

Magnesium in Soils

Photometric determination with phthalein purple subsequent to acid extraction

Introduction

The determination of magnesium in soil is important due to its role as a major nutrient involved in plant growth and metabolism. In soils, magnesium is present as Mg^{2+} in solution and as an exchangeable cation. In plants, magnesium participates in essential metabolic processes, including its function as a central component of the chlorophyll molecule and as an activator of enzymatic reactions.¹

Accurate determination of magnesium in soil is therefore necessary to assess its availability and support soil and plant analysis.

Experimental

This application note details the photometric determination of magnesium in soils after its extraction.

Method

In neutral solution magnesium ions react with phthalein purple to form a violet dye that is determined photometrically.

Measuring Range

Spectroquant® Magnesium Cell Test (1.00815)	Test kit: 5.0–75.0 mg/L Mg Method: 100–1500 mg/kg Mg
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Applicable Sample

Soil samples

Reagents, Instruments and Materials

Test/Reagent Kit(s)

For the measurement one of the following Spectroquant® test kits is necessary:

- Spectroquant® Magnesium Cell Test (1.00815)

Instrument(s) & Devices

For the measurement one of the following Spectroquant® photometers is necessary:

- Spectroquant® VIS Spectrophotometer Prove 100 plus (1.73026)
- Spectroquant® UV/VIS Spectrophotometer Prove 300 plus (1.73027)
- Spectroquant® UV/VIS Spectrophotometer Prove 600 plus (1.73028)
- Spectroquant® Colorimeter Move 100 (1.73632)

Note: Also, legacy Spectroquant® instruments are suitable.

Software for Data transfer

- Optional Spectroquant® Prove Connect to LIMS software package (Y.11086) to transfer your data into an existing LIMS system.

Other Reagents and Accessories

- Hydrochloric acid 25% for analysis (1.00316)
- Hydrochloric acid 1 mol/L for analysis (1.09970)
- Sodium hydroxide solution 10% for analysis (1.05588)
- MQuant® Universal Indicator strips pH 0–14 (1.09535)
- MQuant® pH-Indicator strips pH 0–6 (1.09531)
- Water for analysis (1.16754)
- Analytical balance
- Standard laboratory glassware (e.g., glass beakers) and pipettes
- Shaker or stirring plate
- Spatula
- Sieve
- pH-meter
- Charcoal activated for soil test
- Folded filter

Analytical Procedure

For more information on the measurement see the packaging insert for the test.

Sample Preparation

- In a glass beaker place 10 g of air-dried and sieved (mesh 2 mm) sample with 100 mL hydrochloric acid 1 mol/L and a spatula-tip full of charcoal activated for soil tests and mix well for 1 hour. The pH-value should be 1–2 (check with pH-indicator strips). If necessary, adjust with hydrochloric acid 25%.
- Afterwards adjust the pH value of the suspension to 3.0 with sodium hydroxide solution 10%, using a pH meter.
- Then remove the undissolved matter by filtration through a folded filter and wash the filter residues 3 times with water for analysis.
- Collect the filtrate and the washings in a 200-mL volumetric flask, finally fill up to volume with water for analysis and mix well.

Procedure and Measurement

For more information on the measurement see the packaging insert for the test

Procedure

- Pipette 1.0 mL Pretreated sample into a reaction cell, close the cell, and mix.
- Add 1.0 mL Reagent Mg-1K with a pipette and mix.
- Leave to stand for exactly 3 min (reaction time).
- Add 3 drops Reagent Mg-2K, close the cell, and mix. Hold the bottle vertically while adding the reagent!
- Measure the sample in the photometer.

Measurement

- For photometric measurement the cells must be clean. Wipe, if necessary, with a clean dry cloth.
- Measurement of turbid solutions yields false-high readings.
- The pH of the measurement solution must be approx. 7.5.
- The color of the measurement solution remains stable for at least 60 min after the addition of reagent Mg-2K.

Hints for Measurement

- It is recommended to zero the method each new working day. To do this, open the method, either by manually selecting the method or by inserting a barcoded cell. Tap the <Settings> button and select the <ZERO ADJUSTMENT> menu item. After prompting, insert the 16 mm zero cell through the corresponding opening. The zero adjustment is performed automatically. Confirm the performance of the zero-adjustment procedure by clicking on <OK>.
- After the zero has been performed, insert the barcoded Spectroquant® round cell through the corresponding opening, ensuring that the white position mark on the cell is aligned with the positioning mark on the spectrophotometer. The measurement starts automatically.
- Read off the result in mg/L from the display.

Hint: The above written measurement description is only valid for the Spectroquant® Prove (plus) series photometer. If a different instrument is used, please consult the corresponding instrument manual for more details on how to perform the measurement.

Analytical Quality Assurance

Analytical quality assurance (AQA) is recommended before each measurement series.

To check the photometric measurement system (test reagent, measurement device, handling) and the mode of working, a freshly prepared magnesium standard solution containing 40.0 mg/L Mg (application see the website) can be used.

Sample-dependent interferences (matrix effects) can be determined by means of standard addition or dilution.

To view additional notes, visit

[SigmaAldrich.com/qa-test-kits](https://www.sigmaaldrich.com/qa-test-kits).

Calculation

Magnesium content in mg/kg Mg = analysis value in mg/L Mg x 20

References

1. de Sousa Ferreira, L.; de Souza Oliveira, V.; de Paula Marchiori, J. J.; Ferreira, T. C.; Bernabé, A. C.; Boone, G. T.; dos Santos Pereira, L. L.; Carriço, E. The Nutrient Magnesium in Soil and Plant: A Review. *Int. J. Plant Soil Sci.* **2023**, *35* (8), 136–144. DOI: [10.9734/IJPSS/2023/v35i82890](https://doi.org/10.9734/IJPSS/2023/v35i82890).

Featured Products

Description	Cat. No.
Test Kits	
Spectroquant® Magnesium Cell Test	1.00815
Instruments	
Spectroquant® VIS Spectrophotometer Prove 100 plus	1.73026
Reagents & Test Strips	
Hydrochloric acid 1 mol/L for analysis, Titrisol®	1.09970
Hydrochloric acid 25% for analysis, EMSURE®	1.00316
Sodium hydroxide solution 10% for analysis, EMSURE®	1.05588
MQuant® Universal indicator strips pH 0–14	1.09535
MQuant® pH-Indicator strips pH 0–6	1.09531
Water for analysis	1.16754

Related Products

Description	Cat. No.
Instruments & Software	
Spectroquant® UV/VIS Spectrophotometer Prove 300 plus	1.73027
Spectroquant® UV/VIS Spectrophotometer Prove 600 plus	1.73028
Spectroquant® Colorimeter Move 100	1.73632
Spectroquant® Prove Connect to LIMS software package	Y.11086
Reference Materials	
Magnesium nitrate hexahydrate for analysis EMSURE® ACS, Reag. Ph Eur	1.05853
Reagents	
Sodium hydroxide solution 1 mol/L Titripur®	1.09137
Hydrochloric acid 1 mol/L Titripur®	1.09057

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