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EZ4043 Total Hardness Analyser

Method and reagent sheets

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1. Legal information

Manufacturer: AppliTek NV/SA

Distributor: Hach Lange GmbH

The translation of the manual is approved by the manufacturer.

2. Analytical specifications

Please refer also to the respective technical datasheet at Hach Support Online.

Total Hardness - All specifications			
Analysis method	Colorimetric titration by EDTA using calmagite at 610 nm		
Parameter	Total hardness (TH)		
Cycle time	10 - 15 minutes		
Limit of detection (LOD)	≤ 0.25 mg/L		
Precision/Repeatability	Better than 2% full scale range for standard test solutions		
Cleaning	Automatic; frequency freely programmable		
Calibration	Automatic; one point calibration		
Validation	Automatic; frequency freely programmable		
Interferences	Some metal ions interfere by causing fading or indistinct end points or by stoichiometric consumption of EDTA. Suspended or colloidal organic matter also may interfere with the end point. Large amounts of colour and turbidity interferes. Fats, oil, proteins, surfactants and tar.		
Measuring ranges	% of range - Dilution	Low range (mg/L)	High range (mg/L)
	standard range	0.25	10

3. Analysis method

Summary

The determination of the total hardness concentration in water is based on the reaction of free calcium and magnesium with calmagite in an alkaline solution to form a purplish-red colour. The calcium– indicator complex is release by titration with EDTA, causing a blue colour. The change from red to blue colour is a measure for the amount of calcium and magnesium present in the sample. The colour change is measured at 610 nm.

Analysis steps

The analysis vessel is cleaned and filled with fresh sample. After sampling, the acid solution, buffer solution and colour solution are added. The colorimetric titration with EDTA at 610 nm is performed. After the determination of the end point, the calcium and magnesium concentration in the sample is determined.

Calibration

The calibration procedure measures a REF2 CaCO₃ solution (channel 10, REF2 valve) to adapt the slope factor by means of a one-point calibration.

The calibration is performed in the MAIN method.

Remark

The methods cannot be started at the same time.

4. Reagents

⚠ CAUTION	
	Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Read the safety data sheet from the supplier before bottles are filled or reagents are prepared. For laboratory use only. Make the hazard information known in accordance with the local regulations of the user.

⚠ CAUTION	
	Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

4.1 Reagent overview and consumption

In the tables below, the products that are needed to prepare the reagents are listed. The product name, the formula, the molecular weight, the CAS No. and the amount needed to prepare 1 liter of the reagents is given. Check the consumption of the reagents (28 days) to adapt the volumes needed.

Product	Consumption	Consumption/28 days A rata 1 analysis/10 min	Recommended containers
Acid solution	~ 1 mL	< 4.1 L	Plastic – 5 L
Buffer solution	~ 2 mL	< 8.1 L	Plastic – 5 L
Color solution	~ 2 mL	< 8.1 L	Plastic – 5 L
EDTA solution	Depending on hardness concentration	Concentration on hardness concentration	Plastic – 10 L
REF2 solution	~ 0.5 L / calibration	/	Plastic – 1 L

4.2 Storage and quality of chemicals

Quality of chemicals

All chemicals should be of ACS grade or better. We recommend the use of pro analysis chemicals.

Quality of water

Reagent grade, carbon dioxide-free de-ionized water must be used to prepare the chemical solutions and for rinse purposes.

Storage of Reagents

While operating the instrument, keep in mind the ambient temperature conditions as stated in the data sheet of the instrument.

Store the reagents cold; Store the reagents in the dark; Refresh the reagents after one month (unless stated differently in the chapters below).

4.3 Acid solution (0.5 M)

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Hydrochloric Acid (36%)	HCl	36.46	7647-01-0	41.5 mL

Preparation:

Prepare a 0.5 M hydrochloric acid (HCl) solution. Dilute 41.5 mL of hydrochloric acid (HCl) in 500 mL de-ionized water using a volumetric flask of 1000 mL. Mix and fill up to the grade mark with de-ionized water.

4.4 Buffer solution

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Ammonium chloride	NH ₄ Cl	53.49	12125-02-9	54 g
Ammonia solution 25%	NH ₄ OH	35.05	1336-21-6	350 mL
Mg-EDTA*	C ₁₀ H ₁₂ MgN ₂ Na ₂ O ₈ * 4H ₂ O	430.56	29932-54-5	5 g

*ethylenediaminetetraacetic acid magnesium disodium salt tetrahydrate

Preparation:

Dissolve 54 g of ammonium chloride (NH₄Cl) in 400 mL de-ionized water using a volumetric flask of 1000 mL. Add 350 mL ammonium hydroxide solution (25% NH₄OH) and 5 g Mg-EDTA (C₁₀H₁₂MgN₂Na₂O₈ * 4H₂O). Dissolve completely and fill up to the grade mark with de-ionized water.

Proposal for an alternative product:

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
**EDTA-K ₂ Mg * 2H ₂ O	C ₁₀ H ₁₂ K ₂ MgN ₂ O ₈ * 2H ₂ O	426.75	CAS 15708-48-2	4.96 g
***EDTA-Na ₂ Mg * xH ₂ O	C ₁₀ H ₁₂ N ₂ O ₈ .Mg.2Na	358.8	CAS 14402-88-1	4.17 g

**ethylenediaminetetraacetic acid dipotassium magnesium salt dihydrate

*** ethylenediaminetetraacetic acid magnesium disodium hydrate

4.5 Colour solution

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Calmagite	HOC ₁₀ H ₅ [N=NC ₆ H ₃ (OH)CH ₃]SO ₃ H)	358.37	3147-14-6	0.2 g

Preparation:

Dissolve approximately 0.2 g calmagite in 400 mL degassed de-ionized water using a volumetric flask of 1000 mL. Fill up to the grade mark with de-ionized water.

Stir the colour solution 24 h prior to use.

4.6 EDTA solution

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
EDTA*	C ₁₀ H ₁₄ N ₂ Na ₂ O ₈ * 2H ₂ O	372.2	6381-92-6	x g

*ethylenediaminetetraacetic acid disodium salt dihydrate

Preparation

Prepare a x M EDTA solution. Dissolve accurately x g ethylenediaminetetraacetic acid disodium salt dihydrate (C₁₀H₁₄N₂Na₂O₈ * 2H₂O) in 500 mL degassed de-ionized water and fill up to 1000 mL.

Measuring range	Concentration EDTA solution	Amount to add to 1 litre
10 mg/L CaCO ₃	0.0025 M	0.931 g

4.7 Calibration solution

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Calcium chloride dihydrate	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$	147.02	10035-04-8	1.4702 g

Preparation:

1000 mg/L CaCO_3 stock solution

Dissolve accurately 1.4702 g calcium chloride dihydrate ($\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$) in 200 mL de-ionized water, using a volumetric flask of 1000 mL. Add de-ionized water up to the mark grade.

CaCO_3 standard solution – REF2

Prepare a x mg/L calibration solution. Dissolve accurately x ml of the 1000 mg/L CaCO_3 stock solution in 500 mL degassed de-ionized water and fill up to 1000 mL.

Measuring range	Concentration calibration solution	Amount to add to 1 litre
10 mg/L CaCO_3	10 mg/L CaCO_3	10 mL

4.8 Cleaning solution (facultative)

The cleaning procedure should prevent any build-up of chemicals in the analyser. To obtain an effective cleaning procedure we recommend to test the cleaning solution and the cleaning interval for each application. Perform the selected cleaning solution and interval for a trial period, check then the effectiveness of the procedure and change if necessary.