

AQUAMICRON® -Karl Fischer Reagents-

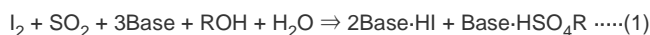
Manufactured by  MITSUBISHI CHEMICAL
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Wako distribute Karl Fischer reagents, AQUAMICRON®, manufactured by Mitsubishi Chemical Corporation, Kashima Plant, which have quality systems that adhere to the requirements of ISO 9001 and have received third party accreditation.

- Karl Fischer Method is ...**
- Coulometric Titration**
- Product List for Coulometric Titration**
AQUAMICRON® Series
- Volumetric Reagents**
- Product List for Volumetric Titration**
AQUAMICRON® SS-Z Series (pyridine-free and chloroform-free type)
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- Standard Water Standards**
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For Coulometric Titration
For Volumetric Titration
For Vaporization Method

1. Karl Fischer Method

As shown in Formula (1) below, the Karl Fischer method uses Karl Fischer reagent, which reacts quantitatively and selectively with water, to measure moisture content. Karl Fischer reagent consists of iodine, sulfur dioxide, a base and a solvent, such as alcohols.



As described below, this method can be used in both coulometric and volumetric titration systems.

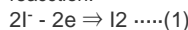


AQUAMICRON Series

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2. Coulometric Titration

With coulometric titration, the sample is added to an electrolytic solution, the main constituents of which are iodide ions, sulfur dioxide, a base, and a solvent (such as alcohol). Electrolytic oxidation causes the production of iodine, as shown in Formula (2), resulting in an immediate Karl Fischer reaction.



According to Faraday's laws, the iodine is produced in proportion to the quantity of electricity. This means that the water content can be determined immediately from the coulombs required for electrolytic oxidation.

1 mg of water = 10.71 Coulombs

As shown in Figure 1, two types of coulometric reagents are required: an anolyte, which is placed in the anode chamber of the electrolysis cell, and a catholyte, which is placed in the cathode chamber. Coulometric reagents do not need assessment. Another advantage is that they can be used repeatedly.

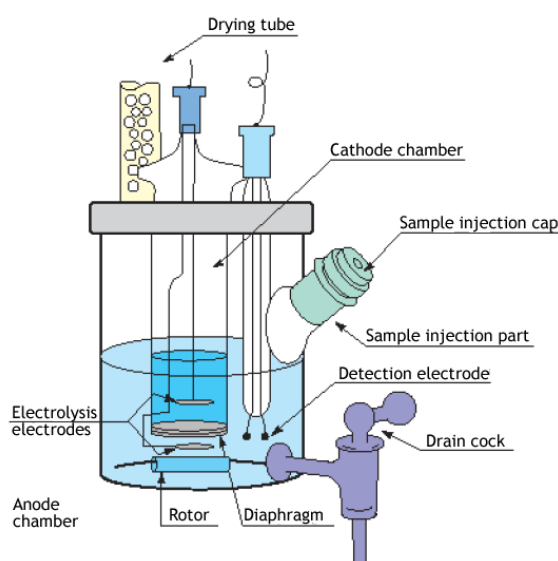


Figure 1: Electrolysis cell of Coulometric Moisture Meter

3. Product List for Coulometric Titration

There are two types of coulometric reagents: the anolyte (generating solution), which is placed in the anode chamber of the electrolysis cell, and

the catholyte (counter electrolyte), which is placed in the cathode chamber. There are also special anlyte for use with ketones, lower carboxylic acids and silicone oils. AQUAMICRON® can be used in coulometric moisture measurement systems sold by various companies, and it has a worldwide reputation for excellent performance.



Example(Coulometric) →

AQUAMICRON® Series

Description [API code No.] Wako Catalog No. (Package Size)	Use	Specification	Main Solvent
AQUAMICRON® AX [XAMA] Wako Cat. #604-07485 (500 mL)	[For General-use] Organic solvents, Inorganic chemicals, Oils, Petroleum products, Various kind of gases. <i>etc.</i>	Moisture maximum 0.15 mg H ₂ O/mL	Methanol, Propylenecarbonate
AQUAMICRON® AX01 [XAMA01] Wako Cat. #633-07051 (100 mL)			
AQUAMICRON® AS [SAMA] Wako Cat. #601-07255 (500 mL)	[For Oils] Naphtha, Gasolone, Diesel oil, Electrical insulation oil, <i>etc.</i>	Moisture maximum 0.15 mg H ₂ O/mL	Methanol, Chloroform
AQUAMICRON® AKX [AKX] Wako Cat. #605-07591 (500 mL)	[For Ketones] Ketones. Silicone oils. Low carboxylic acids, <i>etc.</i>	Moisture maximum 0.15 mg H ₂ O/mL	Propylenecarbonate, Diethyleneglycole monosethylether
AQUAMICRON® CXU [CXU] Wako Cat. #602-07501 (5 mL ampule x 10)	[Catholyte] Both AX and AS and AKX available to combine with	Moisture maximum 0.6 mg H ₂ O/mL	Methanol
AQUAMICRON® FLS [FLS] Wako Cat. #632-07065 (500 mL)	[For fritless type cell] Organic solvents, Inorganic gases, <i>etc.</i>	Moisture maximum 0.15 mg H ₂ O/mL	Methanol, Propylenecarbonate

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AQUAMICRON® AX/CXU

Use: General samples

Characteristics:

Minimal environmental contamination	Does not include carbon tetrachloride or chloroform
Wide range of applications	Suitable for petroleum products
	Can be used with moisture vaporization method (When using AQUAMICRON® AX in a moisture vaporization method, replenish the vaporized portion with methanol.)
High quality, high performance	Excellent reputation for accurate moisture measurement and end-point stability Approximately 800mg of moisture can be measured per 100mL of AQUAMICRON® AX, and approximately 150mg per 5mL of AQUAMICRON® CXU
Easy to use	These products can be used in the existing coulometric moisture measurement system.

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AQUAMICRON® AS/CXU

Use: General samples

Characteristics:

Wide range of applications	Especially suitable for oils, petroleum products
High quality, high performance	Excellent reputation for accurate moisture measurement and end-point stability.
-	Approximately 800mg of moisture can be measured per 100mL of AQUAMICRON® AS, and approximately 150mg per 5mL of AQUAMICRON® CXU.
Easy to use	These products can be used in the existing coulometric moisture measurement system.

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AQUAMICRON® AKX/CXU

Use: Ketones, lower carboxylic acids, some aldehydes (aromatics)

Characteristics:

Minimal environmental contamination	Does not include chloroform or methyl cellosolve
Wide range of applications	Suitable for ketones, lower carboxylic acids and some aldehydes
High quality, high performance	Accurate moisture measurement, good end-point stability Approximately 300mg of moisture can be measured per 100ml of AQUAMICRON® AKX, and

	approximately 100mg per 5mL of AQUAMICRON® CXU (when used with AQUAMICRON® AKX).
Easy to use	These products can be used in the existing coulometric moisture measurement system.

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AQUAMICRON® FLS

Use: Suitable for alcohols, esters, benzene, toluene, inorganic gases, etc.

Characteristics:

Easy to use	AQUAMICRON® FLS is a single-solution type reagent. It should be used in single-solution electrolytic cells without diaphragm, fritless type cell. Can be used with moisture vaporization method(When using AQUAMICRON® FLS in a moisture vaporization method, replenish the vaporized portion with methanol.)
Easy to maintenance	Ceramic diaphragm is not used, therefore it is easy to maintain electrolytic cell in good condition.

4. Volumetric Titration

A dehydrating solvent suitable for the sample is placed in a flask. Titrant is used to remove all moisture from the solvent. The sample is then added. Titration is which has previously been determined. The moisture content of the sample is determined from the titration volume (mL). The end point is detected using the constant-current polarization voltage method. Figure 2 shows the components of typical commercially available automatic volumetric titration system.

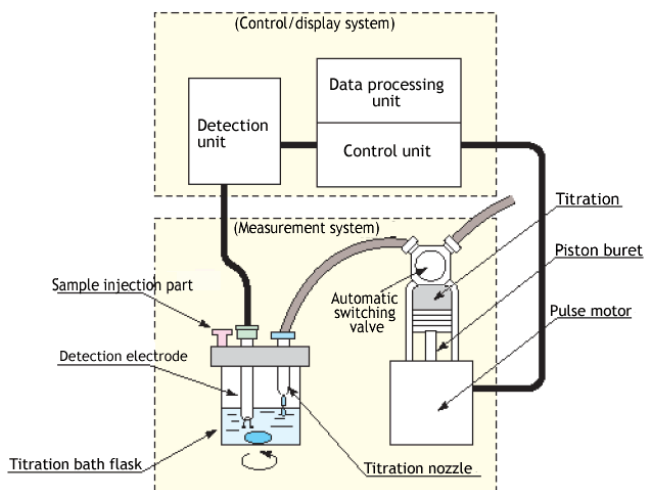


Figure 2: Volumetric Moisture Meter

5. Product List for Volumetric Titration



SS-Z series



SS series

The items required for volumetric titration are a Karl Fischer titrant and methanol or a dehydrated solvent (used to dissolve or disperse the sample). AQUAMICRON® offers a wide range of products suitable for measuring the moisture content of various samples at every levels. Users can select a solvent that is suitable for the samples based on the following tables.

Example (Volumetric) →

AQUAMICRON® SS-Z Series (pyridine-free and chloroform-free type)

Description Wako Catalog No. (Pkg Size) [API code No.]	Use	Specification	Main Solvent
AQUAMICRON® Titrant SS-Z 1 mg Wako Cat. #631-03495 (500 mL) [SSZ10M]	[For General-use] Low moisture content Samples	Titer 0.7-1.2 mg H ₂ O/mL	Diethyleneglycole monoethylether
AQUAMICRON® Titrant SS-Z 3mg Wako Cat. #634-03505 (500 mL) [SSZ30M]	[For General-use]	Titer 2.5-3.5 mg H ₂ O/mL	

AQUAMICRON® Titrant SS-Z 5 mg Wako Cat. #631-03515 (500 mL) [SSZ50M] Wako Cat. #636-03521 (1 L) [SSZ50L]	[For General-use] High moisture content Samples	Titer 4.5-5.5 mg H ₂ O/mL	
AQUAMICRON® Solvent GEX Wako Cat. #608-07525 (500 mL) [GEX]	[For General-use] Organic solvents, Inorganic chemicals, Agricultural chemicals, Pharmaceuticals, Fertilizers, Detergents, Foodstuffs, etc.	Moisture maximum 0.2 mg H ₂ O/mL	Methanol
AQUAMICRON® Solvent OLX Wako Cat. #635-03535 (500 mL) [OLX]	[For Oils] Naphtha, Gasolone, Diesel oil, Electrical insulation oil, etc.	Moisture maximum 0.5 mg H ₂ O/mL	Hexanol, Ethanol
AQUAMICRON® Solvent OLII Wako Cat. #605-07535 (500 mL) [OL2]	[For Oils and Fats] Naphtha, Gasolone, Diesel oil, Heavy oil, Electrical insulation oil, Oils and Fats (Hardened oil, Margarine, etc.), etc.	Moisture maximum 0.2 mg H ₂ O/mL	Chloroform, Methanol
AQUAMICRON® Solvent KTX Wako Cat. #632-03545 (500 mL) [KTX]	[For Ketones] Ketones, Silicone oils, Acetic and other lower carboxylic acids, aldehydes(except acetaldehydes), etc.	Moisture maximum 0.5 mg H ₂ O/mL	Propylenecarbonate, Diethyleneglycole monoethylether
AQUAMICRON® Solvent SU Wako Cat. #603-07335 (500 mL) [SSU]	[For Sugars] Sugars, Proteins, Gelatine, Additives, Animal feeds, etc.	Moisture maximum 0.5 mg H ₂ O/mL	Formamide, Methanol

When using a moisture vaporization method, mix Solvent GEX with propylene glycol(PG) in a 3:1 ratio (e.g. 90 mL of GEX + 30 mL of PG).
When using Solvent KTX, it will be needed to make proper adjustments to the parameters. Please contact a manufacturer of the instruments.
An addition of 3 g of salicylic acid enables the time for dehydration to get shorter at the first measurement in combined use of 50 mL of Solvent SU.

AQUAMICRON® SS Series (pyridine type)

Description Wako Catalog No. (Package Size) [API code No.]	Use	Specification	Main Solvent
AQUAMICRON® Titrant SS 1 mg Wako Cat. #608-07025 (500 mL) [GKS10M]	[For General-use] Low moisture content Samples	Titer 0.7-1.2 mg H ₂ O/mL	Chloroform, Pyridine
AQUAMICRON® Titrant SS 3mg Wako Cat. #601-07015 (500 mL) [GKS30M]	[For General-use]	Titer 2.5-3.5 mg H ₂ O/mL	
AQUAMICRON® Titrant SS 10 mg Wako Cat. #603-07215 (500 mL) [GKS100M]	[For General-use] High moisture content Samples	Titer 8-12 mg H ₂ O/mL	
AQUAMICRON® Solvent ML Wako Cat. #600-07085 (500 mL) [GML]	[For General-use] Organic solvents, Inorganic chemicals, Agricultural chemicals, Pharmaceuticals, Fertilizers, Detergents, Foodstuffs, etc.	Moisture maximum 0.2 mg H ₂ O/mL	Methanol
AQUAMICRON® Solvent MS Wako Cat. #604-07125 (500 mL) [GMS]			Methanol, Pyridine
AQUAMICRON® Solvent CM Wako Cat. #603-07075 (500 mL) [GCM]	[For Oils] Naphtha, Gasolone, Diesel oil, Heavy oil, Electrical insulation oil, Oils and Fats (Hardened oil, Margarine, etc.), etc.	Moisture maximum 0.3 mg H ₂ O/mL	Chloroform, Methanol
AQUAMICRON® Solvent CP Wako Cat. #604-07245 (500 mL) [GCP]	[For Ketones] Ketones, Silicone oils, Acetic and other lower carboxylic acids, aldehydes(except acetaldehydes), etc.	Moisture maximum 0.5 mg H ₂ O/mL	Chloroform, Propylenecarbonate
AQUAMICRON® Solvent PE Wako Cat. #606-07065 (500 mL) [GPE]			Pyridine, Ethylene glycole
AQUAMICRON® Solvent PP Wako Cat. #600-07105 (500 mL) [GPP]	[For Aldehyde] Acetaldehydes, propionaldehydes, Butyraldehydes, etc.	Moisture maximum 0.2 mg H ₂ O/mL	Pyridine, Propylenecarbonate
AQUAMICRON® Solvent FM Wako Cat. #607-07095 (500 mL) [GFM]	[For Sugars] Sugars, Proteins, Gelatine, Additives, Animal feeds, etc.	Moisture maximum 0.2 mg H ₂ O/mL	Formamide, Methanol
AQUAMICRON® Solvent ME Wako Cat. #607-07115 (500 mL) [GME]	[For Vaporizer] Gaseous samples, Nitrogen, etc.	Moisture maximum 0.2 mg H ₂ O/mL	Methanol, Ethylene glycole

When using a moisture vaporization method, mix Solvent MS with propylene glycol (PG) in a 3:1 ratio (e.g. 90 mL of MS + 30 mL of PG).
An addition of 3 g of salicylic acid enables the time for dehydration to get shorter at the first measurement in combined use of 50 mL of Solvent FM.

6. AQUAMICRON® Standard Water Solution

AQUAMICRON® Water Standards are ...

- Manufactured at Mitsubishi Chemical Co. which have ISO9001 accreditation.
- According to ISO, GMP, GLP, and FDA guidelines. Traceable to NIST

SRM2890.

- Consist of a solvent with specific composition, and exactly confirmed water content. Supplied with Certificate of Analysis.
- Packaged in single-use glass ampoules.
- Long shelf life.



7. Product List for AQUAMICRON® Standard Water Solution

For Coulometric Titration

Description [API code No.] Wako Catalog No. (Package Size)	Use	Specification	Main Solvent
AQUAMICRON® Water Standard 0.1 [AWS01] Wako Cat. #639-15101 (5 mL x 10 / case)	For checking the accuracy of the coulometric moisture meter	Titer 0.1 ± 0.01 mg H ₂ O/g	1-Octanol
AQUAMICRON® Water Standar 0.2 [AWS02] Wako Cat. #604-07561 (5 mL x 10 / case)	For checking the accuracy of the coulometric moisture meter	Titer 0.2 ± 0.01 mg H ₂ O/g	1-Octanol (Changed)
AQUAMICRON® Water Standard 1 [AWS10] Wako Cat. #601-07571 (5 mL x 10 / case)	For checking the accuracy of the coulometric moisture meter	Titer 1 ± 0.05 mg H ₂ O/g	Propylenecarbonate
AQUAMICRON® Water Standard P [GCHP] Wako Cat. #609-07511 (100 mL)	The end-point adjustment solution can be used with both AX and AKX. It can also be used for day-to-day management of coulometric moisture measurement systems.	Moisture 3.8 - 4.2 mg H ₂ O/g	Propylenecarbonate

For Volumetric Titration

Description [API code No.] Wako Catalog No. (Package Size)	Use	Specification	Main Solvent
AQUAMICRON® Water Standard 10 [AWS100] Wako Cat. #608-07581 (8 mL x 10 / case)	For determination of Karl Fischer reagent titer	Titer 10 ± 0.5 mg H ₂ O/g	Propylenecarbonate
AQUAMICRON® Standar Water/Methanol [GMW20] Wako Cat. #600-07041 (250 mL glass bottle)	Used to assess titer of Karl Fischer reagents(3-10 mg H ₂ O/mL). Also can be used for reverse titration.	Moisture 2.0 ± 0.04 mg H ₂ O/g	Methanol

For Vaporization Method

Description [API code No.] Wako Catalog No. (Package Size)	Use	Specification	Main Solvent
AQUAMICRON® Solid Water Standard [SWS] Wako Cat. #637-07071 (10 g glass bottle)	For evaluation a moisture meter with a water vaporizer	Moisture $3.83 \pm 0.1\%$	Potassium tetratare hemihydrate

Note

- Listed products are intended for laboratory research use only, and not to be used for drug, food or human.
- Please visit Wako's online catalog to search for other products available through Wako: www.e-reagent.com

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