brine*FAST* S4

30% NaCl Brine

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Brief

The brine*FAST* S4 automates, simplifies, and improves the determination of Ca, Mg, and other trace metals in 30% brines and chlor alkali plant products.

Features:

- Fully automated, inline preconcentration and matrix removal
- Direct mode with up to 50x fixed inline dilution
- Syringe-driven reagents for consistent chemistry and maximum throughput and cleanliness
- Automatic cleaning of buffer cleanup column

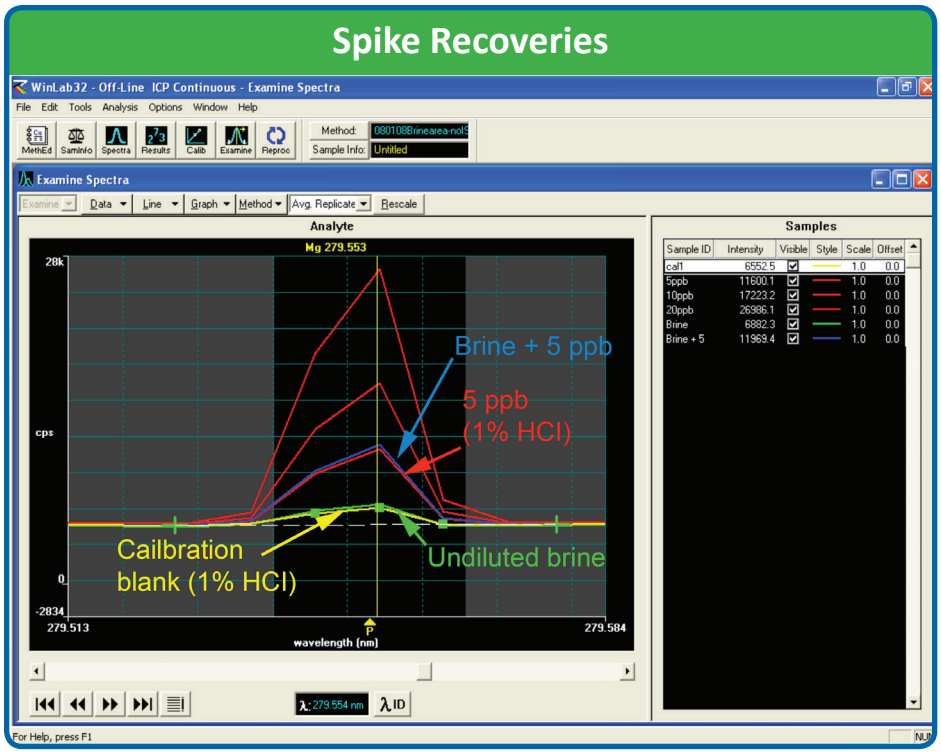

Figure 1. Spectral data shows equal response for a Mg spike in a 1% HCl standard and 30% brine.

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Abstract

The brine*FAST* S4 is a high performance sample introduction system for the determination of trace impurities in brines and other high matrix samples by ICPOES. Early detection of low and sub-ppb alkaline earth and transition metals in high purity brines improves chlor alkali plant process control and prevents costly damage to fluoropolymer membrane cells. Undiluted 30% brines may be sampled and analyzed directly, eliminating offline sample preparation and reducing contamination.

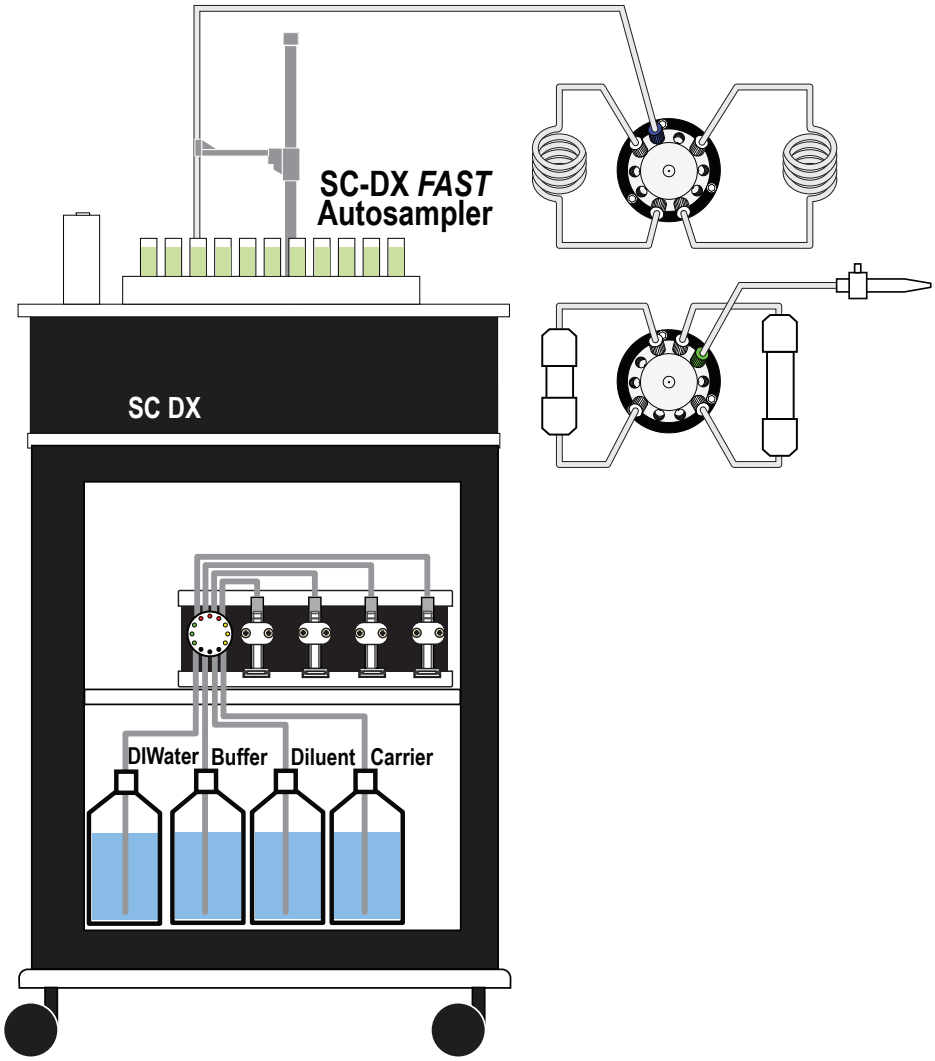


Figure 2. brine*FAST* S4 system schematic

Applications:

- Preconcentration mode for determination of low and sub-ppb Ca, Mg, and other metals in 30% brine
- Chlor alkali plant product monitoring for caustic soda and bleach
- Determination of alkali earth metals and many transition metals in any high salt matrix sample
- High throughput *FAST* analysis with inline dilution in Direct mode

Chloralkali plant process control

The brine*FAST* S4 is ideal for membrane cell chlor alkali plants, which require very reliable quantification of < 5 ppb Ca, Mg, and other elements in 30% ultrapure brine to prevent costly membrane damage. With traditional ICP techniques, detection limits in 30% brine are insufficient to provide plant engineers with precise and accurate results at the required concentrations. With the reliable daily operation and improved detection limits of the brine*FAST*, plant engineers can ensure product specifications are maintained with fewer process adjustments and chemical inputs.

For non-membrane cell chlor alkali plants, the brine*FAST* S4 can be run in direct mode, allowing automatic, inline dilution of samples to limit matrix exposure in the ICP and significantly reduce ICP maintenance. The preconcentration features may still be used when necessary to improve detection limits.

Chloralkali product monitoring and certification

The brine*FAST* provides a convenient and powerful way to measure trace elemental impurities in chlor alkali plant products, such as sodium hydroxide and sodium hypochlorite. These products can be measured with minimal sample preparation using the same instrument methods and conditions as the ultrapure brine analysis. Characterizing final products with the brine*FAST* provides high-precision, long-term data trends, which can benefit plant sales.

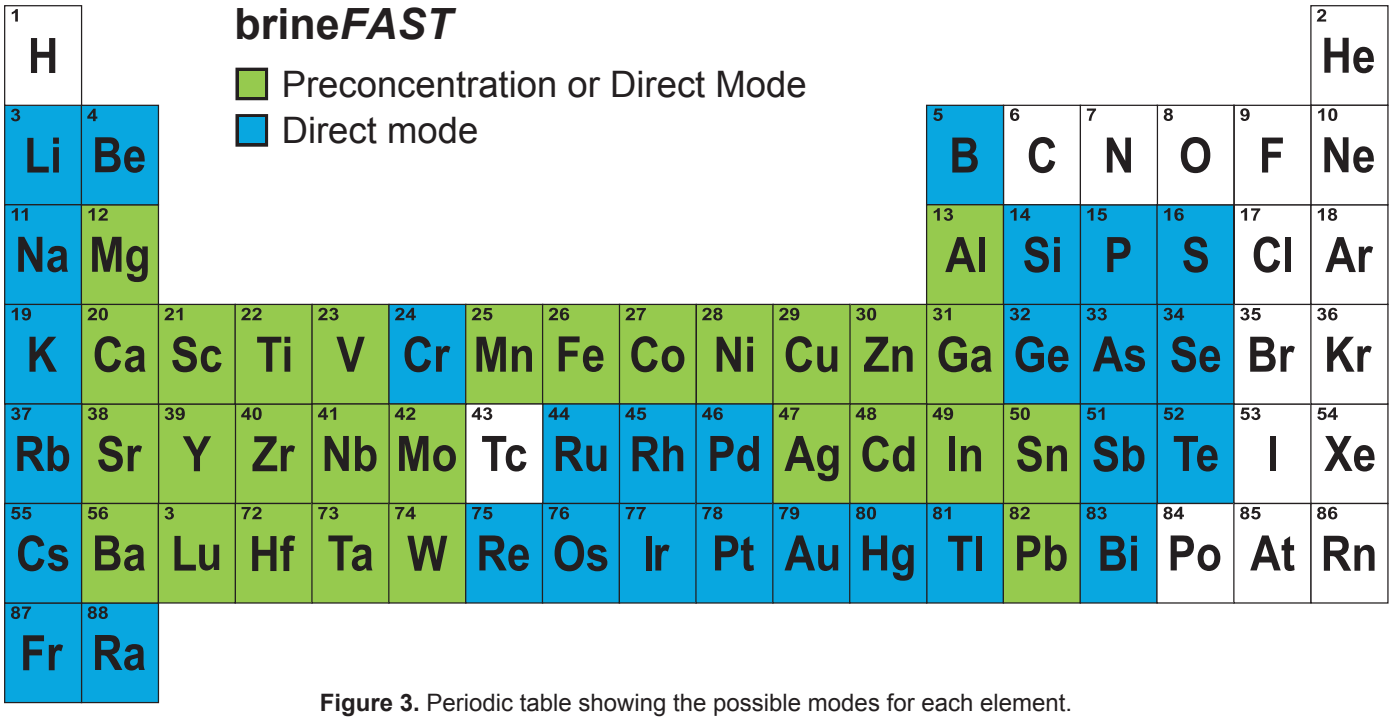


Figure 3. Periodic table showing the possible modes for each element.

Modes

Preconcentration mode:

A chelation column binds alkaline earth metals, transition metals, and rare earth elements but allows matrix Na^+ and Cl^- ions to be rinsed out. After the preconcentration step, analytes are eluted and detected by ICP.

Direct mode:

Sample is automatically diluted inline by high-precision syringe pumps. Dilution reduces matrix effects and allows the determination of elements whose chemistry is not compatible with the preconcentration column.

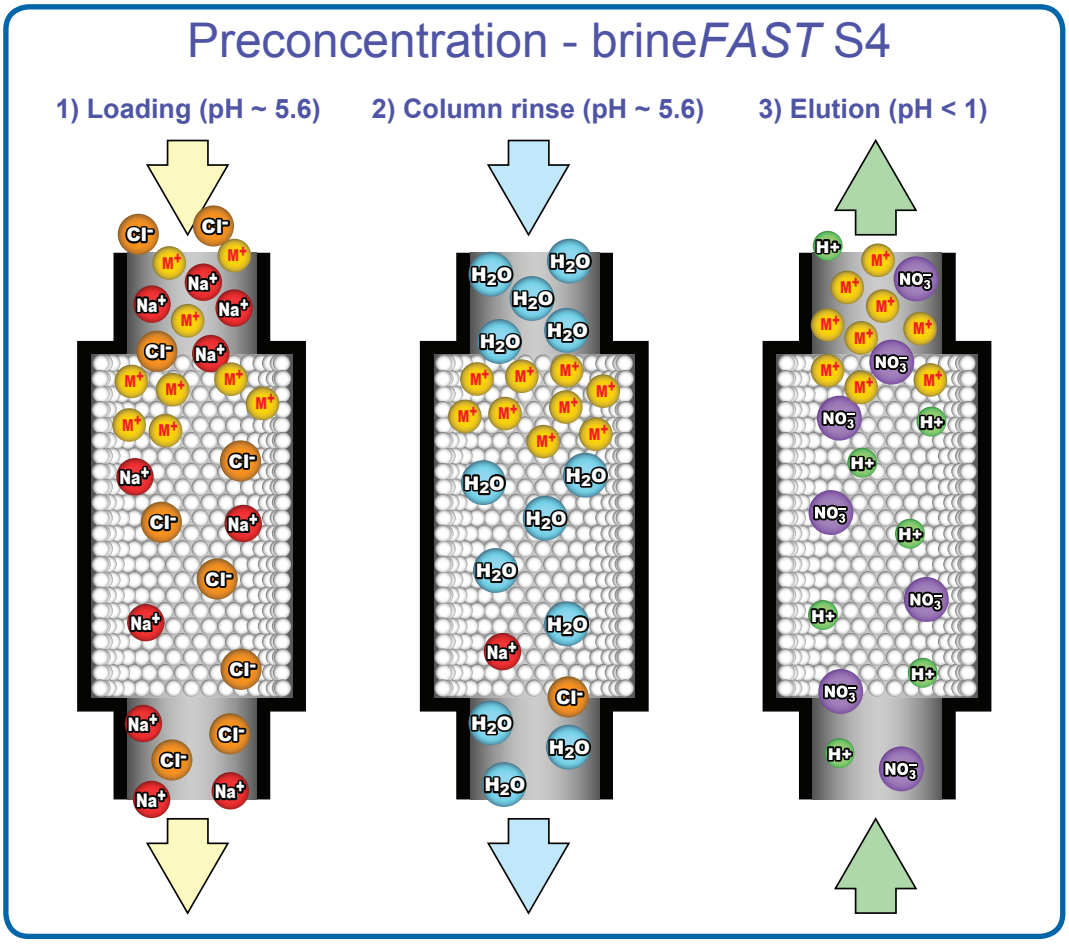


Figure 4. At a pH ~ 5.6, many metals are chelated on the preconcentration column, while matrix elements are flushed from the column. Metals are eluted directly to the ICP with nitric acid.

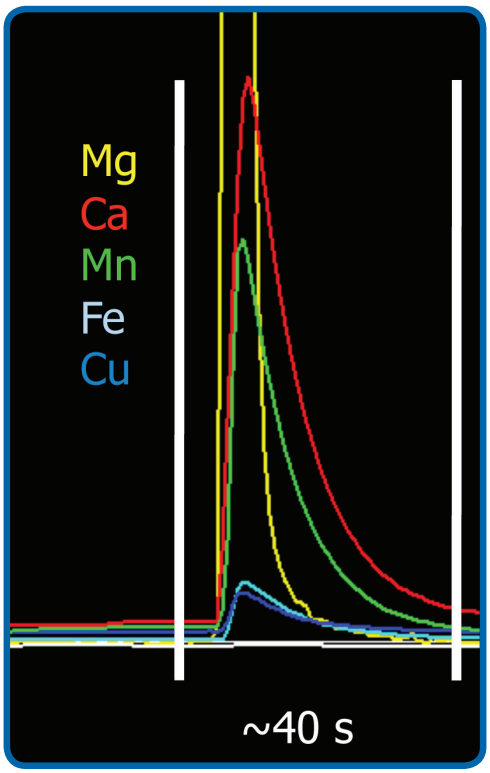


Figure 5. Simultaneous elution profiles for preconcentration elements allows simple quantification after matrix removal

Spike Recovery in 50% caustic soda (10x diluted)	
Analyte	% Recovery
Fe	99
Ni	99
Cu	99
Pb	101

Figure 6. Spike recoveries in 50% Caustic soda (10x diluted) show excellent recovery against a calibration curve prepared in diluted nitric acid. Spike level is 50 ppb (500 ppb for Fe).

Spike Recovery Comparison in 30% brine: brine*FAST* S4 vs Traditional Sample introduction		
Analyte	brine*FAST* S4 (spiked at 5ppb)	Traditional Introduction (spiked at 100 ppb)
Ca	103	132
Mg	96	64
Fe	95	104
Ba	99	106
Sr	99	75
Mn	99	111

Figure 7. Comparison of spike recoveries for traditional analysis and the brine*FAST* S4 preconcentration technique. Note that the spike levels are 20x lower with the brine*FAST* S4 than with the original introduction system.

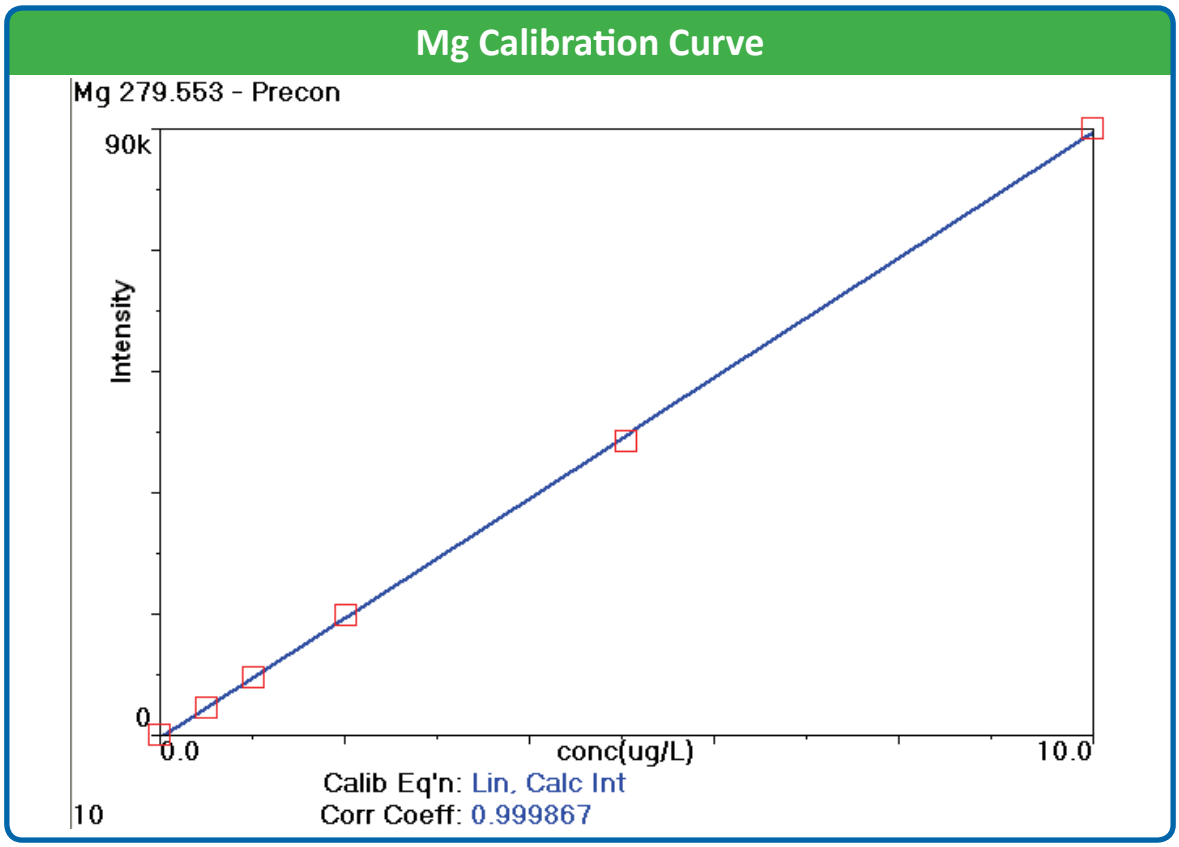


Figure 8. Typical calibration curve for ultra-pure brine, < 10 ppb.

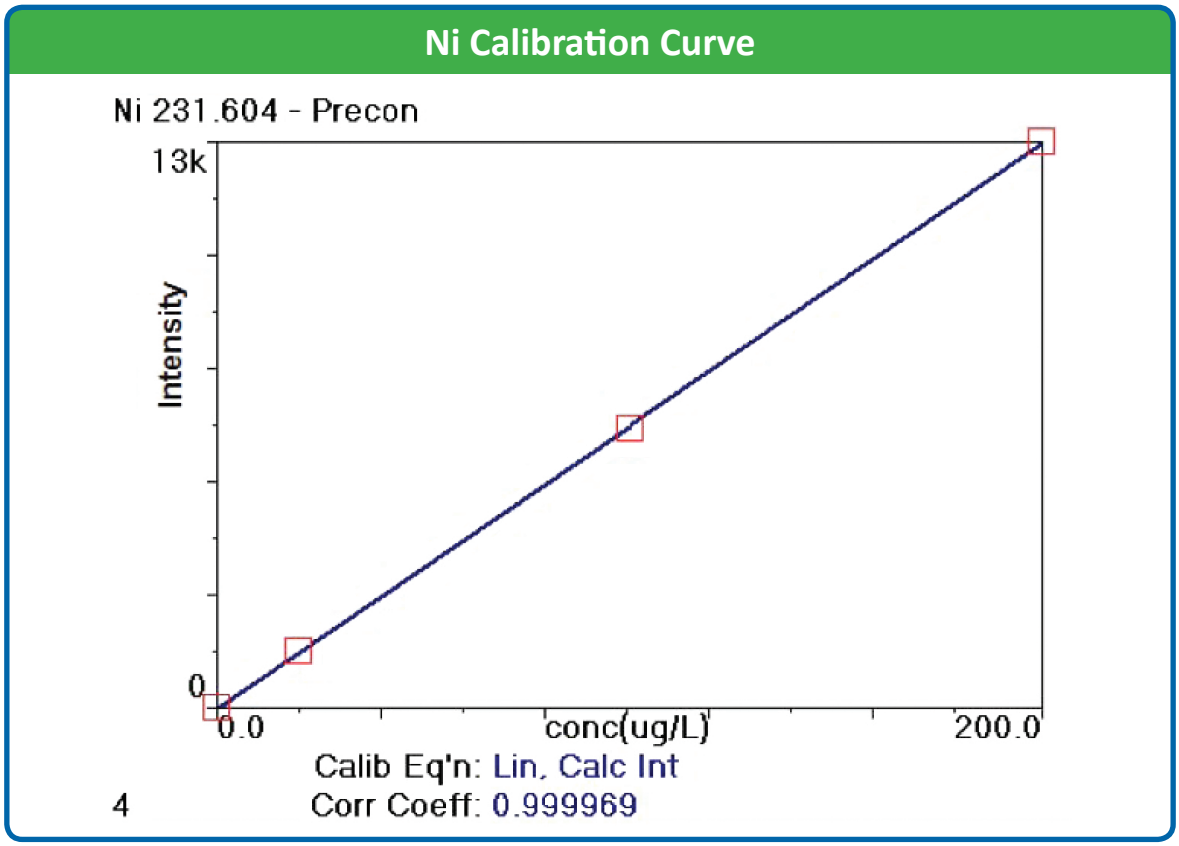


Figure 9. Typical calibration curve for 50% Caustic Soda (10x diluted) demonstrating linearity at higher concentrations. If needed, higher level calibrations at the ppm level are also linear.

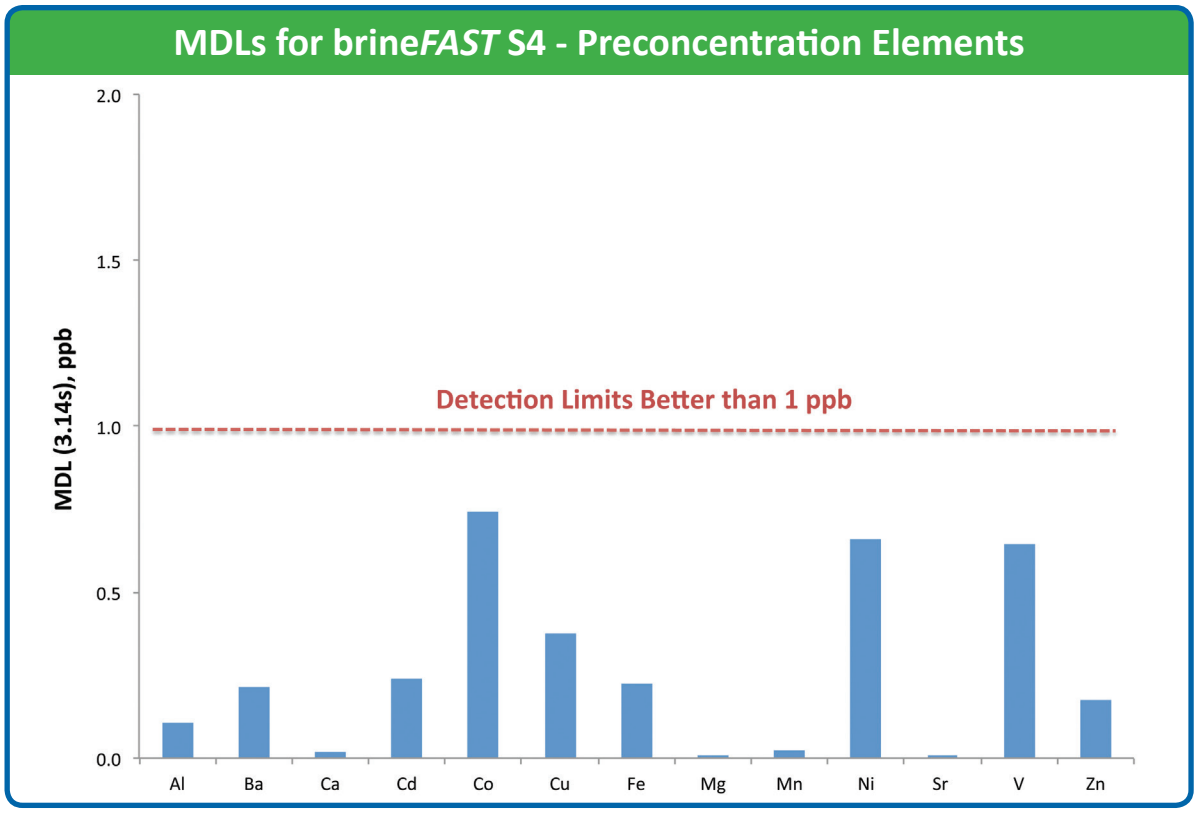


Figure 10. MDLs better than 1 ppb were achieved for preconcentration mode elements (0.5 ppb, n=7, 3.14σ)

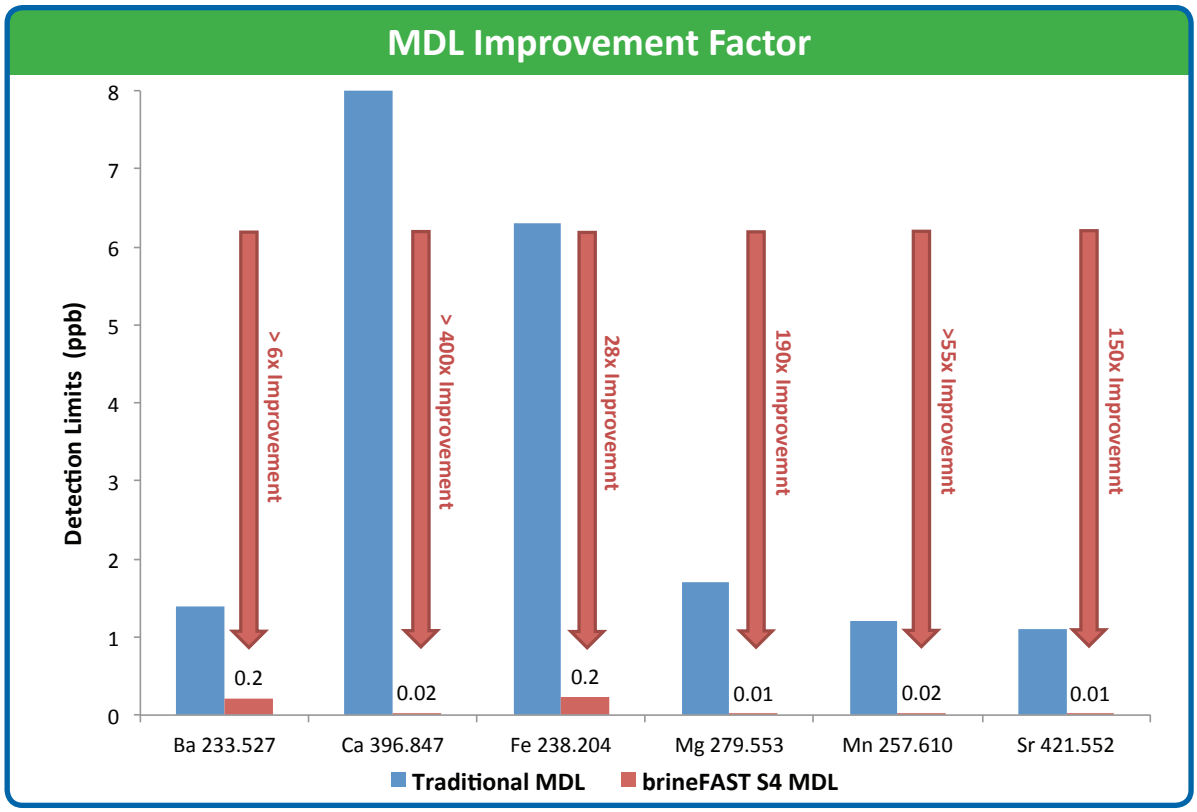
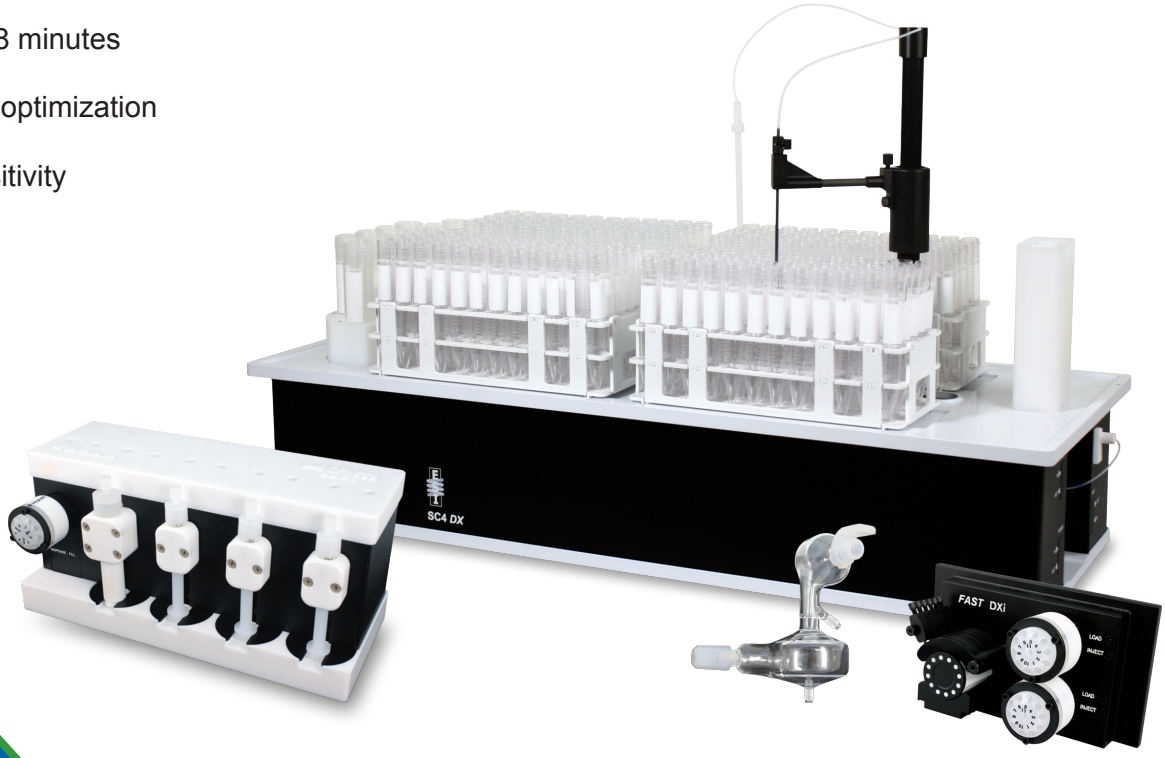


Figure 11. The brine*FAST* S4 MDLs are significantly better than those achieved by traditional sample introduction.

Benefits:

- Detection limits in brine up to 400x better than traditional sample introduction
- Low blanks
- Sub-ppb IDL's
- Eliminate pump tubing
- No daily maintenance
- *FAST*: < 8 minutes
- Easy ICP optimization
- High sensitivity



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