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EZ1016 Total Hardness Analyser

Method and reagent sheets

09/2023, Edition 2.01

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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 measurement using calmagite colour solution		
Parameter	Total Hardness (TH)		
Cycle time	Standard measurement cycle time: 10 minutes Internal dilution: + 5 min. External dilution: + 10 min.		
Limit of detection (LOD)	≤ 25 µg/L		
Precision/Repeatability	Better than 2% full scale range for standard test solutions		
Cleaning	Automatic; frequency freely programmable		
Calibration	Automatic, 2-point; frequency freely programmable		
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)
	B	25% of standard range	0.025
	C	50% of standard range	0.025
	0	standard range	0.05
	1*	internal MP dilution (factor 4)*	0.2
	2*	Internal MP dilution (factor 8)*	0.4
	W	internal dispenser dilution (factor 10)	0.5
	X	internal dispenser dilution (factor 25)	1.25
	Y	internal dispenser dilution (factor 50)	2.5
	Z	internal dispenser dilution (factor 75)	3.75
	5	internal dispenser dilution (factor 100)	5
			High range (mg/L)
			0.25
			0.5
			1
			4
			8
			10
			25
			50
			75
			100

*Not applicable for EZ1016.xxxxxxT (SC-version)

3. Analysis method

Summary

Calcium or magnesium reacts with calmagite in a alkaline medium to form a red coloured complex. EDTA is added and binds with calcium and magnesium and the colour changes back to blue. The absorption change is measured at a wavelength of 610 nm.

Analysis steps

The analysis vessel is cleaned and filled with fresh sample. After sampling and addition of the acid, buffer and colour solution the initial absorbance value is measured at 610 nm. Next, the EDTA solution is added and after respecting a stirring period – performed to obtain complete colour development – the final absorbance value is determined. With the obtained absorbance values, the total hardness concentration can be calculated according to Beer's law.

Calibration

The calibration procedure measures a REF1 CaCO_3 solution (channel 9, REF1 valve) and a REF2 CaCO_3 solution (channel 10, REF2 valve) to adapt the slope and offset factors by means of a two 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 litre of the reagents is given. Check the consumption of the reagents (28 days) to adapt the volumes needed.

Reagents

TAG	Code	Product	Consumption	Consumption/28 days A rata 1 analysis/10 min	Recommended containers
Reagent 1	Red	Acid	~ 0.5 mL / analysis	~ 2.02 L	Plastic – 2.5 L
Reagent 2	Blue	Buffer	~ 0.5 mL / analysis	~ 2.02 L	Plastic – 2.5 L
Reagent 3	Green	Colour	~ 0.5 mL / analysis	~ 2.02 L	Plastic – 2.5 L
Reagent 4	Yellow	EDTA	~ 0.5 mL / analysis	~ 2.02 L	Plastic – 2.5 L

Calibration solutions

TAG	Product	Consumption	Recommended containers
REF1	REF1 solution	~ 0.5 L / calibration	Plastic – 1 L
REF2	REF2 solution	~ 0.5 L / calibration	Plastic – 1 L

4.2 DI-water overview and consumption

	TAG			
	Rinse (mL/analysis) Type I	Dispenser Dilution (mL/analysis) Type I	Total (mL/analysis)	Consumption/28 days A rata 1 analysis / 10 min
B	N.A.	N.A.	N.A.	N.A.
C	N.A.	N.A.	N.A.	N.A.
0	N.A.	N.A.	N.A.	N.A.
1	60 mL	15 mL	75 mL	302 L
2	60 mL	15 mL	75 mL	302 L
W	60 mL	15 mL	75 mL	302 L
X	60 mL	15 mL	75 mL	302 L
Y	60 mL	15 mL	75 mL	302 L
Z	60 mL	15 mL	75 mL	302 L
5	60 mL	15 mL	75 mL	302 L

Remark

The indicated volumes are an estimation of the consumption for rinse and dilution water, based on a standard operating procedure, as defined in the specifications of the EZ analyser. Please be aware that, depending on the sample matrix, the rinse water volumes might increase.

4.3 Storage and quality of chemicals

Quality of chemicals

All chemicals should be of Reagent grade, ACS grade or better (*). The use of pro analysis chemicals is recommended. Poor quality of the reagents can affect the analyser performance.

(*) Analytical Reagent (AR), Guaranteed Reagent (GR), UNIVAR, AnalaR, Premium Reagent (PR), ReagentCertified ACS reagent, ACS Plus reagent, puriss p.a. ACS reagent, ReagentPlus®, TraceCERT®, Suprapur®, Ultrapur®, or better are also possible.

Quality of DI-water

All EZ analysers are tested with standard solutions, reagents and dilution water prepared using type I water or better as defined by ASTM D1193-91.

To achieve the specifications as stated on the data sheet, method and reagents sheet and acceptance test reports, the same water quality (or better) must be used for the preparation of the standard solutions, reagents and dilution water.

Additionally the water used for the preparation of the standard solutions for an EZ analyser must be free of the parameter or any of the interferences for the method of that EZ analyser.

Storage of Reagents

While operating the instrument, keep in mind the reagent requirements as stated in the reagent overview, the chapters below and/or in the data sheet of the instrument.

⚠ CAUTION	
	For longer-term storage: Store the reagents cold; Store the reagents in the dark; If applicable: Store the reagents in a fridge during operation

⚠ CAUTION	
	Refresh the reagents after one month (unless stated differently in the chapters below). Do not mix old reagents with freshly prepared reagents. Remove old reagents from the container before adding freshly prepared reagents.

Materials

In order to avoid Ca contamination in the reagents we recommend to prepare the reagents into dedicated plastic flasks. Prior to the use of the flask we recommend to rinse the flasks with acid (0,1M HCl) and de-ionized water to clean any contamination.

4.4 Reagent 1: Acid (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 36%) 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.

4.5 Reagent 2: Buffer

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Ammonium hydroxide solution 25%	NH ₄ OH	35.05	1336-21-6	160 ml
Mg-EDTA*	C ₁₀ H ₁₂ MgN ₂ Na ₂ O ₈ · 4H ₂ O	430.56	29932-54-5	0.2 g

*ethylenediaminetetraacetic acid magnesium disodium salt tetrahydrate

Preparation

Dissolve 160 ml ammonium hydroxide solution (NH₄OH 25%) in 500 ml de-ionized water. Next, add 0.2 g of Mg-EDTA (C₁₀H₁₂MgN₂Na₂O₈ · 4H₂O), mix and fill up to 1 litre with de-ionized water.

4.6 Reagent 3: Colour

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 0.2 g of calmagite (HOC₁₀H₅[N=NC₆H₃(OH)CH₃]SO₃H)) in 500 mL de-ionized water. Mix and fill up to 1 litre with de-ionized water. Stir the colour solution for minimum 24 h prior to use.

4.7 Reagent 4: EDTA (0.025M)

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
EDTA*	$C_{10}H_{14}N_2Na_2O_8 \cdot 2H_2O$	372.2	6381-92-6	9.305 g

*ethylenediaminetetraacetic acid disodium salt dihydrate

Preparation

Dissolve 9.305 g of EDTA in 300 mL de-ionized water. Mix and fill up to 1 litre with de-ionized water.

4.8 Stock solution

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Calcium chloride dihydrate	$CaCl_2 \cdot 2H_2O$	147.02	10035-04-8	1.4689 g

Preparation

1000 mg/L $CaCO_3$ stock solution

Prepare a stock solution of 1000 mg/L $CaCO_3$: Dissolve accurately 1.4689 g calcium chloride dihydrate ($CaCl_2 \cdot 2H_2O$) in 300 mL de-ionized water using a volumetric flask of 1000 mL. Add de-ionized water up to the mark grade.

4.9 REF2 Calibration solution

REF2 – $CaCO_3$ standard solution

Prepare a standard solution for calibration according to the following table: take accurately x mL of the 1000 mg/L $CaCO_3$ stock solution (§4.8) and transfer into a volumetric flask of 1000 mL. Add de-ionized water up to the mark grade.

	Measuring range	Concentration REF2	Amount of stock solution to add to 1 litre
B	0.25 mg/L $CaCO_3$	0.25 mg/L $CaCO_3$	0.25 mL
C	0.50 mg/L $CaCO_3$	0.50 mg/L $CaCO_3$	0.50 mL
0	1.0 mg/L $CaCO_3$	1.0 mg/L $CaCO_3$	1.0 mL
1	4.0 mg/L $CaCO_3$	4.0 mg/L $CaCO_3$	4.0 mL
2	8.0 mg/L $CaCO_3$	8.0 mg/L $CaCO_3$	8.0 mL
W	10 mg/L $CaCO_3$	10 mg/L $CaCO_3$	10 mL
X	25 mg/L $CaCO_3$	25 mg/L $CaCO_3$	25 mL
Y	50 mg/L $CaCO_3$	50 mg/L $CaCO_3$	50 mL
Z	75 mg/L $CaCO_3$	75 mg/L $CaCO_3$	75 mL
5	100 mg/L $CaCO_3$	100 mg/L $CaCO_3$	100 mL

4.10 REF1 Calibration solution

REF1 – CaCO₃ standard solution

Prepare a standard solution of 0 mg/L CaCO₃. Use de-ionized water.

4.11 Cleaning reagent (facultative)

The cleaning procedure should prevent any build-up of chemicals in the analyser. To obtain an effective cleaning procedure one has 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.

Change Information	
Date: 13/09/2023	Previous version: Edition 1.01 to Edition 2.01
Reason for Change	
- Correction of analytical specifications: Limit of detection (LOD) - Addition of TAG's to reagents description - Split between stock solution and calibration solutions	
Description of Change	
- Correction LOD-value from 2.5 µg/L to 25 µg/L, typo in analytical specifications compared to measuring ranges. - Addition of 'Reagent x'-TAG to all reagent/water/reference solutions descriptions (Chapter 4.1, 4.2 and 4.3) - Creation of chapter for stock solution preparation and calibration solution preparation (Chapter 4.8, 4.9 ad 4.10)	