Streamlining Method Development for Metals Analysis Using Agilent 5900 ICPOES and IntelliQuant 2.0

National Environmental Monitoring Conference 2021
Metals Analysis and Remediation Session
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Agilent Technologies

Agilent
Trusted Answers

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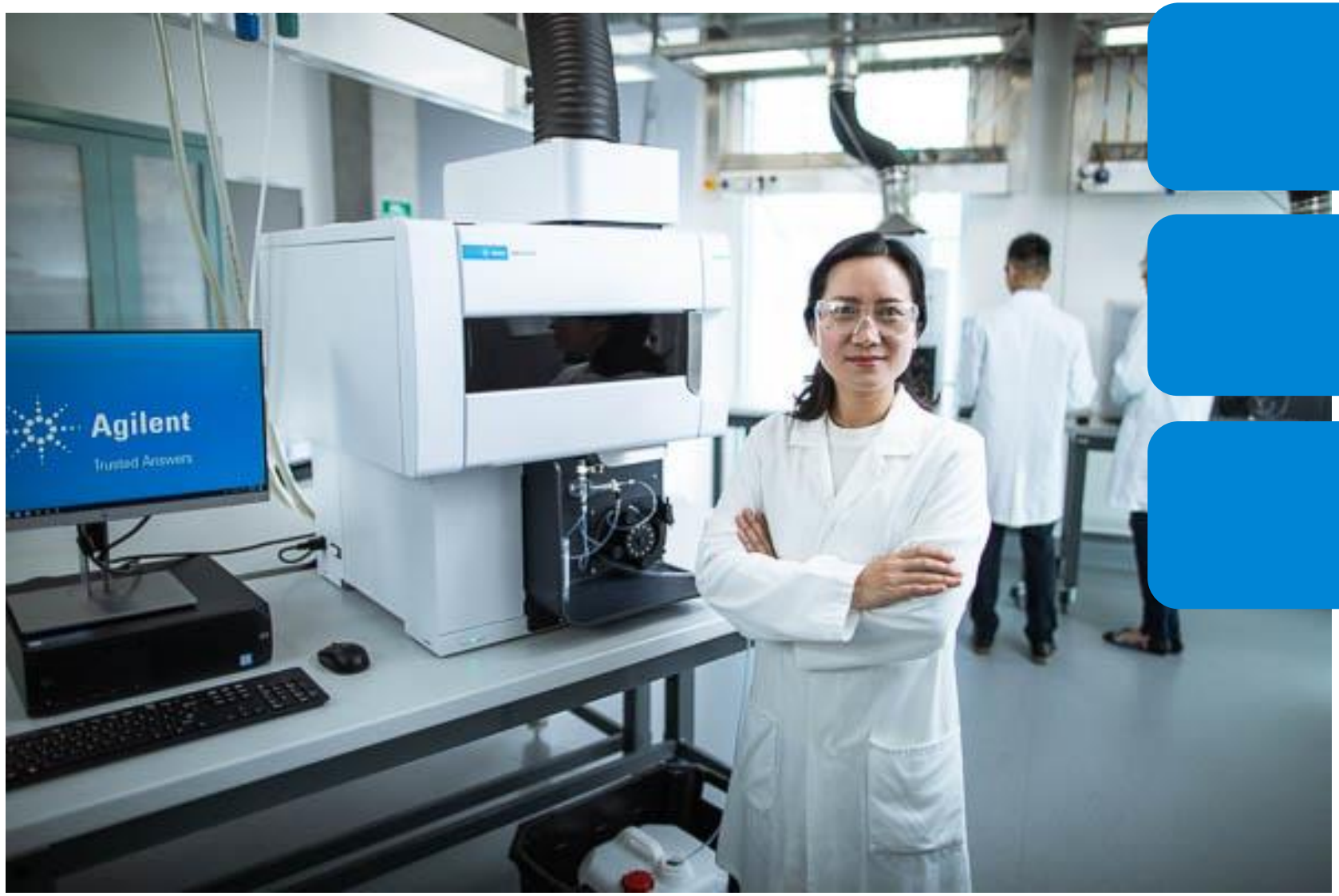
Agilent Smart Tools reduce your remeasurement



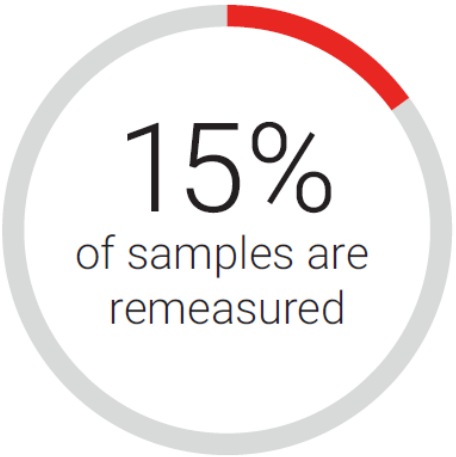
Intelligent

Efficient

Confident

All labs remeasure some of their ICP-OES samples.
Do you know how much remeasurement is costing you?

A recent online poll showed the average amount of remeasurement is 15%.



For a small to medium lab* this will consume almost 2 additional weeks per year

* 250 samples per week, 2.5 minutes ICP-OES analysis time per sample

What issues lead to sample remeasurement?

Sample Related

- Spectral Interference
- Analytical Line Saturated
- Improper prep

Operation Related

- Nebulizer blockage
- Peri pump tubing disconnected
- Internal Standard failure
- Analyte carry-over

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5800/5900 ICP-OES with Smart Tools to reclaim your wasted time

Use Smart Tools to gain insights into your **instrument operation** to reduce remeasurement

- NebAlert
- Outlier Conditional Formatting (OCF)
- Early Maintenance Feedback (EMF)
- Automated air filter blockage alert
- Automated instrument performance tests
- Intelligent rinse
- Plasma ignition optimization
- Internal standard monitor

Smart Tools

Operational Insights

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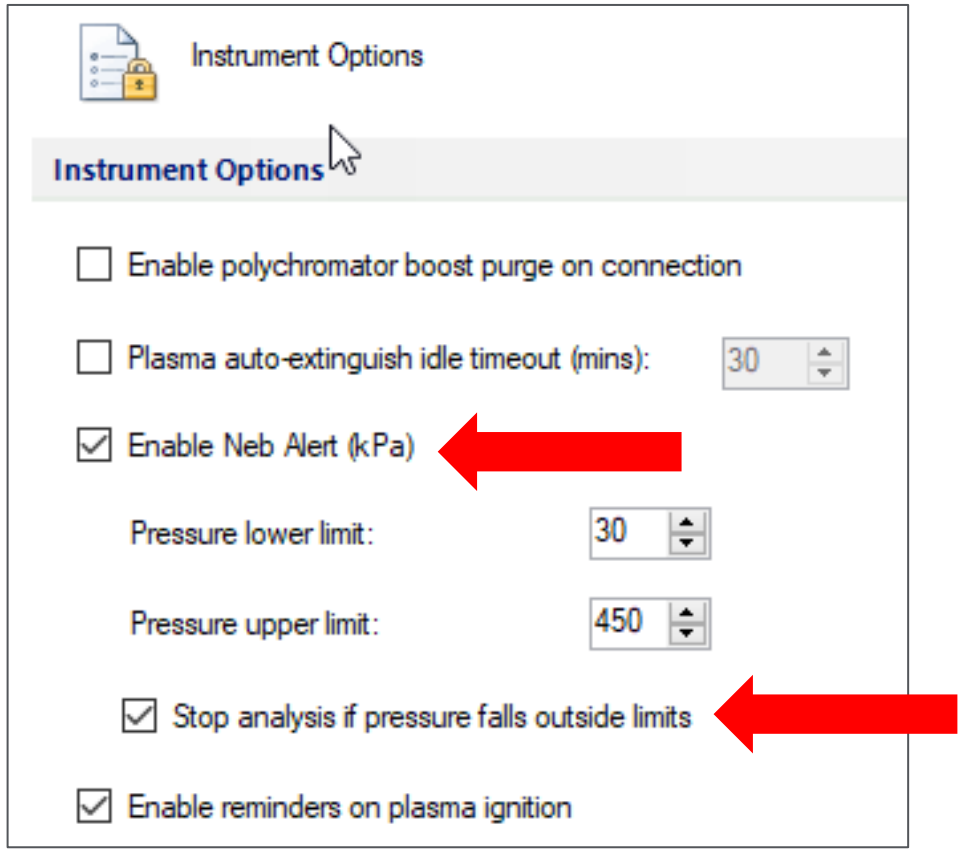
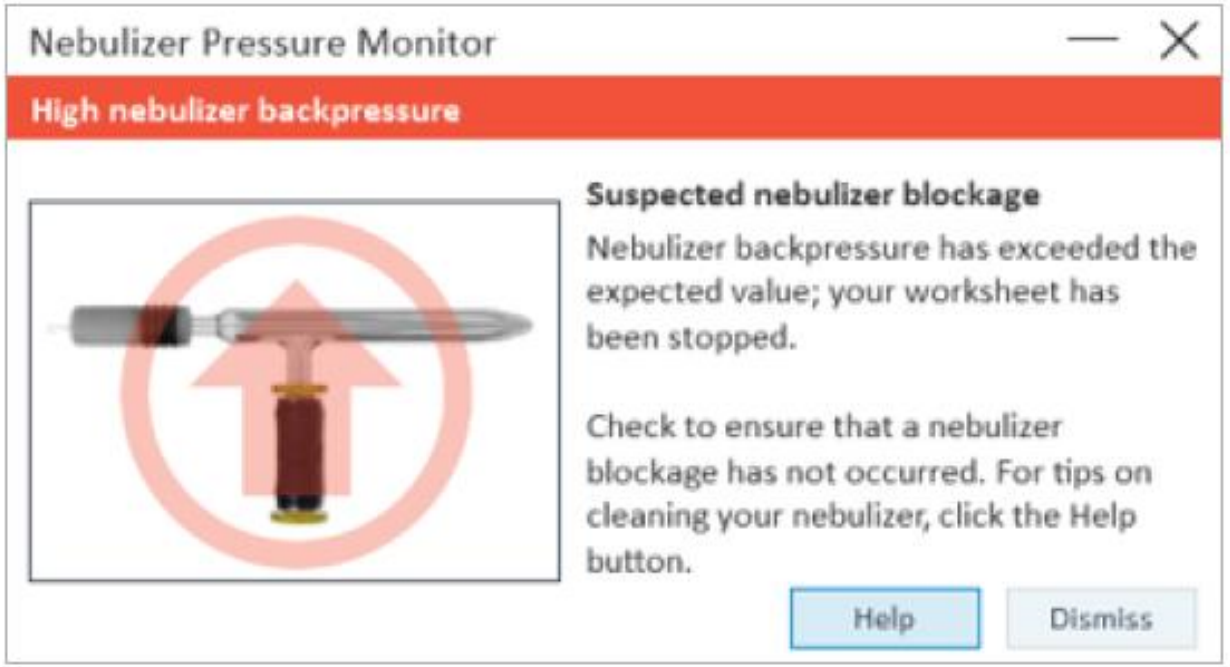
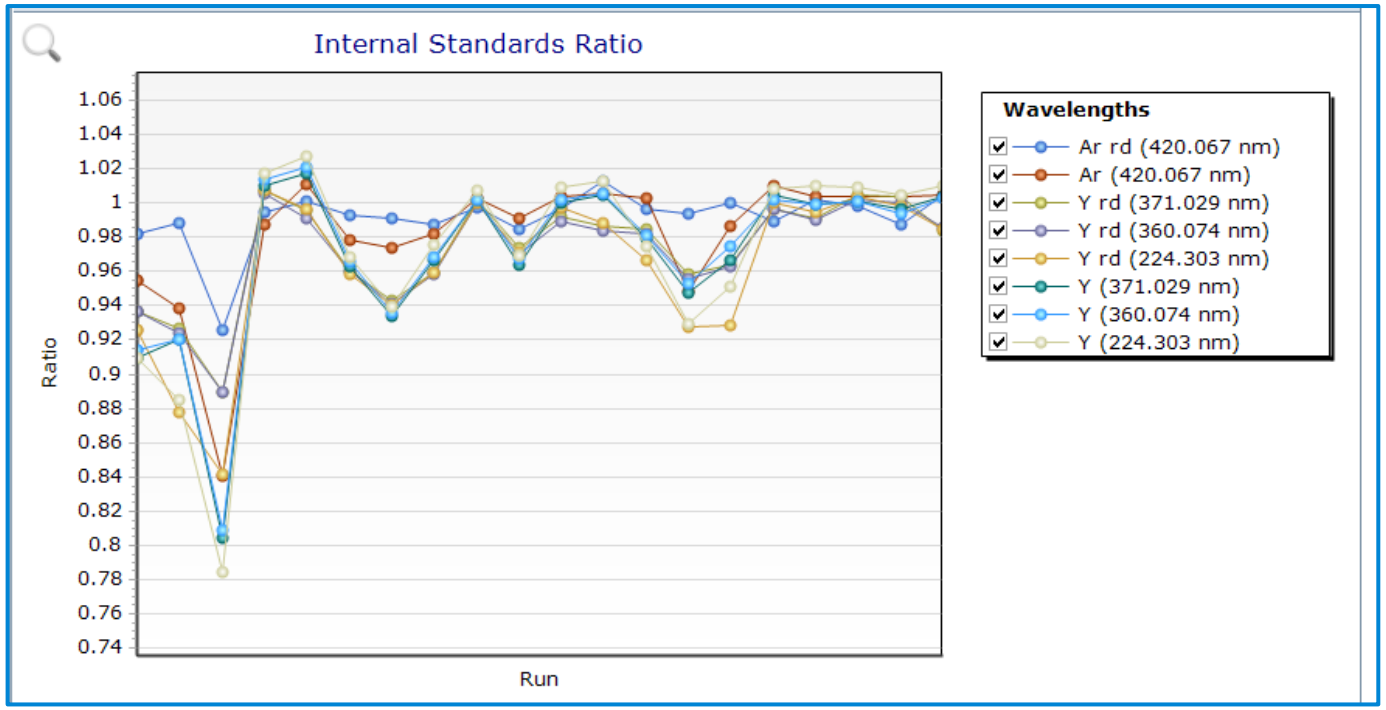
Smart tools for operational insight



NebAlert



Smart tools for operational insight



Internal Standard monitor

Smart tools for operational insight

Outlier Conditional Formatting (OCF)

Rack:Tube	Solution Label	Outlier Summary	Co 8.615 nm ppm	Co 230.786 nm ppm	Cr 267.716 nm ppm	Cu 327.395 nm ppm	Fe 273.358 nm ppm	K 766.491 nm ppm	La 408.671 nm ppm	Li 670.783 nm ppm	Mo 279.80 ppm
2:2	ORESA 45e 2		1.3645	1.1683	19.5747	14.8628	3340.6496	57.8595	0.0167	0.1325	7
2:3	SRM 2781 1		0.2291	0.1247	3.7995	11.3385	520.5713	93.9258	0.3927	0.1407	107
2:4	SRM 2781 2		0.2323	0.1270	3.8096	11.8384	531.5788	97.1176	0.3894	0.1445	109
2:5	SRM 2782 1	A	1.5177	1.4996	2.3091	53.5224	5852.2210 o	71.4071	1.2246	0.1355	55
2:6	SRM 2782 2		1.4482	1.4303	2.1963	51.4172	5474.6380	67.6546	1.1696	0.1378	52
2:1	ORESA 45e 1		1.4282	1.2215	20.2531	15.9087	3385.5674	61.0864	0.0047		
2:2	ORESA 45e 2		1.4042	1.1999	20.0833	15.1864	3409.9162	59.4210	0.0166		
2:3	SRM 2781 1		0.2293	0.1244	3.8020	11.4742	534.8713	96.1179	0.3911	0.1418	110
2:4	SRM 2781 2		0.2405	0.1306	3.9745	12.0563	550.3115	100.0555	0.4072	0.1418	112
2:5	SRM 2782 1	A	1.5041	1.4722	2.2825	53.6837	5822.7552 o	71.1665	1.2091	0.1284	55
2:6	SRM 2782 2		1.4680	1.4463	2.2234	51.6004	5436.4548	66.9066	1.1841	0.1276	51
2:1	ORESA 45e 1		1.4573	1.2448	20.6513	16.0510	3447.9631	62.1334	0.0053	0.1377	4
2:2	ORESA 45e 2		1.4048	1.2037	20.1358	15.2630	3419.2366	59.4457	0.0166	0.1269	7
2:3	SRM 2781 1		0.2334	0.1267	3.8933	11.6111	551.2126	98.6493	0.3990	0.1374	113

Rack:Tube	Solution Label	Outlier Summary	Co 8.615 nm ppm	Co 230.786 nm ppm	Cr 267.716 nm ppm	Cu 327.395 nm ppm	Fe 273.358 nm ppm	K 766.491 nm ppm	La 408.671 nm ppm	Li 670.783 nm ppm	Mo 279.80 ppm
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2:6	SRM 2782 2										
2:1	ORESA 45e 1										
2:2	ORESA 45e 2										
2:3	SRM 2781 1										

Display flagged only

Flag	Flag Rule	Pass Value	Enable	
A	Result Concentration Overrange	N/A	☑	
B	Result Concentration % RSD > Pass Value	10.00	☐	☐ Only apply when result > 10.0 * MDL
C	Result Concentration < MDL	N/A	☐	
D	Internal standard % recovery variation > Pass Value	15.00	☐	
E	QC Equation Test Fail	N/A	☐	

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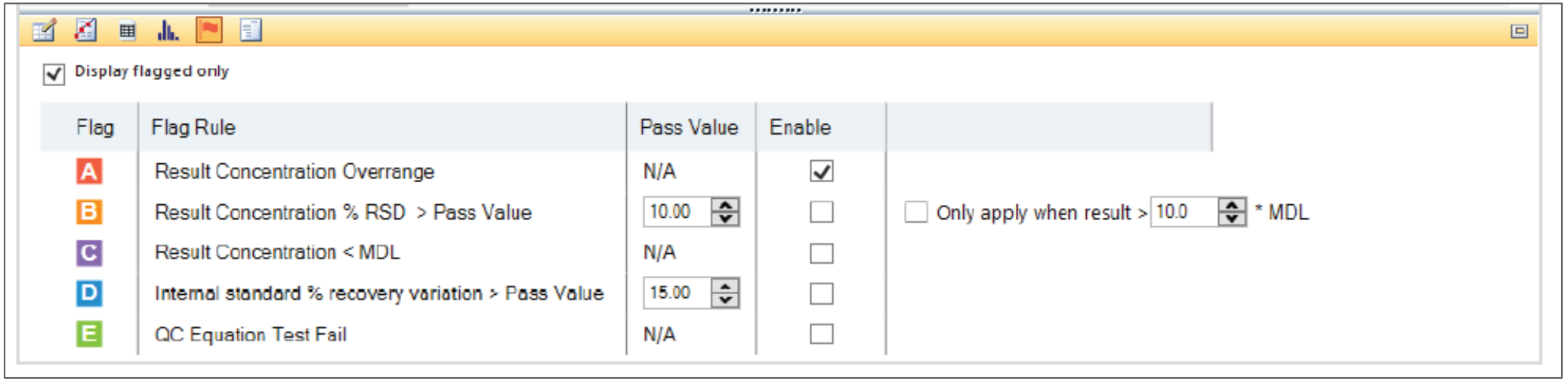
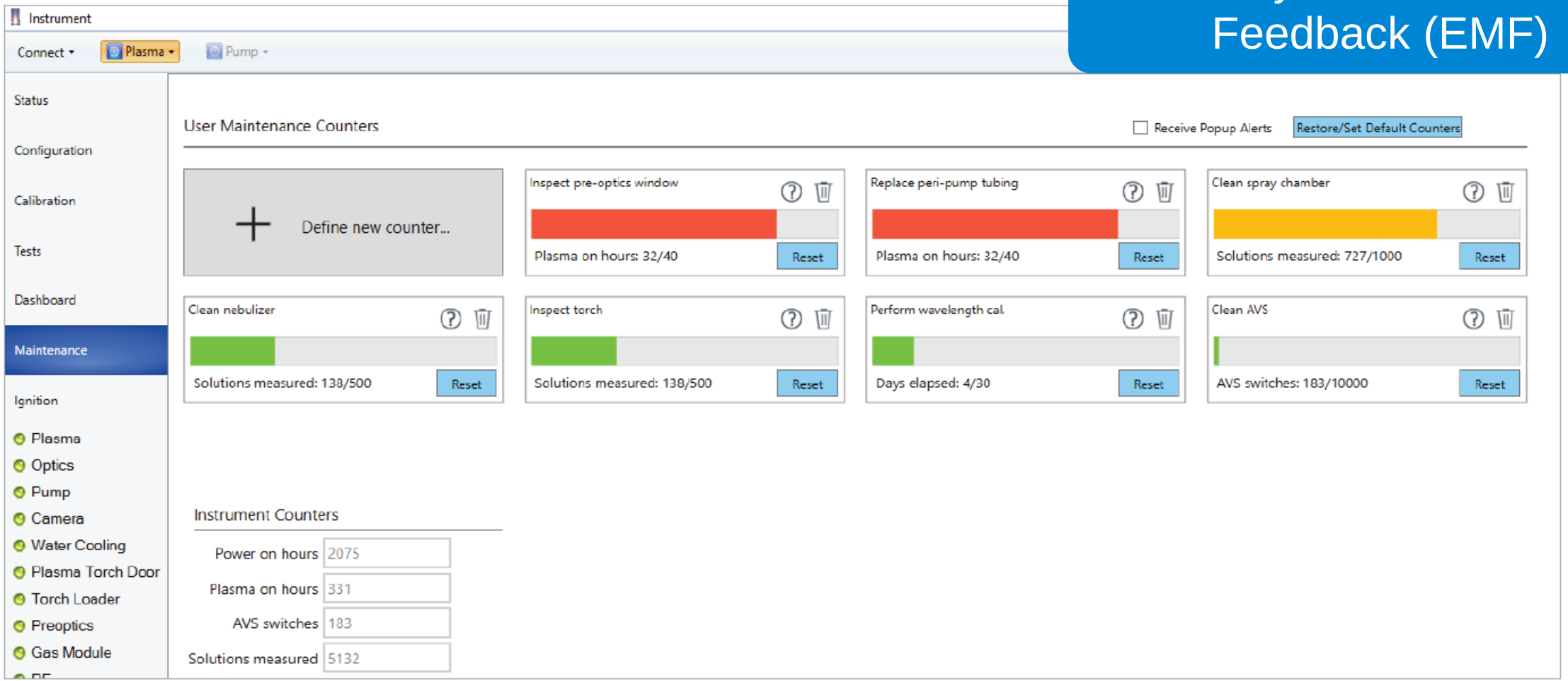
Smart tools for operational insight

Outlier Conditional Formatting (OCF)

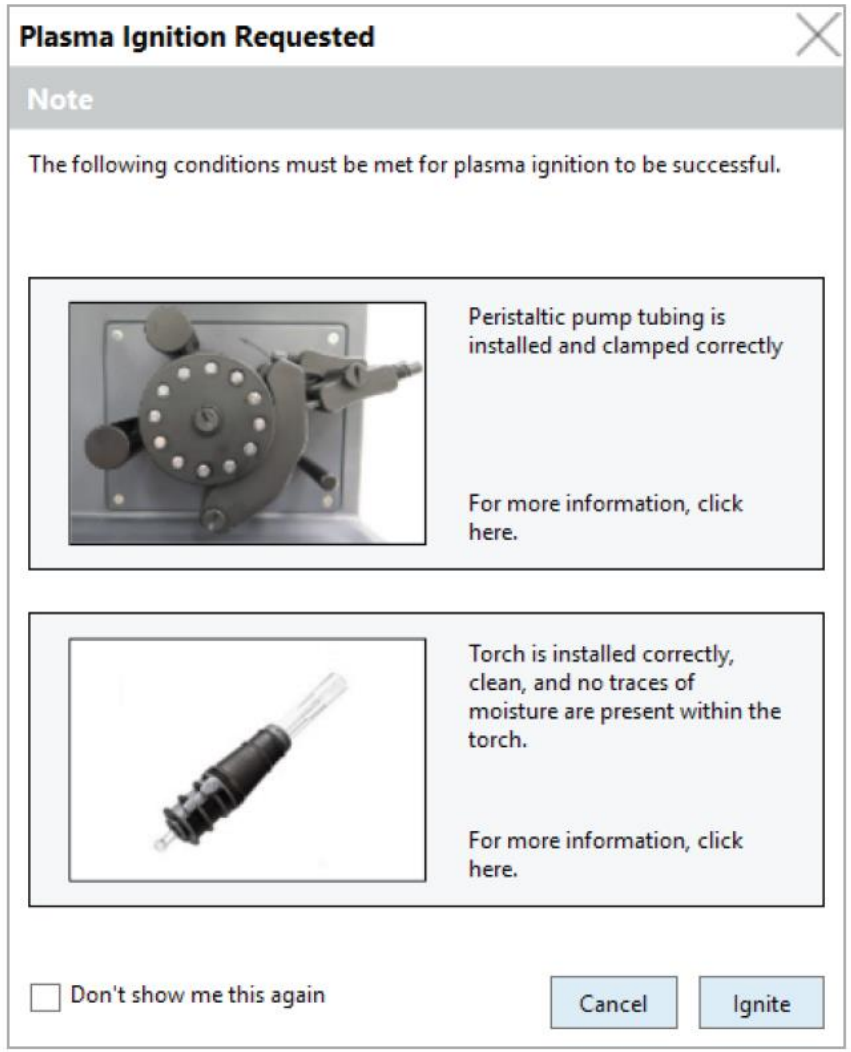


Smart tools for operational insight

Early Maintenance Feedback (EMF)



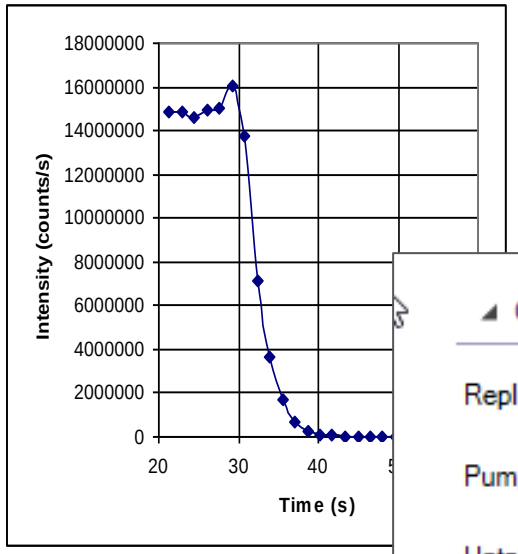
Smart tools for operational insight



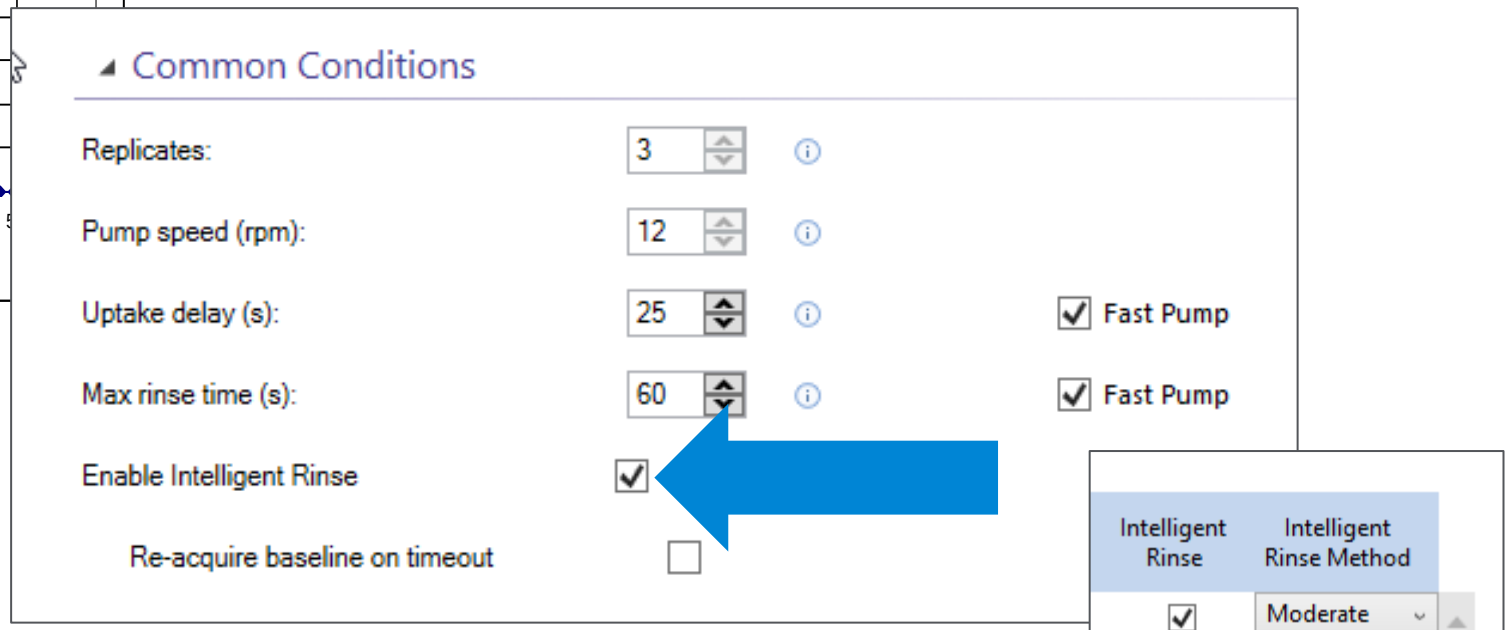
Optimized plasma ignition

- Prevents difficult ignition
- Prevents torch melts
- Prevents torch ‘fountains’

Smart tools for operational insight



Intelligent Rinse



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- Analyte carry-over

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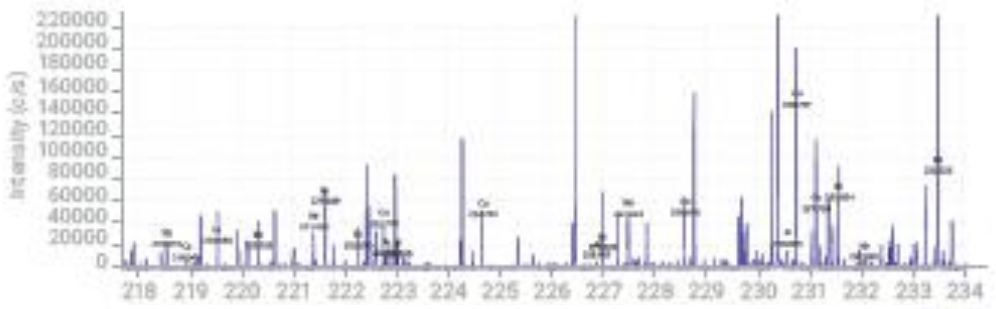
Smart tools that reduce your remeasurement

Use Smart Tools to gain **insights into your samples**

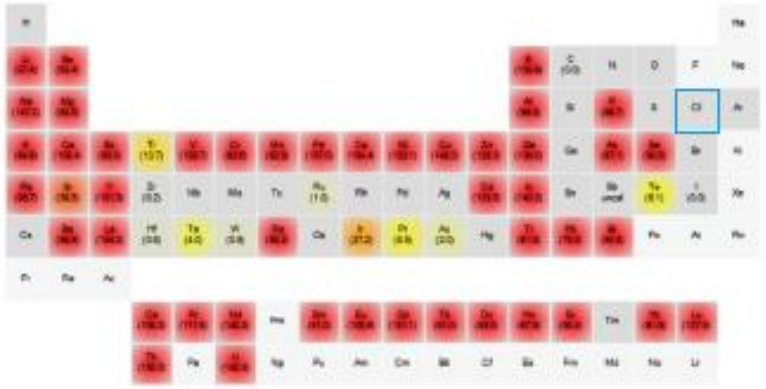
- IntelliQuant *2.0*
  - Full spectrum scan
  - Identify sample preparation and chemical compatibility mistakes
  - Automated spectral interference identification
  - Understand sample composition
- IntelliQuant Screening
- Internal Standard Monitor
- Argon Emission Monitor

Smart Tools → Sample Insights

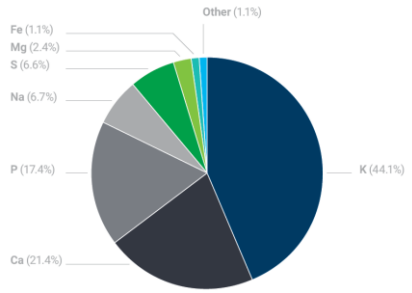
IntelliQuant 2.0 features to help reduce re-measurement



Full spectrum scan shows everything that is in the sample



Periodic table heat map with semi-quant values to quickly identify sample preparation mistakes.



Smart view to identify composition of a sample

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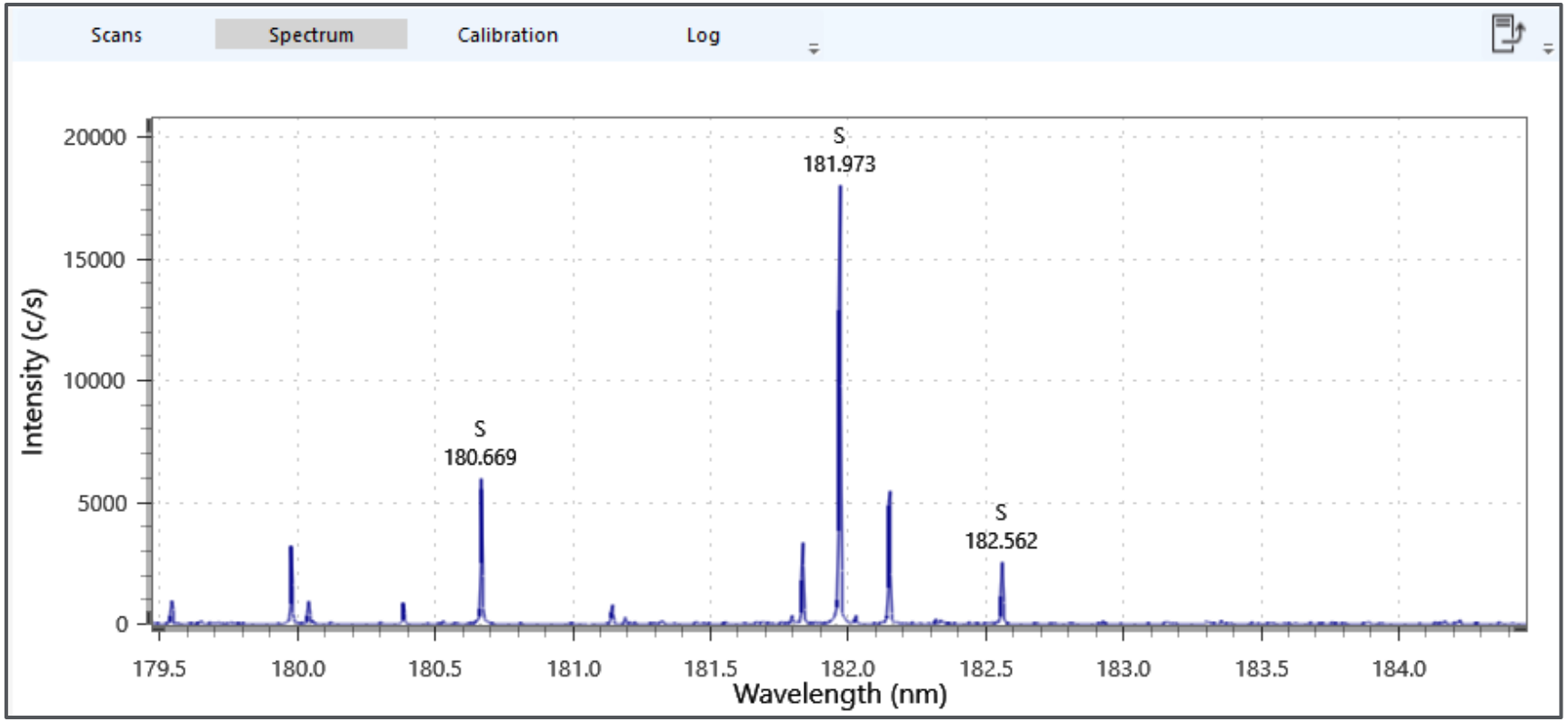
IntelliQuant 2.0 features to help reduce re-measurement

Full spectrum scan shows everything that is in the sample



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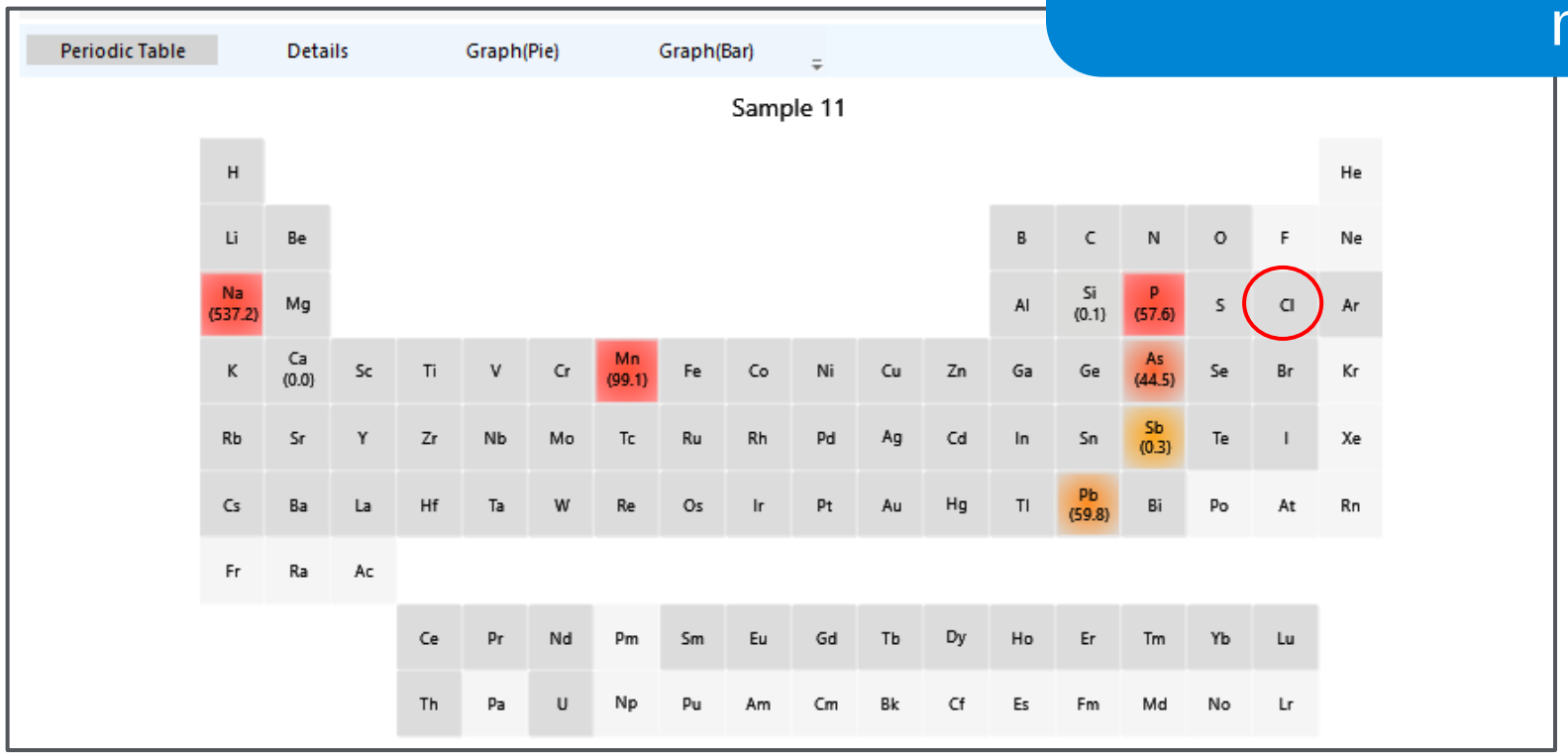
IntelliQuant 2.0 features to help reduce re-measurement

Periodic table heat map with semi-quant values to quickly identify potential spectral interferences and sample preparation mistakes.



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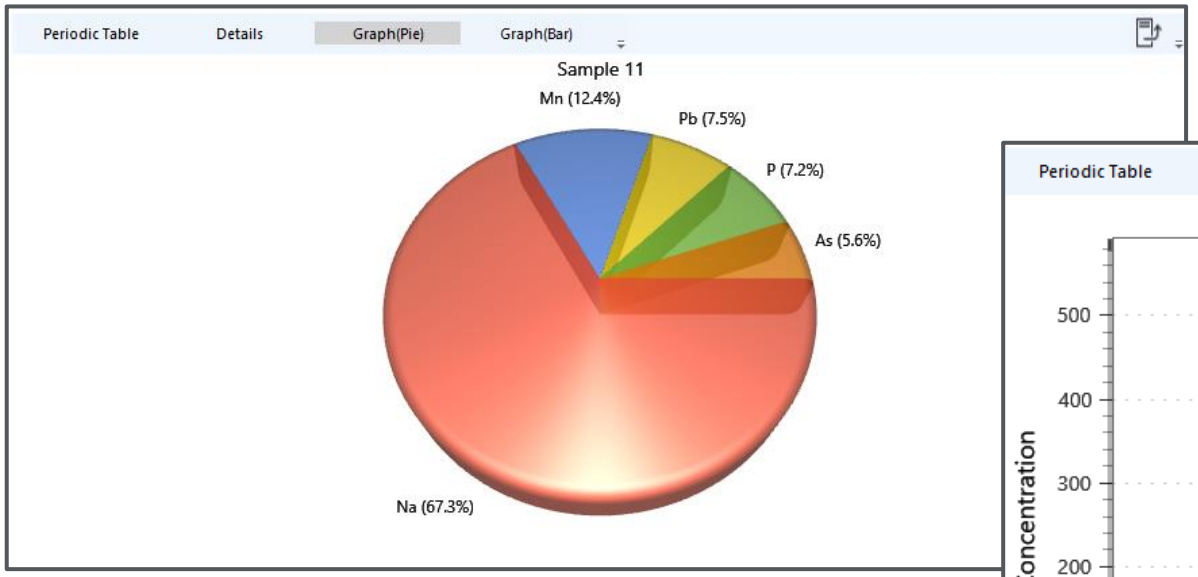
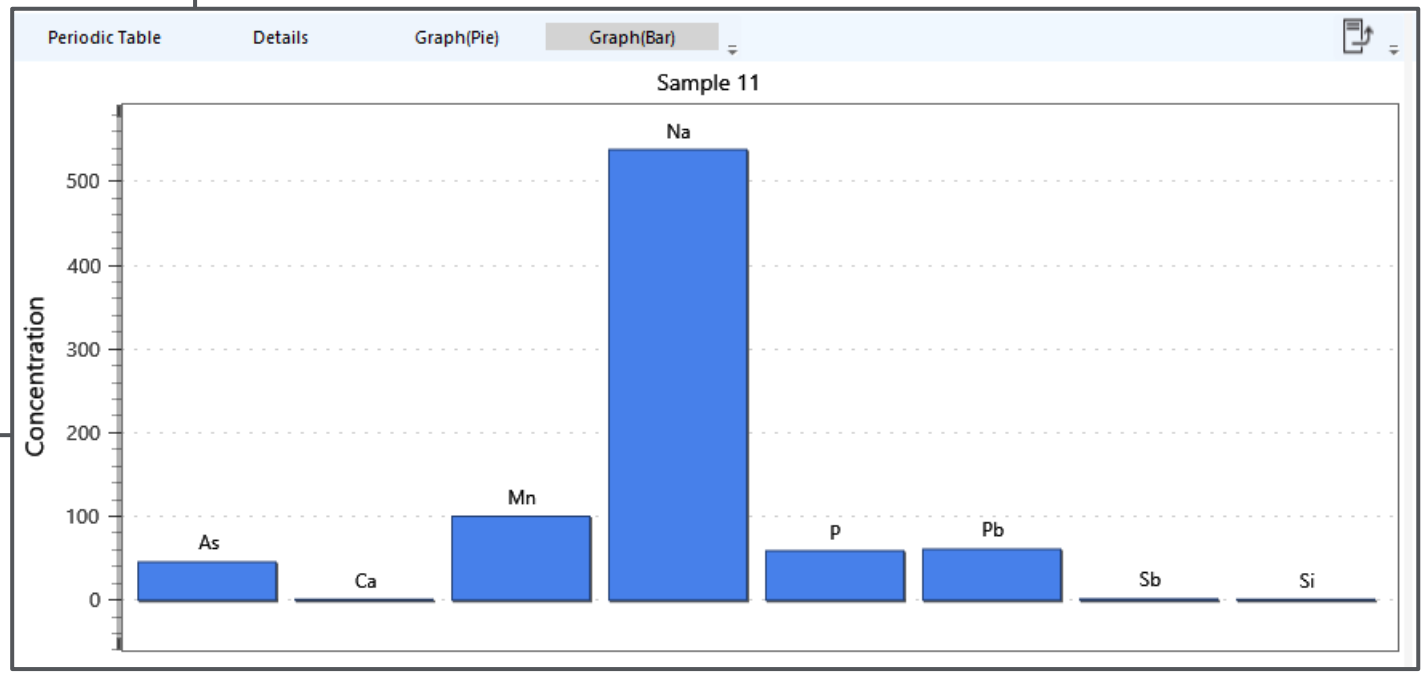
IntelliQuant 2.0 features to help reduce re-measurement

Smart view to identify composition of a sample





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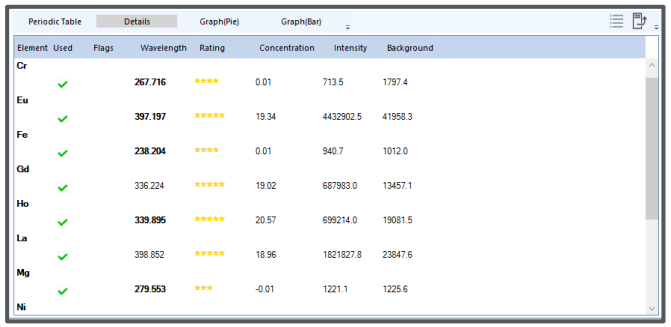
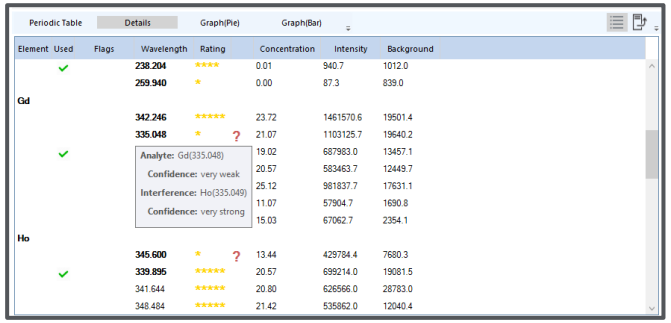
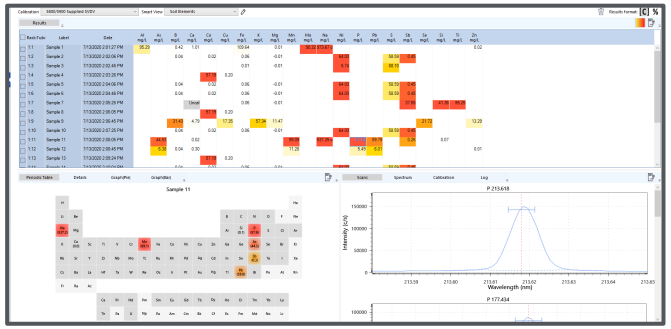
IntelliQuant 2.0 features to help with method development



List of recommended wavelengths based on standard IntelliQuant analysis or IntelliQuant screening



Star rating system for analyte wavelengths along with question marks next to concentration outliers or those with spectral interferences



Background-corrected scans at multiple wavelengths to confirm presence or absence

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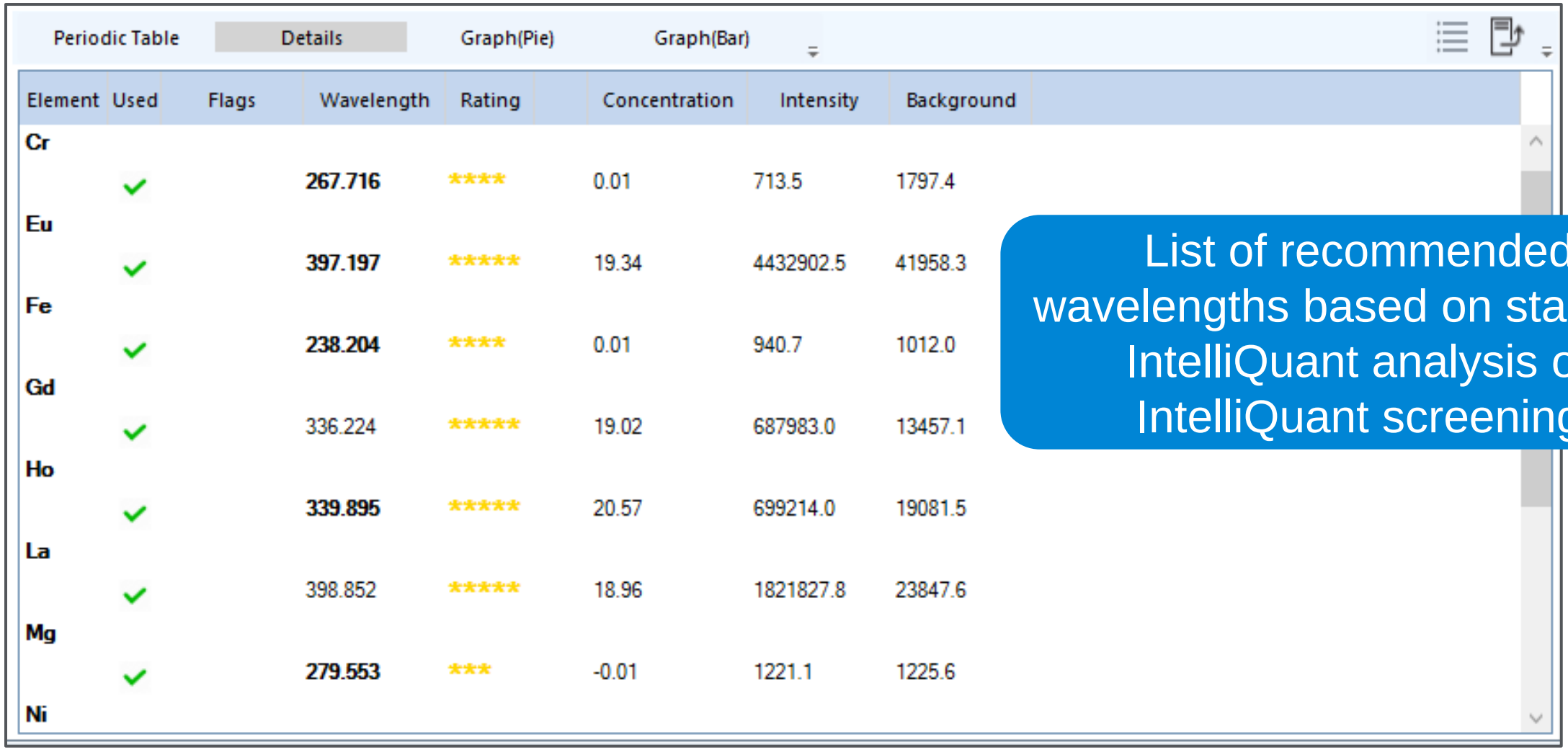
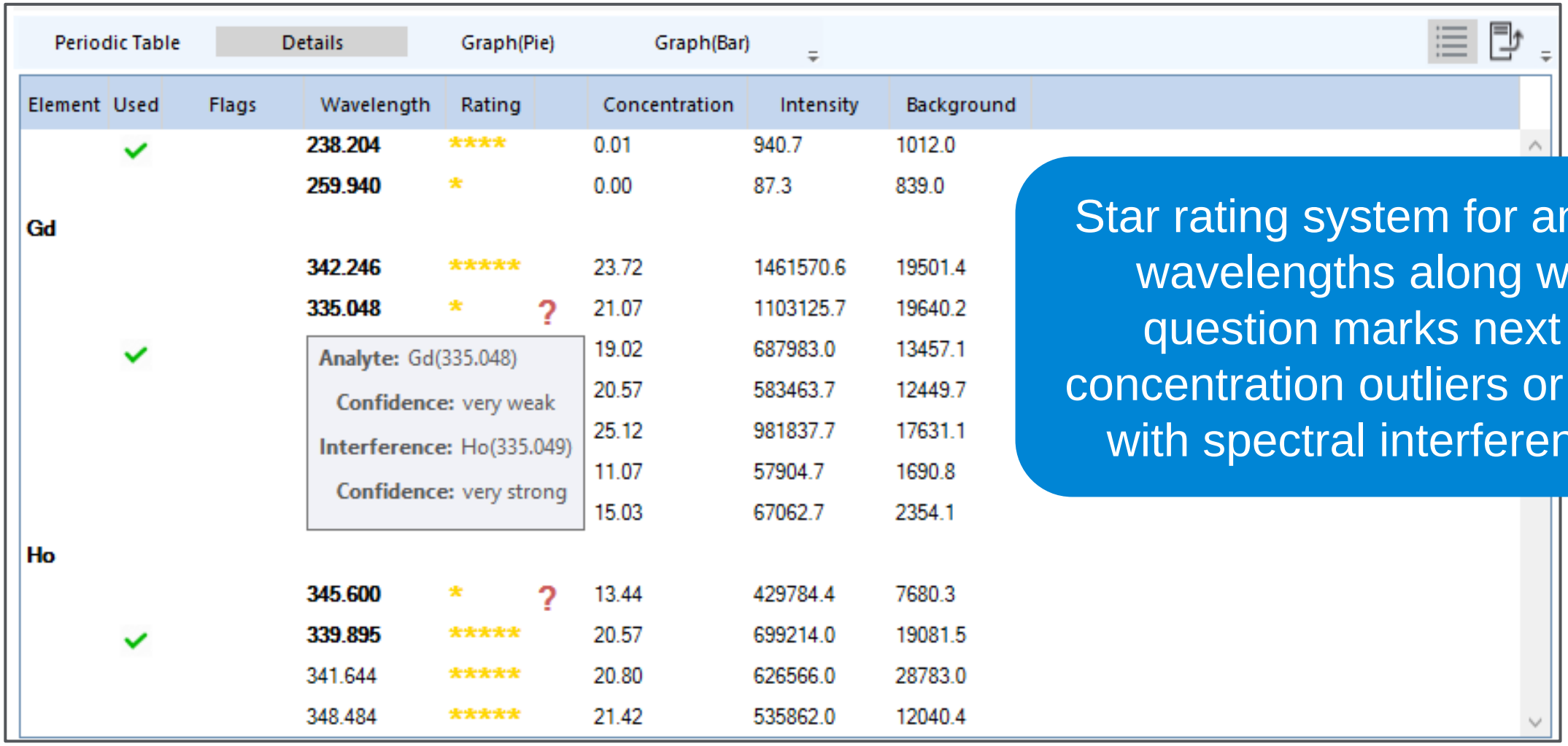
IntelliQuant 2.0 features to help with method development



Element	Used	Flags	Wavelength	Rating	Concentration	Intensity	Background
Cr							
	✓		**267.716**	****	0.01	713.5	1797.4
Eu							
	✓		**397.197**	*****	19.34	4432902.5	41958.3
Fe							
	✓		**238.204**	****	0.01	940.7	1012.0
Gd							
	✓		336.224	*****	19.02	687983.0	13457.1
Ho							
	✓		**339.895**	*****	20.57	699214.0	19081.5
La							
	✓		398.852	*****	18.96	1821827.8	23847.6
Mg							
	✓		**279.553**	***	-0.01	1221.1	1225.6
Ni							

List of recommended wavelengths based on standard IntelliQuant analysis or IntelliQuant screening

IntelliQuant 2.0 features to help with method development



Star rating system for analyte wavelengths along with question marks next to concentration outliers or those with spectral interferences

IntelliQuant 2.0 features to help with method development

Background-corrected scans at multiple wavelengths to confirm presence or absence

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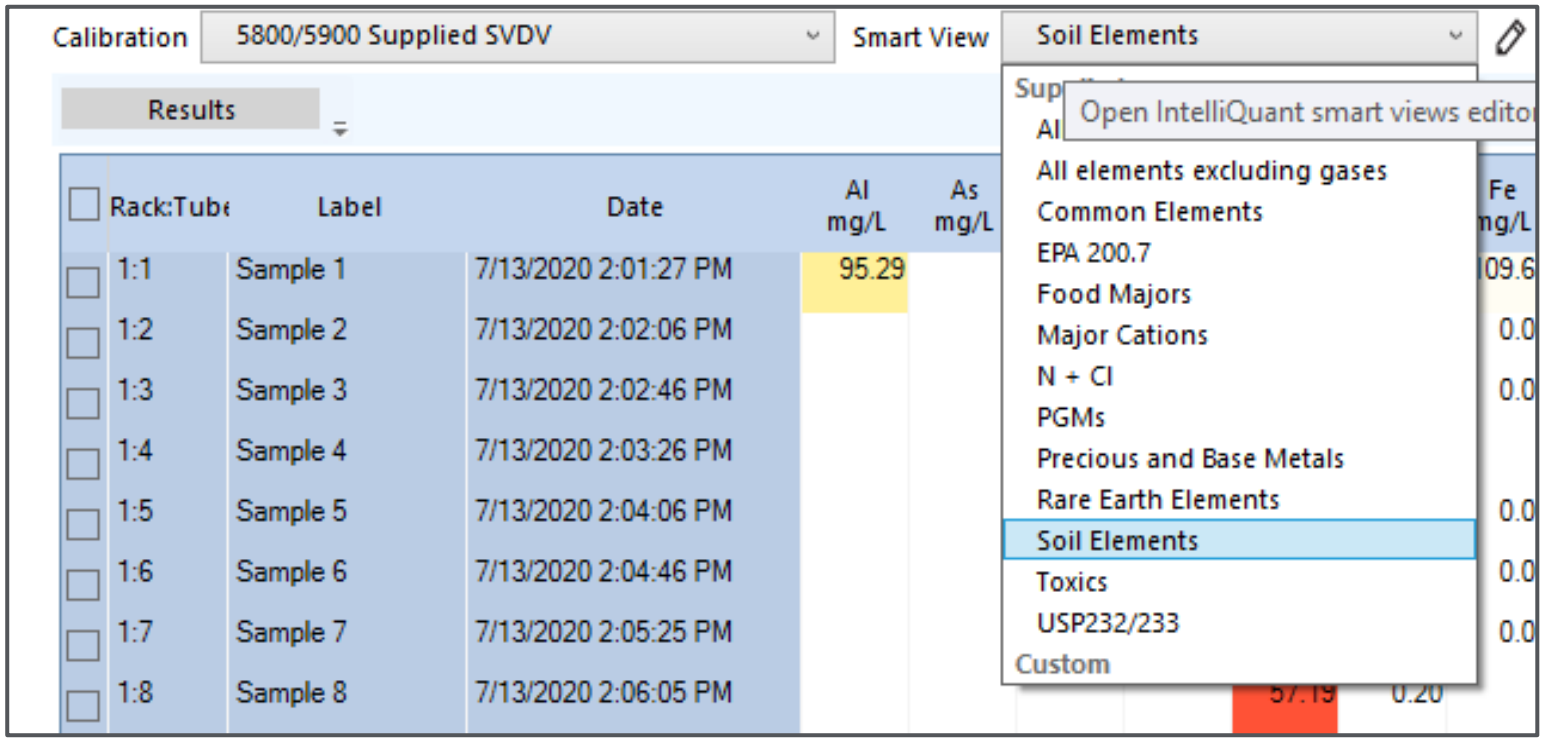

Background-corrected scans at multiple wavelengths to confirm presence or absence

- Customizable element lists
- Customizable calibrations

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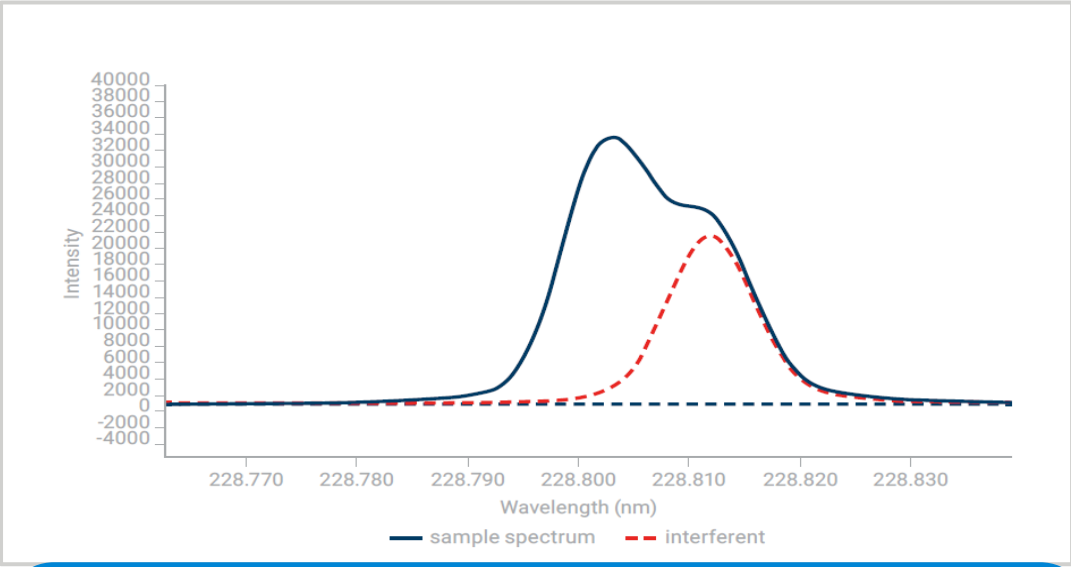
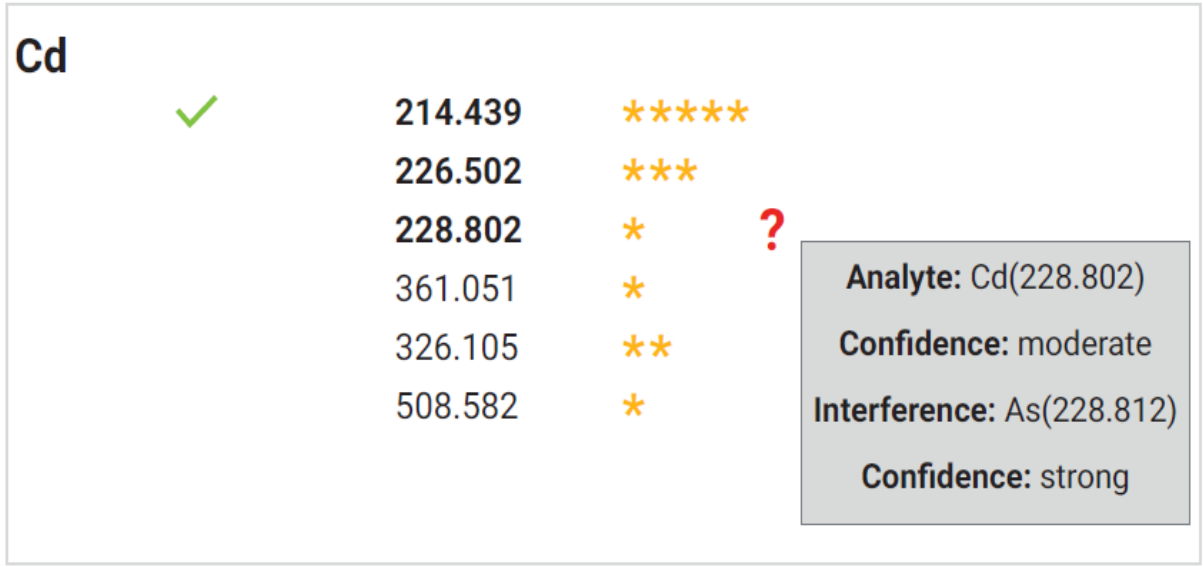
How does IntelliQuant *2.0* reduce your remeasurements?

Get greater **sample insight** by automatically detecting spectral overlap.



Cd 228.802nm has unusual peak shape. User is unsure about this result. (User will not see red interferent spectrum, this was added in to help understand existence of overlap)



IntelliQuant automatically identifies Cd 228 had a spectral overlap and ranked it low with one star. IntelliQuant identified that Cd 214.439nm was the best wavelength to report a result with five stars. Data analytics is used to rank the wavelengths.

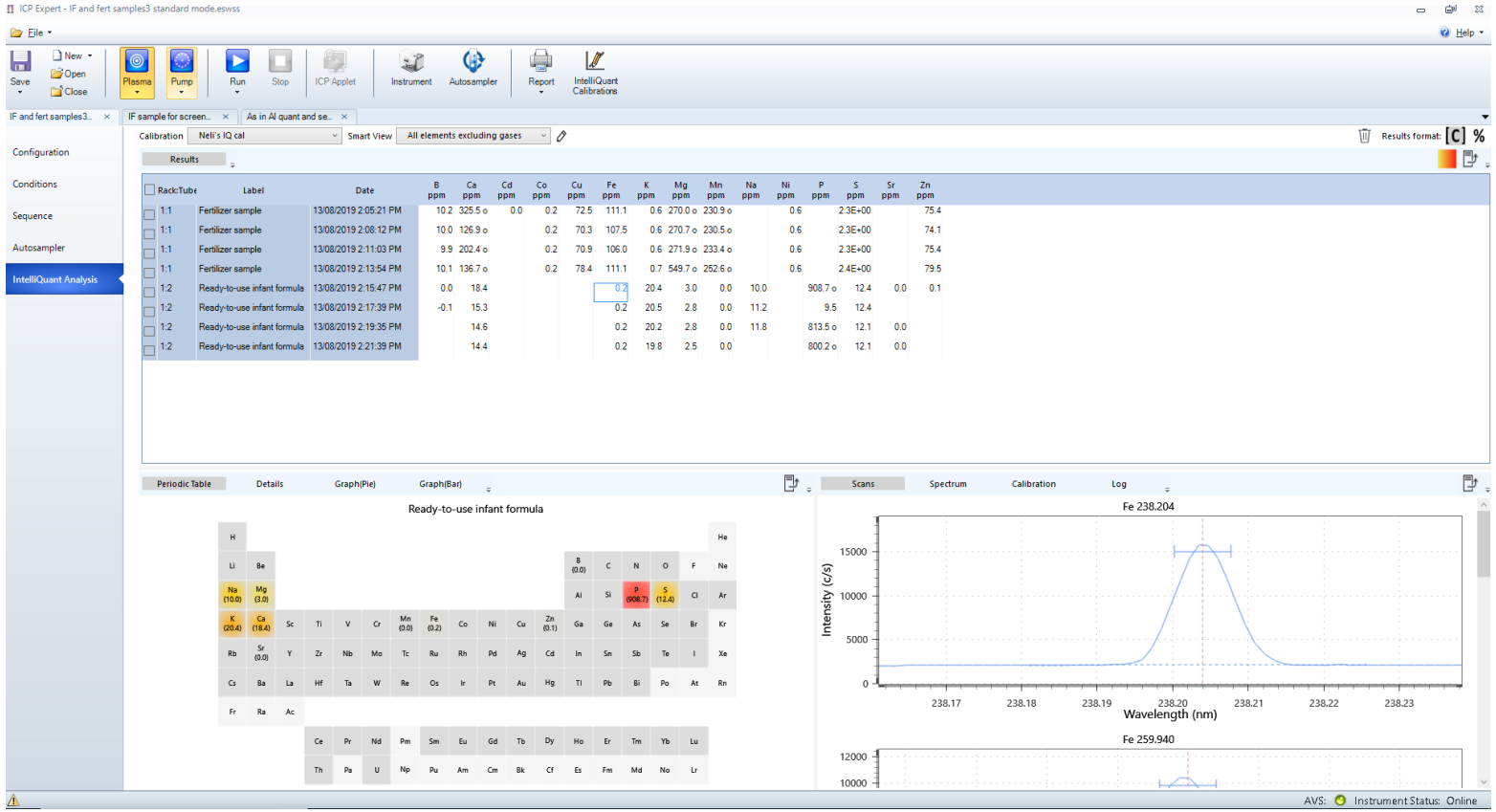
*Based on a user inserted %RSD threshold in OCF smart tool

How does IntelliQuant *2.0* reduce your remeasurements?

Have semi quant result in ~20s*

Know what is in the sample to avoid interference

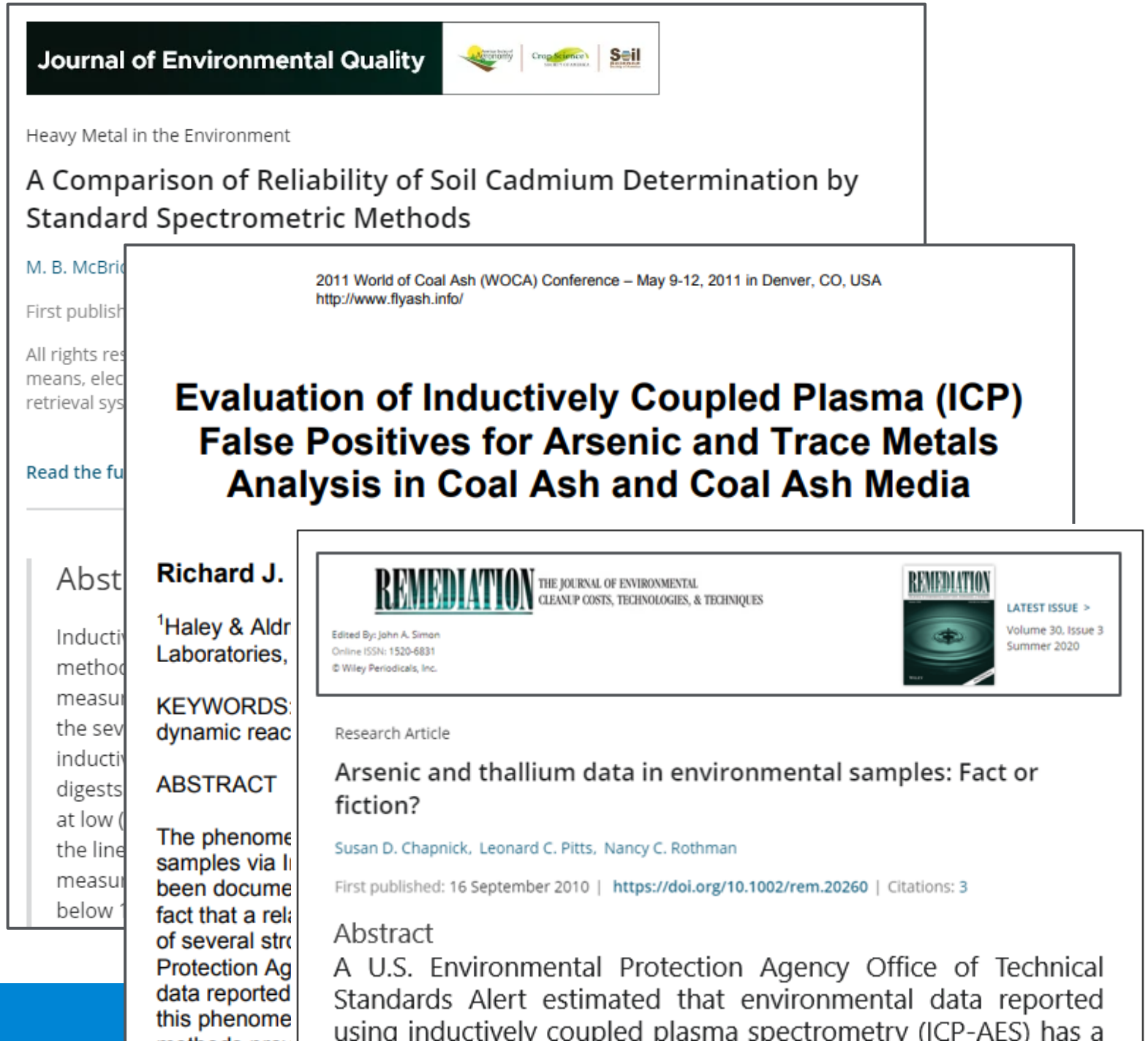
Know what concentration to make the calibration standards



*20s achieved using automation

Real World Examples:

- EPA OTS report estimated that ICP has a 99.9% false positive rate for Tl and 25-50% for As
- Similar observations have been made regarding Cd data in soils containing significant amounts of As
- This can lead to expensive and unnecessary remediation and possible exposure to legal action



Journal of Environmental Quality

Heavy Metal in the Environment

A Comparison of Reliability of Soil Cadmium Determination by Standard Spectrometric Methods

2011 World of Coal Ash (WOCA) Conference – May 9-12, 2011 in Denver, CO, USA
http://www.flyash.info/

Evaluation of Inductively Coupled Plasma (ICP) False Positives for Arsenic and Trace Metals Analysis in Coal Ash and Coal Ash Media

REMEDIATION THE JOURNAL OF ENVIRONMENTAL CLEANUP COSTS, TECHNOLOGIES, & TECHNIQUES

Research Article

Arsenic and thallium data in environmental samples: Fact or fiction?

Susan D. Chapnick, Leonard C. Pitts, Nancy C. Rothman

First published: 16 September 2010 | https://doi.org/10.1002/rem.20260 | Citations: 3

Abstract

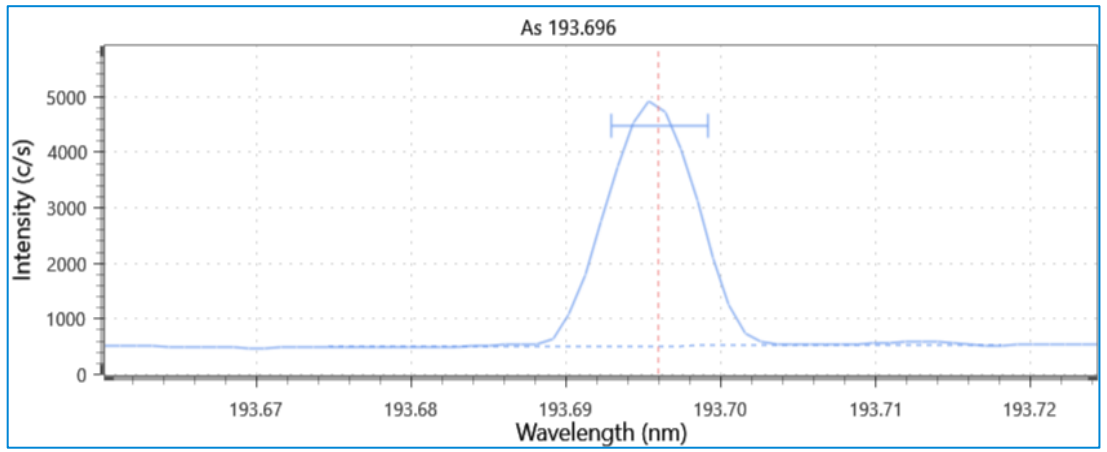
A U.S. Environmental Protection Agency Office of Technical Standards Alert estimated that environmental data reported using inductively coupled plasma spectrometry (ICP-AES) has a

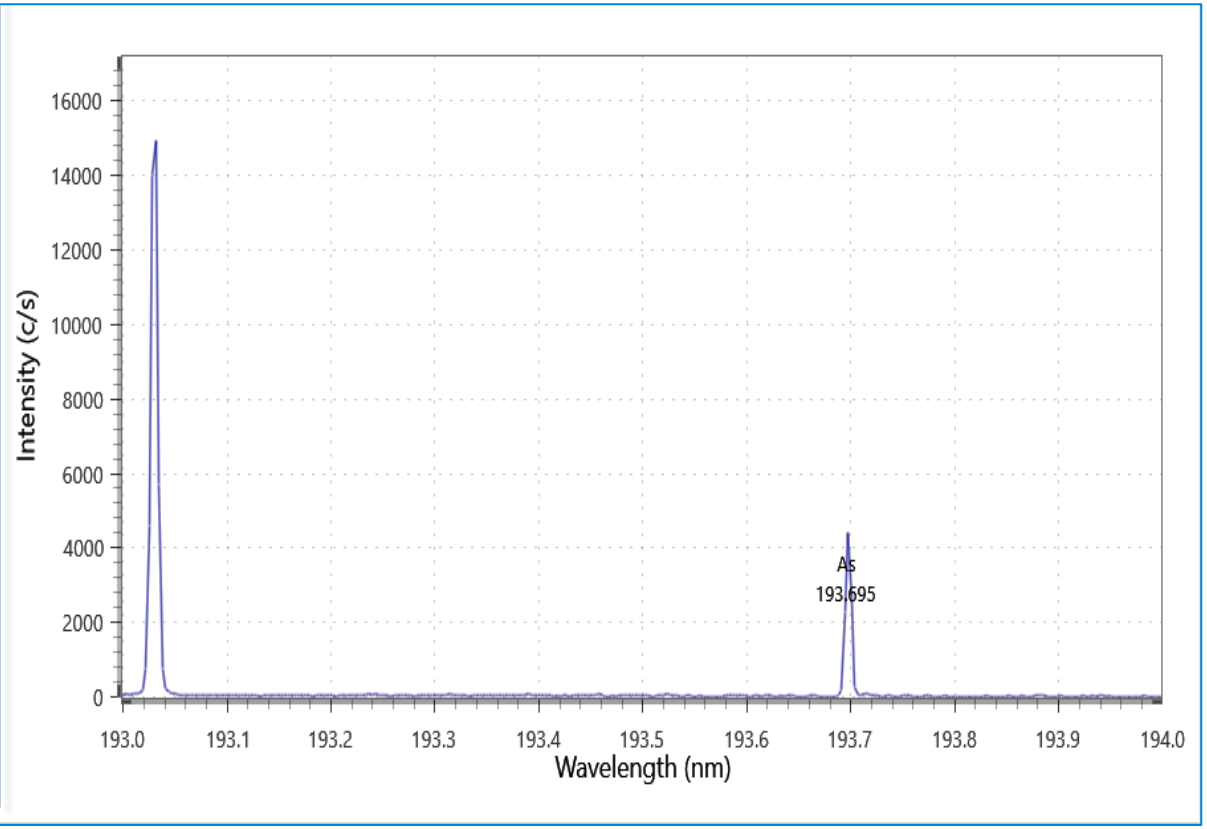
Real World Examples

Al interference on As in earth sample

US EPA method 6010 recommends the As193.696 nm emission line

Element	Used	Flags	Wavelength	Rating	Concentration	Intensity	Background
As							
			188.980	*****	1.82	5841.9	495.6
			193.696	****	1.80	4278.1	502.2
			197.198	*****	1.85	4129.4	771.9
			228.812	****	1.86	2452.8	973.9
			234.984	****	1.84	4687.7	2419.7





2 mg/L As in 0ppm Al (minimal background signal). Carbon emission line at 193.028 nm)

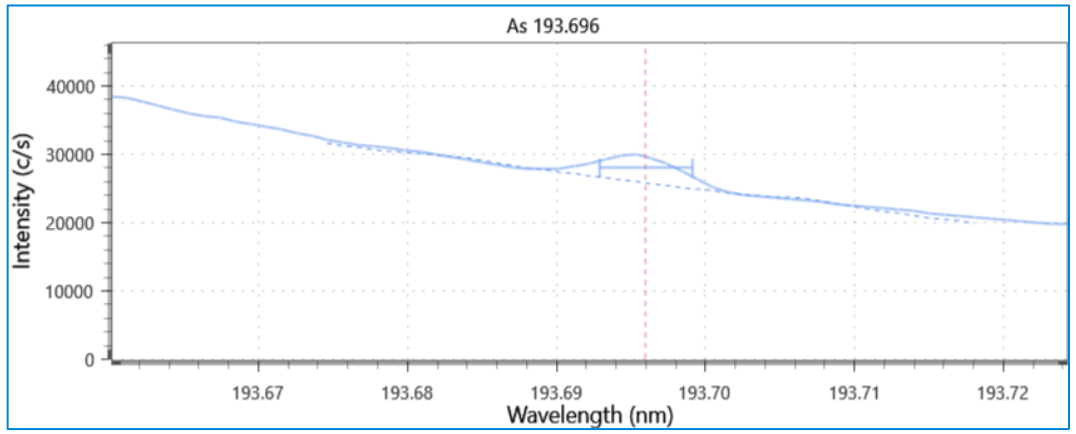
INSET – As wavelength scan at 193.696 nm

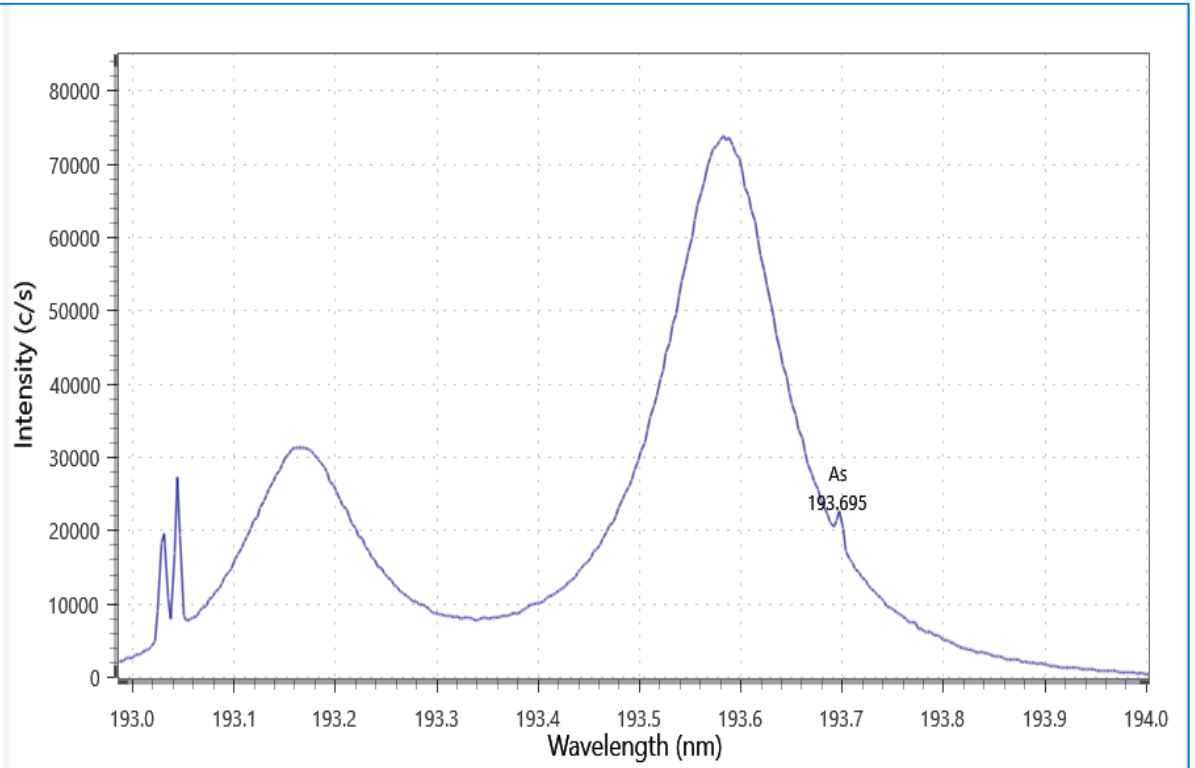
Real World Examples

Al interference on As in earth sample

US EPA method 6010 recommends the As193.696 nm emission line

Element	Used	Flags	Wavelength	Rating	Concentration	Intensity	Background
As							
			188.980	****	1.72	5516.1	4549.7
			193.696	*	1.65	3919.9	25746.2
			197.198	***	1.80	4014.5	9379.9
			228.812	***	1.72	2274.6	1589.1
✓			234.984	*****	1.67	4268.1	2919.1





2 mg/L As in 5,000ppm Al (broad aluminum auto-ionizing doublet is clearly visible)

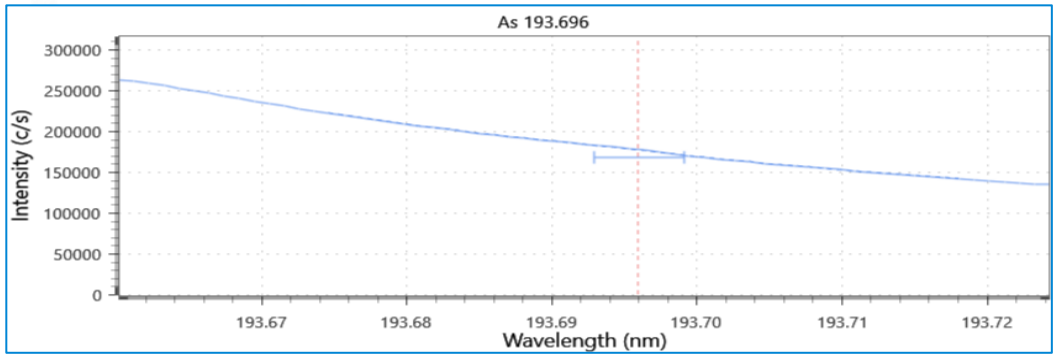
INSET – As wavelength scan at 193.696 nm

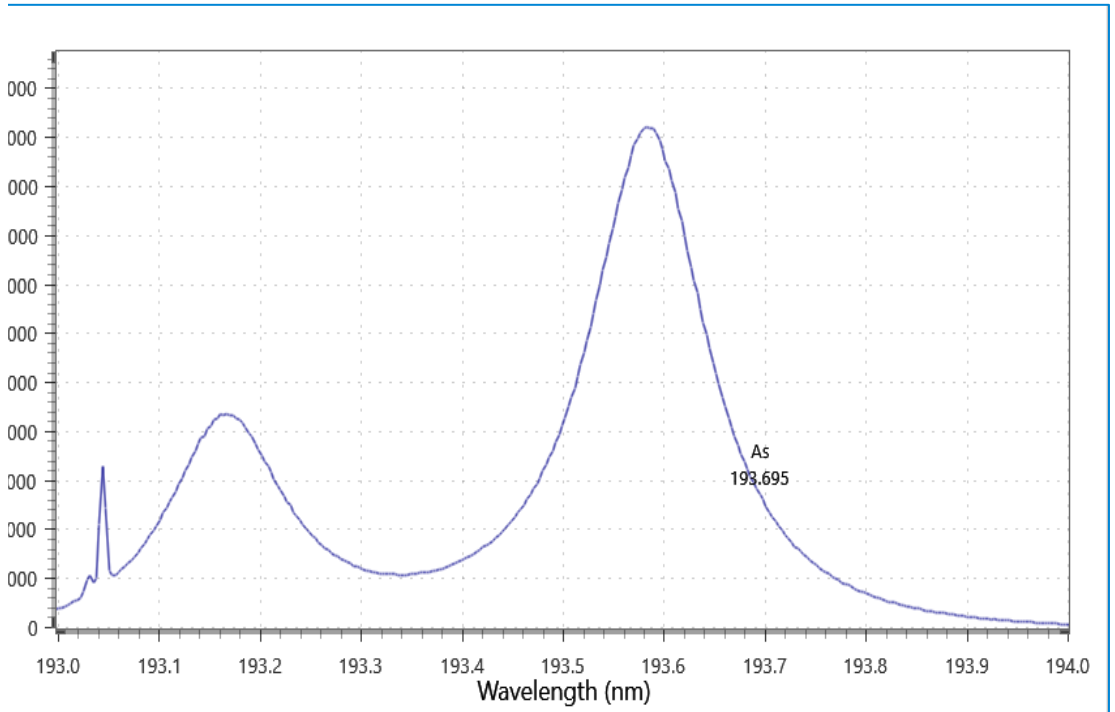
Real World Examples

Al interference on As in earth sample

US EPA method 6010 recommends the As193.696 nm emission line

Element	Used	Flags	Wavelength	Rating	Concentration	Intensity	Background
As							
			188.980	**	1.07	3453.6	27500.3
			193.696	*	0.56	1334.1	176791.4
			197.198	*	1.32	2952.9	61540.7
			228.812	***	1.00	1336.4	4824.7



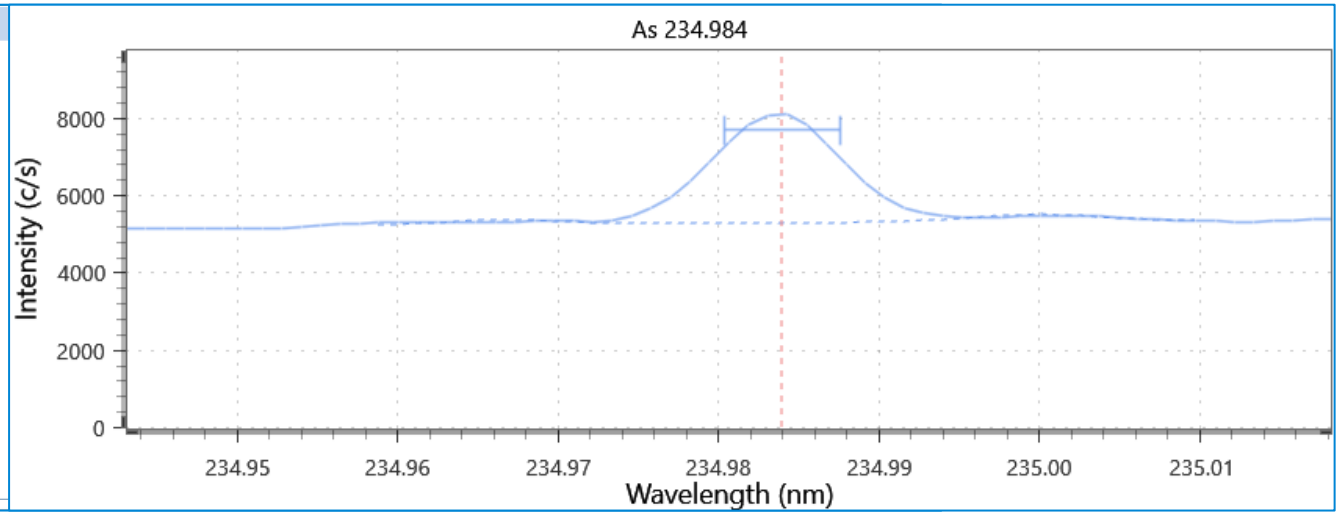


2 mg/L As in 50,000ppm Al
INSET – As wavelength scan at 193.696 nm

The Solution: IntelliQuant for High Aluminium on As

How do I recognize when Al is affecting my results?

Element	Used	Flags	Wavelength	Rating	Concentration	Intensity	Background
As							
			188.980	**	1.07	3453.6	27500.3
			193.696	*	0.56	1334.1	176791.4
			197.198	*	1.32	2952.9	61540.7
			228.812	***	1.00	1336.4	4824.7
	✓		234.984	***	1.07	2801.8	5278.0



2 mg/L As in 50,000ppm Al

IntelliQuant analyzes a suite of As lines for SRBR and recommends As 234.984nml line in the presence of high Al.

IntelliQuant informs the operator that the result from the As 193 line is of poor quality for this particular sample and recommends a suitable alternative wavelength with a lower MDL.

Thank you for your attention!
Questions?

Agilent

Trusted Answers

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