Sheath Gas High Solids Torch

Technical Overview

700 Series ICP-OES

Introduction

Optimized ICP-OES Torch for Samples with High Total Dissolved Solids Content

Use of the Sheath Gas Torch on an axially-viewed ICP provides prolonged instrument stability and lower detection limits when analyzing samples of (very) high total dissolved solids (TDS) content. Moreover, as periodic recalibration and sample dilution are no longer necessary, productivity is increased.

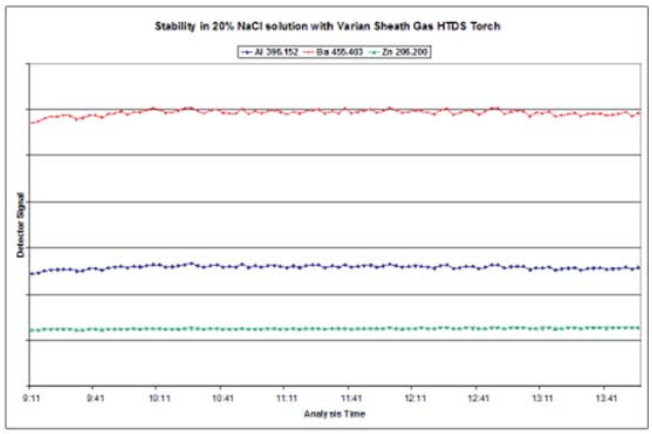
Figure 1. The Agilent axially-viewed 730 ICP-OES, shown with the optional SVS1 Switching Valve System.

ICP-OES instruments with axially-viewed plasmas are preferred over radially-viewed systems for trace analysis due to higher sensitivity and lower detection limits. Traditionally, axially-viewed plasmas were less suited to analysis of samples with TDS content higher than 50 g/L because the torch injector suffered from blockage. Dilution overcomes this problem, but deteriorates the detection limits that can be obtained. Progressive injector blockage also results in reduced instrument stability and signal drift, requiring more frequent recalibration and/or use of internal standards. This advantage note describes the potential of a novel Sheath Gas High Solids Torch.

The introduction of Agilent's patented High TDS Torch[1] partially addressed TDS analysis problems by providing ICP users with the capability to run samples containing high TDS on their axially-viewed ICPs, without experiencing immediate injector blockage. By eliminating the need for dilution of high TDS samples, users were able to determine both low and high TDS samples in the same sequence.

To further enhance performance and extend the operating time during analysis of high TDS samples, the SVS1 Switching Valve System is recommended. Not only does the SVS1 increase the productivity of sample analyses by up to 33%, it also reduces sample loading by diverting excess sample away from the spraychamber immediately after measurement. Sample carry-over and deposition within the torch injector is reduced, resulting in extended torch lifetime and improved long-term stability.

Now, Agilent introduces the Sheath Gas High Solids Torch for the axial ICP, which extends the capability to provide (ultra) trace analysis of samples with exceptionally high TDS content (200-300 g/L NaCl). The torch design allows for the introduction of an additional flow of argon (that is, sheath gas), which surrounds the aerosol, thereby preventing the deposition of solids on the inner walls of the injector. With reduced torch blockage, instrument stability is improved, reducing the need for periodic recalibration and improving productivity. Figure 2 demonstrates performance of the Sheath Gas Torch for continuous aspiration of a multi-element test solution containing 200 g/L NaCl. 25 elements were determined simultaneously using 68 wavelengths over a period of 5 hours, with data collected every 3 minutes. The average Relative Standard Deviation (RSD) for all results was 1.10% with all measured values ranging from 0.64% to 1.77%. After 12 hours, RSD is typically <3%.



Element	Atomic or Ionic	Wavelength (nm)	Eexc or Esum (eV)	STD (%)
Al	Atomic	396.152	3.14	1.60
Ba	Ionic	455.403	7.93	1.05
Zn	Ionic	206.200	15.40	1.05

Figure 2. ICP-OES stability achieved with the Sheath Gas High Solids Torch during measurement of a high TDS sample (20% NaCl solution). Results for three key elements (Al, Ba and Zn) are illustrated.

The three generations of torches are compared in Figure 3. From top to bottom, a) the standard axially-viewed torch; b) the High TDS Torch with the gradual tapered injector and more laminar aerosol flow; c) the Sheath Gas High Solids Torch, which includes all the features of the High TDS Torch with a modified sample inlet to incorporate a flow of argon as sheath gas.

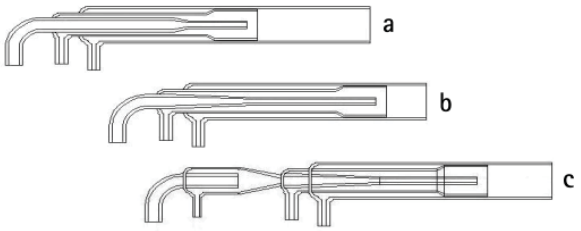


Figure 3. Three generations of Agilent torches. a) Standard axial torch. b) High TDS Torch. c) Sheath Gas High Solids Torch. (Not to scale).

Element/Wavelength (nm)	Detection Limit (µg/L)
Ag 328.068	0.7
Al 167.019	0.5
As 188.980	5
Ba 455.403	0.2
Be 313.042	0.07
Cd 214.439	0.4
Co 238.892	1
Cr 205.560	1
Fe 238.204	1.7
K 766.491	1.5
Li 670.783	0.4
Mg 279.553	0.1
Mn 257.610	0.2
Mo 202.032	2
Ni 231.604	2.5
Pb 220.353	6
Sb 206.834	5
Se 196.026	10
Sr 407.771	0.1
Ti 336.122	0.5
Tl 190.794	9
V 292.401	1
Zn 213.857	0.5

Table 1. Measured Instrument Detection Limits for a sample containing >250 g/L TDS using the Sheath Gas Torch with the Agilent 720/730 Series ICP-OES. Replicate read time was 20 s.

Conclusion

The Sheath Gas High Solids Torch allows axial ICP users to achieve maximum sensitivity, lower detection limits, excellent long-term instrument stability and reduced downtime (from torch blockage) when measuring samples with exceptionally high total dissolved solids content (200-300 g NaCl/L). This avoids the need for periodic recalibration and sample dilution, resulting in a significant increase in productivity.

Ordering Information

To ensure optimum performance with high TDS samples, the sample introduction system on the axial ICP should consist of a double-pass spraychamber, V groove nebulizer, argon saturation accessory, Sheath Gas Torch, AGM-1 auxiliary gas module for flow control over sheath gas flow and smaller ID pump tubing for the sample (black/black tubing recommended). These components are available separately, or can be ordered as a complete kit.

Product Description	Part Number
Sheath Gas Torch	2010122400
High Solids Kit 3 (Contains V-groove nebulizer, double-pass Sturman-Masters spraychamber, mounting bracket, Sheath Gas Torch, AGM-1 auxiliary gas module, argon saturator accessory and all necessary tubing)	9910141000
AGM-1 auxiliary gas module	0010055900
Argon saturation accessory	0210128690
Double-pass Sturman-Masters spraychamber (inert)	0110593190
Mounting bracket for Sturman-Masters spraychamber	0410328600
V groove nebulizer	9910057400
Optional items:	
SVS1 Switching Valve Package for 710/720/730 Series	9910123300
SVS1 Switching Valve Package for Vista-PRO	9910118400

References

1. Tran T. Nham, Alan G. Wiseman, J. Anal. At. Spectrom., 2003, (7), 790-794

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