SampleSense *FAST* UHT-S with 4DXCi autocorrecting autosampler on the iCAP PRO XPS ICP-OES

Ultra-high Throughput Mehlich-3 ICP Analysis with SampleSense *FAST* UHT-S for Thermo iCAP™ PRO XPS ICP-OES

Introduction

Mehlich-3-ICP is a method for determining bioavailable concentrations of 11 extractable micronutrient elements in soil samples. Mehlich-3-ICP is invaluable for determining the amount of fertilizer to apply to farm fields. Because soil analyses must be completed in a narrow time window, ultra-high sample throughput with high reliability is required.

SampleSense *FAST* UHT-S* uses an inert injection valve with built-in optical sensors that automatically detect the liquid sample, inject the valve and trigger the ICP read in a tightly-timed analytical sequence. SampleSense *FAST* UHT-S eliminates wasted time from the ICP method and can more than double sample throughput on the iCAP ICP-OES while recording missing or empty tubes.

SampleSense *FAST* UHT-S Benefits

- 7 samples per minute Mehlich-3-ICP
- Automatic sensing, injection, and triggering of the ICP analytical read
- Detection and reporting of missing or empty sample tubes as “unsensed” samples
- DXCi autosampler automatically goes to the correct sample position – even when accidentally obstructed
- Adding SampleSense *FAST* UHT-S can double or even triple sample throughput

** Formerly SampleSense Soil*

SampleSense *FAST* UHT-S

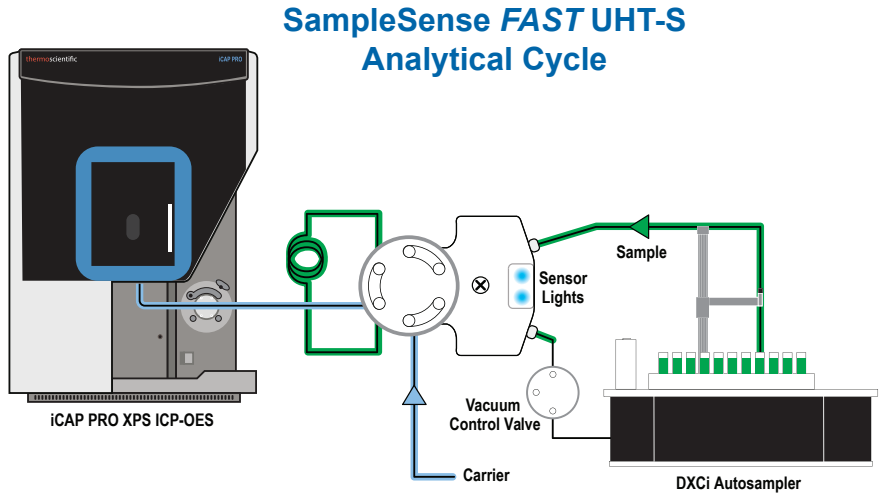

Figure 1. Flow diagram of SampleSense *FAST* UHT-S and DXCi autosampler coupled to Thermo Scientific iCAP PRO XPS ICP-OES

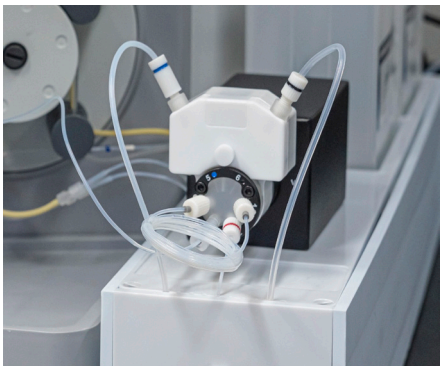

Figure 2. Sample not present, sensors not activated

Figure 3. Valve sensors activated, sample is sensed

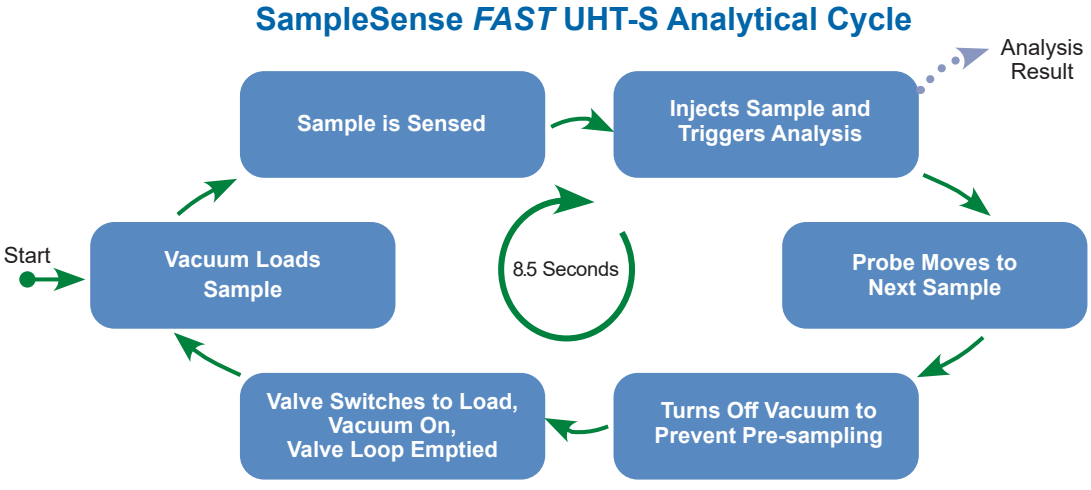

Figure 4. Analytical Cycle of SampleSense *FAST* UHT-S

Method Conditions

- Plasma Gas Flow: 12 L/min
- Aux Gas Flow: 0.5 L/min
- PFA MicroFlow OneTouch (ICN40X-68) Nebulizer Flow: 0.55 L/min
- Plasma Power: 1150 W
- Plasma View: Radial
- Sample Loop Size: 250 µL

Table 1. Wavelengths and calibration results.

Element	Wavelengths (nm)	Bottom Std (PPM)	Low Std (PPB)	High Std (PPM)	Top Std (PPMm)	Correlation Coefficient (r^2)
S	180.731	4	10	20	40	0.998
P	213.618	8	20	40	80	0.999
Zn	213.856	0.4	1	2	4	0.999
B	249.773	0.2	0.5	1	2	0.999
Mn	257.610	2	5	10	20	0.998
Fe	259.940	8	20	40	80	0.998
Mg	279.079	24	60	120	240	0.999
Ca	315.887	10	25	50	100	0.999
Cu	324.754	0.8	2	4	8	1.000
Na	589.592	6	15	30	60	1.000
K	766.490	40	100	200	400	0.999

Experimental

SampleSense *FAST* UHT-S performs the Mehlich 3 analysis in 8.5 seconds (sample to sample) when performing one replicate, and in 10.5 seconds with two replicate measurements. The image on the right shows the remaining sample consumption is <2 mL of sample per analysis – the black line indicates the original sample level of the 6 mL extract. Multiple sample analyses can be performed without re-extraction.

Table 2. Method performance and sample consumption.

iCAP PRO XPS Plasma View	Integration Time(s)	# of Replicates	Sample to Sample Time(s)	Sample Consumption (mL)
Radial	1	1	8.5	<2
	1	2	10.5	<2

Figure 5. Low Sample Consumption

Unsensed Samples Detected

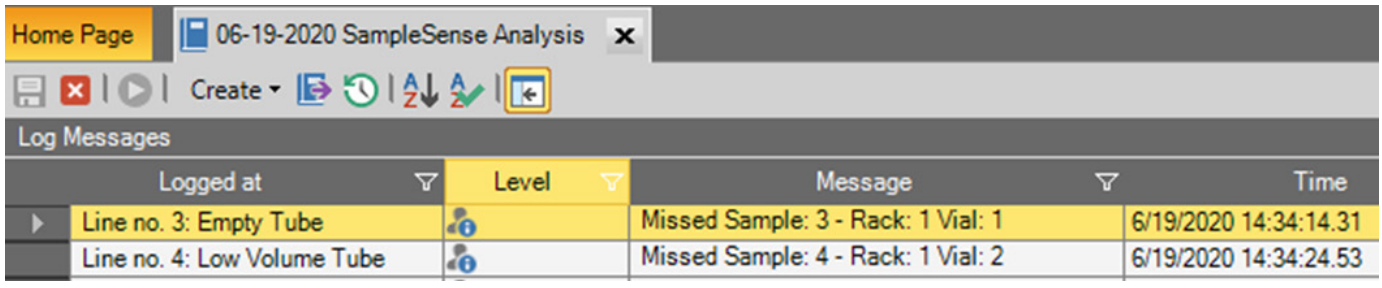

Figure 6. This view of the Thermo Scientific Qtegra™ Log within the LabBook displays the automatic logging capabilities provided by SampleSense. An empty vial and a low volume vial were inserted into rack 1. SampleSense identified the missed samples that were not successfully loaded and provides this notification to the instrument software.

Results

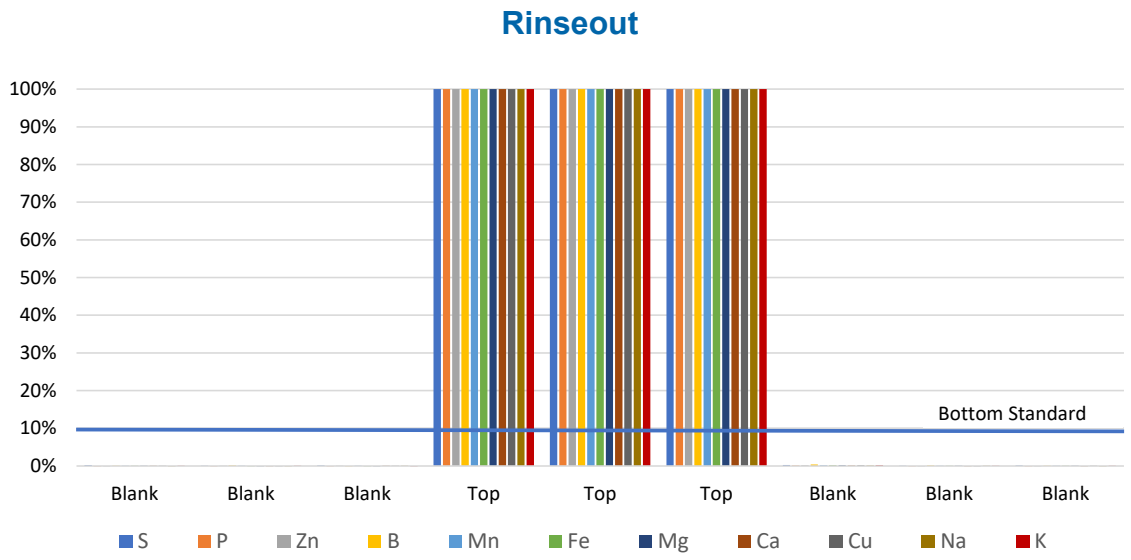

Figure 7. The SampleSense *FAST* UHT-S rinseout immediately reduces all elements to concentrations well below the bottom standard when performing the Mehlich-3 analysis procedure. Additional time can be added to the rinseout parameters to meet laboratory requirements. The system can deliver rinseout factors of 1000X, 10,000x or more depending on how clear the spray chamber needs to be before the next sample is introduced.

Conclusion

At 7 samples per minute, SampleSense *FAST* UHT-S for Mehlich-3-ICP method can more than double the productivity of the ICP instrument. It delivers reliable and reproducible data, while providing quick and effective sample rinseout. The unique DXCi autosampler automatically monitors and corrects positions for all axes of motion – e.g when the probe motion is blocked accidentally by the operator adding samples into an active analytical run.

Table 3. SampleSense *FAST* UHT-S systems.

Description	Part Numbers for iCAP PRO XPS ICP-OES
SampleSense *FAST* UHT-S 2DXCi	2F-SS-Soil-68
SampleSense *FAST* UHT-S 4DXCi	4F-SS-Soil-68
SampleSense *FAST* UHT-S 8DXCi	8F-SS-Soil-68
SampleSense *FAST* UHT-S 14DXCi	14F-SS-Soil-68