ElvaX ProSpector for Regulatory Compliance

Introduction

A lot of European, US and international directives has been introduced for reducing the impact of harmful elements in consumer goods on human health and environmental. The best technique for screening of products for heavy metals and restricted substances is X-ray fluorescence analysis due to its excellent sensitivity (lead, mercury, chromium, antimony and other hazardous elements can be detected at ppm level), high performance and non-destructive testing.

ElvaX ProSpector offers compliance testing for different directives, such as ROHS, WEEE, ELV, according ASTM F2617-15.

Application

ElvaX Prospector solves a lot of tasks, including following restricted hazardous substance directives:

- **EU RoHS II**. Restricted substances: *Pb, Hg, Cd, Cr, PBB, PBDE* in electronic equipment;
- **EU WEEE**. The same restricts, as in RoHS, but in waste electronic equipment;
- **EU ELV**. Restricts an amount of certain heavy metals, such as cadmium, lead, mercury and hexavalent chromium in end of live vehicles;
- **USA CPSIA 2008.** It limits the lead content in toys to 100 ppm level;
- **USA Halogen free Directive;**
- **California Proposition 65;**

And testing methods:

- **ASTM F2617-15.** Standard Test Method for Identification and Quantification of Chromium, Bromine, Cadmium, Mercury, and Lead in Polymeric Material Using Energy Dispersive X-ray Spectrometry.
- **ASTM F963-11.** Standard Consumer Safety Specification for Toy Safety.
- **CPSC-CH-E1001-08.3.** Standard Operating Procedure for Determining Total Lead (Pb) in Children's Metal Products.
- **CPSC-CH-E1002-08.3**. Standard Operating Procedure for Determining Total Lead (Pb) in Nonmetal Children's Products.

Instrumentation

ElvaX ProSpector is a handheld ED-XRF spectrometer equipped with 40kV tungsten anode tube, 5 primary beam filters and Silicon drift detector (SDD) or PIN detector. Instrument provides measurement of all toxic elements listed in majority regulatory directives.

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.

You can customize the display choosing between ppm and PASS/FAIL mode. ElvaX ProSpector will automatically identify plastic or metal and choose appropriate measurement mode.

Typical measurement screen in ppm mode is shown at Fig. 1, and PASS/FAIL mode is demonstrated at Fig. 2

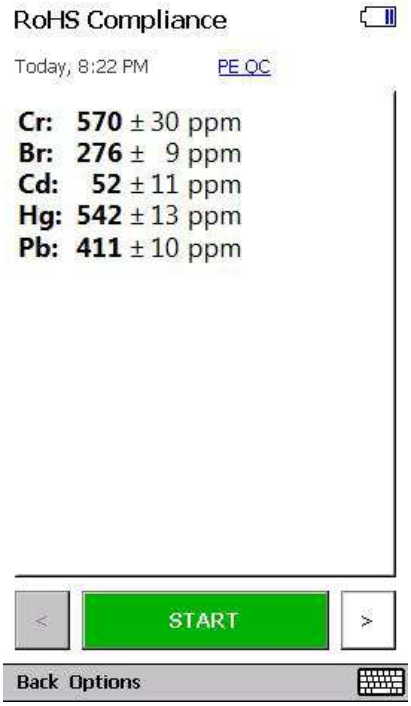

Figure 1. Measurement screen in ppm mode.

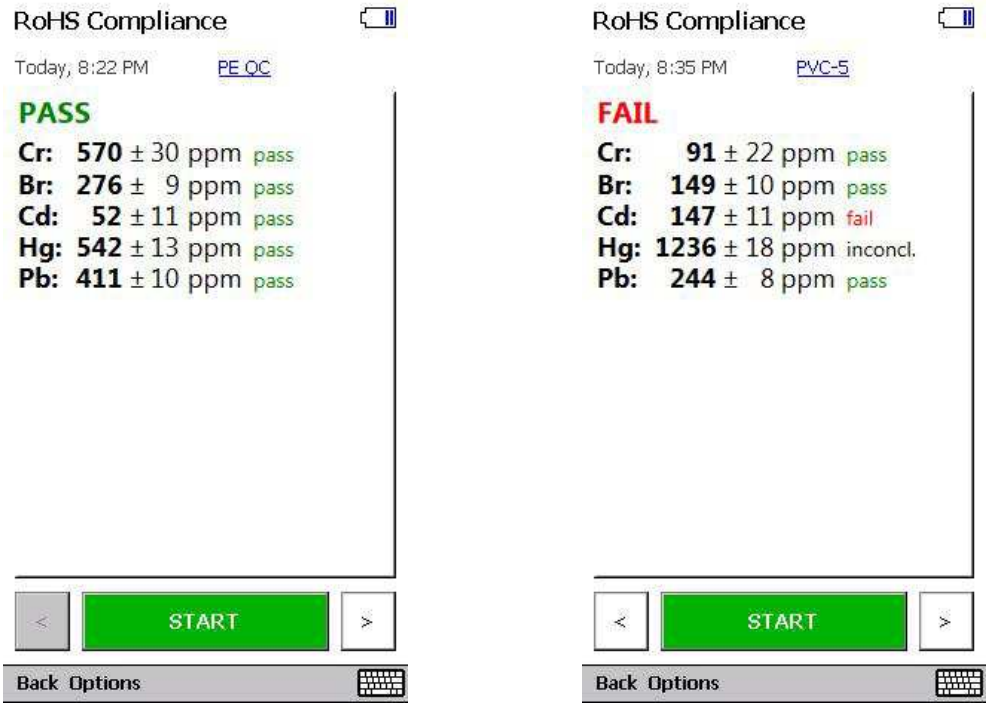

Figure 2. Measurement screens in Pass|Fail mode.

Method

ProSpector was calibrated for hazardous elements using sixteen PVC and PE calibration standards. Consumer products can be directly measured without any sample preparation. In some cases, when material is heterogeneous, it is recommended to screen different area of product.

In ROHS-Compliance mode two-beam x-ray regime is installed. Anode voltage was 40 kV with Ni100 filter at the first pass and Ni300+Al300 during the second pass.

Typical measurement time is 15 seconds using SDD detector or 30 seconds with PIN detector. Duration can be increased for better precision.

Testing results

Figures 3-12 show the correlation curves between certified concentrations and measured by ElvaX ProSpector for chrome, brome, lead, cadmium and mercury in PE and PVC.

This data was approximated with linear function.

R^2 is the coefficient of determination which shows how closely lab and XRF results correlate to each other. An ideal correlation would have an R^2 value of 1.

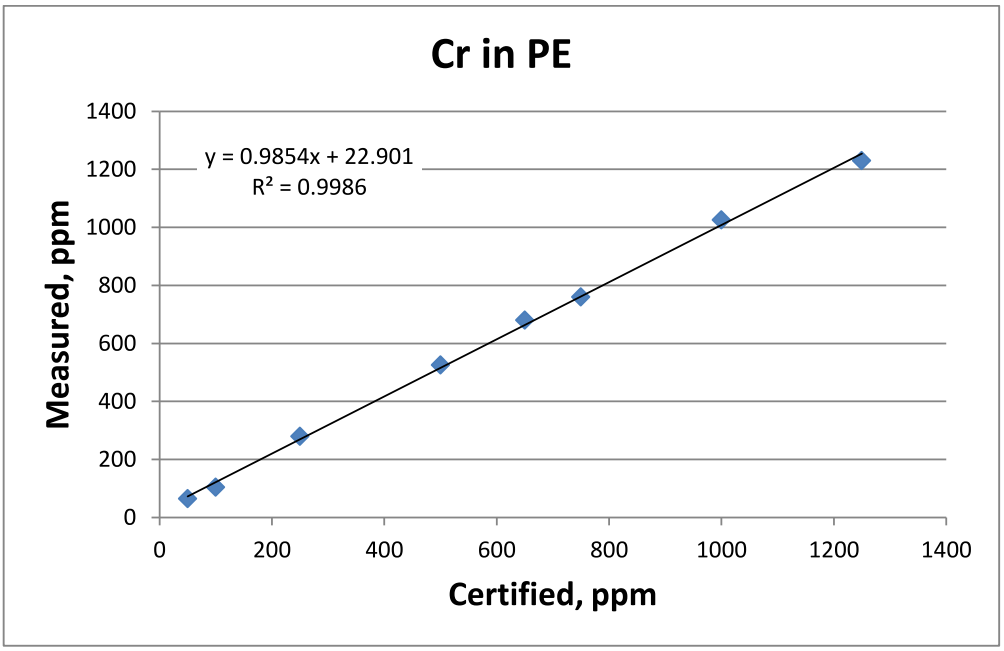

Figure 3. Correlation curve for chrome in PE.

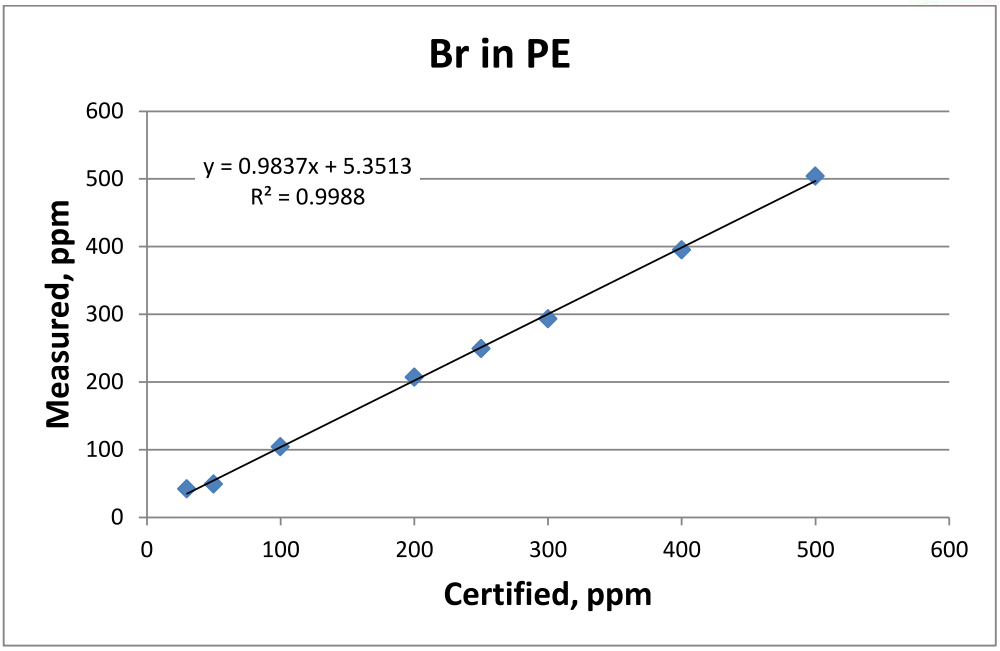

Figure 4. Correlation curve for brome in PE.

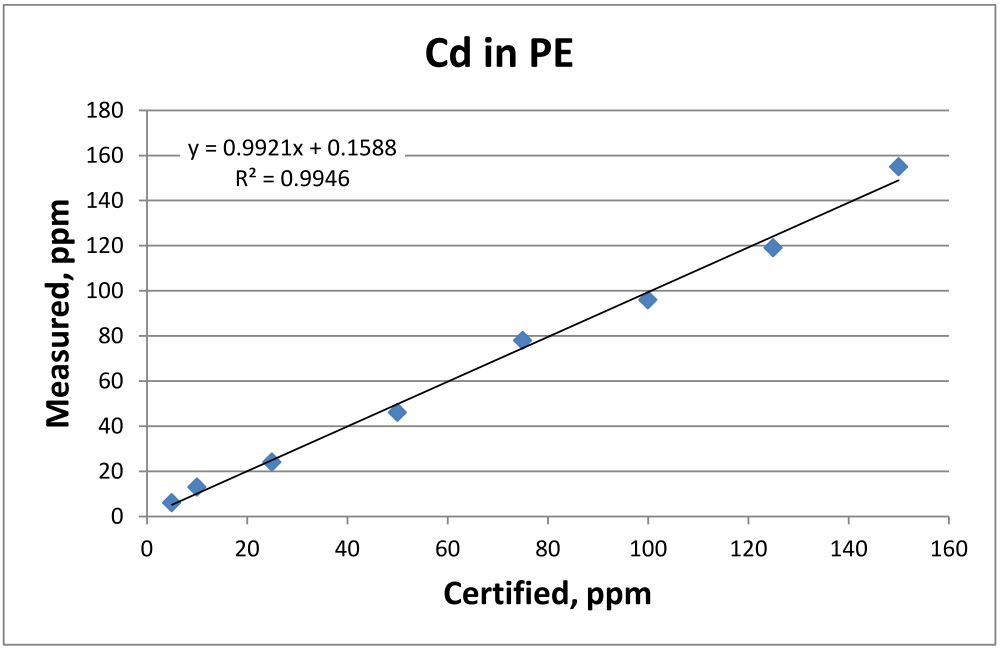

Figure 5. Correlation curve for cadmium in PE.

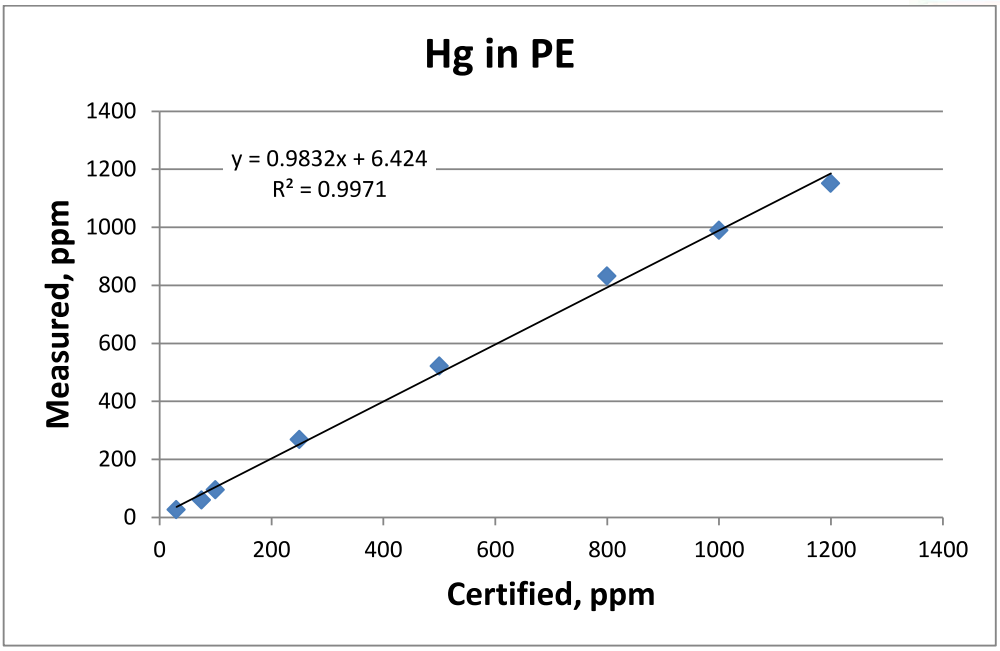

Figure 6. Correlation curve for mercury in PE.

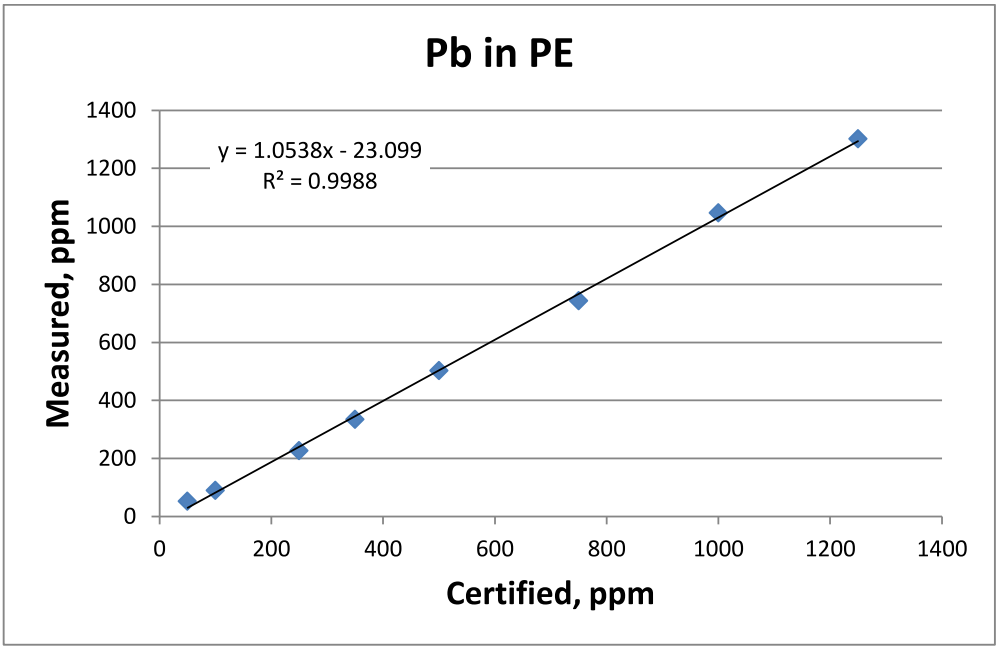

Figure 7. Correlation curve for lead in PE.

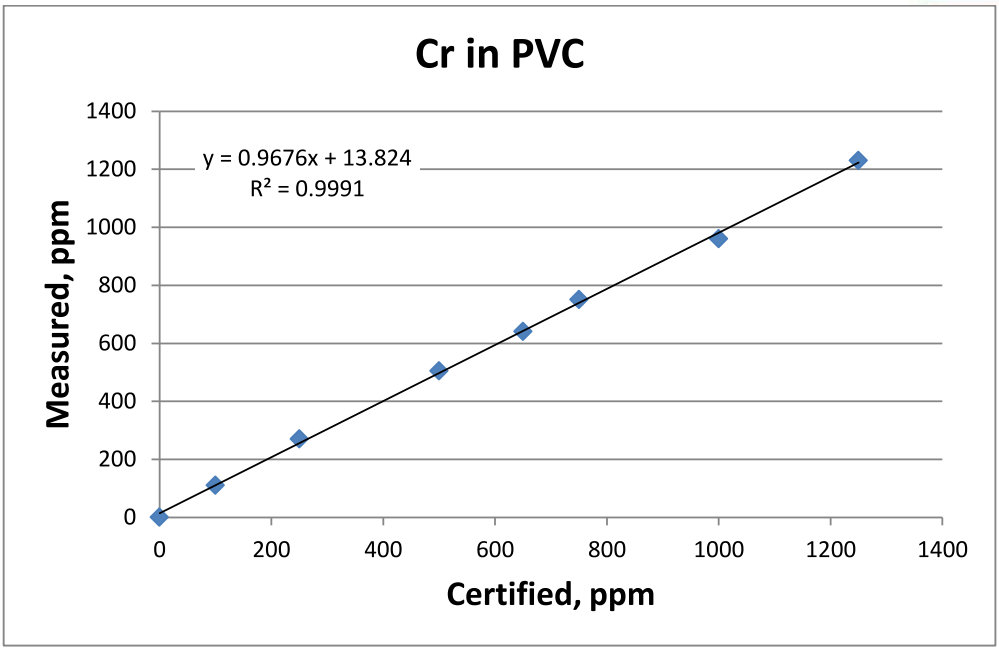

Figure 8. Correlation curve for chrome in PVC.

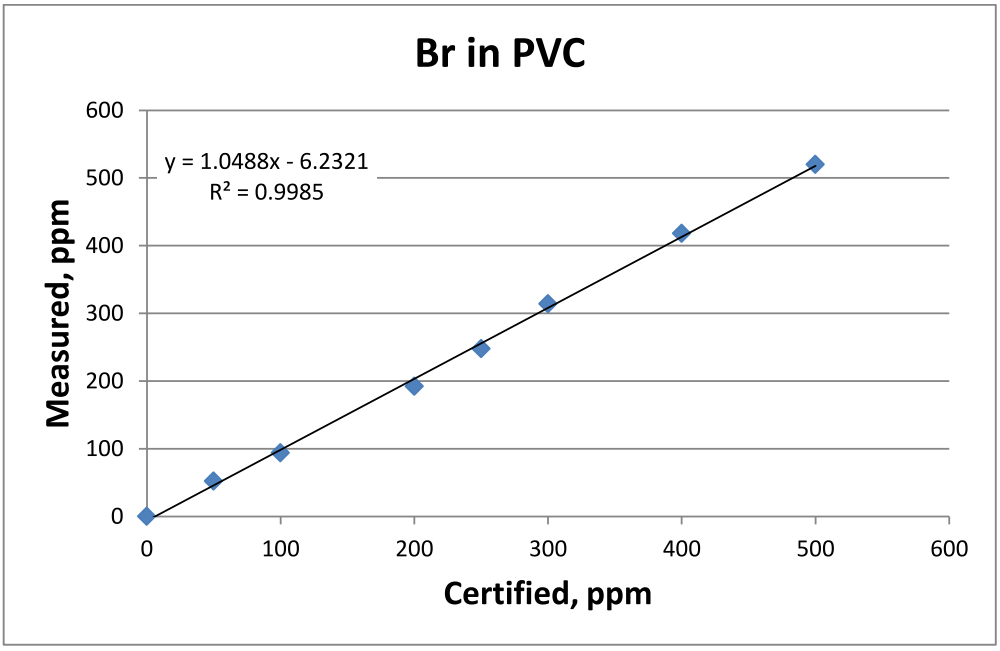

Figure 9. Correlation curve for brome in PVC.

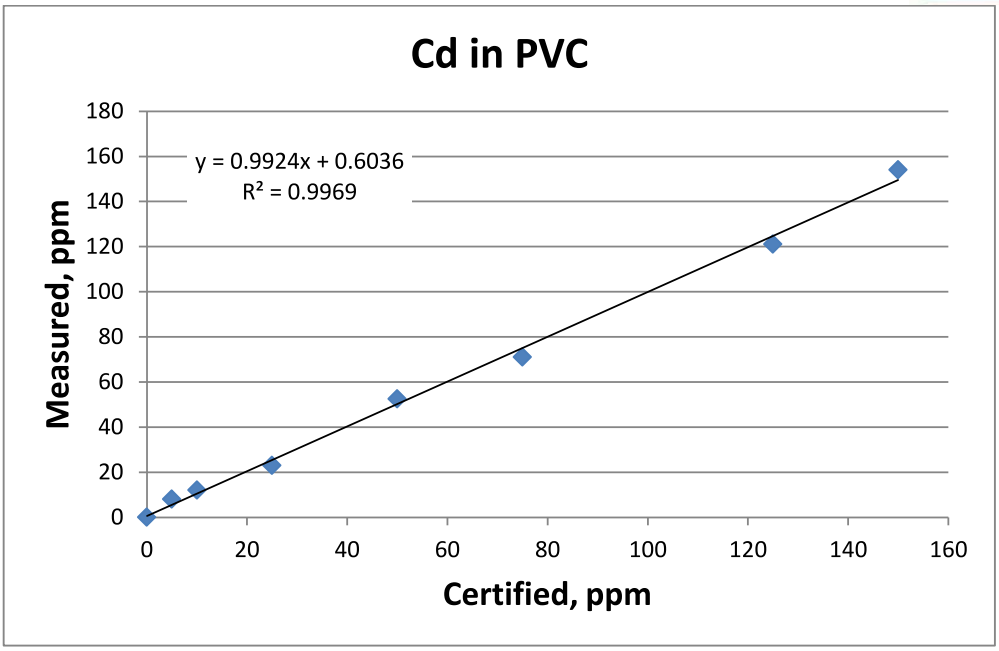

Figure 10. Correlation curve for cadmium in PVC.

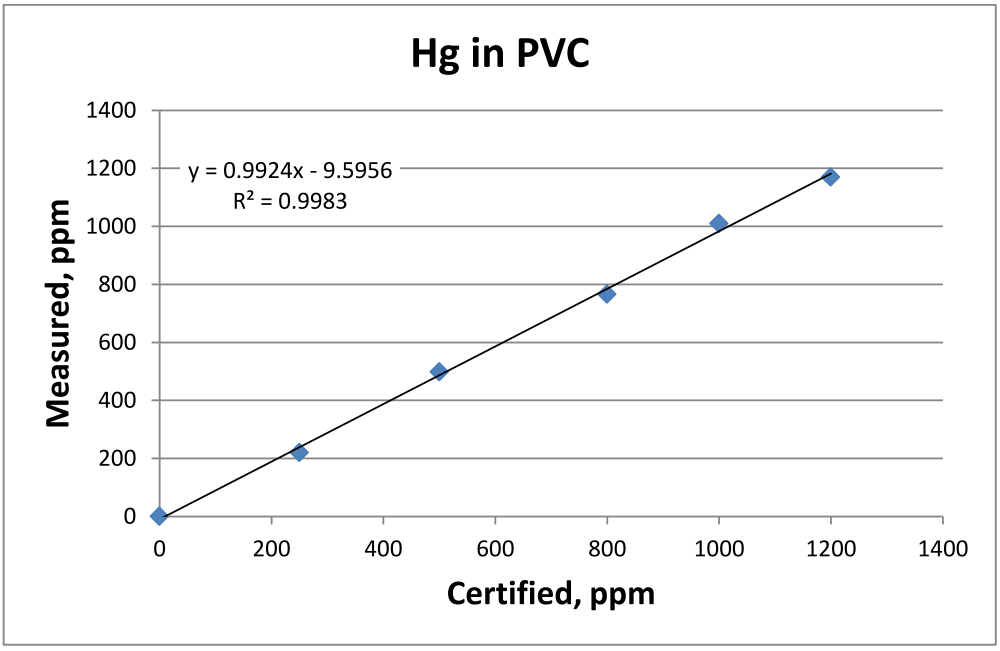

Figure 11. Correlation curve for mercury in PVC.

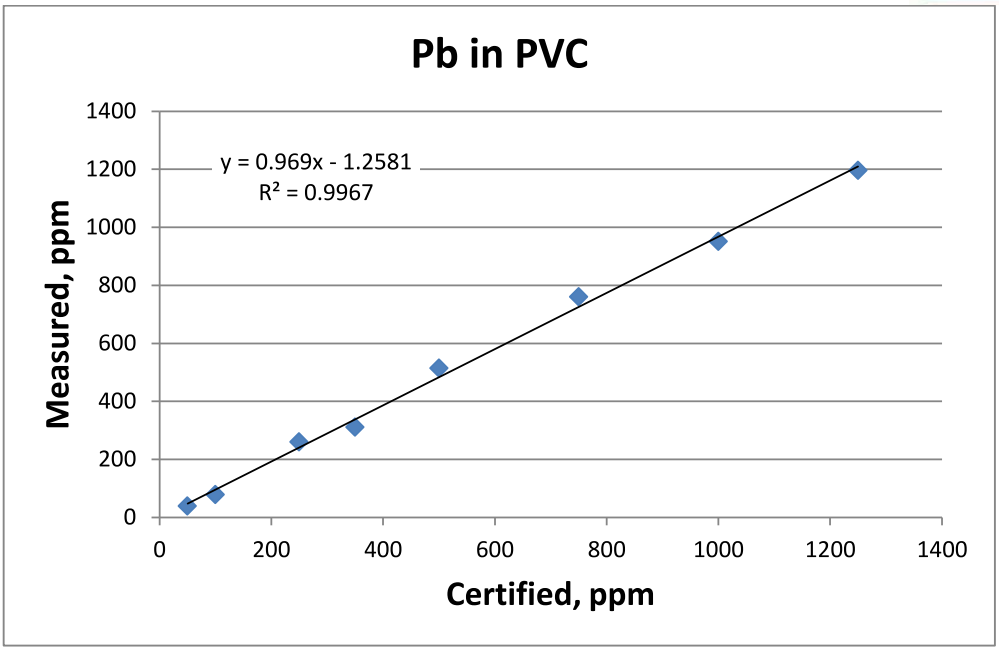

Figure 12. Correlation curve for lead in PVC.

Repeatability test was made to demonstrate the precision of the instrument. Both PE and PVC samples were measured 10 times for 30 seconds each time. Average concentration, absolute and relative standard deviation was calculated. Repeatability test for PE and PVC is demonstrated at tables 1 and 2 respectively.

Sample: PE	**Unit: ppm**				
measure #	**Cr**	**Br**	**Cd**	**Hg**	**Pb**
1	528	237	48	480	469
2	502	224	45	475	457
3	502	230	50	472	459
4	489	233	51	465	460
5	516	234	51	473	464
6	510	232	48	471	461
7	513	233	45	477	465
8	517	234	48	475	459
9	508	237	44	476	468
10	516	231	50	468	458
Average	**510.1**	**232.5**	**48**	**473.2**	**462**
Std Dev	**7.9**	**2.6**	**2**	**3.4**	**3.6**
% RSD	**1.55**	**1.12**	**4.17**	**0.72**	**0.78**

Table 1. Repeatability test for PE sample.

Sample: PVC	Unit: ppm				
measure #	Cr	Br	Cd	Hg	Pb
1	438	271	43	498	538
2	415	260	61	485	521
3	425	262	46	494	523
4	434	271	51	503	544
5	433	271	47	494	539
6	412	257	44	483	517
7	432	260	52	483	519
8	435	274	46	505	538
9	464	275	49	505	552
10	416	274	47	512	556
Average	**430.4**	**267.5**	**48.6**	**496.2**	**534.7**
Std Dev	**10.72**	**6.2**	**3.72**	**8.4**	**11.76**
% RSD	**2.49**	**2.32**	**7.65**	**1.69**	**2.2**

Table 2. Repeatability test for PVC sample.

Conclusions

Obtained results indicate a good correlation between lab and measured concentration values and demonstrate a high precision of ElvaX ProSpector instrument.

Device covers major of EU, USA and international regulatory directives, including ROHS 2, WEEE, CPSIA and other.

The main advantages of ProSpector are a high precision and performance, non-destructive testing and very simple operation method.