Supelco®
Analytical Products

Application Note

Nitrate in Soil

Smartphone-based determination of nitrate after reduction to nitrite and reaction with Griess reagent

Introduction

Analyze your MQuant® test strips with your smartphone for fast, convenient, and precise results. Test the simplest way to determine Nitrate in aqueous solutions. This low-priced and easy-to-use analytical detection system provides reliable quantification of water, food & beverage samples for customers from research, industry, environment and diagnostics.

The following application note describes the determination of the nitrate concentrations in soil samples using the MQuant® Nitrate test strips in combination with the MQuant® StripScan App.

Experimental

Method

Nitrate ions are reduced to nitrite ions by a reducing agent. In the presence of an acidic buffer, these nitrite ions react with an aromatic amine to form a diazonium salt, which in turn reacts with N-(1-naphthyl)-ethylene-diamine to form a red-violet azo.

Measuring range

0–500 mg/L NO_3-

Sample material

Soil samples

Reagents, Instruments and Materials:

Reagents

Cat. No. 110020 MQuant® Nitrate Test, colorimetric with test strips

Cat. No. 102382 Calcium chloride dihydrate for analysis

Cat. No. 116754 Water for analysis or distilled water

Accessories

MQuant® Card (provided with the test strip box)

MQuant® StripScan App (can be downloaded via the Apple App Store or Google Play Store)

Analytical approach

Preparing the reagents

0.01 M $CaCl_2$-solution

Dissolve 0.735 g calcium chloride dihydrate in water for analysis and make up to 500 ml with water for analysis in a volumetric flask.

Sample preparation

Homogenize ca. 100 g of soil sample (exactly weighed) with 100 ml of 0.01 M $CaCl_2$ solution by shaking for 30 minutes. Filter through nitrate-free folded filter.

Measurement

For analysis, follow this procedure:

- Start the App.
- Get your MQuant® test strip and the MQuant® Card ready.
- Dip the test strip into the prepared sample (15–25 °C) for ca. 2 seconds, ensuring that the reaction zone is completely immersed.
- Shake off excess liquid from the strip and dry the backside of the strip using a paper towel.
- Select the parameter NO_3- (110020) in the app. Wait 60 seconds until the color of the nitrate strip is completely developed (a countdown is displayed on the screen, which begins immediately after selecting the parameter NO_3-).
- Just before the end of the countdown, place the test strip on the MQuant® Card.
- After the waiting time is elapsed, place the MQuant® Card with the test strip within the viewfinder on your phone screen, and align the camera along the reference points.
- The picture is captured automatically by the camera of the smartphone.
- The result is displayed on the screen in mg/L NO_3-.

Calculation

$$\text{Nitrate content}\left[\frac{\text{mg}}{\text{kg}}\right] = \frac{\text{Measured value}\left[\frac{\text{mg}}{\text{l}}\right] \cdot \text{Volume } CaCl_2\text{-solution [ml]}}{\text{Weight of sample [g]}}$$

Conversion to kg NO3-N/hectare (layer of soil):

kg NO_3-N/ha = A x BF x 3 x D x 0.226

where:

A Measured value

BF Factor for wetness of soil and extraction BF = 1.41 at an extraction ratio of 1+1 and 83 % dry mass

3 For a 30-cm thick layer of soil

D Soil density (1.5 kg/dm³)

0.226 Conversion factor NO_3- into NO_3-N

Results

Comparison with visual evaluation, Reflectoquant® Nitrate Test, and Spectroquant® Nitrate Test:

Sample	NO_3- content in mg/kg			
	StripScan*	visual readout*	Reflectoquant®*	Spectroquant®
1	100	100	159	144.8
2	50	50	67	73.0
3	50	50	77	73.4
4	10	10	15	15.6
5	20	25	24	23.0

*results are based on the average of a 5-fold determination

Note: Result graduation provided by MQuant® StripScan is identical with graduation on test strip package. (The results above were obtained using the previous app version with its graduations: 0 - 5 - 10 - 15 - 20 - 25 - 35 - 50 - 75 - 100 - 250 - 500 - >500 mg/l NO_3-)

Methods used for comparison:

Reflectoquant® nitrate test, Cat. No. 116971, same sample preparation as described above

Spectroquant® nitrate test, Cat. No. 109713, sample preparation according to test-specific application (for more information see product page)

Conclusion

The MQuant® Nitrate strip in combination with the MQuant® StripScan app is a quick and easy way to analyze the nitrate concentration in soil samples. The measured values are comparable to those measured with the Reflectoquant® and the photometric Spectroquant® Nitrate test.

For more information

- MQuant® StripScan see **SigmaAldrich.com/mquant-stripscan**
- MQuant® Test Strips see **SigmaAldrich.com/test-strips**
- Applications see **SigmaAldrich.com/wfa-applications**

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