

Improved Trace Element Detection for Inductively Coupled Plasma- Atomic Emission Spectrometry (ICP-AES) with the CETAC Marin-5 Enhanced Nebulizer System

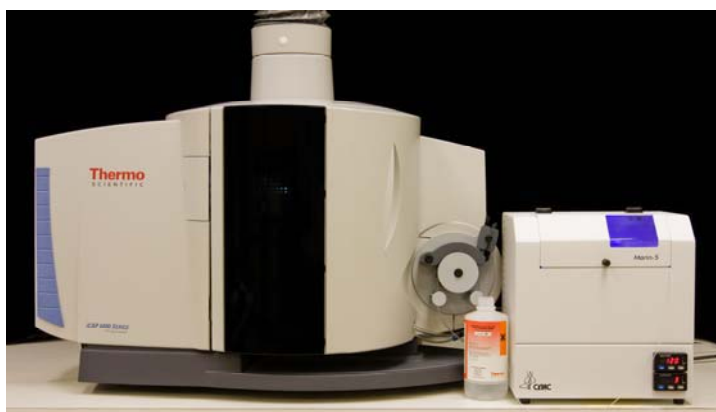
INTRODUCTION

Conventional liquid sample introduction for ICP-AES usually consists of a pneumatic nebulizer / spray chamber combination with 2% or 3% sample transport efficiency. While this efficiency can provide ppb and sub-ppb detection limits for many elements, improved analyte signal may be needed for detection of difficult elements such as antimony, arsenic, lead, selenium, and thallium.

The coupling of a contemporary dual-viewing ICP-AES instrument with the CETAC Marin-5 Enhanced Nebulizer System can help lower detection limits by up to a factor of 5 or more. The Marin-5 features a conventional pneumatic nebulizer and heated spray chamber / desolvation system to enhance analyte transport to the ICP-AES. This technical note will show the improvement in absolute analyte signal and instrument detection limits.



CETAC Marin-5 Enhanced Nebulizer System



Marin-5 with Thermo iCAP 6500 ICP-AES

EQUIPMENT

ICP-AES Instrument:	Thermo Scientific iCAP 6500 ICP-AES with SIK (standard introduction kit); glass concentric nebulizer / cyclonic spray chamber
Enhanced Nebulizer Accessory:	CETAC Marin-5

OPERATING CONDITIONS

	Concentric Nebulizer	CETAC Marin-5
ICP Power	1150 W	1150 W
Plasma gas flow	14 L/min	14 L/min
Auxiliary gas flow	0.5 L/min	0.5 L/min
Nebulizer gas flow	0.70	0.63 L/min
Sample uptake rate	3.0 mL/min	0.5 mL/min
Sample Viewing	axial	axial
Integration time	15s	15s
Heater temperature	NA	125°C
Cooler temperature	NA	3°C

NA = not applicable

ANALYTE SIGNAL INTENSITY

A comparison of analyte signal intensity with the standard introduction kit (SIK) and the Marin-5 is given below for 22 elements. The signal enhancement range with the Marin-5 is 3 to 7 times for a 500µg/L multi-element standard, with most elements showing a 6 fold signal increase. Note the significantly lower sample uptake rate of 0.5 mL/min used with the Marin-5 versus the 3mL/min used with the standard introduction kit (SIK).

Element	λ (nm)	SIK	CETAC Marin-5	Factor
Ag	328.0	13620	81710	6
Al	167.0	1503	10110	6
As	193.7	240	1448	6
Ba	455.5	405100	2593000	6
Be	313.0	334800	2167000	6
Bi	223.0	570	3120	5
Cd	226.5	7460	49790	6
Co	228.6	3740	25530	6
Cr	267.7	9034	63340	7
Cu	324.7	14790	105200	7
Fe	259.9	9073	59940	6

Element	λ (nm)	SIK	CETAC Marin-5	Factor
Mn	257.6	47180	315300	6
Mo	202.0	2075	14210	6
Ni	231.6	1801	12580	7
Pb	220.3	599	3860	6
Sb	206.8	373	2190	5
Se	196.0	193	1170	6
Sn	189.9	680	4590	6
Ti	334.9	41160	279700	6
Tl	190.8	337	2092	6
V	292.4	10010	62600	6
Zn	213.8	6052	20050	3

DETECTION LIMITS

Instrument detection limits are based on 3x the standard deviation of the blank concentration after calibration with the 500µg/L multi-element standard; concentration units are given as µg/L (ppb). Detection limits improve from a factor of 2 (ex. Se) to as much as 11 fold (ex. Ni). Detection limits for difficult elements (As, Pb, Sb, Se, Tl) are now below 1ppb with the Marin-5.

Element	λ (nm)	SIK	CETAC Marin-5	Factor
Ag	328.0	0.3	0.06	5
Al	167.0	0.3	0.04	7
As	193.7	2.5	0.5	5
Ba	455.5	0.01	0.005	2
Be	313.0	0.03	0.005	6
Bi	223.0	3.5	1.0	3
Cd	226.5	0.2	0.02	10
Co	228.6	0.2	0.05	4
Cr	267.7	0.3	0.05	6
Cu	324.7	0.2	0.1	2
Fe	259.9	0.1	0.03	3

Element	λ (nm)	SIK	CETAC Marin-5	Factor
Mn	257.6	0.06	0.03	2
Mo	202.0	0.3	0.04	7
Ni	231.6	0.6	0.05	11
Pb	220.3	1.4	0.4	3
Sb	206.8	2.4	0.7	3
Se	196.0	1.3	0.7	2
Sn	189.9	1.0	0.2	5
Ti	334.9	0.1	0.02	5
Tl	190.8	1.9	0.4	5
V	292.4	0.3	0.03	10
Zn	213.8	0.2	0.03	6

SUMMARY

The CETAC Marin-5 provides significant enhancement in absolute analyte signal and lower detection limits for axial-viewing ICP-AES. Sample consumption is also considerably reduced (80%), minimizing sample waste.