Application Note EDXRF3279

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EDXRF3279 - Sulfur in Oil by ASTM D4294

Scope

The analysis of sulfur in petroleum oil according to ASTM D4294 is demonstrated using the Rigaku NEX QC II EDXRF analyzer. The performance shown is applicable for the measurement of 17 mg/kg to 5% sulfur in petroleum and petroleum products, including:

- crude oil
- residual oil
- bunker fuel
- diesel fuel
- kerosene
- jet fuel
- heating oil
- hydraulic oil
- naphtha
- lubricating base oil

Background

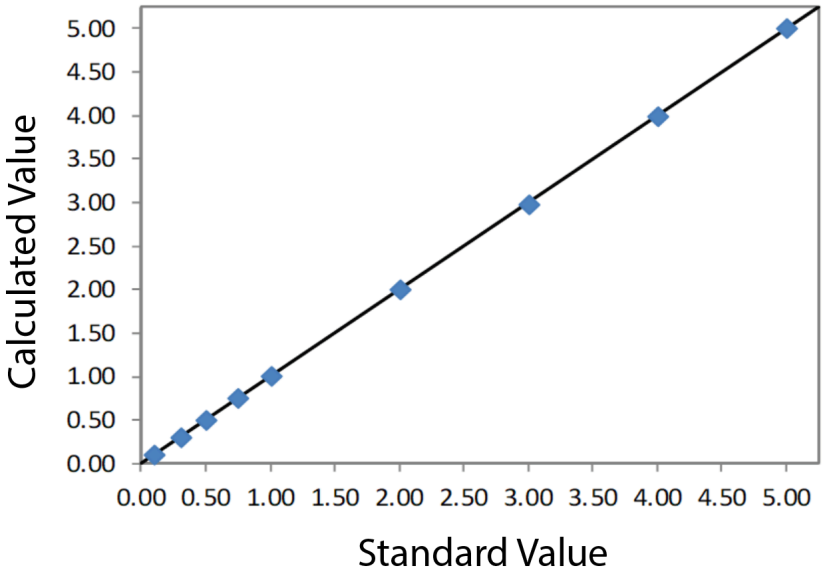
Sulfur is an important element in crude oils and fuel oils. Sulfur content is regulated in many products and plays an important role in fuel quality and the control of pollutant emissions. Around the world, regulations limit the amount of sulfur allowable in diesel fuels, kerosene, heating oils, and other petroleum products, affecting the price and quality of crude oil based on its sulfur content. Reliably characterizing the sulfur content of crude oils helps ensure proper quality for various refinery feedstocks and optimum blending ratios when blending different crudes to meet a desired sulfur concentration. Monitoring sulfur is also important when characterizing other similar oils, such as residual oils and bunker

fuels. To meet the needs of the industry, Rigaku offers the NEX QC II, a simple and versatile benchtop EDXRF analyzer for the analysis of sulfur and other elements in petroleum and petroleum products according to ASTM D4294 and other international test methods.

Calibration — broad range

An empirical calibration was developed using a set of commercially available certified standards in mineral oil.

Element: Sulfur **Units: mass %**		
Sample I.D.	**Standard value**	**Calculated value**
2	0.1000	0.1045
3	0.3000	0.3066
4	0.5000	0.4962
5	0.7500	0.7523
6	1.0000	1.0147
7	2.0000	2.0000
8	3.0000	2.9898
9	4.0000	3.9961
10	5.0000	5.0062



Correlation plot Sulfur broad range

Repeatability (precision) — broad range

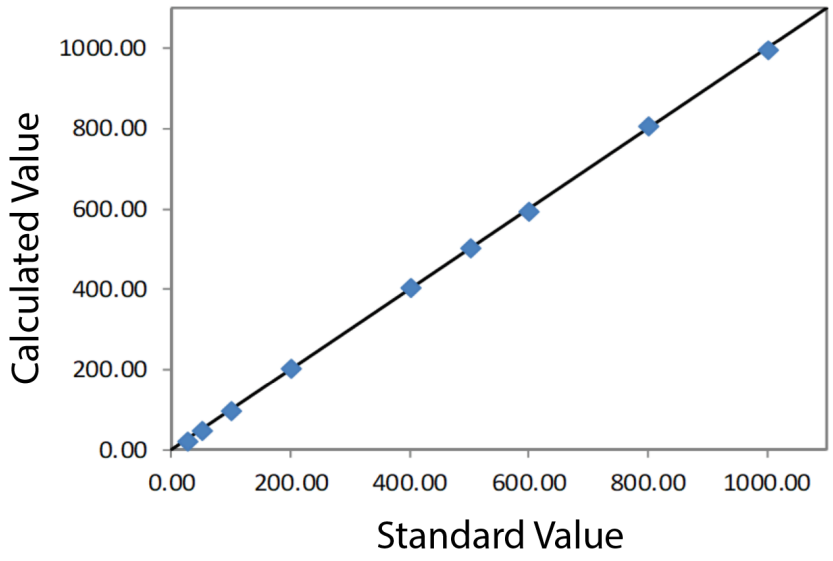
Repeatability (precision) is demonstrated below. Each sample was measured in a static position.

Element: Sulfur **Units: mass %**				
Sample I.D.	**Standard value**	**Average value**	**Std. dev**	**% Relative**
2	0.1000	0.1052	0.0007	0.7
6	1.0000	1.0145	0.0047	0.5
10	5.0000	5.0078	0.0110	0.2

Calibration — low range

An empirical calibration was developed using a set of commercially available certified standards in mineral oil.

Element: Sulfur **Units: mg/kg**		
Sample I.D.	**Standard value**	**Calculated value**
2	25	23
3	50	50
4	100	98
5	201	205
6	400	403
7	500	504
8	600	593
9	800	805



Correlation plot Sulfur low range

Repeatability (precision) — low range

Repeatability (precision) is demonstrated below. Each sample was measured in a static position.

Element: Sulfur **Units: mg/kg**				
Sample I.D.	**Standard value**	**Average value**	**Std. dev**	**% Relative**
2	25	27	1	4.0
4	100	99	1	1.0
10	1001	1010	2	0.2

International standard test methods

The Rigaku NEX QC II complies with the following international standard test methods for measuring sulfur in crude oil and petroleum products. Note that by weight, 1 ppm = 1 mg/kg.

ASTM D4294	**ISO 20847**	**ISO 8754**	**IP 496**	**IP336**	**JIS K 2541-4**
17 mg/kg – 5 mass %	30 – 500 mg/kg	100 mg/kg – 5 mass %	100 mg/kg – 5 mass %	100 mg/kg – 5 mass %	0.01 – 5 mass %

Conclusion

The results presented here demonstrate the performance of the Rigaku NEX QC II for fast and simple measurement of sulfur in oil in air, without the need for helium purge. With single-position or batch analysis, the NEX QC II provides a practical solution for ASTM D4294 sulfur measurement upstream, midstream, downstream, and in commercial laboratories.

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