

Application Note

Keywords

- Paper sorting
- Recycling
- Moisture and crystallinity

Techniques

- NIR spectroscopy
- Reflection

Applications

- Materials identification
- Paper recycling

Paper Sorting Using NIR Spectroscopy

Written by Ocean Optics Staff

Near infrared spectroscopy is a viable alternative to density and dynamic behavior techniques as a method for sorting paper in recycling operations. Moisture and crystallinity are among the criteria that can be used to differentiate a mixed stream of paper.

Experimental Conditions

We performed reflection measurements of paper and cardboard using a NIRQuest256-2.5 (900-2500 nm) with a 75 l/mm grating blazed at 1700 nm. An HL-2000-HP high-power tungsten halogen source and a QR600-7-VIS-NIR Reflection Probe completed the setup.



Reflection measurements were performed on three samples: white paper, grey cardboard and brown cardboard. The spectrometer integration time was 1 millisecond with the NIRQuest256-2.5 in high gain mode. This demonstrated there is enough signal present to make qualitative repetitive measurements. Spectral averaging was set for 100.

Equipment Used

- NIRQuest256-2.5 (900-2500 nm) with Grating NIR1 and 200 μ m slit
- HL-2000-HP High-power Tungsten Halogen Light Source (360-2500 nm)
- QR600-7-VIS-NIR Reflection Probe (600 μ m core diameter, 6.35 mm OD x 76.2 mm)

Results

Using NIR spectroscopy, we observed absorption dips at 1200 nm, 1450 nm and 1950 nm, primarily related to the absorption of water content in the paper (Figure 1). However, the peak at 1950 nm also correlates to O-H bands in the cellulose. Other dips are paper-specific.

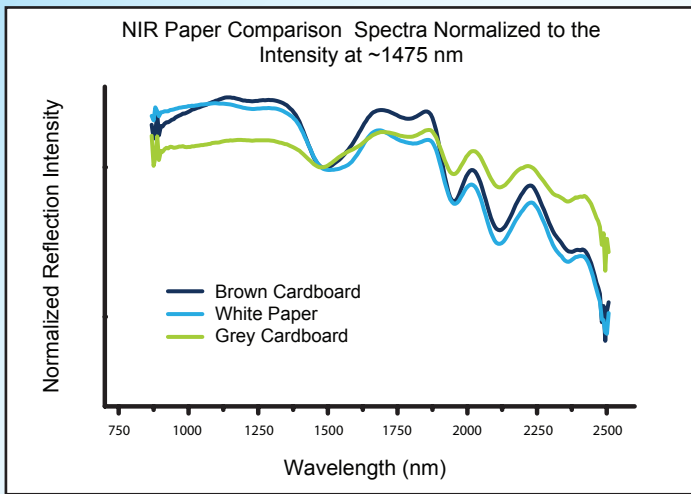


Figure 1: Absorption dips related to water content are observed for paper samples.

Also, differences in crystallinity can be detected in the NIR range. Because cardboard is often less crystalline than other paper, differences in crystallinity can be useful for differentiating cardboard versus white paper. Indeed, the ratios between the peaks of the different samples are very different. This suggests that different kinds of paper can be recognized by using chemometric analysis.

In addition to NIR analysis, UV-Vis spectroscopy can be used to identify white paper samples that have been bleached. That's because the whitening agent will fluoresce when excited with a ~405 nm source and provide a very distinct peak. 🌐

References

M. Alia, A.M. Emsley, H. Herman, R.J. Heywood. Spectroscopic studies of the aging of cellulosic paper, *Polymer* 42 (2001) 2893±2900 11 September 2000

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