Application Brief

Environmental

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Measuring Arsenic in Water

Utilizing intelligent optimization of analysis parameters

Element: As

Matrix: Water
Modifier: $Pd(NO_3)_2$ + $Mg(NO_3)_2$
Instrumentation: Agilent 240Z Graphite Furnace AAS

Standards:

ISO 15586:2003
U.S. EPA Method 200.9
IS 10500; IS 14543, IS 13428
GB 5749-2006
3113 B:2012

Introduction

From the World Health Organization (WHO) Arsenic is introduced into water through the dissolution of rocks, minerals and ores, from industrial effluents, including mining wastes, and via atmospheric deposition. In 2011, WHO confirmed the guideline value for Arsenic in drinking water at 10 µg/L.

With its great sensitivity, graphite furnace is a cost-effective technique for such analysis. The Agilent 200 AA Series significantly simplifies graphite furnace method implementation through intelligent ashing and atomization optimizations. Furthermore, Agilent AA instruments feature the Stabilized Temperature Platform Furnace (STPF) concept. The instruments' Tube-CAM video can be used to control the injection and dry steps of the measurement. The SRM Wizard, an integrated feature of the instrument software, can automatically determine the best ash and atomize temperatures. Please see Optimizing GFAAS ashing and atomizing temperatures using Surface Response Methodology (*2*).

Example analysis

Furnace measurements were performed using an Agilent 240Z AAS with transverse Zeeman background correction. The instrument features the highly sensitive and accurate Agilent GTA 120 Graphite Tube Atomizer and an Agilent PSD 120 Programmable Sample Dispenser autosampler.

The 240Z AA comprises patented Zeeman effect with longitudinal graphite tube heating and a Constant Temperature Zone (CTZ) design.

Atomization for Arsenic was from a pyrolytic platform Omega tube. The inert gas used was 99.99% pure argon.

Analytical Conditions

Lamp	UltrAA Lamp Arsenic (Part no. 5610108100)
Graphite tube Platform	Omega Platform (Part No. 6310003700)
Wavelength	193.7 nm
Slit Width	0.5 nm
Lamp current	10 mA
Mode	Peak Area

Standard solution: 50 µg/L As

Standard Reference Material: NIST 1640a: 8.075 ± 0.070 µg/L

Method optimization

Dry steps were optimized by using the integrated camera (Figure 1). Ash and atomize temperatures were optimized by a chemometric method included in the instrument software (the Surface Response Methodology tool). Tests were performed on a standard and on a spiked water sample. All measurements were made using the Peak Area calculation.

Based on the results of the chemometric analysis, the Surface Response Methodology tool determined the optimum conditions, shown in Tables 1 and 2, and Figure 2.

Figure 1. The view inside the tube, using the integrated camera. The probe is dispensing the sample into the tube.

Table 1. Experimental design factors

Ash: 1000 °C	Atomize 2400 °C
Change: 250 °C	Change: 250 °C

Table 2. The optimum conditions determined for the standard and sample were very similar, indicating that the modifer mix was ideally suited for the application.

Temperature	Standard	Sample
Ash (°C)	926	952
Atomize (°C)	2448	2497

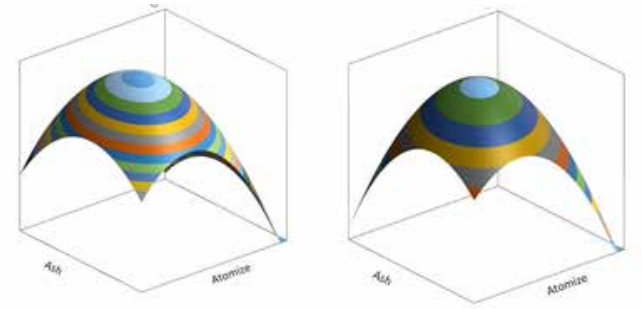

Figure 2. The Surface Response Methodology tool in the software uses chemometrics to automatically optimize the ash and atomize temperatures. Shown here is the plot for the standard reference material (left) and the spiked sample (right).

Results

- Characteristic concentration in peak area: 0.58 µg/L
- Characteristic Mass in peak area: 18.6 pg
- Method Detection Limit for 20 µL: 0.26 µg/L
- Validated quantification limit for 20 µL: 1.0 µg/L
- % recovery NIST 1640a: 100.4 %
- % recovery bottled water spiked with 10.0 µg/L: 102.4 %

Conclusion

The Arsenic in drinking water method, applicable for a wide range of worldwide standards, was optimized automatically on the Agilent 240Z GFAA system. The method exceeded the required performance for detection limits and accuracy.

With the most sensitive Zeeman workhead, local fume extraction, LED lighted injection hole, Tube-Cam, and SRM wizard, the 240Z has the perfect tools for ease of use and method optimization. The 240Z is a cost effective solution, lowering argon consumption and increasing graphite tube lifetime without compromising accuracy and precision. It is ideal for any laboratory performing routine testing that wishes to minimize initial setup and optimization.

Optimize fume extraction for improved laboratory safety

The optional fume extraction accessory (Figure 3) includes an LED lighted mirror to provide a clear view of the graphite tube injection hole. Alignment of the autosampler capillary is worry-free while the exhaust system removes ashing vapors at their source. The extraction accessory provides flexibility of the furnace placement eliminating the need for direct position under the exhaust fan.

Figure 3. The optional extraction/LED accessory for the Agilent furnace.

References

1. World Health Organization 2011, WHO/SDE/WSH/03.04/75/Rev/1- Arsenic in Drinking-water
2. Optimizing GFAAS ashing and atomizing temperatures using Surface Response Methodology, Agilent publication number 5991-9156EN.

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