DETERMINATION OF ZINC IN NATURAL WATERS USING A MULTISYRINGE FLOW INJECTION ANALYSIS APPROACH COUPLED WITH A LONG LIQUID WAVEGUIDE CAPILLARY FLOW CELL

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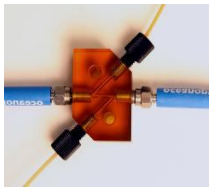
Introduction

Zinc is a natural microelement important for maintaining the normal physiological processes in living organisms. It is involved in various biochemical processes and is essential for the functioning of enzymes that control protein synthesis and the growth/repair of cells. Therefore, it is crucial to develop simple, robust and low cost methods to accurately determine its concentration in water samples.

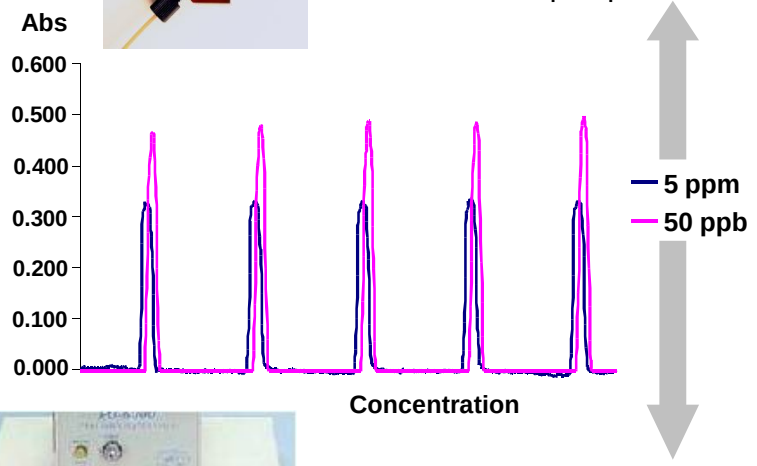
However, in natural waters, it's present at very low concentrations and therefore, a long liquid waveguide capillary cell with 100 cm of optical path was applied to increase the sensitivity of the spectrophotometric detection mode.

The spectrophotometric determination of zinc can be based on the colourimetric reaction between zinc and zincon.

For flow manipulation/programming a multi-syringe flow injection analysis (MSFIA) was developed.



Results obtained with a SMA-Z cell (made of Ultem) with 1 cm of optical path



Results obtained with a long liquid waveguide capillary cell (LWCC) with 100 cm of optical path

Manifold

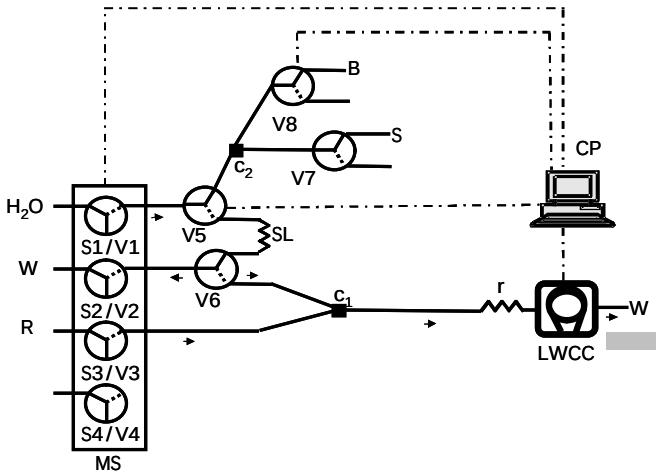


Figure 1. Multi-syringe flow injection analysis manifold for the determination of zinc in waters. Si: syringes, Vi: solenoid valves; SL: sample loop (400 µL); r: reaction coil (200 cm); ci: confluences; LWCC: detector (100 cm of optical path); CP: computer; W:waste; S: sample or standard; B: buffer solution; R: colour reagent (zincon, 620 nm).

Figures of merit

Detection limit (ppb) *	2
Quantification limit (ppb)	4
Working range (ppb)	4-80
Determination rate (h^{-1})	40
Reagent consumption (mmol/assay)	
Zincon	0.001
Buffer solution:	
Sodium hydroxide	0.035
Potassium chloride	0.007
Boric acid	0.02
Waste produced (mL/assay)	4.15

* - assessed from three times the standard deviation from blank signal (n=10)

Protocol sequence

Step	Piston movement	Position of syringes and solenoid valves S1	S2	S3	S4	V5	V6	V7	V8	Volume (mL)	Flow rate (mL/min)	Description
1	Pick up	0	1	0	0	1	1	1	1	1.4	5	Aspirate sample and buffer solution
2	Dispense	1	0	0	1	0	0	0	0	0.5 C 0.25 R	1.5 C 0.75 R	Propel carrier and color reagent to the detectoru
3	Dispense	1	0	0	0	0	0	0	0	2.0	4	Propel the mixture to the detecor and signal registration

Note: 0 - off; 1 - on; The volume and the flow rate are presented with respect to syringe 1. Syringe 1 and 2 have 5 mL of capacity and syringe 3 and 4 have 2.5 mL of capacity; C - carrier; R - colour reagent;

Application to water samples

Concentration of zinc added (ppb)	Recovery (%) Sample 1	Sample 2
4	95.0 ± 4.1	118.8 ± 0.9
10	101.4 ± 0.6	115.7 ± 1.2
20	102.8 ± 3.9	113.3 ± 2.8

Sample 1- Groundwater; Sample 2- Well water

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