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TECHNICAL NOTE 43251

Highly stable performance of the Thermo Scientific iCAP 7000 Plus Series ICP-OES Duo instrument for aqueous sample matrices

Keywords
Aqueous, Long-term stability, Performance, Duo

Introduction

Routine analysis typically has a focus on reducing cost and time as well as increasing operator efficiency. To meet these requirements, stable and reliable performance of analytical instrumentation is critical. Stable performance reduces quality control failures and the need to recalibrate which saves operational costs such as gas and time spent by the analyst at the instrument. The Thermo Scientific™ iCAP™ 7000 Plus Series ICP-OES includes advanced technologies to maintain long term analytical stability. The technologies used to achieve this include:

- A high efficiency, free-running, 27.12 MHz solid state RF generator, which provides rugged and reliable performance of the plasma,
- Mass Flow Controllers (MFCs), which are utilized to stabilize the plasma conditions, and
- A polychromator, thermally stabilized to 38±0.1°C, leading to high stability of the optical system.

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Instrumentation

The Thermo Scientific iCAP 7400 ICP-OES Duo instrument was chosen for this analysis. The axial view is ideal for analyses that require the determination of low concentrations, for example trace elements in drinking water, whilst the radial view of the instrument can be used for higher concentration matrix elements.

The iCAP 7400 ICP-OES Duo is compatible with a Teledyne CETAC ASX-560 Autosampler, which was used for this analysis.

Sample preparation

A multi-element solution (10 µg·kg^{-1} of Be, Cd, Cr, and Mn and 5 mg·kg^{-1} of Ag, Al, Ba, Cu, and Zn) was prepared from single element standards (1000 mg·kg^{-1}, SPEX CertiPrep Group, Metuchen, US) in an acidic matrix (2% HNO_3, Fisher Chemical, Loughborough, UK). This solution was labeled stability test solution.

Method development and analysis

The Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ (ISDS) Software was used to create a LabBook that contained sensitive wavelengths for each of the elements of interest (Table 2). These wavelengths were free from interferences and were selected using the intuitive wavelength selection tool of the Qtegra ISDS Software. The method parameters used were the default parameters (Table 1). The plasma was ignited and the instrument allowed to warm up for a period of 15 minutes. The stability test solution was then analyzed over a period of 11 hours.

Table 1. Method parameters.

Parameter	Setting	
Pump Tubing (Standard Pump)	Sample Tygon® orange/white Drain Tygon® white/white	
Pump Speed	50 rpm	
Nebulizer	Glass concentric	
Nebulizer Gas Flow	0.55 L·min^{-1}	
Spray Chamber	Glass cyclonic	
Auxiliary Gas Flow	0.5 L·min^{-1}	
Coolant Gas Flow	12 L·min^{-1}	
Center Tube	2 mm	
RF Power	1150 W	
Wash Time	45 s	
Exposure Time	**Axial**	**Radial**
	UV 15 s Vis 5 s	Vis 5 s

Results

The recovery of each sample was calculated in respect to the first sample (Figure 1). Over the period of analysis no drift correction of any type or internal standardization was applied. Figure 1 shows that excellent long term stability was achieved over the period of analysis with all recoveries within 5% and many better than 2%. For the sample, an overall RSD (the RSD of all sample measurements) of <1.5% was derived, and for all of the analytes the average RSD of the replicates was ≤1%.

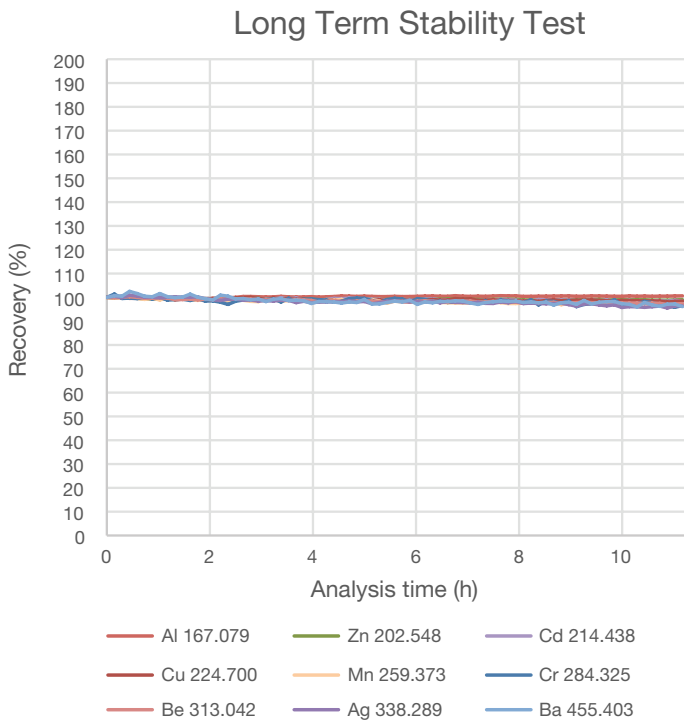

Figure 1. Recoveries of the analysis of the stability test solution over an 11 hour period.

Table 2. Recovery range, long term overall RSD of all measurements and average RSD of replicates for stated element wavelengths in %.

Element and wavelength (nm)	Plasma view	Recovery range (%)	Overall RSD (%)	Average replicates RSD (%)
Ag 338.289	Radial	95.5 - 100.9	1.3	0.3
Al 167.079	Axial	99.2 - 100.7	0.4	0.1
Ba 455.403	Radial	96.0 - 102.5	1.4	1.0
Be 313.042	Axial	97.0 - 100.3	0.8	0.3
Cd 214.438	Axial	98.1 - 100.6	0.5	0.4
Cr 284.325	Axial	95.8 - 101.4	1.1	1.0
Cu 224.700	Axial	98.0 - 100.3	0.5	0.2
Mn 259.373	Axial	96.5 - 100.2	0.9	0.5
Zn 202.548	Axial	98.8 - 100.1	0.3	0.1

Conclusion

The Thermo Scientific iCAP 7000 Plus Series ICP-OES Duo demonstrates excellent stability of the analytical signal over the period of a typical analytical run (240 samples), with less than 5% drift occurring. With the need for regular recalibration minimized and sample re-analysis decreased, a higher sample throughput is achieved. This results in a reduced cost per analysis.

Find out more at **thermofisher.com/ICP-OES**

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