction model was evaluated using correlation diagrams which display a high

correlation ($R^2 = 0.9061$) between the Vis-NIR prediction and the reference viscosity values. The respective figures of merit (FOM) display the expected precision and confirm the feasibility during routine analysis (**Figure 3**).

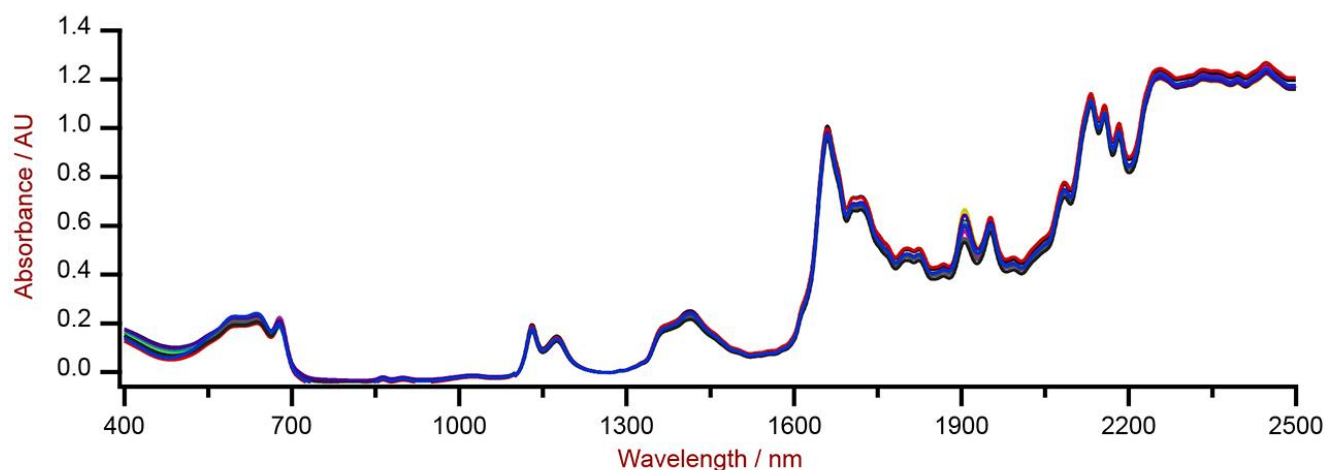


Figure 2. Selection of Vis-NIR spectra of rPET samples analyzed on a DS2500 Solid Analyzer with the large sample cup.

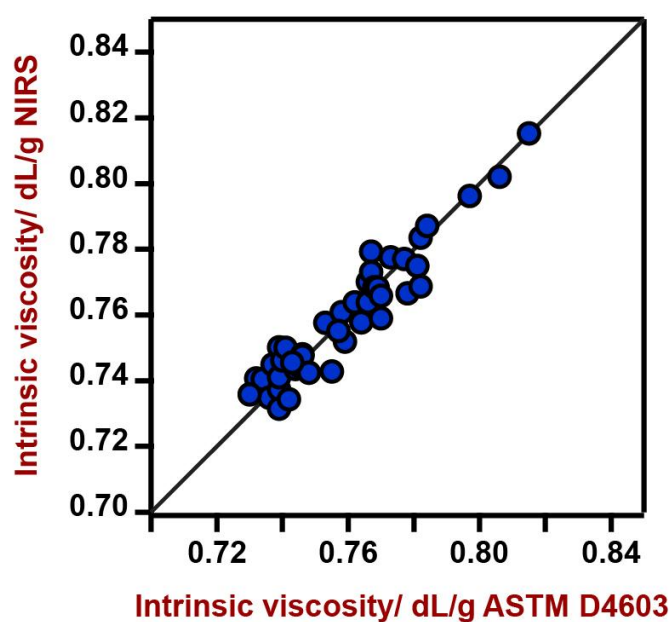


Figure 3. Correlation diagram and the respective figures of merit for the prediction of intrinsic viscosity in rPET using a DS2500 Solid Analyzer. The lab value was evaluated according to ASTM D4603.

Figures of Merit	Value
R^2	0.9061
Standard Error of Calibration	0.0068 dL/g
Standard Error of Cross-Validation	0.0084 dL/g

CONCLUSION

This Application Note demonstrates the feasibility of the Metrohm DS2500 Solid Analyzer for the determination of intrinsic viscosity in rPET. Vis-NIR spectroscopy enables fast determination (**Table 2**) without any sample preparation. In addition, the use of toxic

chemicals is obsolete which increases lab safety and avoids chemical waste. Next to intrinsic viscosity, additional parameters like diethylene glycol or isophthalic acid can be determined in rPET with Vis-NIR spectroscopy.

Table 2. Time to result overview for the parameter intrinsic viscosity (IV) in recycled polyethylene terephthalate (rPET).

Parameter	Method	Time to result
Intrinsic viscosity	Viscometer (ASTM D4603)	~2–3 h drying, dissolving, and measuring

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CONFIGURATION



DS2500 Solid Analyzer

固耐用的近外光,用于生境和室中的量。

DS2500 分析是的活解决方案,用于整个生程中的固体、乳膏和液体行常分析。其固耐用的使 DS2500 Analyzer 分析不受灰、湿度、振和温度波的影,因此非常用于在劣的生境中使用。

DS2500 涵盖了从 400 到 2500 nm 的整个光范,并能在不到一分内提供准和可再的果。DS2500 Analyzer 足制行的要求,并由于操作便而能助用完成其日常工作任。

由于与完美匹配,附件可以承受任何具有挑性的品型,例如:粒料之的粗粒固体或乳膏之的半固体品,可得最佳果。量固体的候,使用 MultiSample Cup 可以提高生率,可以自批批量最多 9 个品。



DS2500

用于在不同品位置使用 NIRS DS2500 Analyzer 采集粉末和粒反射光的大号品容器。