Elemental Analysis

PetroilQuant for ARL OPTIM'X

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, 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 of 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 the petroleum industry using WDXRF.

Figure 1. ARL OPTIM'X WDXRF Spectrometer.

Figure 2. Cylindrical cassettes are designed to hold oily and liquid samples during analysis.

Figure 3. PetroilQuant Calibration Package.

Thermo Fisher Scientific 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 instrument (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 advanced ARL PERFORM'X Series with IntelliPower™ 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. PetroilQuant is designed for use in conjunction with the ARL OPTIM'X X-ray spectrometer and can quantify up to 23 elements in a variety of light and heavy fuels, lubricants, crude oil, and other petroleum process streams both quickly and cost-effectively.

With PetroilQuant, Thermo Scientific X-ray spectrometers are calibrated for a series of elements in a wide dynamic range covering multiple petroleum matrices. PetroilQuant 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, PetroilQuant covers typical elements needed for blending control of fresh lubricants namely Zinc (Zn), Phosphorus (P), Chlorine (Cl), Calcium (Ca), Magnesium (Mg), Molybdenum (Mo), Silicon (Si), and Barium (Ba). Additional elements are available on option. They are listed in the appended table.

Main features of this unique package

- The pre-calibration program facilitates quantitative analysis for several elements in automotive fuels, lubricants, heavy residual oils and wear metals in lubricants.
- PetroilQuant is developed with built-in knowledge and expertise to help the analyst deal with a variety of petroleum samples in wide concentration ranges.
- PetroilQuant provides a "ready to run" analytical package for beginners as well as advanced users of our XRF instruments.
- PetroilQuant 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 Series, PetroilQuant offers a cost-effective solution for any laboratory dealing with petroleum products.

PetroilQuant can be installed on ARL OPTIM'X equipped with its unique 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 with its famous universal goniometer for a more extended range of elements, lower concentration limits, higher throughput, and faster speed of analysis. In addition, PetroilQuant facilitates further improvements to accuracy for specific elements whenever needed.

Instrumentation

ARL OPTIM'X
Low power WDXRF
50W or 200W
No water cooling
Plug and analyze cost effective solution
SmartGonio: Three crystals (LiF200, InSb, AX06)
Helium environment
Sample holders with 29 mm diameter opening

When using the ARL OPTIM'X 200W version instead of the 50W version, the counting times can be decreased by factor 2.5 and still reach the same performance as shown in this document.

Specifications

A series of reference materials are used to derive calibration working curves for analysis of additives in a petroleum base. This factory pre-calibration can be optimized on-site using customer's own standard samples. The standard PetroilQuant package for ARL OPTIM'X includes up to 23 elements in petroleum products.

Analysis times typically range from 8 to 20 seconds depending on the element and the precision required. A working curve is established for each element using the Multi-Variable-Regression incorporated in the instrument software package. This pre-calibration includes a set of setting-up samples for maintenance of the calibration curves over time. No standard samples are delivered with this pre-calibration.

Pre-calibrated elements

Element	Range [%]	Typical SEE [PPM]	Typical LOD on ARL OPTIM'X 50W (3 sigma) [PPM] Counting Time Shown	TYPICAL LOD on ARL OPTIM'X 50W (3 sigma) [PPM] in 100s counting Smartgonio	TYPICAL LOD on ARL OPTIM'X 200W (3 sigma) [PPM] in 100s counting Smartgonio
Mg	LoQ - 0.4	9	83 ppm in 20s	38	24
P	LoQ - 0.5	7.9	22 ppm in 20s	10	6.3
S low %	LoQ - 0.1	3	4.5 ppm in 20s	2	1.3
S high %	0.05 - 5	100	n.r.	n.r.	n.r.
Cl	LoQ - 2.5	19	22 ppm in 20s	10	6.3
Ca	LoQ - 0.8	9.5	3.2 ppm in 20s	1.5	0.9
Cu	LoQ - 0.12	1.3	1.8 ppm in 20s	0.8	0.5
Zn	LoQ - 0.5	5	1.6 ppm in 20s	0.6	0.4
Ba	LoQ - 0.4	2.2	11.2 ppm in 20s	5	3.2
Na	LoQ - 0.4	23	700 ppm in 20s	314	200
Al	LoQ - 0.06	3.4	9.4 ppm in 20s	4.2	2.7
Si	LoQ - 0.4	8	9 ppm in 20s	4	2.5
K	LoQ - 0.8	8	3.1 ppm in 20s	1.4	0.9
Ti	LoQ - 0.06	0.7	2.2 ppm in 20s	1	0.6
V	LoQ - 0.06	0.6	2.2 ppm in 20s	1	0.6
Cr	LoQ - 0.06	0.8	2.2 ppm in 20s	1	0.6
Mn	LoQ - 0.06	0.1	2.2 ppm in 20s	1	0.6
Fe	LoQ - 0.12	0.3	2.4 ppm in 20s	1.1	0.7
Ni	LoQ - 0.06	0.1	1.3 ppm in 20s	0.6	0.4
Br	LoQ - 0.06	0.5	2.9 ppm in 8s	0.8	0.5
Mo	LoQ - 0.4	5.8	2 ppm in 20s	0.9	0.6
Sn	LoQ - 0.06	2.9	22 ppm in 12s	7.6	4.8
Sb	LoQ - 0.06	0.6	22 ppm in 12s	7.6	4.8
Pb	LoQ - 0.12	0.6	3.8 ppm in 20s	1.7	1.1

SEE = Standard Error of Estimate is a measure of accuracy | n.r. = not relevant | LOD = Limit of Detection | The Limit of Quantification can be estimated from the LoD: LoQ = 3 x LoD

Learn more at **thermofisher.com/petroilquant**

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