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# EDXRF1293 - Analysis of S, Ni, V, Fe in Residual Oil



## Scope

The analysis of sulfur (S), nickel (Ni), vanadium (V), and iron (Fe) in residual oil is demonstrated.

## Background

Residual oil is the low-grade oil that remains after the distillation and refining of crude oil. Residual oil, also called resid, has many uses, including in the blending of bunker fuel, and the production of adhesives and asphalt. In some regions resid can be burned as a secondary fuel and may be further refined as a heating fuel. Characterization of the nickel and vanadium content is important for many reasons. Chief among these is that nickel and vanadium are considered catalyst poisons and need to be removed prior to the cracking of petroleum crude or residual oils. Applied Rigaku Technologies meets the industry analytical need with the NEX QC series of EDXRF analyzers. Fast and simple, the [NEX QC](#) provides an ideal tool for monitoring the concentrations of nickel, vanadium, and iron in resid as well as the sulfur content.

## Calibration

Empirical calibrations were built using a suite of 12 commercially available residual oil calibration standards. Alpha corrections are then employed to automatically compensate for variations in X-ray absorption and enhancement effects within the sample due to the independent variations in element concentration. A summary of the empirical calibrations is shown here.

Element	Concentration range
S	0.24 – 5.50 %
Ni	3 – 100 ppm

V	25 – 500 ppm
Fe	15 – 500 ppm

## Repeatability

To demonstrate repeatability (precision), two typical calibration standards were selected. Each was measured in 10 repeat analyses without moving the sample between measurements.

Sample: Std 2				
Element	Standard value	Average value	Std. dev	% Relative dev
S	0.50 %	0.503	0.007	1.4
Ni	10 ppm	11	0.6	6.0
V	500 ppm	501	5	1.0
Fe	300 ppm	300	3	1.0

Sample: Std 12				
Element	Standard value	Average value	Std. dev	% Relative dev
S	5.50 %	5.52	0.012	0.2
Ni	100 ppm	98	1.7	1.7
V	51 ppm	53	1.4	2.7
Fe	50 ppm	48	2.1	4.2

Sample: Std 5				
Element	Standard value	Average value	Std. dev	% Relative dev
S	2.00 %	2.03	0.008	0.4
Ni	40 ppm	42	1.3	3.3
V	100 ppm	102	1.1	1.1
Fe	201 ppm	198	4.6	2.3

## Conclusion

The NEX QC offers analysts a simple yet powerful and versatile system for quantifying elemental composition using the empirical approach. The results of this study indicate that given stable samples, proper sample handling, and proper calibration technique, the Rigaku NEX QC EDXRF can achieve excellent results in monitoring the concentration of sulfur, nickel, vanadium, and iron in residual oil.

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## Related products



### **NEX QC II Series**

Compact, intuitive benchtop EDXRF for everyday elemental testing