



Determination of nickel in soil using the Thermo Scientific ICE FIOS AAS

Authors

Ayan Bhardwaj,
Harish Barve,
Bhagyesh Surekar,
Dr Biswajayee Airaraj Patra,
Thermo Fisher Scientific, India

Keywords

Agriculture, Crop health,
Plant nutrition, Soil,
Toxic elements

Goal

Demonstrate the suitability of AAS for the determination of nickel in soils.

Introduction

Nickel is a component of some plant enzymes, most notably urease, which metabolizes urea nitrogen into useable ammonia within the plant. Nickel deficiency can lead to toxic levels of urea that can accumulate within the plant tissue forming necrotic lesions on the leaf tips. Nickel is also used as a catalyst in other plant enzymes used to help legumes fix nitrogen. There is evidence that nickel helps with disease tolerance in plants. However, excess concentration of nickel in soil can result in toxicity which can impact the growth and quality of agricultural products. Therefore, accurate measurement of nickel content in soil is quite important.

Here, a fast, accurate and precise method for determination of total nickel in soil sample is presented.

Standard and sample preparation

Samples

A soil CRM sample (PID: SQC001-30G, Lot: LRAB7490) was weighed (0.25 g) in to PTFE microwave digestion system (Multiwave PRO, Anton Paar) vessels and digested with 3ml nitric acid (concentrated, trace metal grade), 1ml hydrochloric acid (concentrated, trace metal grade) and 0.5 ml hydrofluoric acid (concentrated, trace metal grade) using the program in Table 1. The resulting solution was then diluted to 50 ml using with 18 MΩ ultra-pure water (followed by filtration using nylon syringe filter to obtain a clear solution). Three independent samples were prepared to check the method repeatability and reproducibility.

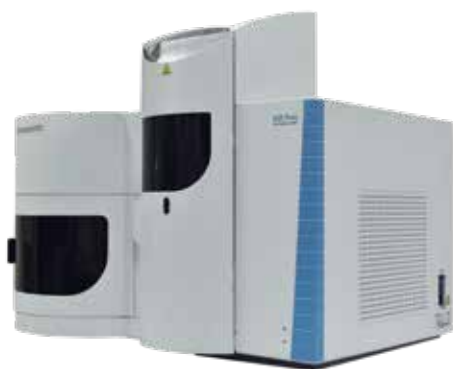
Table 1. Microwave digestion program.

Steps	Temperature (°C)	Time (mm:ss)	Fan level
Temperature ramp	100	10:00	1
Temperature hold	-	5:00	1
Temperature ramp	185	10:00	1
Temperature hold	-	30:00	1
Cooling	65	20:00	3

Standards

Working Standards of nickel (0.5, 1, 2 & 4 mg·kg⁻¹)

0.025, 0.05, 0.1 and 0.2 mL of nickel standard stock solution (1000 mg·kg⁻¹) was transferred into a series of 50 mL volumetric flasks and diluted to volume with 1% (v/v) nitric acid to prepare working standards with 0.5, 1, 2 and 4 mg·kg⁻¹ of nickel respectively.



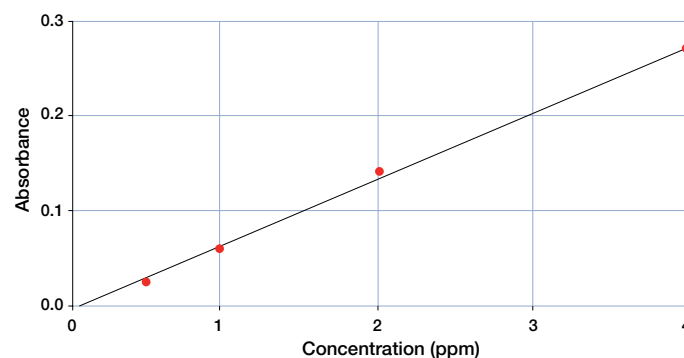
Method

The Thermo Scientific™ iCE™ FIOS™ AAS was set up with method parameters applicable for nickel analysis, using a nickel coded hollow cathode lamp. Method parameters are presented in Table 2.

Table 2. Instrument parameters.

Instrument conditions for Ni	
Turret No.	7
Current (mA)	9.0
D2 Cur (mA)	149
Pmt (v)	476.9
Burner horizontal	3.00
Wavelength (nm)	232.00
Slit (nm)	0.3
Fuel (litre/min)	1.00
Burner height (mm)	2.0
Burner angular	0.00

Initially, the instrument was calibrated using working standards of nickel in the range of 0.5 mg·kg⁻¹ to 4 mg·kg⁻¹ then the sample solutions were aspirated into the iCE FIOS AAS. Absorbance values were recorded for the blank, standard and sample solutions. Concentration values of the unknown samples were calculated directly through software using slope and intercept of linearity plot (Figure 1).



Calibration Graph : (LINEAR) 5.49684 R-squared = 0.998
Eqn (-0.0022+ 0.0705*X)

Figure 1. Standard calibration of nickel using the iCE FIOS AAS.

Results

Table 3. Absorbance and concentration values.

Sample name	Absorbance (A)	Concentration (mg·kg ⁻¹)	Weight of sample (g)	Volume made (ml)	Ni content (mg·kg ⁻¹)
Blank	0	0	0	50	0
Standard 1	0.047	0.5	0	50	0
Standard 2	0.085	1	0	50	0
Standard 3	0.153	2	0	50	0
Standard 4	0.276	4	0	50	0
Soil sample prep -1	0.121	1.63	0.2585	50	315.3
Soil sample prep -2	0.119	1.60	0.2579	50	310.2
Soil sample prep -3	0.121	1.63	0.2602	50	313.2

Table 4. Comparison of sample results with certified value.

Sample name	Obtained concentration (mg·kg ⁻¹)	Reference value (mg·kg ⁻¹)	% Accuracy
Soil sample prep -1	315.3	303.2	104.0
Soil sample prep -2	310.2		102.3
Soil sample prep -3	313.2		103.3

Conclusion

The data obtained clearly indicates that, values of nickel content in all three-replicate preparation of samples obtained by this method are in close agreement with each other as well as with the certified value given for the CRM.

The method presented here using the iCE FIOS AAS is accurate, precise and reproducible for determination of nickel content in soil samples.

References

1. <https://www.pthorticulture.com/en/training-center/role-of-nickel-in-plant-culture/>

Find out more at thermofisher.com/TEA

ThermoFisher
SCIENTIFIC

For Research Use Only. Not for use in diagnostic procedures. ©2018 Thermo Fisher Scientific Inc. All rights reserved. All trademarks are the property of Thermo Fisher Scientific. This information is presented as an example of the capabilities of Thermo Fisher Scientific products. It is not intended to encourage use of these products in any manner that might infringe the intellectual property rights of others. Specifications, terms and pricing are subject to change. Not all products are available in all countries. Please consult your local sales representative for details. **AN44395-EN 0818**