



Application Note AN-NIR-074

Quality control of liquid laundry detergents by NIR spectroscopy

Multiparameter determination of surfactants, dry matter, pH, and viscosity in a few seconds

Liquid laundry detergents contain fabric softeners, bleaching agents, surfactants, and enzymes. Of these, the surfactant is the most important contributor for the cleaning effect, as it breaks down the interface between polar and nonpolar compounds. This allows detergents to be effective cleaning agents against grease and stains. Surfactant content together with viscosity, pH value, and dry matter are important

quality control parameters in detergent formulations. Measurement of these parameters is usually performed by time-consuming primary analysis methods (e.g., two-phase potentiometric titration for surfactants), often requiring different techniques. Near-infrared spectroscopy (NIRS) is a fast, chemical-free alternative for use atline or in a quality control lab.

EXPERIMENTAL EQUIPMENT

Samples of liquid laundry detergent were measured at 30 °C in an OMNIS NIR Analyzer Liquid (Figure 1) in transmission mode (1000–2250 nm) using 8 mm disposable vials. Vessel temperature control was selected.

Reference values of dry matter were measured by loss on drying. The pH value and viscosity were measured with a pH meter and viscometer, respectively. Surfactant content in detergent was measured with potentiometric titration.

OMNIS Software was used for all data acquisition and prediction model development.



Figure 1. OMNIS NIR Analyzer Liquid/Solid with 8 mm vials.

RESULT

The obtained NIR spectra (Figure 2) were used to create prediction models for the quantification of dry matter, pH, viscosity, and surfactants in laundry detergent. The quality of the prediction models was evaluated using correlation diagrams which display

the relation between the NIR prediction and the reference values. The respective figures of merit (FOM) display the expected precision of a prediction during routine analysis (Figures 3–6).



Figure 2. NIR spectra of detergent analyzed on an OMNIS NIR Analyzer Liquid.

Result pH in liquid laundry detergent

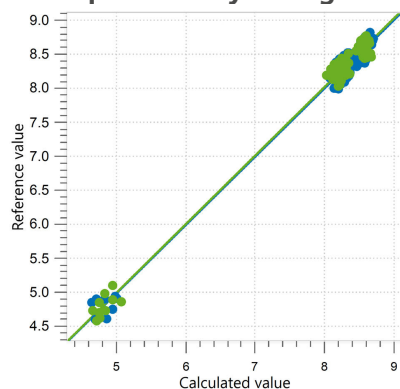


Figure 3. Correlation diagram and the respective FOMs for the prediction of pH value in liquid laundry detergent using an OMNIS NIR Analyzer Liquid. The correlation set is shown in blue, and the external validation set is in green. Reference values were obtained with a pH meter.

R^2	SEC	SECV	SEP
0.990	0.11	0.11	0.12

Result dry matter in liquid laundry detergent

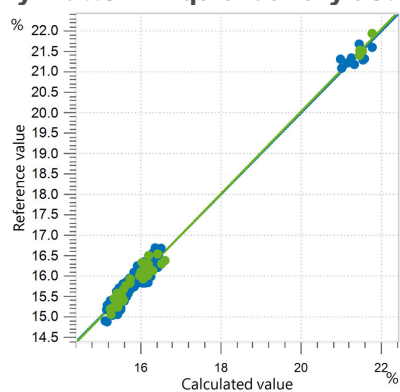


Figure 4. Correlation diagram and the respective FOMs for the prediction of dry matter in liquid laundry detergent using an OMNIS NIR Analyzer Liquid. The correlation set is shown in blue, and the external validation set is in green. Reference values were obtained via loss on drying.

R^2	SEC (%)	SECV (%)	SEP (%)
0.994	0.15	0.16	0.14

Result viscosity in liquid laundry detergent

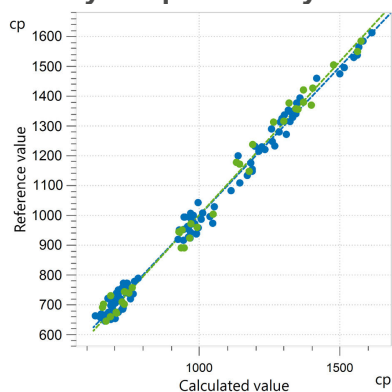


Figure 5. Correlation diagram and the respective FOMs for the prediction of viscosity of laundry detergent using an OMNIS NIR Analyzer Liquid. The correlation set is shown in blue, and the external validation set is in green. Reference values were obtained with a viscometer.

R^2	SEC (cp)	SECV (cp)	SEP (cp)
0.990	27.26	28.75	32.42

Result surfactant in liquid laundry detergent

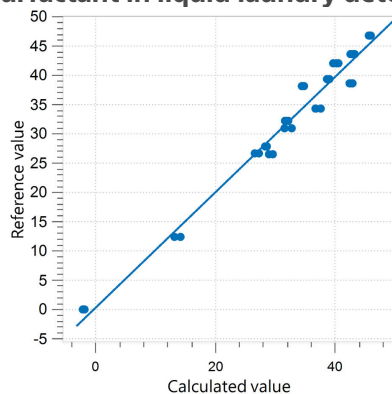


Figure 6. Correlation diagram and the respective FOMs for the prediction of surfactant content in liquid laundry detergent using an OMNIS NIR Analyzer Liquid. No external validation set was used. Reference values were obtained with potentiometric titration.

R^2	SEC (mmol/100g)	SECV (mmol/100g)	SEP (mmol/100g)
0.970	1.73	2.00	N/A

CONCLUSION

This Application Note shows the feasibility of using near-infrared spectroscopy for the analysis of dry matter, pH value, viscosity, and surfactant content in liquid detergent. These quality control parameters can be measured simultaneously in seconds without any chemicals or sample preparation.

NIRS saves laundry detergent manufacturers time and

money as it can be used in several steps of the production chain or during quality control of the final product. Additionally, only one technology is required with NIRS, compared to the other standard analytical techniques often used for these determinations (Table 1).

Table 1. Overview of standard methods used for the determination of different reference values in liquid laundry detergents.

Parameter	Method	Time to result
Dry matter	Loss on drying	30 min
pH	pH meter	5 min
Viscosity	Viscometer	15 min (sample preparation + measurement)
Surfactant (anionic)	Potentiometric titration	10 min (adding solutions, stirring, pH adjustments, determination)

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CONFIGURATION



OMNIS NIR Analyzer Liquid

Spectromètre proche infrarouge pour échantillons liquides.

L'OMNIS NIR Analyzer est la solution de spectroscopie proche infrarouge (NIRS) développée et produite selon les normes de qualité suisses pour les analyses de routine tout au long de la chaîne de fabrication. L'utilisation des technologies les plus récentes et l'intégration dans le logiciel OMNIS moderne se reflètent dans la vitesse, la facilité d'utilisation et la flexibilité d'utilisation de ces spectromètres NIR.

Vue d'ensemble des avantages de l'OMNIS NIR Analyzer Liquid :

- Mesures d'échantillons liquides en moins de 10 secondes
- Contrôle de la température sur l'échantillon de 25 °C à 80 °C
- Détection automatique de l'insertion et du retrait d'échantillons du récipient d'échantillon
- Intégration simple dans un système d'automatisation ou liaison avec d'autres technologies d'analyse (titrage)
- Prise en charge de nombreux récipients d'échantillon de différentes longueurs de chemin

Support OMNIS NIR, flacon, 8 mm

Support de flacon pour l'OMNIS NIR Analyzer pour flacons à usage unique de 8 mm (6.7402.240).





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Flacon à usage unique, 8 mm, transmission, Qté 100
100 flacons en verre (borosilicate) à usage unique avec une longueur de chemin de 8 mm pour des analyses de liquides lors d'une transmission. Les flacons à usage unique sont fournis avec les bouchons de fermeture correspondants (quantité = 100).

Compatible avec :

- Support OMNIS NIR, flacon, 8 mm (6.07401.070)
- Support DS2500 pour flacons à usage unique 8 mm (6.7492.020)

Licence OMNIS autonome

Elle permet l'exploitation autonome du logiciel OMNIS sur un ordinateur Windows™.

Caractéristiques :

- La licence comprend déjà une licence pour appareils OMNIS.
- Elle doit être activée via le portail d'octroi de licences Metrohm.

Licence logicielle Quant Development

Licence logicielle pour la création et l'édition de modèles de quantification dans une installation du logiciel OMNIS Stand-Alone.