Application Brief

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Multi-Element Analysis of Air-Filters using the Agilent 5110 VDV ICP-OES

Fast, quantitative analysis of 44 elements

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Routine method for monitoring workplace air quality

Standard methods have been developed for the determination of metals and metalloid pollutants in air samples. In this study, ICP-OES was used to quantify 44 elements in filter media, prepared by microwave digestion. The elements were those listed in the standard methods HJ 777-2015, ISO 15202, and ASTM D7035-16.

An Agilent 5110 VDV ICP-OES was fitted with an AVS 7 switching valve and SPS 4 autosampler. Sample-to-sample analysis times of 63 seconds and consumption of only 21 L of argon per sample were achieved. To reach the lowest detection limits, an axial plasma view was used for all elements. Using an axial view can lead to requiring correction for complex background structures.

Automated interference correction

A combination of automated Fitted Background Correction (FBC) and Fast Automated Curve-fitting Technique (FACT) modeling was used to correct complex background structures (Figure 1). FBC provides accurate correction of both simple and complex background structures, with no method development. FACT corrects for spectral interferences and models complex background structures in the plasma.

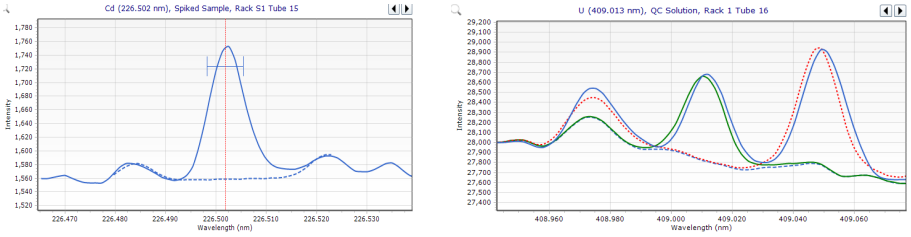

Figure 1. Left: FBC has accurately modeled the Co 226.488 nm and Cr 226.519 nm interfering peaks on Cd 226.502 nm, allowing easy correction. Right: FACT model for U 409.013 nm. The solid blue and blue dashed lines represent the total signal and the background, respectively. The green and red solid lines represent the uranium and cerium signals, respectively.

Reference material analysis

The method DLs (Table 1) are all significantly lower than the MDLs specified in HJ 777-2015, ISO 15202, and ASTM D7035-16. The CRM QC-TMFM-D and QC-TMFM-G were sourced from High Purity Standards, USA. Table 1 shows results for these CRMs are all within the expected ±10% recovery. A sample was spiked with a low concentration of each element to determine the recoveries. These recoveries are all within ±10% of expected values, as shown in Table 1.

Table 1. MDLs, CRM recoveries, and spike recoveries for elements where a certified value was available for at least one of the CRMs.

Element and Wavelength (nm)	MDL (µg/filter)	Spike Recovery (%)	QC-TMFM-D Recovery (%)	QC-TMFM-G Recovery (%)
Ag 328.068	1.7	102	102	105
Al 396.152	6.4	110	101	-
As 188.980	5.9	94	100	101
Ba 455.403	0.39	98	101	95
Be 234.861	0.095	102	110	95
Cd 226.502	0.37	106	101	99
Co 228.615	0.74	97	100	96
Cr 267.716	2.1	103	96	93
Cu 327.395	1.4	108	99	96
Fe 259.940	6.9	97	101	94
Mn 257.610	0.14	99	103	97
Ni 231.604	2.6	98	102	96
Pb 220.353	2.7	102	97	99
Tl 190.794	5	90	93	96
U 409.013	16	96	-	96
V 292.401	1.1	96	98	95
Zn 213.857	2.5	95	105	96

Note: Dash indicates no certified value was provided.

Long-term stability

To demonstrate the robustness and precision of the 5110 ICP-OES over an extended period, approximately 350 solutions were analyzed over six hours (Figure 2). QC solutions were measured every 10 samples. The results for all elements show:

- Recoveries within ±10%
- Less than 2.1% RSD, except Te (4% RSD)

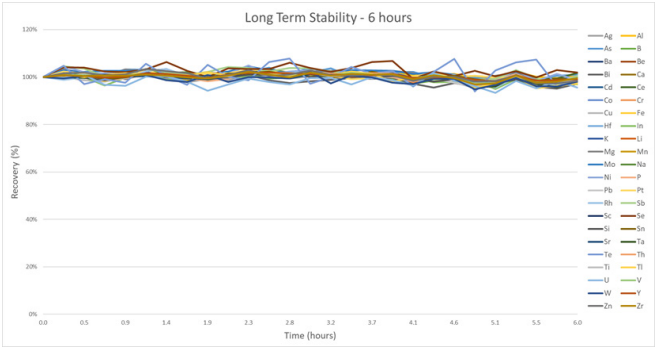

Figure 2. Long-term stability: recovery of QC sample analyzed every 10 samples over a six-hour period.

Conclusion

Accurate, routine measurements of metals in filter media can be carried out using the Agilent 5110 VDV ICP-OES with AVS 7 switching valve. The AVS 7 and the Vista Chip II increase productivity and maintain excellent stability over extended runs, while minimizing argon consumption and sample-to-sample analysis times.

Automated correction techniques, FBC and FACT, simplify method development, and provide an accurate correction for background and spectral interferences.

Find out more

Full details of this study can be found in Agilent publication number 5994-0690EN.

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