# QuantaRed Laser Technology Revolutionises Oil in Water Measurement

**L. K. Hoffmann, T. Furch, W. Ritter & B. Lendl, QuantaRed Technologies GmbH**
Phorusgasse 8, A-1040 Vienna, Austria • Email: office@quantared.com • Website: www.quantared.com

**CFC-free measurements on site: the ERACHECK goes below 1 ppm**

The advent of Quantum Cascade Lasers (QCLs) as a new, powerful mid-IR light source has opened the possibility to develop a fast and ecologically friendly method for quantifying oil in production water and wastewater. After extracting the hydrocarbons with cyclohexane or cyclopentane instead of ozone depleting freon, precise concentrations can be determined by means of mid-IR laser spectroscopy.
The ERACHECK oil in water analyser was developed by QuantaRed Technologies GmbH, Austria (www.quantared.com), in cooperation with EralyticsTM GmbH, Austria (www.eralytics.com). The benchtop instrument is easy to use (touch screen operation) and allows CFC free measurements with high precision and sensitivity (sub-ppm concentrations). Due to its portability and a measurement time of only 2 minutes the ERACHECK may be used on-site as well as in mobile or stationary laboratories.

## The obstacles of standard methods

In the petrochemical industry there is a need for a portable analyser capable of rapid and accurate analysis of hydrocarbons in water in the low ppm range. Information on the hydrocarbon content is needed for process control as well as to comply with regulatory issues. Former well established methods for this parameter (DIN 38409-H18, ASTM 3921) were based on mid-IR spectroscopy. These methods required a liquid-liquid extraction step using fully halogenated solvents, in most cases 1,1,2 trichloro-1,2,2 trifluoro-ethane (CFC) prior to analysis by mid-IR spectroscopy. This method was well accepted in routine laboratories due to its simplicity and ease of use. However, due to environmental concerns, especially with regard to the ozone depleting effect of CFCs, alternative methods have been developed in recent years. In this context ISO 9377-2 needs to be mentioned as it is the new European standard method for measuring hydrocarbons in water. As DIN 38409-H18, ISO 9377-2 is based on a liquid-liquid extraction step which ensures complete recovery of the hydrocarbons from water as well as from the surfaces of sample containers. Extraction solvent hydrocarbons with a low boiling point, such as hexane or cyclopentane should be used. In contrast to DIN 38409-H18, ISO 9377-2 uses gas chromatography for quantifying the extracted hydrocarbons. This chromatographic step allows separation of the analytes from the extraction solvent and thus enables quantification of hydrocarbons present in the extraction solvent. Quantitative results are obtained from integration of the chromatogram between the retention times of decane (C10) and tetracontane (C40). Due to the nature of this analysis procedure a fully equipped laboratory is required to carry out ISO 9377-2. Therefore ISO 9377-2 cannot easily be implemented in portable analysers.

## QCLs make the difference

Quantum Cascade Lasers (QCLs) are new, powerful mid-IR light sources which enable combining the advantages of DIN 38409-H18 with those of ISO 9377-2. The new method for determining hydrocarbons in water was developed by QuantaRed Technologies GmbH in close cooperation with the Vienna University of Technology and with Eralytics GmbH. It is based on extracting the sample with a cyclic hydrocarbon, preferably cyclohexane or cyclopentane and measurement of the extracted hydrocarbons in the cyclic extraction solvent by mid-IR laser spectroscopy. This is made possible by the fact that non-cyclic hydrocarbons show IR absorptions slightly different from those of cyclic aliphatic hydrocarbons. Using QCLs it becomes possible to exploit these small differences for accurate determination of hydrocarbons in the low ppm and even sub-ppm range.

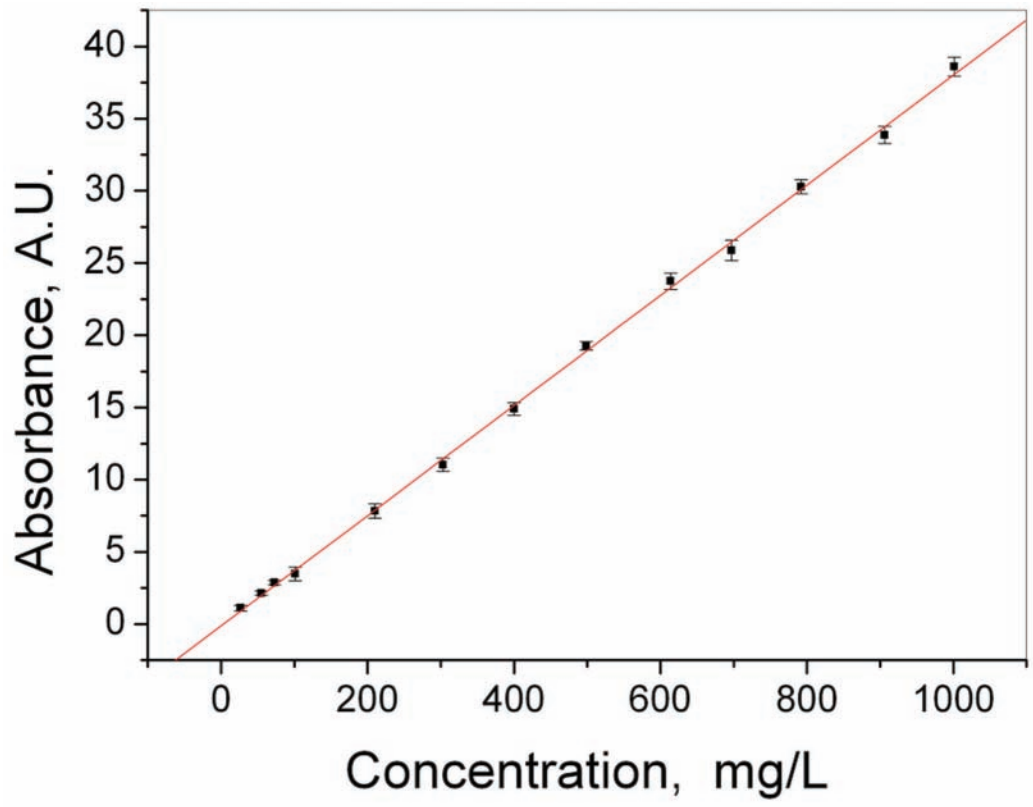


Figure 1: Calibration curve using hexadecane

With state of the art FTIR instrumentations it is not possible to measure hydrocarbons extracted into cyclohexane or cyclopentane at the desired concentration levels. However, when the FTIR instrument is replaced with a QCL, reliable measurements become possible, even at path lengths of several millimetres. This is due to the spectral power densities of QCLs, which are several orders of magnitude higher than those of thermal light sources employed in FTIR spectrometers.

## Never change a winning team

Whereas novel quantum cascade laser technology has practical benefits in terms of measurement quality and environmental issues, the procedure for extracting the hydrocarbons from water stays unchanged. When using cyclohexane or cyclopentane as the extraction solvent, complete recovery of the hydrocarbons in an aqueous sample can be achieved. Similar to DIN 38409 H18 and ISO 9377-2 the obtained extract can be dried with Na2SO4 and filtered over solid phase materials like Florisil® to remove polar components.

## ERACHECK – calibration and operation

The ERACHECK can be calibrated using standards containing the target hydrocarbon source or hexadecane standards, respectively, both dissolved in


Eracheck - Total oil and grease in water by QCL-IR technology

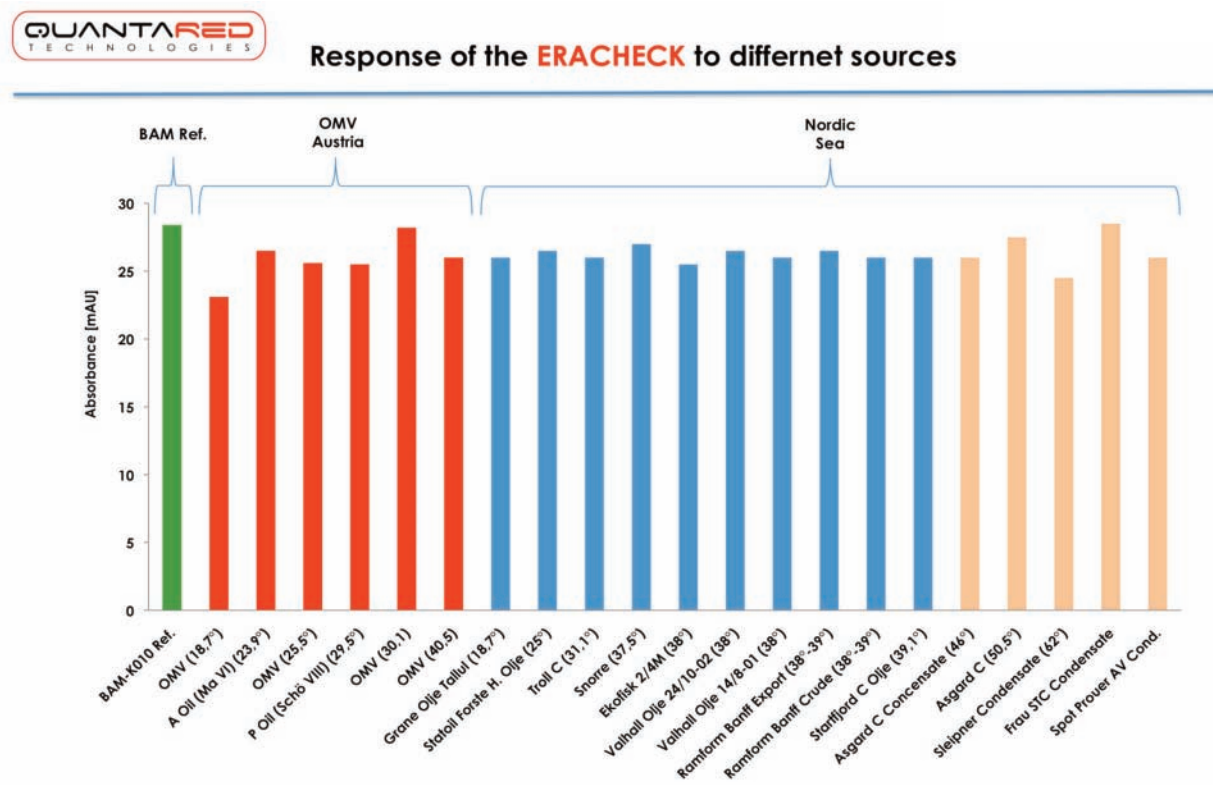


Figure 2: Response of the ERACHECK to 22 different 500ppm samples including crude oil and condensate in cycloheaxane

cyclohexane or cyclopentane. Different calibrations can be stored on the instrument and selected whenever necessary. Prior to sample measurement a background measurement needs to be performed which is stored on the instrument. Measurement of background and sample is accomplished within two minutes. Push button simplicity using the touch screen display also allows non-specialist personal to perform reliable measurements. Experimental data and results are stored on the instrument's PC and can be accessed via USB, Ethernet and RS 232 interfaces.

The linear range of the ERACHECK extends from 0.5 to 1000 ppm. A characteristic calibration curve established with hexadecane dissolved in cyclohexane is shown in Figure 1.

## One Calibration fits all

The capability of the ERACHECK to analyse samples from different sites in Austria and the North Sea, including crude oil and condensate samples, using one calibration, was assessed. For this purpose a constant amount (500 ppm) of these samples was dissolved in cyclohexane and measured with the ERACHECK. The results obtained were uniform as depicted in Figure 2. It is of special interest to see that no significant difference in the response of the ERACHECK between crude oil and condensate samples was observed. Therefore it may be concluded that using the ERACHECK it would be possible to analyse all studied samples using the same calibration. The BAM ("Bundesanstalt für Materialforschung und -prüfung") reference standard can be used as a reproducible hydrocarbon composition.

## Conclusion

Based on mid-IR quantum cascade laser technology the ERACHECK is capable to perform fast and reliable measurement of hydrocarbons in water from 0.5 to 1000 ppm. The ERACHECK method is CFC free and guarantees high precision and sensitivity. Due to its portability the ERACHECK provides reliable results on-site which save time and transportation costs.

# Novel Half-Inch Needle Valve Boosts Reliability In Viscous And Contaminated Media Applications

A novel new half-inch (12.7 mm) bore instrumentation needle valve gives plant engineers the means to improve reliability, and save both money and space, in process and instrumentation applications involving viscous and contaminated media. Today, such applications are often implemented using much larger and more expensive piping valves.

Believed to be the first of its type on the market, the half-inch needle valve has been developed by the instrumentation products division of **Parker Hannifin** (UK). Parker's new H-series needle valve is available in two forms: as either a discrete hand valve for controlling media flow, or integrated into a monoflange-style manifold for the safe 'double-block-and-bleed' connection of instruments to process lines.

The large flow path of the half-inch H-series needle valve makes it much less prone to blockages or related problems when dealing with viscous and contaminated media. Such issues can lead to measurement errors, necessitating costly maintenance or even process shutdown while problems are fixed. The new valve also offers a metal-to-metal seal. This provides a bubble-tight shut-off mechanism and operation over a very wide temperature range of -55 to +538°C in its standard stainless steel form.

The H-series valve has a bore size of 1/2 inch/12.7 mm, with a Cv value of 2.6. In its standard form the valve is fabricated from 316 stainless steel, and is rated for operation at pressures up to 6,000 PSIG (414 barg). The metal to metal sealing of the new valve also meets the firesafe requirements of ISO 10497 (the international equivalent to the API 607 and BS6755 Part 2 standards).

The valve design can help process engineers achieve new levels of compactness and performance in a wide range of process and instrumentation applications involving difficult media. These applications include level measurement in refineries, chemical injection, gas lines that are prone to hydrate formation, and process lines carrying dangerous gases. The monoflange variant in particular extends application potential, as these space-saving manifolds are often favoured in sensitive applications such as skids for oil and gas platforms. By extending the bore size of monoflange needle valves to half an inch, engineers can now employ monoflange form-factor manifolds on skids handling liquid or gas media that are prone to hydrate deposition - saving considerable weight and size compared with conventional double-block-and-bleed manifolds.

Reader Reply Card No 132

# Digital Pressure Gauge for Extreme Surroundings

With the Barflex, **Baumer** (Germany) offers a robust digital manometer with integrated data memory. In the ATEX version Barflex 4Y, it is also suitable for the use in rough and hazardous surroundings. It can measure the gauge and absolute pressure of almost all liquid and gaseous media in a range from 500 mbar to up to 1000 bar and with an accuracy of up to 0.1 % of full scale. Used as a barometer, the Barflex displays the atmospheric pressure from 200 to 1150 hPa with an accuracy of 1 hPa.

The digital pressure gauge is housed in a splash water-proof Epoxy-coated aluminium case and corresponds to the protection class IP65. It is available in a stationary and portable version and is most suitable for measurements on site. Via a standardized infrared interface, the collected data can be transferred directly to a PC. The device automatically memorises minimum and maximum pressures recallable at the display. The measurement of pressure deviations in a given time interval enables leak tests. In addition, the Barflex allows the calibration and verification of the correct operation of the installed devices as well as the verification of pressure switch and transmitter settings.

The Barflex is suitable for applications in pneumatic, hydraulic and thermodynamic areas as for example in gas engines, laboratories or maintenance. In its ATEX version, the Barflex can also be used for the petrochemical and gas industry, for example in gas underground stores, gas delivery installations or gas expansion systems.

Reader Reply Card No 196

# Moisture Measurement in Natural Gas

Combining a new laser based sensor with an integrated sample system, Aurora from **GE Sensing & Inspection Technologies** (UK) offers a complete solution for moisture measurement in natural gas processing, transmission, and distribution. Aurora utilises tunable diode laser absorption spectroscopy (TDLAS), to deliver reliable, accurate measurement data. With process information available in seconds, users can more efficiently manage their process, reduce downtime, and increase throughput of natural gas.

"Aurora represents a new measurement platform for our gas and moisture product line," says Tim Povall, General Manager of Measurement Solutions at GE Sensing & Inspection Technologies. "GE's expertise in moisture measurement technology coupled with extensive application knowledge in oil & gas allowed us to create a world class system to improve the operating efficiency for natural gas customers."

Aurora utilises a non-contact laser light, which is selective to water molecules in natural gas. With no sensor in contact with the gas, Aurora alerts operators of natural gas processing plants and pipeline systems when moisture concentrations are out of compliance within seconds and enables suppliers to be online faster following upset conditions. Once the process is corrected, Aurora assures the natural gas flowing back into the energy grid is sufficiently dry, meeting specifications in the minimum amount of time. Additionally, Aurora provides very accurate measurements of the moisture content in natural gas due to the highly selective TDLAS technology.

Reader Reply Card No 134