

ElvaX ProSpector in air pollution analysis

Introduction

Monitoring of air pollution in industrial areas and big cities is a key task for the human health preservation. The most dangerous air pollutant is particulate matter. It is microscopic solid or liquid matter suspended in Earth's atmosphere.

Particle pollution includes "inhalable coarse particles," with diameters larger than 2.5 micrometers and smaller than 10 micrometers (PM₁₀) and "fine particles," with diameters that are 2.5 micrometers and smaller (PM_{2.5}).

Particle pollution contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. The size of particles is directly linked to their potential for causing health problems. Small particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream.

Application

The analysis of particulate matter elemental composition is the main factor in forecasting health effects of pollution. Suspended particles are collected on Teflon or Nuclepore filters. EPA method IO-3.3 describes elemental analysis of air filters using energy-dispersive XRF spectrometers.

ElvaX spectrometers provide air filter analysis according EPA method IO-3.3.

Instrumentation

ElvaX ProSpector LE was used for this application note. It is equipped with 40 kV Rh anode tube and Silicon drift detector (SDD), which provides light elements analysis, higher count rate and better energy resolution.

Lab stand is required because of long measurement times (5-10 minutes).

ElvaX Light with 50 kV x-ray tube is a better choice for heavy metals analysis, such as barium and cadmium.

Method

Air filters can be measured without any sample preparation. In air filters with typical loadings, peak intensity from each element is a linear function from an amount of this element. So, a linear empirical calibration was made.

Typical measurement time in light mode is 3 minutes, and in heavy mode is 5 minutes.

Results

Limit of Detection (LOD) 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 1.

Limit of Detection, ng/cm ²				
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 1. 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 1.

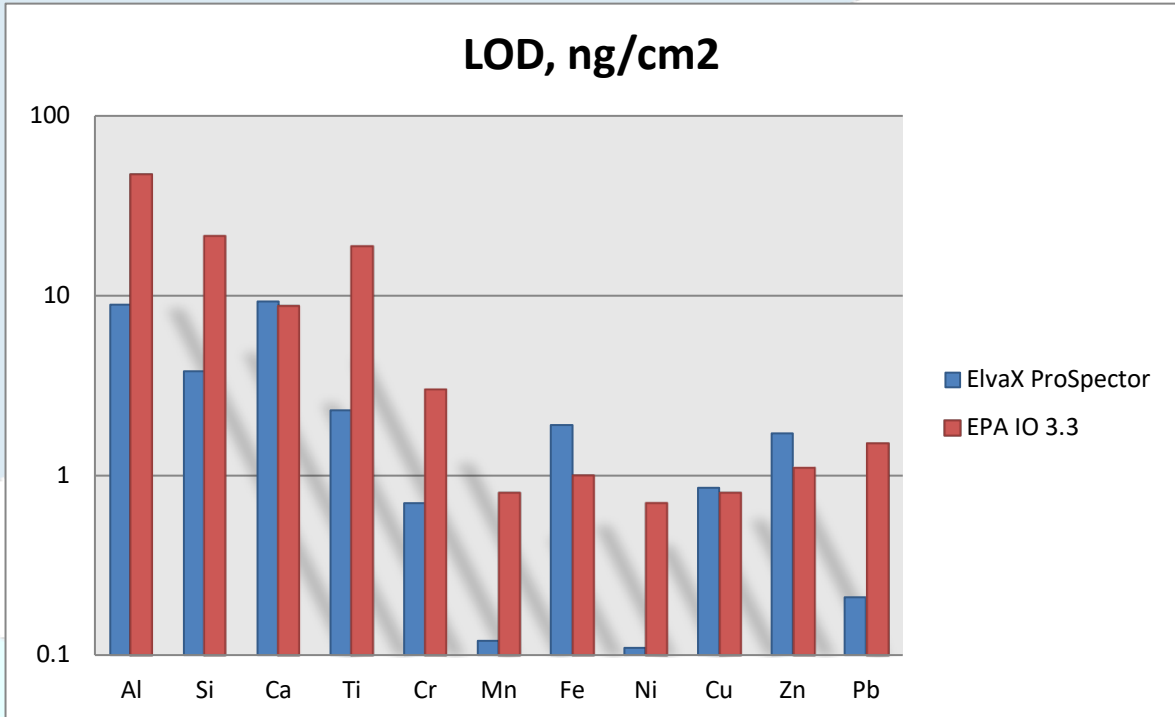


Figure 1. Detection limits using ElvaX ProSpector compared with those reported by EPA IO-3.3.

Conclusions

ElvaX ProSpector is a good choice for air filter analysis according EPA method IO-3.3. Device doesn't require any sample preparation and offers a precision for a wide element range.

Obtained results demonstrated good instrument sensitivity and low detection limits.

Lab stand, designed especially for ElvaX ProSpector, converts your handheld device to lab and allows air filter analysis.