ICP-DES with axially viewed plasma typically offers an order of magnitude improvement in detection limit performance compared to an ICP-DES with radially viewed plasma. However, for samples with total dissolved solids (TDS) greater than 3% an axially viewed plasma traditionally been more prone to blockages. Through improvements in the torch geometry and optimization of sample introduction components, the tolerance axially viewed plasma to samples with very high TDS has improved markedly. Further improvements in torch design ensure the tolerance of axially viewed plasma ICP-DES for samples with very high dissolved solids are now comparable to systems with a radially viewed plasma with the benefit of improved detection limit performance. This work will evaluate detection limits, short term precision and long term stability of 20 elements in 20% NaCl brine solution.

**Results and Discussion**

**Stability test**

Comparison of the stability test using the HDS torch (B) and the sheath gas HDS torch (C) is shown. The standard conventional torch would not provide more than a couple of hours of reasonable stable performance and results were not included for comparison. Figure 2 shows the signal measured over 4 hours using the HDS torch (B). Reproducibility over 4 hours as found to be less than 5% RSD.

**New Torches design**

Agilent introduced the High Dissolved Solids (HDS) torch for axially ICP in 2002. Figure 2 shows both conventional axially-viewed torch (A) and the HDS torch (B). (International publication number WD 03/005780 A1). This latter features:  
- A modified and patented gradually tapered injector tube  
- A reduced torch length to minimize devitrification

HDS torch (B) provides more laminar pathway for the aerosol reducing salt build-up in injector at a specific point.

New HDS torch with sheath gas option has been developed (C)

Uses patented torch injector

Reduced torch length

Additional Sheath gas option:
- Reduces impact of droplets on injector walls
- Significantly reduces salt build up in injector
- Improves long term stability and precision
- Improves detection limits

This is in comparison to the previous HDS torch

Comparison of results shows improvement of the method detection limits by a factor of 2 – 3 when using the sheath gas torch as compared to the HDS torch. The addition of argon through the sheath gas line helps dilute sample aerosol in the plasma improving thus the desolvation efficiency and plasma robustness. A better accuracy on the blank measurements has also been observed leading to lower detection limits.

**Conclusion**

Innovative designs for torches have been used for determination of metals in brines using ICP-DES with axial-viewing. The HDS Torch with Sheath Gas shows excellent performances when running solutions up to 20% w/v NaCl solution due to the higher torch and significantly better performance compared to the standard torch which would not be capable of handling this application. Only a negligible flow of 0.13L/min of sheath gas is required.

Increasing tolerance of axial ICP when using the sheath gas HDS torch offers many advantages:
- Achieve even lower detection limits
- Grearter long term stability during analysis
  - Improved accuracy and precision
  - Greater productivity
  - Less cleaning and maintenance
- Reduce sample preparation
  - Eliminate dilution of concentrated brines
  - Avoid contamination
- Make analysis simple and routine
  - As per radial viewed ICP-DES