

Abstract

Wide-area transmission NIR measurement for diverse solid samples

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Introduction

A wide-area transmission (WAT) NIR scheme that can illuminate a large sample area of 9.6 cm² has been used to measure diverse samples such as polyethylene (PE) pellets, rice and feed. For comparison, diffuse reflectance NIR spectra were also collected and resulting spectral features were compared with those from the transmission measurement. Finally, the resulting accuracies using PLS from both measurements were compared.

Materials and Methods

NIR radiation was collimated to a beam diameter of 3.5 cm and then directly illuminated onto sample packing. The packing thickness was optimised by considering sample shape, degree of transmittance and reproducibility. The transmitted radiation was delivered to an FT-NIR spectrometer for spectral acquisition.

Results and Discussion

In the case of granular samples such as PE pellet and rice, the baselines of transmission spectra varied largely and the spectral features observed were not consistent. When granular samples are packed, there is considerable void space inside the packing. The majority of radiation should interact with samples but some portion of radiation would propagate through the void space in the sample packing by successive reflections at sample surfaces. This radiation without full interaction with samples was a major source of unsatisfactory reproducibility. When a beam diffuser was positioned, the reproducibility of measurement was improved. The improved reproducibility of transmission measurement eventually led to better accuracy.

Conclusion

The WAT scheme has a strong potential for analysis of diverse granular-type samples and should compete with diffuse reflectance measurement which has been a default for NIR spectroscopic analysis of solid samples. As long as reproducibility of transmission measurement for solid samples can be confirmed, the resulting spectral features should be more selective and representative especially when a sample is inhomogeneous.