



TECHNICAL NOTES

Analysis of Naphtha

Introduction

Naphtha is commonly used as a fuel in gas turbines. The presence of certain elements, such as Ca, Pb, V and the alkali elements, can cause the formation of hard deposits which significantly shorten the lifetime of the turbines. The detection limit capability of an axial plasma is an excellent match for the requirements of this analysis.

Elements

Ag, Al, As, B, Ba, Ca, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Ni, P, Pb, Se, Si, Sn, Ti, V, Zn

Instrumentation

Leeman Labs Prodigy High Dispersion ICP

- State-of-The-Art, Large Format, Programmable Array Detector (L-PAD)
- Long Focal Length Optical System
- Temperature Controlled Optical System
- Image-Stabilized ICP Source
- Computer Controlled Source Mirror
- Operator Selectable Input Slit
- Axial, Radial or Dual View



ICP Parameters

RF Power	1.3 kW
Coolant Flow	20 l/min
Auxiliary Flow	1.5 l/min
Plasma View	Axial
Nebulizer Pressure	12 psi
Nebulizer Type	Concentric
Torch	Narrow Bore
Spray Chamber	Cooled Cyclonic Without Baffle
Chiller Temperature	-10°C
Uptake Rate	0.5 ml/min
Integration Time	60 sec

Element Parameters

For each wavelength, the *Prodigy* uses a 15 pixel wide by 3 pixel high subarray, which is centered on the wavelength of interest. Background correction points and the analytical peak have both position and width values within the subarray. In the table, the position value is designated by "x" in the column header, while "w" indicates the width. The default position for the analytical peak is 7 with a width of 3. All data in the subarrays are collected simultaneously. In addition, all pixel data are saved, permitting recalculation of results at a later time. An example of a subarray is shown in **Figure 1**.

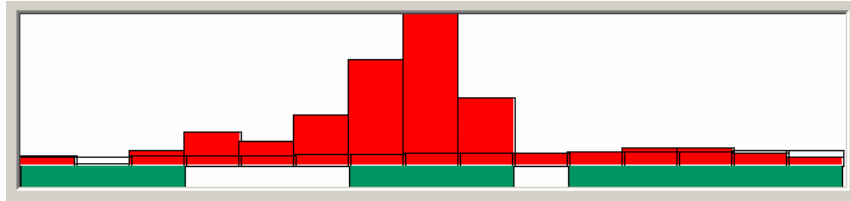


Figure 1 As 189.042 Sub-array data

Element		LBG X	LBG W	Peak	Peak W	RBG X	RBG W
Line		Left Background Position	Left Background Width	Peak Position	Peak Width	Right Background Position	Right Background Width
Ag 328.068		1	4	7	3	12	4
Al 396.152		3	3	7	3	11	3
As 189.042		1	3	7	3	11	5
B 208.890		1	4	7	3	13	3
Ba 455.403		5	1	7	3	12	4
Ca 317.933		1	5	7	3	12	4
Cd 214.441		1	4	7	3	12	4
Cr 267.716		1	4	7	3	11	4
Cu 324.754		1	4	7	3	12	4
Fe 259.940		1	4	7	3	12	4
K 766.491		4	3	7	3	14	2
Mg 279.553		1	4	7	3	12	4
Mn 257.610		1	4	7	3	12	4
Mo 277.540		1	4	7	3	12	4
Na 588.995		3	2	7	3	14	0
Ni 221.648		1	4	7	3	14	2
P 213.618		1	1	7	3	12	4
Pb 220.353		1	3	7	3	12	4
Se 196.090		1	4	7	3	12	4
Si 251.611		1	4	7	3	12	4
Sn 189.991		1	3	7	3	11	3
Ti 334.941		4	0	7	3	11	5
V 310.230		1	4	7	3	12	4
Zn 206.200		3	3	7	3	12	4

Calibration Standards

Calibration standards were made by dissolving metallo-organic standards in naphtha. The concentrations used for all elements were 0, 1, 2 and 5 ppm.

A typical calibration curve is shown in **Figure 2**.

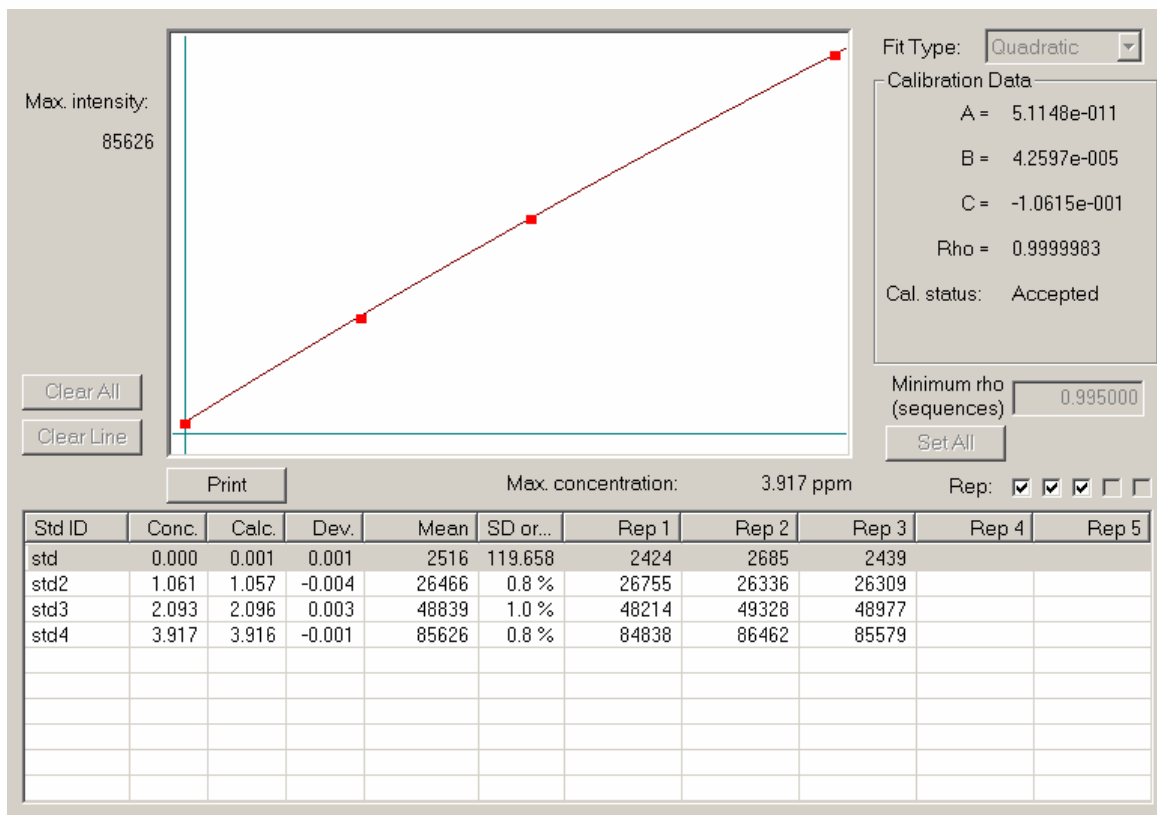


Figure 2 As 189.042 nm Calibration Curve

Detection Limits

The detection limits are determined by analyzing the blank and multiplying the standard deviation by 3.

Element	DL, ppb
Ag 328.068	4.1
Al 396.152	31.0
As 189.042	29.8
B 208.890	28.0
Ba 455.403	0.7
Ca 317.933	4.4
Cd 214.441	0.9
Cr 267.716	2.0
Cu 324.754	2.1
Fe 259.940	1.6
K 766.491	23.9
Mg 279.553	0.1
Mn 257.610	0.4
Mo 277.540	7.6
Na 588.995	17.5
Ni 221.648	2.5
P 213.618	12.0
Pb 220.353	10.3
Se 196.090	18.4
Si 251.611	4.5
Sn 189.991	6.8
Ti 334.941	1.4
V 310.230	1.9
Zn 206.200	1.0

Conclusion

The Teledyne Leeman Labs Prodigy ICP is able to provide direct analysis of highly volatile organic solvents, such as naphtha. Because of the robust plasma generated by the free-running 40.68 MHz generator, no dilution of the solvent is necessary. As a result, excellent detection limits are achieved, minimal sample preparation is required and sample throughput is maximized.