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EZ2300 Total Aluminium & Aluminium (III) Analyser

Method and reagent sheets

11/2021, Edition 1.01

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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.

Aluminium – All specifications				
Analysis method	Colorimetric measurement using pyrocatechol violet method at 578 nm			
Parameter	Al Total, Al (III)			
Cycle time	Standard measurement cycle time: 30 minutes Internal dilution: + 5 min. External dilution: + 5 – 10 min.			
Limit of detection (LOD)	≤ 10 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	No significant interference of Fluoride (F^-) and Iron (Fe^{3+}) concentrations at levels <1 mg/L (on standard range). Large amounts of colour and turbidity interferes. Fats, oil, proteins, surfactants and tar.			
Measuring ranges	**% of range - Dilution**		**Low range (mg/L)**	**High range (µg/L)**
	C	50% of standard range	10	75
	0	**standard range**	**10**	**150**
	1	internal MP dilution (factor 4)	80	600
	3	internal MP dilution (factor 10)	160	1500

3. Analysis method

Summary

The determination of Aluminium (III) and total Aluminium and is based on two methods, combined in one analyser.

The Aluminium (III) concentration is determined in the ‘Al’ method. The total Aluminium concentration is determined in the ‘Total Al’ method. The concentration of both Total Al and Al (III) is determined alternately in the ‘Main’-method.

The calibration for total Aluminium is determined in the ‘Total Al’ method. The calibration for Aluminium (III) is determined in the ‘Al’ method.

Remark

The methods cannot be started at the same time.

3.1 Aluminium (III)

Summary

The determination of the aluminium concentration in water is based on the reaction of aluminium with the pyrocatechol violet at a pH of 6.0±0.2 to form an intense coloured orange-brown complex (the blue colour is only visible at high aluminium concentrations) The absorption is measured at 578 nm.

Analysis steps

The analysis vessel is cleaned and filled with fresh sample. After sampling, the initial absorbance value is measured at 578 nm. Next, the mixed reagent solution, colour solution and buffer solution are 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 aluminium concentration can be calculated according to Beer's Law.

Calibration

The calibration procedure measures a REF1 Al solution (channel 9, REF1 valve) and a REF2 Al solution (channel 10, REF2 valve) to adapt the slope and offset factors by means of a two point calibration.

3.2 Total Aluminium

Summary

The determination of the aluminium concentration in water is based on the reaction of aluminium with the pyrocatechol violet at a pH of 5.9±0.1 to form an intense coloured orange-brown complex (the blue colour is only visible at high aluminium concentrations) The absorption is measured at 578 nm. Prior to the total aluminium analysis, the sample is digested by use of an acid solution.

Analysis steps

The sample is mixed with acid solution and heated to 120 °C (or up to 150 °C – programmable) in an oven during several minutes (standard 10 minutes; programmable up to 60 minutes). During the digestion process, the undissolved aluminium is converted to soluble aluminium. After digestion, the sample is cooled and transferred into the analysis vessel. The initial absorbance value is measured. Next, the mixed reagent solution, colour solution and buffer solution are added and the final absorbance value is determined. With the obtained absorbance values, the aluminium concentration can be calculated according to Beer's Law

Calibration

The calibration procedure measures a REF1 Al solution (channel 9, REF1 valve) and a REF2 Al solution (channel 10, REF2 valve) to adapt the slope and offset factors by means of a two point calibration.

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/30 min	Recommended containers
Acid solution (Total Al)	~ 1.0 mL / analysis	~ 2.7 L	Plastic – 5 L
	~ 1.0 mL / cleaning*		
Buffer solution (Total Al)	~ 2.0 mL / analysis	~ 5.4 L	Plastic – 10 L
Buffer solution (Al)	~ 2.0 mL / analysis		
Colour solution (Total Al)	~ 0.5 mL / analysis	~ 1.5 L	Plastic – 2.5 L
Colour solution (Al)	~ 0.5 mL / analysis		
Mixed reagent solution (Total Al)	~ 0.5 mL / analysis	~ 1.5 L	Plastic – 2.5 L
Mixed reagent solution (Al)	~ 0.5 mL / analysis		
REF1 solution (Total Al + Al)	~ 1 L / calibration	/	Plastic – 1 L
REF2 solution (Total Al + Al)	~ 1 L / calibration	/	Plastic – 1 L

4.2 DI-water overview and consumption

	Rinse water (mL/analysis) Type I		Dilution water (mL/analysis) Type I		Total (mL/analysis)	Consumption/28 days A rata 1 analysis/30 min
	Total Al	**Al (III)**	**Total Al**	**Al (III)**	**Total Al + Al (III)**	**Total Al + Al (III)**
C	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1	55 mL	55 mL	20 mL	10 mL	140 mL	190 L
3	55 mL	55 mL	20 mL	10 mL	140 mL	190 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.

4.4 Acid solution

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Nitric acid (65%)	HNO_3	63.01	7697-32-2	6 mL

Preparation

Take 6 mL nitric acid (HNO_3 65%) and dilute to 1 litre with de-ionized water in a plastic beaker. Store this solution in a plastic container.

4.5 Buffer solution

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Hexamethylene-tetramine	$C_6H_{12}N_4$	140.19	100-97-0	210 g

Preparation

Dissolve 210 g Hexamethylene-tetramine (C6H12N4) in 800 ml distilled water. Fill up to 1 litre with de-ionized water. The pH-value of the Buffer solution is ~ 9. Store this solution in a plastic container.

This solution is stable for 2 months.

4.6 Colour solution

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Pyrocatechol violet	$C_{19}H_{14}O_7S$	386.38	115-41-3	0.50 g

Preparation

Dissolve 0.50 g of pyrocatechol violet ($C_{19}H_{14}O_7S$) in 500 mL de-ionized water. Fill up to 1 litre with de-ionized water. Store this solution in a plastic container.

4.7 Mixed reagent solution

Products	Formula	MW (g/mol)	CAS No.	1 litre solution
Nitric acid 65%	HNO_3	63.01	7697-37-2	10 mL
Magnesium sulphate heptahydrate	$MgSO_4 * 7H_2O$	246.47	10034-99-8	250 g
Ascorbic acid	$C_6H_8O_6$	176.12	50-81-7	50 g
1,10-phenantroline monohydrate	$C_{12}H_8N_2 * H_2O$	198.22	5144-89-8	2.5 g
Aluminum standard solution 100 mg/L (*)				5 mL

Preparation

Add 10 mL nitric acid (HNO_3 65%) to 700 mL de-ionized water in a plastic beaker. Next, add 250 g of magnesium sulphate heptahydrate ($MgSO_4 \cdot 7H_2O$), 50 g of ascorbic acid ($C_6H_8O_6$), 2.5 g of 1,10-phenanthroline monohydrate ($C_{12}H_8N_2 \cdot H_2O$) and 5 mL of a 100 mg/L aluminium standard solution (*) to this solution. Transfer to a plastic volumetric flask of 1 litre and add de-ionized water to the mark grade.

(*) We recommend to use the Aluminium standard solution with following specifications:

Product	Brand	Product No.
Aluminium standard solution 100 mg/L as Al (NIST) (100 mL)	Hach	1417442

4.8 Calibration solution

Product	Brand	Product No.
Aluminium standard solution 10 mg/L as Al (NIST) (100 mL)	Hach	2305842
Aluminium standard solution 100 mg/L as Al (NIST) (100 mL)	Hach	1417442

Al standard solution – REF2

Prepare a standard solution for calibration according to the following table: take accurately x mL of the 100 mg/L Al standard solution and transfer into a plastic volumetric flask of 1 litre. Add de-ionized water up to the mark grade.

	Measuring range	Concentration REF2	Amount of stock solution to add to 1 litre
C	75.0 µg/L Al	75.0 µg/L Al	0.75 mL
0	**150 µg/L Al**	**150 µg/L Al**	**1.5 mL**
1	600 µg/L Al	600 µg/L Al	6 mL
3	1500 µg/L Al	1500 µg/L Al	15 mL

Al standard solution – REF1

Prepare a standard solution for calibration according to the following table: take accurately x mL of the 10 mg/L Al standard solution and transfer into a plastic volumetric flask of 1 litre. Add de-ionized water up to the mark grade.

	Measuring range	Concentration REF1	Amount of stock solution to add to 1 litre
C	75.0 µg/L Al	15 µg/L Al	1.0 mL
0	**150 µg/L Al**	**15 µg/L Al**	**1.5 mL**
1	600 µg/L Al	80 µg/L Al	8 mL
3	1500 µg/L Al	160 µg/L Al	16 mL

4.9 Rinsing solution

The analysis vessel is rinsed during analysis with de-ionized water. The cleaning valve will be activated during this procedure. The tubing of the cleaning valve should always be submerged in a container filled with de-ionized water during analysis.

4.10 Cleaning solution (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: 10/11/2021	Previous version: Edition 11 to Edition 1.01

Reason for Change

- Addition of interference level
- Change in consumption for acid solution
- Addition of water consumption
- Addition of information reagents

Description of Change

- Addition of interference level of Fluoride and Iron (chapter 2)
- Change in consumption for acid solution: implementation of additional rinse steps in the program, starting from June 2021. (chapter 4.1)
- Addition of estimated consumption of water for rinse and dilution (chapter 4.2)
- Addition of extra information regarding storage and quality of reagents (chapter 4.3)