Application Brief

Environmental

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Analysis of Trace Elements in Water Samples per ISO 17294-2

Agilent 7850 ICP-MS smart tools streamline your routine water analysis workflow

ISO 17294-2 compliant water analysis

The international standard ISO 17294-2 specifies an ICP-MS method for the determination of multiple analytes in drinking water, surface water, ground water, and wastewater (*1*). Several of the Rare Earth Elements (REEs) are included as analytes in ISO 17294-2, but the presence of REEs can also cause spectral overlap on other required analytes. Usually, water samples contain low concentrations of the REEs, but some natural water samples can contain raised levels, and human activities can increase the level of REEs above natural levels. The REEs have low second ionization potentials, which mean they form doubly charged ions (M^{2+}) more easily than most other elements. These doubly charged ions appear at half their true mass when measured using a quadrupole ICP-MS, which separates masses based on mass to charge ratio (*m/z*). If a sample contains raised levels of the REEs, these M^{2+} interferences could contribute to the signal measured for elements such as arsenic and selenium. This contribution can potentially lead to false positive results being reported for these important elements (*2*). Agilent ICP-MS MassHunter software includes a function to apply real-time correction of REE^{2+} interferences, ensuring accurate results for As and Se in the presence of REEs.

Time saving method development

An Agilent 7850 ICP-MS was used for the analysis. Plasma parameters were applied by selecting a “general purpose“ preset method, and all lenses were autotuned. Method settings were defined by the ICP-MS MassHunter "Method Wizard", an automated function that applies all necessary acquisition and data analysis parameters, including M^{2+} corrections. This approach ensures that the best acquisition parameters are always used regardless of user experience.

Simple, automated correction of REE^{2+} interferences

The M^{2+} ions of the REEs neodymium (Nd), samarium (Sm), gadolinium (Gd), and dysprosium (Dy) appear at the same *m/z* as the singly charged ions of As and Se. For example, $^{150}Nd^{2+}$ and $^{150}Sm^{2+}$ overlap $^{75}As^{+}$, and $^{156}Gd^{2+}$ and $^{156}Dy^{2+}$ overlap $^{78}Se^{+}$.

The 7850 ICP-MS—with and without M^{2+} correction—was used to measure As and Se in NIST SRM 1640a water spiked with REEs. Recoveries of the certified values for As in the presence of 100 ppb Nd and Sm and for Se in the presence of 10 ppb Gd and Dy are shown in Figure 1. Without M^{2+} correction, the contribution of the REE^{2+} overlaps led to falsely high recoveries for As and for Se. However, by applying automated M^{2+} correction, the accuracy for both elements was improved significantly—with recoveries within ±3% of the certified values.

The mean concentrations and recoveries for all 28 analytes measured in a range of water samples can be found in the full application note on this analysis (*3*).

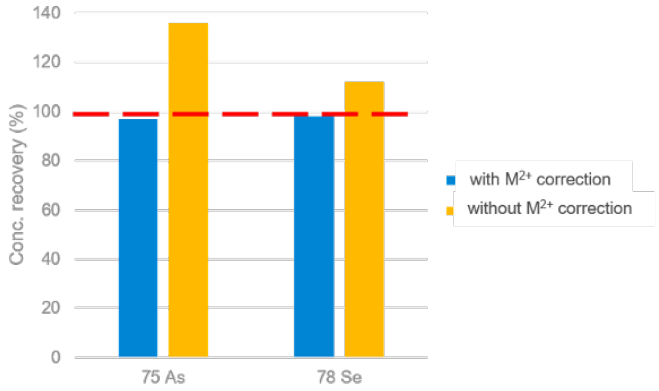


Figure 1. Recovery of ^{75}As and ^{78}Se in SRM 1640a spiked with REEs, with M^{2+} correction (blue bars) and without M^{2+} correction (yellow bars).

Streamline routine maintenance

To maximize analytical performance, stability, and productivity in water-testing labs, it can be beneficial to schedule routine maintenance based on the number of solutions measured rather than elapsed time. The 7850 ICP-MS allows the user to set up early maintenance feedback (EMF) usage counters for common maintenance tasks like changing pump tubing, cleaning the cones, or changing the vacuum pump oil. The timing can be customized depending on the sample types being run, ensuring the ICP-MS is always well maintained and running at peak performance, and helping you avoid unplanned downtime.

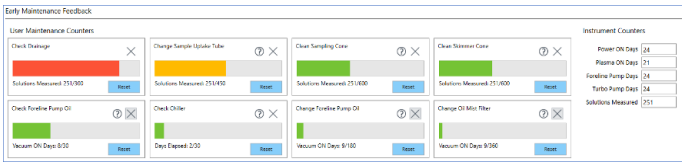
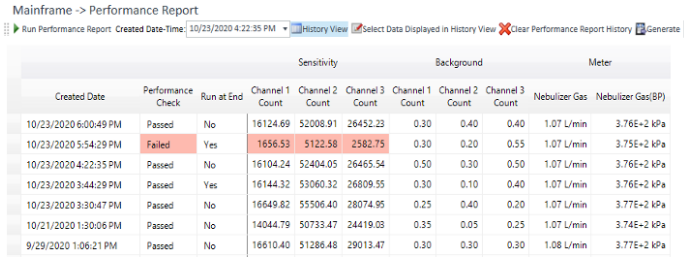


Figure 2. To keep the ICP-MS running flawlessly, EMF prompts the user to perform routine maintenance when required, after a specified number of samples have been analyzed.

In addition to EMF and the standard pre-run performance checks, the 7850 can be configured to do a post run performance check at the end of the day. Results from the post run check can be reviewed before you start the next day's analysis, flagging potential issues before they impact your work. Combining the tune check results with the EMF display makes it easy to identify any required maintenance.



			Sensitivity			Background			Meter	
Created Date	Performance Check	Run at End	Channel 1 Count	Channel 2 Count	Channel 3 Count	Channel 1 Count	Channel 2 Count	Channel 3 Count	Nebulizer Gas	Nebulizer Gas(BP)
10/23/2020 6:00:49 PM	Passed	No	16124.69	52008.91	26452.23	0.30	0.40	0.40	1.07 L/min	3.76E+2 kPa
10/23/2020 5:54:29 PM	Failed	Yes	1656.53	5122.58	2582.75	0.30	0.20	0.55	1.07 L/min	3.75E+2 kPa
10/23/2020 4:22:35 PM	Passed	No	16104.24	52404.05	26465.54	0.50	0.30	0.50	1.07 L/min	3.76E+2 kPa
10/23/2020 3:44:29 PM	Passed	Yes	16144.32	53060.32	26809.55	0.30	0.10	0.40	1.07 L/min	3.76E+2 kPa
10/23/2020 3:30:47 PM	Passed	No	16649.82	55506.40	28074.95	0.25	0.40	0.20	1.07 L/min	3.77E+2 kPa
10/21/2020 1:30:06 PM	Passed	No	14044.79	50733.47	24419.03	0.35	0.05	0.25	1.07 L/min	3.74E+2 kPa
9/29/2020 1:06:21 PM	Passed	No	16610.40	51286.48	29013.47	0.30	0.30	0.30	1.08 L/min	3.77E+2 kPa

Figure 3. Performance report screen (history view) displays pre-run and post run check results. Cells in red show values that don't meet the defined performance criteria, indicating that the instrument needs to be checked (cone maintenance, nebulizer flow check, etc.).

References

1. ISO 17294-2:2016 Water quality—Application of ICP-MS—Part 2: Determination of selected elements including uranium isotopes, accessed Oct 2020, https://www.iso.org/standard/62962.html
2. Simplifying Correction of Doubly Charged Ion Interferences, Agilent publication, 5994-1435EN
3. Fast, Accurate Analysis of 28 Elements in Water using ISO Method 17294-2, Agilent publication, 5994-2804EN

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DE.1110763889

Printed in the USA, December 3, 2020
5994-2803EN