

Thermo Scientific PetroilQuant for ARL OPTIM'X 200W

X-Ray Fluorescence Analytical Package

PetroilQuant™ is a comprehensive analytical package which covers the widest range of elements and concentrations in a variety of petroleum industry products. In conjunction with the Thermo Scientific™ ARL™ OPTIM'X 200W spectrometer, PetroilQuant offers the most cost effective solution for any laboratory dealing with petroleum products.



As quality and environmental demands on the petroleum industry become stricter, key elemental contaminants require ever-lower levels of quantification, for example, stricter regulations on sulfur (S) in vehicle fuels, reduced trace metals that poison catalysts and induce corrosion such as nickel (Ni) and vanadium (V), and reduced catalyst fines containing aluminum (Al) and silicon (Si). The proven ability of Wavelength Dispersive X-ray Fluorescence (WDXRF) to produce highly reliable and repeatable results is increasingly solicited for such analyses in the petroleum industry. Its main advantages for such analyses are:

- Excellent repeatability
- Excellent resolution, especially for light elements (Na to Ca)
- High dynamic range (sub-ppm to 100 %)
- Flexibility in terms of measurement of analytical lines, background positions and internal references
- Little or no sample preparation in most cases (samples can be directly measured without dilution)
- Multi-element and multi-matrix capability

Numerous ASTM, ISO, IP and other international standard test methods have been developed for petroleum industry using WDXRF.

Our company offers a range of X-ray instruments and solutions depending on the elements needed, their concentration ranges, the variety of samples (liquids and solids) and the throughput requirements. The cost effective ARL OPTIM'X spectrometer (Figure 1) demonstrates compliance in routine but important dedicated applications (sulfur in fuels, additive elements to lubricants) per ASTM D 2622, ASTM D 4927, ISO 20884, and others. The instrument is noted for high sensitivity and stability across a wide range of petroleum applications. The advanced ARL PERFORM'X Series provides full capabilities for more demanding applications such as trace contaminant quantification in heavy fuels, wear metals in used lubricants, and fresh and spent catalyst characterization. The instruments are noted for high sensitivity and stability across a wide range of petroleum applications.

To provide faster solutions and meet tougher requirements in the evolving industry, we developed PetroilQuant, a unique pre-calibration program with petroleum analysts in mind.



ARL OPTIM'X WDXRF spectrometer

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PetrolQuant used in conjunction with the ARL OPTIM'X X-ray spectrometer is capable of quantifying up to 21 elements in a variety of light and heavy fuels, lubricants, crude oil and other petroleum process streams both quickly and cost-effectively (see also product specification PS41286 PetrolQuant for ARL PERFORM'X that allows analysis of up to 30 elements).

With PetrolQuant, Thermo Scientific X-ray spectrometers are calibrated for a series of elements in a wide dynamic range covering multiple petroleum matrices. PetrolQuant requires no analytical expertise and provides a "ready to run" analytical package for beginners as well as advanced users of our XRF instruments. Further refinement or fine tuning for specific elements can always be achieved either in the factory prior to shipment or after installation using the customer's own set of standards.

In addition to sulfur in light and heavy fuels, PetrolQuant covers other elements needed for blending control of fresh lubricants such as Zinc (Zn), Phosphorus (P), Chlorine (Cl), Calcium (Ca), Magnesium (Mg), Molybdenum (Mo), Silicon (Si), Barium (Ba) and others. The salient features of this unique package are:

- The pre-calibration program facilitates quantitative analysis for a number of elements in automotive fuels, lubricants, heavy residual oils and wear metals in lubricants
- PetrolQuant is developed with built-in knowledge and expertise in order to help the analyst deal with a variety of petroleum samples in wide concentration ranges
- PetrolQuant saves time and money as it offers a global calibration program which otherwise would require many standards, analytical expertise and instrument time
- In conjunction with ARL OPTIM'X or ARL PERFORM'X Series, it offers the most cost effective solution for any laboratory dealing with petroleum products.

PetrolQuant can be installed on ARL OPTIM'X equipped with the patented SmartGonio™ and is best suited for key elements in fuels and lubricants when the required throughput is reasonable. The program can also be installed on the ARL PERFORM'X Series for a more extended range of elements, lower concentration limits, higher throughput and faster speed of analysis. In addition, PetrolQuant facilitates further improvements to accuracy for specific elements whenever needed.

Instrumentation

- Low power WDXRF
- 200W
- No water cooling
- Plug and analyze cost effective solution
- SmartGonio: 3 crystals (LiF200, InSb, AX06)
- Helium environment
- Sample holders with 29mm diameter opening
- Liquid cells using spectrolene 6µm film

Specifications

A series of reference materials are used to derive calibration curves for analysis of additives in a petroleum base. A working curve is established for each element using the Multi-Variable-Regression incorporated in the instrument software package. This factory pre-calibration can be optimized on-site using customer's own standard samples. The standard PetrolQuant package for ARL OPTIM'X spectrometer includes up to 21 elements in petroleum products.

Analysis times typically range from 8 to 20 seconds depending on the element, the precision required and the power level. Table 1 shows typical limits of detection which are 3 sigma values from running a repeatability test on a blank oil sample.

The PetrolQuant pre-calibration includes a set of three setting-up samples for maintenance of the calibration curves over time (SUS Petro1 S703976, SUS Petro2

S703977 and SUS Petro3 A036472). No standard samples are delivered with this pre-calibration.

Pre-calibrated elements

Element	Range [%]	Typical SEE [ppm]	Typical LoD (3σ) [ppm] in 20s	Typical LoD (3σ) [ppm] in 100s
Al	LoQ-0.05	5.6	11.3	5.1
Ba	LoQ-0.8	6.6	6.4	2.9
Ca	LoQ-0.8	4.1	2.2	1.0
Cl	LoQ-2.5	6.1	9.3	4.2
Cr	LoQ-0.05	0.9	1.3	0.6
Cu	LoQ-0.05	0.8	1.2	0.5
Fe	LoQ-0.05	0.9	1.3	0.6
K	LoQ-0.05	2.7	1.4	0.6
Mg	LoQ-0.4	9.3	18.0	8.2
Mn	LoQ-0.05	0.7	1.3	0.6
Mo	LoQ-0.13	3.2	1.3	0.6
Ni	LoQ-0.05	0.6	1.4	0.6
P	LoQ-0.5	3.5	4.3	1.9
Pb	LoQ-0.05	2.3	4.4	2.0
S	LoQ-5.0	60.0	5.3	2.4
Sb	LoQ-0.05	5.3	10.3	4.6
Si	LoQ-0.13	1.6	3.6	1.6
Sn	LoQ-0.05	5.1	10.2	4.6
Ti	LoQ-0.05	1.2	2.3	1.1
V	LoQ-0.05	1.0	1.4	0.6
Zn	LoQ-0.5	1.0	1.0	0.5

Table 1: Concentration ranges and typical performance using the SmartGonio

SEE: Standard Error of Estimate is a measure of accuracy
LoD: Limit of Detection

LoQ: Limit of Quantification: $LoQ = 3 \times LoD$

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Africa-Other +27 11 570 1840
Australia +61 2 8844 9500
Austria +43 1 333 50 34 0
Belgium +32 53 73 42 41
Canada +1 800 530 8447
China +86 10 8419 3588
Denmark +45 70 23 62 60

Europe-Other +43 1 333 50 34 0
Finland /Norway/Sweden +46 8 556 468 00
France +33 1 60 92 48 00
Germany +49 6103 408 1014
India +91 22 6742 9434
Italy +39 02 950 591

Japan +81 45 453 9100
Latin America +1 608 276 5659
Middle East +43 1 333 50 34 0
Netherlands +31 76 579 55 55
South Africa +27 11 570 1840
Spain +34 914 845 965
Switzerland +41 21 694 71 11

UK +44 1442 233555
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