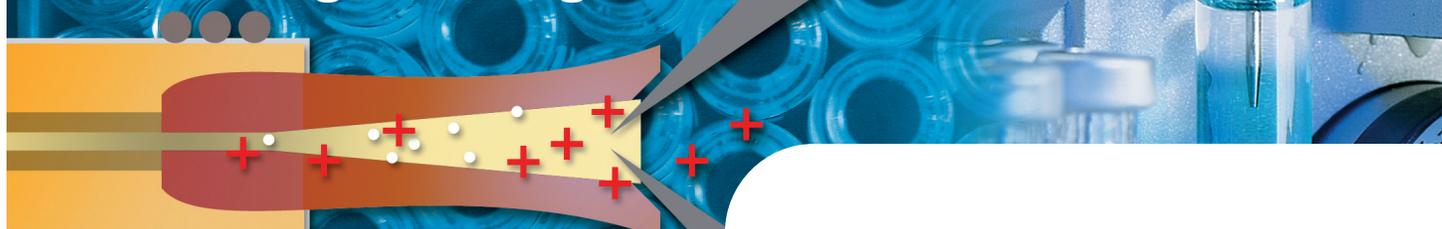


Eliminate the Dilution Step from ICP-MS Sample Prep with the Agilent High Matrix Introduction System



Introduction

Agilent has developed the High Matrix Introduction (HMI) accessory for ICP-MS as an alternative to conventional dilution. The HMI modifies the sample introduction system of the Agilent 7500 Octopole Reaction System (ORS) ICP-MS, making it possible to directly measure sample solutions with total dissolved solids (TDS) exceeding 1%.

Analytical Challenges

Analysts at TestAmerica Savannah labs in the USA tested the HMI for the analysis of soil and Toxicity Characteristic Leaching Procedure (TCLP) samples. For ICP-MS analysis in the Savannah Labs, these types of samples are typically diluted by a factor of 1:5 for liquids and 1:10 for soils. The dilution steps reduce the matrix effects contributed by both the acids used in the preparation and the samples themselves. There are several disadvantages associated with this practice:

- Possibility of introducing contamination from the pipette tips or the diluent
- Chance of “human” error of simply preparing an inaccurate dilution
- Sample prep time and cost of reagents
- Increased waste disposal volume

HMI Methodology

With the HMI unit installed on the 7500ce, TestAmerica analysts are now able to introduce most typical environmental samples to the ICP-MS directly, without a dilution step, and thus eliminate the disadvantages associated with conventional dilution.

High Acid Matrices

A significant hurdle to running undiluted environmental samples is related to the final acid concentration specified in USEPA method 3050B for soils and wastes using the “hot-plate” procedure, which includes 10% HCl. Method 3010A for liquids specifies a final concentration of 5% HCl. Prior to using the HMI, matrix matching during the dilution step was used to reduce and normalize the acid concentration in standards and both types of samples. Not only does the HMI eliminate the matrix effects from varying acid concentrations, it also removes the need for expensive platinum cones when analyzing high acid concentrations. TestAmerica now uses 5% HNO₃ /5% HCl for standards and blanks with all sample types run using HMI.

The HMI was set-up for typical “ultra-robust” analysis. Table 1 shows comparison Method Detection Limit (MDL) data (mg/kg) for soils with and without the HMI. With the HMI, the digestates were analyzed directly (undiluted); without the HMI, the digestates were diluted 1/10. The results highlight an improvement in MDLs for the majority of elements when the HMI is used.

Element (Mass)	HMI	w/o HMI
	MDL	MDL (1/10 dil.)
	mg/kg	mg/kg
Al (27)	4.1	5.8
Sb (121)	0.026	0.031
As (75)	0.03	0.15
Ba (137)	0.053	0.17
Be (9)	0.021	0.018
B (11)	0.33	1.3
Cd (111)	0.029	0.031
Ca (40)	5.7	8.4
Cr (52)	0.031	0.13
Co (59)	0.0064	0.0094
Cu (63)	0.078	0.14
Fe (56)	1.7	4.6
Pb (208)	0.055	0.03
Mg (24)	1.3	1.9
Mn (55)	0.037	0.11
Mo (95)	0.036	0.058
Ni (60)	0.024	0.036
K (39)	3.8	6.5
Se (78)	0.13	0.044
Ag (107)	0.005	0.0071
Na (23)	1.8	15
Sr (88)	0.051	0.066
Tl (205)	0.026	0.015
Sn (118)	0.105	0.24
Ti (47)	0.17	0.12
V (51)	0.041	0.096
Zn (66)	0.84	0.64

Table 1. Comparison of MDL for a suite of elements using HMI and normal dilution.

Conclusions

The addition of the High Matrix Introduction system to the Agilent 7500ce ICP-MS allows the analysis of soils without the complications of a dilution step and with slightly improved Method Detection Limits (MDL). This ensures that soils analyzed according to USEPA methodologies can now be done so with significantly improved productivity and reduced costs.

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More Information www.agilent.com/chem/hmi

