TECHNICAL NOTE

ICP - Mass Spectrometry

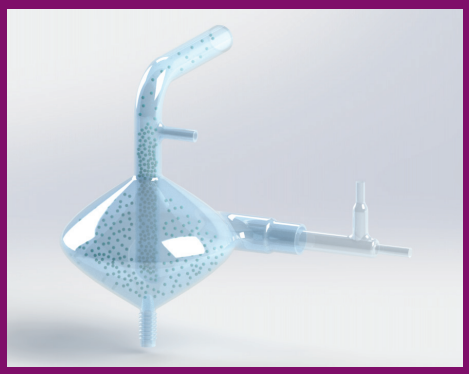

Figure 1: NexION AMS system minimizes the need for dilution prior to analysis.

All Matrix Solution System for NexION ICP-MS Platforms

Introduction

PerkinElmer has a long tradition of producing robust ICP-MS instruments capable of analyzing samples with high levels of total dissolved solids (TDS). The NexION® family of ICP-MS instruments carries on this tradition by being exceptionally resistant to high matrix samples due to the combination of the unique Triple Cone Interface and Quadruple Ion Deflector. Nevertheless, there is a fundamental limitation for all ICP sources in terms of amount of material delivered to the plasma before ionization efficiency degrades, leading to matrix suppression and deposition on the cones during long analytical runs.

To minimize the need for dilution of environmental or other high-TDS samples prior to analysis, PerkinElmer offers the All Matrix Solution (AMS) system for its NexION ICP-MS platforms. This system (shown in Figure 1) consists of a high solids nebulizer and a spray chamber with an argon inlet port critically positioned to provide maximum mixing efficiency from a dedicated argon line which controls the linear velocity of the dilution gas. The principle of operation is that the flows of the dilution and nebulizer argon gases can be adjusted while maintaining a constant flow to the torch, where the ratio of the flows determines the dilution factor, as shown in Figure 2. By varying the flows, dilutions up to 200 times can be attained, avoiding off-line dilutions of high-matrix samples and the associated risks of contamination and error. However, if samples that do not require dilution are analyzed, the dilution gas can be turned off with no need to disconnect the dilution gas line. In this way, AMS can be used to run undiluted samples as well as any dilution up to 200x without the need for any special instrument optimizations.

PerkinElmer®
For the Better

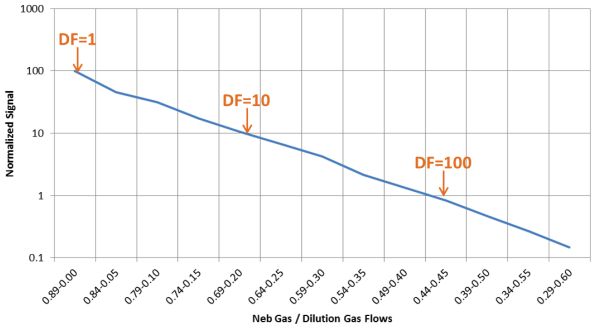

Figure 2: Normalized indium (In) vs. nebulizer/dilution gas flows, with numbers in orange showing the dilution factors.

The AMS system can be used with a variety of sampling accessories. Most importantly, it is compatible with virtually any autosampler used for ICP-MS analysis, including the PerkinElmer S20 series, and works exceptionally well with the *FAST* and prep*FAST* systems for increased sample throughput and further automation of sample analysis.

Additionally, AMS can be paired with an argon humidifier to provide two benefits: resistance to nebulizer clogging and enhanced ionization. When working with high-matrix samples, solid deposition at the nebulizer tip is possible, which could affect the nebulization efficiency. With AMS, by humidifying the nebulizer argon, the nebulizer tip is continually flushed with moist argon, thus preventing deposition.

The second benefit of the humidifier is enhanced ionization. At high dilution flows (when not using a humidifier), the plasma becomes drier, which reduces its thermal conductivity. However, with the humidifier, the water content of the plasma is maintained, ensuring high thermal conductivity and allowing efficient heat transfer from hotter regions of the plasma to the central channel, resulting in improved ionization.

The analytical benefits of AMS are seen in Figures 3-5. Figure 3 shows spike recoveries for 18 elements in undiluted seawater which span both the mass range (Be at m/z 9 to U at m/z 238) and range of ionization potentials (5.21 - 9.32 eV). Despite these wide ranges, all elements have greater than 70% recovery, a requirement of many environmental, pharma, and biomonitoring labs.

The linearity of AMS is demonstrated in Figure 4, which shows calibration curves at different levels. Whether measuring at low levels (such as Hg in Figure 4a), high levels (Na in Figure 4c), or anything in between (Mn in Figure 4b), AMS provides repeatable dilutions which do not affect the linearity of the system.

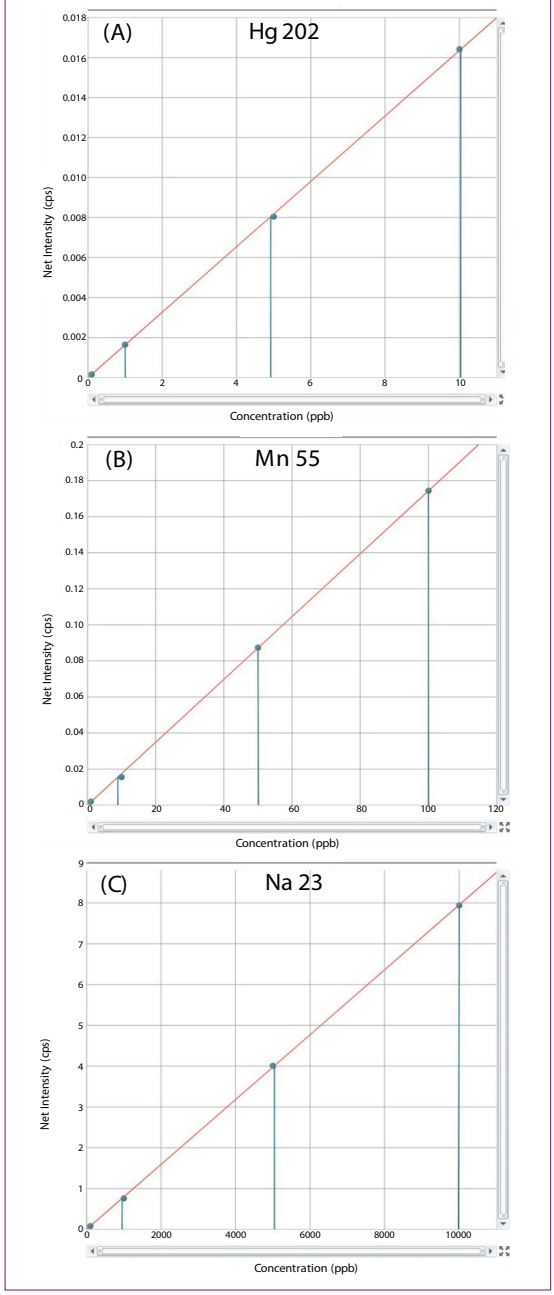

Figure 4: Calibration curves with AMS for Hg/low concentrations (A), Mn/mid-range concentrations (B), and Na/high concentrations (C).

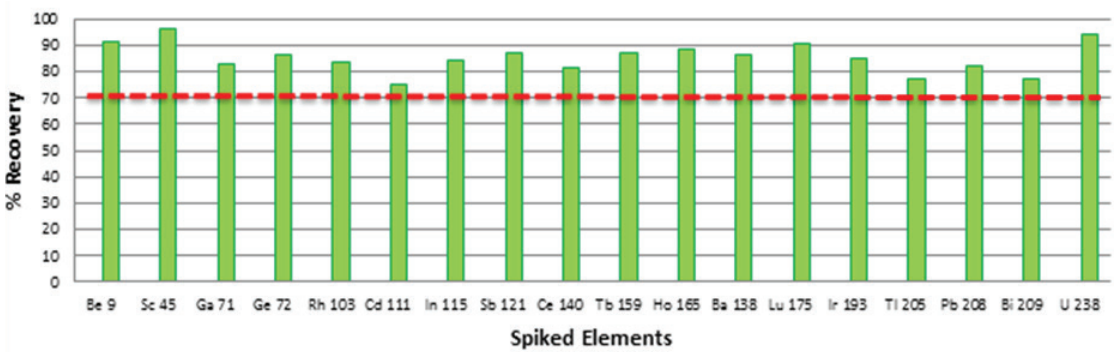

Figure 3: Spike recoveries in undiluted seawater.

The stability of the AMS system is shown in Figure 5, which displays the CCV recoveries during an 8-hour run of 100 simulated seawater samples in Standard mode, with AMS set for 5x dilution. This stability, combined with accurate calibrations at any level, demonstrates the utility of AMS for analysis of samples with challenging matrices.

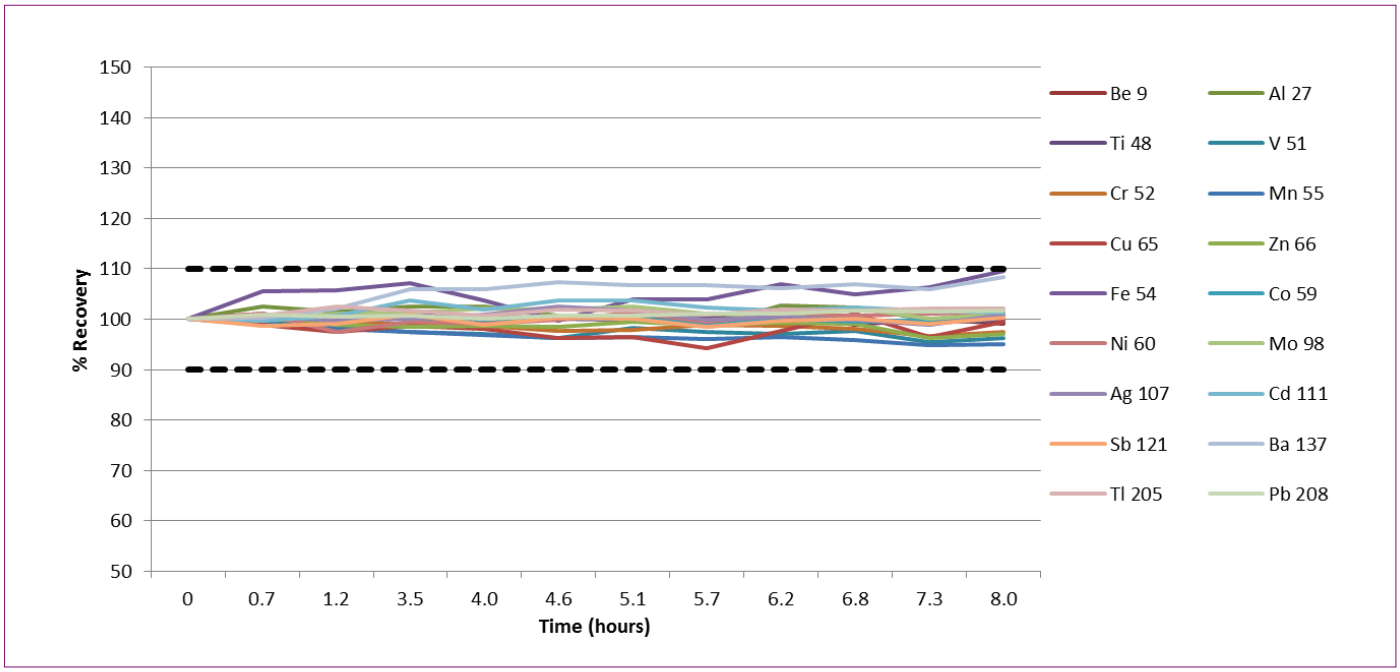

Figure 5: CCV recovery during an 8-hour analysis of 100 simulated seawater samples, with AMS dilution set to 5x.

In summary, PerkinElmer's AMS system provides a number of benefits to simplify analysis of high-matrix samples with the NexION family of ICP-MS instruments. By introducing a flow of argon into the spray chamber neck, the aerosol stream is diluted, allowing for more efficient ionization, fewer matrix effects, and less deposition on the interface cones, resulting in simplified sample preparation and higher quality data.

PerkinElmer U.S. LLC
710 Bridgeport Ave.
Shelton, CT 06484-4794 USA
(+1) 855-726-9377
www.perkinelmer.com

PerkinElmer®

27495 (013224A_01)