The Niagara Plus sample introduction accessory has greatly enhanced the performance of ICP-OES and ICP-MS instruments. The accessory uses flow injection technology to reduce analysis time by 30%, resulting in reduced environmental impact and lower operating cost. In addition to the cost and environmental benefits, the Niagara Plus delivers an improvement in analytical performance. Currently, instruments use a nebulizer spray delay, stabilization delay, and nebulizer delay (incorporated in the nebulizer dead time, read/analysis time, and rinse time). With the Niagara Plus only a nebulizer delay and read/analysis time are required. The nebulizer spray delay is performed during the sample rinse period, thus eliminating the rinse delay. The constant flow of solution to the plasma and uniform internal diameter throughout the entire system allows the stabilization time to be reduced significantly and it is incorporated into the read/analysis delay to simplify the setup process. The purpose-built 6/7-port valve with built-in internal standard The sample is swept through a unique volume of only 6-8 μL, before mixing and internal standard. This allows for automatic addition of the internal standard or diluent (see figure below) simplifying the sample preparation for ICP-OES and ICP-MS.

The Niagara Plus sample introduction accessory has 3 unique features that separate it from similar systems:

1. Bubble Injector: The Niagara Plus automatically injects several air bubbles at the end of the sample pulse while filling the sample loop (see diagram below). These air bubbles prevent boundary diffusion allowing for a smaller volume of sample to fill the loop and prevent any sample dilution/mixing with the carrier solution. The bubble injector reduces carryover (point 4) and its action is reduced at a programmed time if you enter into your bubble which would cause plasma disturbances.

2. Time in Sample: This feature allows after the needle spray hits the nebulizer probe at the moment that you reduce allowing the time to analyze and without a delay injection. The data shown above is the testing of the new sampling system which is great in terms of stabilization and rinse time. The Johnston profile shown above is a great example of the new sample introduction system.

3. Built-in Internal Standard: This low volume removable mixing tee allows the operator to directly introduce the internal standard or diluent without either the equilibrium time or washout time. If you select to see no internal standard or diluent, the tee can simply be removed from the valve.

Combining the Bubble Injector and TiS, the Niagara Plus can use up to 53% of the sample compared to conventional sample introduction systems. This feature is staffed with experimental and marine science internal standards, estuaries, wetlands, and rivers. A second typical sample matrix, but as a commercial and university laboratory they also receive various students and sample research projects. The data discussed in this report is from a project examining the delivery of both sample matrix and sample throughout.

The installation of the Niagara Plus valve at MAFRL has resulted in a marked improvement in carryover and productivity along with reduced arguing, sample, and internal standard addition. With multiple different configurations available (see Figure 5), the Niagara Plus module can be customized to improve the ICP operating conditions with and without the Niagara Plus are listed in the table below. The result with the Niagara Plus is a reduction in sample time from 95 seconds to only 48 seconds per sample, which translates to a 40 to 50 % reduction in argon usage.

Niagara Plus Unique Features

Improved Performance & Enhanced Productivity

When the Niagara Plus the Fast Pump function can be turned on and the pump rate can be reduced without sacrificing analyte time, translating to a savings in sample and internal standard consumption, in addition to an improvement in the lifetime of the peristaltic pump tubing and other consumables.

Conclusions

The results in the figures below compare the accuracy and precision of internal dilution and internal standard (IS) addition with use of the Assist and peristaltic pump. The results show that the accuracy of the Assist is better at delivering the internal standard compared to the peristaltic pump. And the precision for either internal dilution or internal addition of internal standard is far better with the Assist than with a peristaltic pump.