Elvatech
Advanced XRF equipment and solutions

ElvaX ProSpector in Environmental analysis

Introduction

ElvaX ProSpector is a fast, accurate and easy tool for non-destructive environmental screening. It provides in situ and intrusive analysis of pollutants in soils and sediments. ElvaX ProSpector meets all the requirements of EPA Method 6200 and measures all harmful metals including RCRA 8s and priority pollutant metals (except Be).

Application

ElvaX ProSpector solves several environmental problems:

- Soil and sediment analysis. Both in-situ and lab measurement of harmful metals in soils according EPA 6200.
- Liquids analysis. Measurement of toxic pollutants in waste water, lead in paint.
- Air pollutants analysis. Measurement of air filters according EPA IO-3.3.

Instrumentation

There are two models of ElvaX ProSpector: Standard Edition and Light Edition. Standard edition equipped with 40 kV Tungsten anode tube and Si-PIN detector and allows to determine elements from Cl to U.

Both instruments provide accurate analysis of all 26 elements listed in EPA Method 6200.

For light elements analysis, including Mg, Al, Si, P, S ProSpector Light Edition is needed. It equipped with a 40 kV Rhodium anode tube, 5 different filters and high resolution large area Silicon Drift Detector (SDD), which provides excellent energy resolution, lower detection limits and shorter measurement times comparing with the standard edition.

ElvaX ProSpector is rugged and light (around 1.5 kg) and provides full-day (8 hours) of constant operations on battery. Device has intuitive user interface and requires very little operation training.

Typical measurement screen in soil mode is demonstrated at fig. 1.

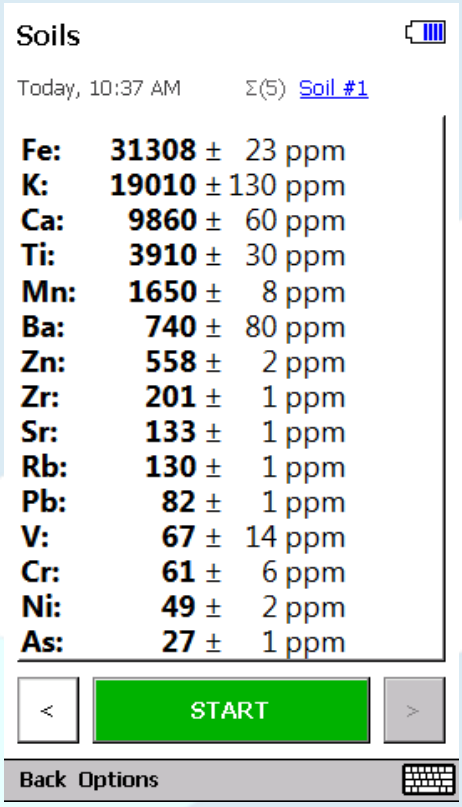

Figure 1. Soils mode testing screen.

Method

ElvaX ProSpector can be used for both in-situ (measuring the soil directly) and ex-situ(measuring prepared samples) analysis.

For in-situ analysis, operator must remove debris from soil surface first, and then tap soil to increase density and compactness.
It is strongly recommended to make several measurements around point of interest and average this measurements using software averaging option.

For more accurate measuring sample preparation is required.

1. Collect sample from 4*4 inch square of soil and 1 inch depth.
2. Thoroughly mix sample in beaker or plastic bag. Monitor homogenization with sodium fluorescein dye.
3. Dry 20-50 grams of sample for 2-4 hours at a temperature no greater than 150 °C.
4. Ground sample until 90% of original sample passes through a 60-mesh sieve.
5. Place sample in standard 32mm XRF sample cup and perform analysis

Total analysis time depends from instrument configuration and required accuracy. Accuracy increases with measurement time increasing. Usually, 30 seconds for ProSpector and 10 seconds for ProSpector LE is enough.

Testing results

1. Soil and sediment.

ElvaX Prospector LE was tested for its performance in measuring soil sample NCS DC73382 (Table 1) and lake sediment sample CANMET LKSD-2 (Table 2).

Element	Lab, ppm	ElvaX Prospector, ppm
K(%)	2.15	2.16
Ca(%)	1.23	1.33
Ti	4830	4702
V	86	82
Cr	62	61
Mn	1760	1957
Fe(%)	3.63	3.62
Ni	20.4	42
Cu	21	13
Zn	680	658
As	34	31
Rb	140	152
Sr	155	159
Zr	245	233
Mo	1.4	0.3
Ba	590	791
Pb	98	101

Table 1. Comparison of reference and measured values for DC73382 soil sample.

Element

	Lab, ppm	ElvaX Prospector, ppm
Ti	3460	3226
V	77	95
Cr	57	52
Mn	2020	1987
Fe(%)	4.3	4.5
Co	17	21
Ni	26	25
Cu	37	34
Zn	209	198
As	11	13
Rb	85	86
Sr	220	250
Zr	254	261
Ba	780	805
Pb	44	41
Th	13.4	21

Table 2. Comparison of reference and measured values for LKSD-2 sediment sample.

Another important parameter of XRF device is measurement repeatability. The NIST 2710 soil sample was measured 10 times over a period of time. An average, standard deviation (Std Dev) and relative standard deviation (RSD) for elements is soil was calculated. Results are given in Table 3.

Element	Concentration values, ppm		% RSD
	Average	Std Dev	
K, %	2.27	0.027	1.188
Ca, %	1.34	0.019	1.414
Ti	2708	38.4	1.418
V	359	15.4	4.29
Mn, %	1.15	0.006	0.522
Fe, %	3.49	0.012	0.344
Cu	2822	18	0.638
Zn	6443	23.6	0.366
As	626	10.8	1.725
Rb	91.6	1.2	1.31
Zr	98.2	2.28	2.322
Sr	277	2.1	0.758
Pb	4884	22	0.45

Table 3. Repeatability test for NIST 2710 soil sample.

2. Air particulate on filter media.

Limit of Detection (LOD) for air filters analysis was determined using empirical method. Blank filter sample was analyzed ten times and the standard deviation was calculated. LOD is defined as three times the standard deviation.

LOD for various measurement times is shown at table 4.

Limit of Detection, ng/cm2				
Element	**Time, minutes**			
	5	**10**	**20**	**60**
Al	30.9	21.9	15.5	8.9
Si	13.1	9.3	6.5	3.8
Ca	32.4	22.9	16.2	9.3
Ti	7.9	5.6	4	2.3
Cr	2.3	1.6	1.2	0.7
Mn	0.4	0.3	0.2	0.1
Fe	6.6	4.7	3.3	1.9
Ni	0.2	0.2	0.1	0.1
Cu	3	2.1	1.5	0.9
Zn	5.9	4.2	3	1.7
Pb	0.7	0.5	0.4	0.2

Table 4. Typical detection limits (3 sigma).

Actual detection limits may vary from filter material and combination of presented elements.

Comparison between LOD determined in EPA method IO-3.3 and ElvaX ProSpector (acquisition time one hour) demonstrated at figure 2.

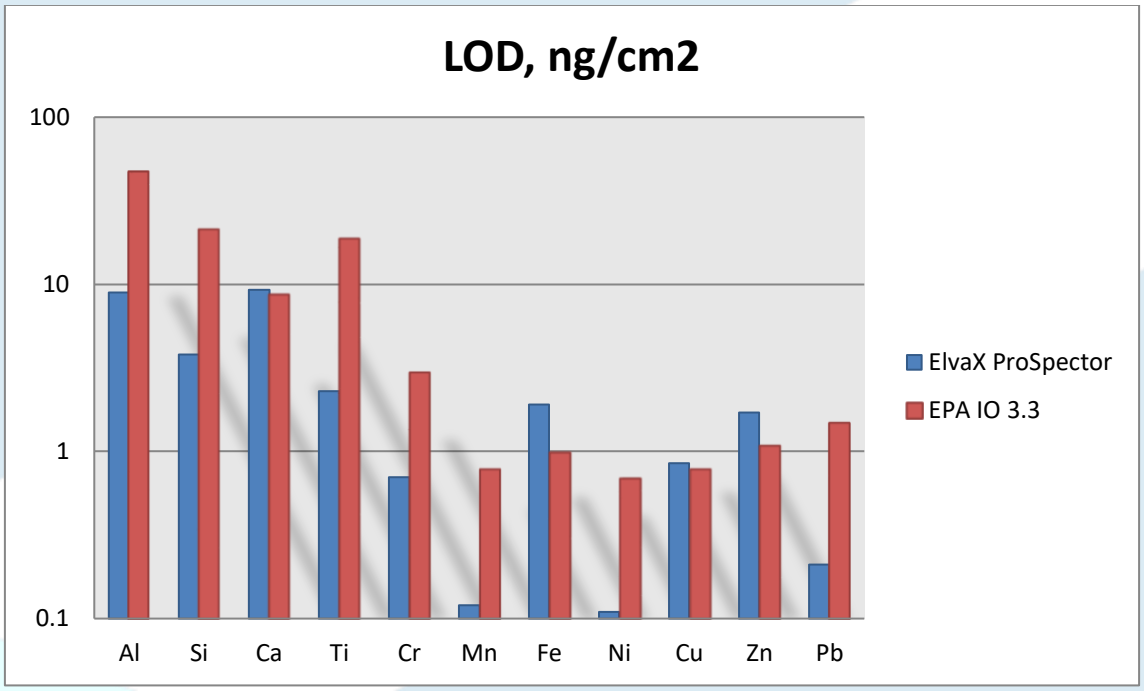

Figure 2. Detection limits using ElvaX ProSpector compared with those reported by EPA IO-3.3.

Conclusions

The results shown demonstrate the ability of ElvaX ProSpector instrument to analyze heavy metal pollutants in soils, sediments according EPA Method 6200. Good correlation between lab and measured values was obtained.

Detection limits for air filters analysis by EPA Method IO-3.3 was calculated.

Our instrument offer rapid testing for fast decision making and cost saving comparing with off-site laboratory.