



Application Note AN-NIR-086

# Quality Control of Diesel Exhaust Fluid

## Fast determination of urea content with high accuracy

The quality control of diesel exhaust fluids (DEF) is key to ensure the optimal catalytic performance and prevent damage to the exhaust system in diesel vehicles. The standard method to determine urea content is measuring the refractive index (ISO 22241-2:2019). The issue is that although this method is fast, it is not as accurate as other methods (e.g., HPLC). This

application note demonstrates that the DS2500 Liquid Analyzer provides a **fast solution with high accuracy** for the determination of urea in DEF. With **no sample preparation or chemicals needed**, visible near infrared (Vis-NIR) spectroscopy allows for the analysis of diesel exhaust fluids in **less than a minute**.

## EXPERIMENTAL EQUIPMENT

Aqueous urea samples with different urea content from 0.5% to 40% (v/v) were measured in transmission mode with a DS2500 Liquid Analyzer over the full wavelength range (400–2500 nm). Reproducible spectrum acquisition was achieved using the built-in temperature control at 40 ° C. For convenience, disposable vials with a path length of 2 mm were used, which made cleaning of the sample vessels unnecessary. The Metrohm software package Vision Air Complete was used for all data acquisition and prediction model development.



**Figure 1.** DS2500 Liquid Analyzer and a diesel exhaust fluid sample filled in a disposable vial.

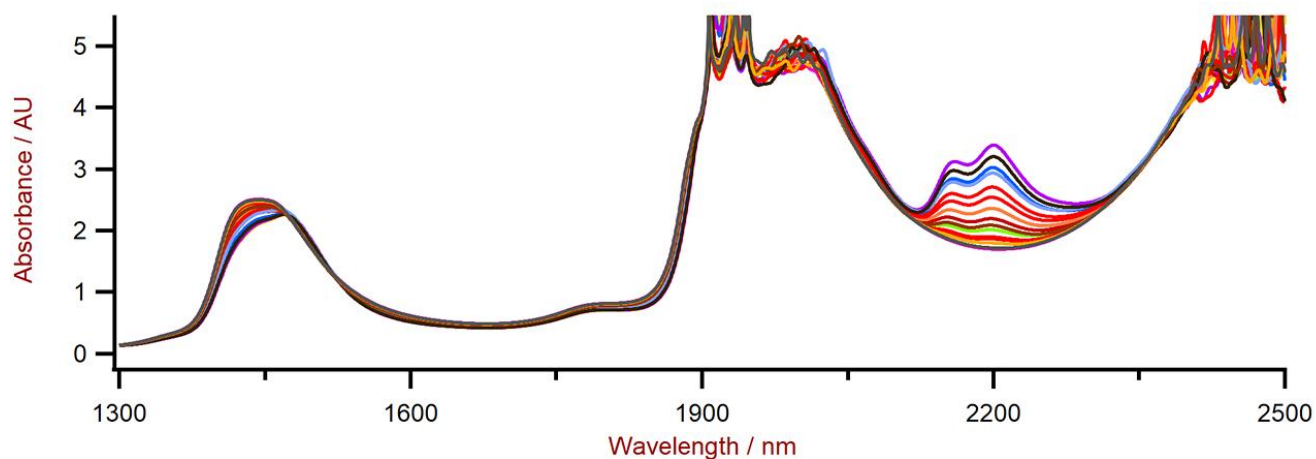
**Table 1.** Hardware and software equipment overview

Equipment	Metrohm number
DS2500 Liquid Analyzer	2.929.0010
Disposable vials, 2 mm diameter, transmission	6.7492.000
Vision Air 2.0 Complete	6.6072.208

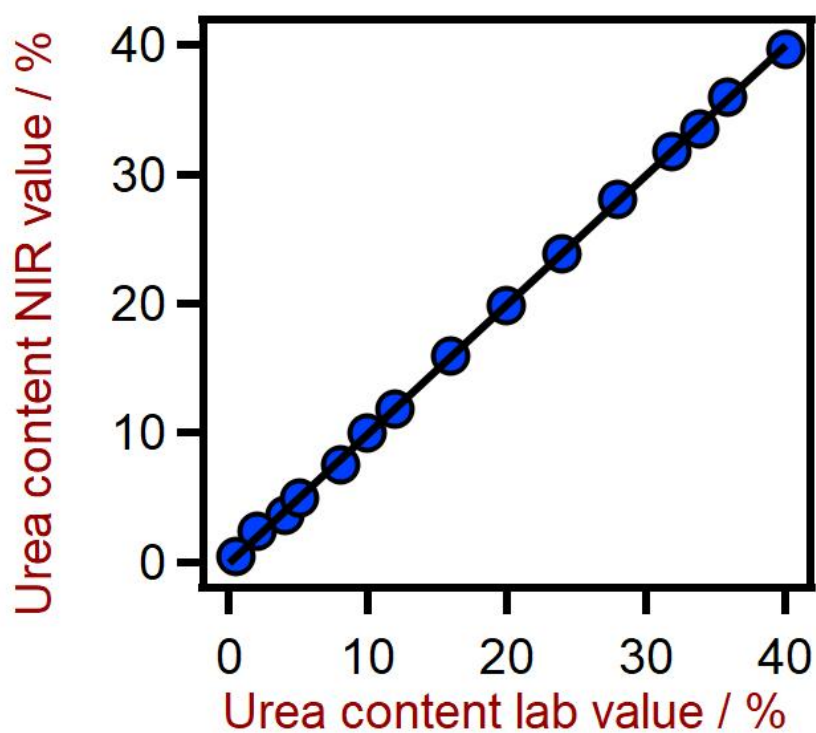
## RESULTS

All 16 measured Vis-NIR spectra (**Figure 2**) were used to create a prediction model for quantification of the urea content. The quality of the prediction models was evaluated using correlation diagrams, which display a very high

correlation between Vis-NIR prediction and primary method values. The respective figures of merit (FOM) display the expected precision of a prediction during routine analysis.



**Figure 2.** Vis-NIR spectra of diesel exhaust fluids with varying urea content measured on a DS2500 Liquid Analyzer.



**Figure 3.** Correlation diagram for the prediction of urea content in diesel exhaust fluids using a DS2500 Liquid Analyzer.

**Table 2.** Figures of merit for the prediction of urea content in diesel exhaust fluids using a DS2500 Solid Analyzer.

Figures of merit	Value
$R^2$	0.999
Standard error of calibration	0.23%
Standard error of cross-validation	0.25%

**CONCLUSION**

This application note demonstrates the feasibility of the DS2500 Liquid Analyzer for the determination of urea content in diesel exhaust fluids. Vis-NIR spectroscopy enables a fast determination with high accuracy, and therefore

represents a suitable alternative to the standard method. Additionally, it should be pointed out, that for further parameters such as density, similar NIR methods can be developed.

**Table 3.** Time to result for the urea content determination in aqueous urea solutions using HPLC

Parameter	Method	Time to result and workflow
Urea content	HPLC	~5 min (preparation) + ~10 min (HPLC)

Internal reference: AW NIR CH-0015-051520

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### DS2500 Liquid Analyzer

固耐用的近外光,用于生境和室中的量。

DS2500 Liquid Analyzer 是一成熟且活的解决方案,其用于在整个生中行液体常分析。其固耐用的使 DS2500 Liquid Analyzer 不受灰、潮湿、振的影,因此非常用于在劣的生境中使用。

DS2500 Liquid Analyzer 覆盖 400 至 2500 nm 的整个光范,将品加至 80° C 高温,并与各不同的一次性小瓶和石英比色皿兼容。因此,DS2500 Liquid Analyzer 可的个性化品要求,助在一分内得精和具有可重性的果。借助集成的品架装置和自的 Vision Air 件,保了用能松和安全地行操作。

如果是大的品量,可通将流通池与一个 Metrohm 机器人自器搭配使用的方法著提高生率。



### DS2500 2 mm

直径 2 mm 且更加智能的一次性玻璃小瓶支架



## Vision Air 2.0 Complete

### Vision Air – 通用的光分析件。

Vision Air Complete 是用于管范境的先易用的件解决方案。

Vision Air 点一:

- 独特的件用和配的用界面保了直的操作方式
- 操作程的建与方式
- SQL 数据,可安全且地管理数据

Vision Air Complete (66072208) 版本包含所有用于可近外光分析量保程的用:

- 器和数据管理用
- 方法用
- 常分析用

其它 Vision Air Complete 解决方案:

- 66072207 (Vision Air Network Complete)
- 66072209 (Vision Air Pharma Complete)
- 66072210 (Vision Air Pharma Network Complete)