

Polyvinyl alcohol (PVA) analysis using FT-NIR

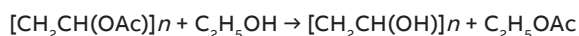


FT-NIR spectroscopy offers a fast and non-destructive technique to determine transesterification degree during polyvinyl alcohol synthesis.

Overview

Polyvinyl alcohol (PVA) is a water-soluble synthetic polymer used in manufacturing synthetic fabrics. It is also used as a suspension polymerization agent, as a base material in a variety of medical device applications due to its biocompatibility and as a base polymer for additive manufacturing (*e.g.*, 3D printing).

PVA is synthesized through polyvinyl acetate (PVAc) hydrolysis conducted by a base-catalyzed transesterification (*i.e.*, alcoholysis) with an alcohol, such as ethanol or methanol. The resulting reaction replaces the acetate groups into hydroxyl groups.



The degree of transesterification (*i.e.*, hydroxyl group conversion yield) is an important index because it has a direct correlation with the final PVA product properties. Conventionally, the degree of transesterification is measured offline by time-consuming laboratory titration methods. Alternatively, FT-NIR spectroscopy can be used as a fast and non-destructive technique to determine the degree of transesterification on both solid and liquid product forms.

Method

Instrument: MB3600-CH20

Detector: InGaAs 2.6 μm thermoelectrically cooled

Sampling technique:

- Solid: reflectance (Powder SampleIR)
- Liquid: transmittance in disposable vials (Universal Vial Holder)

Analysis temperature:

- Solid: room temperature
- Liquid: 50°C

Resolution:

- Solid: 32 cm^{-1}
- Liquid: 16 cm^{-1}

Number of scans:

- Solid: 256
- Liquid: 128

Acquisition time: less than a minute

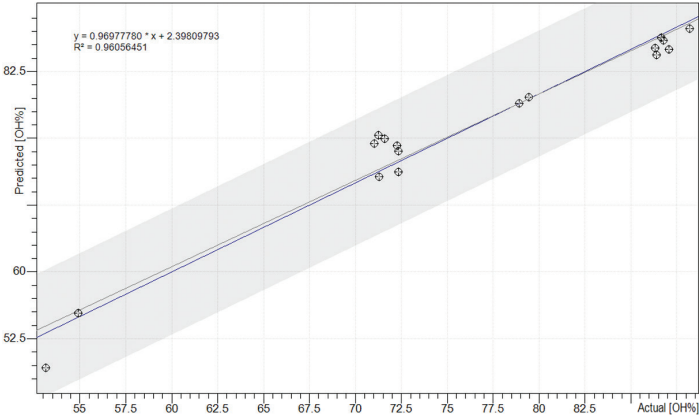
- 01 MB3600-CH20 with Universal Vial Holder accessory
- 02 Powder SampleIR accessory
- 03 Solid PVA calibration results
- 04 Liquid PVA calibration results



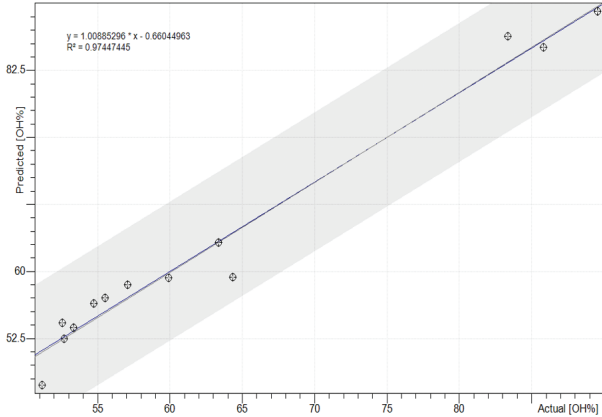
01



02



03



04

Product	Range (%)	r ²	SECV (%)
Solid PVA	71.04 - 88.20	0.9644	1.39
Liquid PVA	51.16 - 89.55	0.9745	2.24

Conclusion

The degree of PVA transesterification measured with the FT-NIR technique shows good agreement with the expected values. This study demonstrates that FT-NIR spectroscopy can be reliably used to quantify the transesterification degree of PVA products, as an alternative to slower laboratory methods.

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