

# Scharlau

*The wise choice*



## Aquagent®. Pyridine-free volumetric and coulometric Karl Fischer reagents

- One-component reagents
- Two-component reagents
- Reagents for aldehyde and ketone analysis
- Working Media
- Dry solvents
- Standards
- Coulometric reagents for cells with and without diaphragm
- Pyridine-free
- Fast titration
- Stable titration end-points
- Less toxic



*Karl Fischer titration is a well known method for water determination since the beginning of the 20th century. KF titration uses coulometric or volumetric titration to determine the water content in a wide variety of samples. It is used both in industrial processes as well as in quality control laboratories.*

*The first KF reagents that were developed contained pyridine, which was assumed to be essential for the reaction. Further experiments demonstrated that pyridine acted just as a buffer substance and could be replaced by other basic compounds, which were able to play the same role providing less toxicity.*

*Most of the pyridine-free reagents including our Aquagent®, contain imidazole instead of pyridine. Imidazole is a non-toxic base, has a good buffering capacity and allows fast and stable titration end-points.*

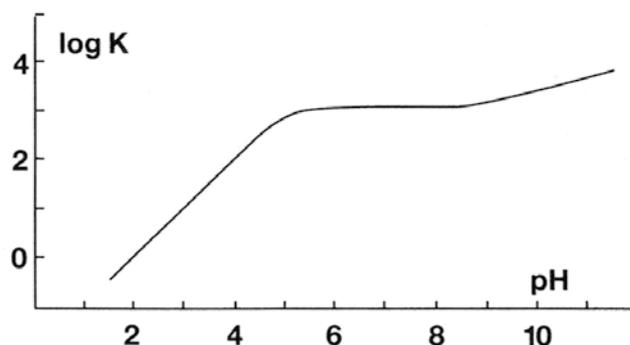
## Why should you switch to Aquagent®?

The first reason to change from the classical KF reagents to Aquagent® seems to be to avoid the use of pyridine because of its toxicity. Nevertheless, there are other practical advantages that are very important to decide to change to Aquagent®.

### Faster titration – End point stability – Accuracy

Kinetic studies demonstrate that the KF reaction runs quickly and stoichiometrically in the pH range of 5-7. The titration of water produces acidic intermediates that must be neutralized and pyridine is not the best base to do it. Pyridine has a low pH and poor buffering capacity and hence the KF reaction is very slow and end point is not stable.

Aquagent® reagents contain imidazole, which is proven to have a better buffering capacity than pyridine. This leads to a faster reaction, stable end points and more accurate and reproducible results.



## There are two types of KF titrations: Volumetric and Coulometric

*Since the reaction that takes place is the same in both cases, we find that the main difference between volumetric and coulometric titrations is in their application. For their composition and type of cell, volumetric titrations allow the analysis of water content between 0,1% and 100%. In coulometric titrations, iodine is generated in situ by the oxidation of iodide at the anode and, as Faraday's law says, water concentration can be measured from the current used to generate the iodine, thus being an absolute technique that allows determination of water amounts between 10 ppm and 1000 ppm. The combination of both techniques provides the user with very good tools to analyze the water content in a wide variety of samples.*

*Because of their configuration, coulometric cells require different reagents than volumetric ones. After months of research, we have been able to widen our Aquagent® family product range and Scharlau is now able to offer 3 new reagents for Coulometric KF.*

## Volumetric KF

When analyzing the water content of a sample by volumetric KF, it can be done using one-component or two-component systems.

### One component system

All substances involved in the Karl Fischer reaction are mixed in one reagent. One-component reagents are very simple to use, but they must be re-titrated frequently due to the reactivity of their components.

#### Aquagent® Complet 5

A general purpose reagent for samples with high and medium water content. It has a titre of approx. 5 mg water / ml. Shelf life is two years.

It is generally used in conjunction with methanol as a solvent.

#### Aquagent® Complet 2

A general purpose reagent for samples with low water content. It has a titre of approx. 2 mg water / ml. Shelf life is two years.

It is generally used in conjunction with methanol as a solvent.

#### Aquagent® Complet 5K

Aldehydes and ketones react with methanol and water is a by-product of this reaction. Hence erroneous results are obtained. To avoid this effect a specific reagent is needed: our Aquagent® Complet 5K. It is used in conjunction with Aquagent® Medium K, a specific solvent that does not contain methanol. It has a titre of 5 mg water / ml and shelf life is 2 years.



Description	Capacity	Art. no.
Aquagent® - Complet 2	500 ml	AQ00070500
(1 ml = 2 mg H <sub>2</sub> O approx.)	1 l	AQ00071000
	2,5 l	AQ00072500
Aquagent® - Complet 5	500 ml	AQ00030500
(1 ml = 5 mg H <sub>2</sub> O approx.)	1 l	AQ00031000
	2,5 l	AQ00032500
Aquagent® - Complet 5K	500 ml	AQ00040500
(1 ml = 5 mg H <sub>2</sub> O approx.)	1 l	AQ00041000

The sample must always be dissolved in an anhydrous liquid to be titrated. The most common solvent is dry methanol. If the sample is not soluble in methanol, any other dry solvent can be used (see our ordering information on the rear of this brochure).

We also offer other solvents for specific applications:



#### Aquagent® MEDIUM K

Methanol reacts with both ketones or aldehydes and water is a by-product of these reactions. For this reason, methanol must be substituted by another solvent, our Aquagent® Medium K.

#### Aquagent® BUFFER ACID

The Karl-Fischer reaction runs optimally at pH between 5 and 7. When determining water in strongly acidic compounds, it is recommended to neutralize the working medium with our Aquagent® Buffer Acid.

#### Dry formamide

Formamide improves the solubility of carbohydrates, proteins and inorganic salts. This solvent can be added to methanol in no more than 50% by volume.

Description	Capacity	Art. no.
Methanol, dry, reagent grade	1 l	ME03041000
(max. 0,005% water)	2,5 l	ME03042500
Aquagent® Medium K	1 l	AQ00051000
(to be used with Aquagent® Complet 5K)		
Aquagent® Buffer Acid	500 ml	AQ00090500
	1 l	AQ00091000
Formamide, dry (max. 0,02% water)	1 l	FO00281000



We add a label on each bottle of Aquagent® Complet, where the user can write down reagent titration dates and obtained titre. Thus, the user has the whole titration history of each bottle at a glance.

## Two-component system

In two-component systems, the solvent-component doesn't act just as a solvent medium, but also contains part of the reagents. This allows longer shelf-life and avoids the need for frequent re-titration.

The use of two component reagents is more expensive but presents several advantages:

- **Faster reaction**
- **Less consumption of titration reagents**
- **Better stability of the reagents**



### Aquagent® Titrant 5

A general purpose reagent that contains iodine and methanol. Titre is approx. 5 mg water / ml. Shelf life is 3 years. Must be used in conjunction with Aquagent® Solvent.

### Aquagent® Titrant 2

A general purpose reagent that contains iodine and methanol. Titre is aprox. 2 mg water / ml. Shelf life is 3 years. Must be used in conjunction with Aquagent® Solvent.

Description	Capacity	Art. no.
Aquagent® Titrant 2	500 ml	AQ00060500
	1 l	AQ00061000
Aquagent® Titrant 5	500 ml	AQ00010500
	1 l	AQ00011000

We offer several products to be used as solvent-component in conjunction with Aquagent® Titrant:

### Aquagent® Solvent

A general purpose reagent that contains SO<sub>2</sub>, imidazole and methanol. It must be used in conjunction with Aquagent® Titrant. Shelf life is 5 years.

### Aquagent® Solvent CM

Solvent-component for titration of fats and oils. It contains chloroform, which improves solubility of long-chained hydrocarbons.

### Aquagent® Solvent OIL

Solvent-component for titration of fats and oils. It contains 1-hexanol and avoids use of halogenated reagents.

Description	Capacity	Art. no.
Aquagent® Solvent	1 l	AQ00021000
	2,5 l	AQ00022500
<b>NEW</b> Aquagent® Solvent CM	1 l	AQ00081000
	2,5 l	AQ00082500
<b>NEW</b> Aquagent® Solvent Oil	1 l	AQ00101000



## Coulometric KF

There are two types of coulometric cells depending on whether they have a diaphragm or not.

### Aquagent® Coulometric A. Anolyte for coulometric KF titration (AQ0022)

Suitable for cells with diaphragm. This general purpose reagent contains methanol, trichloromethane, imidazole and sulfur dioxide. Shelf life is 3 years. To be used in conjunction with AQ0023.

### Aquagent® Coulometric GC. Catholyte for coulometric KF titration (AQ0023)

Suitable for cells with diaphragm. This general multipurpose reagent contains diethanolamine and methanol. Shelf life 3 years. To be used in conjunction with AQ0022.

### Aquagent® Coulometric AG, for coulometric KF titration, suitable for cells without diaphragm (AQ0024)

Contains methanol, Imidazole, diethanolamine, sulfur dioxide and iodine. Suitable for cells with and without diaphragm. Shelf life 3 years.



Description	Capacity	Art. no.
Aquagent® coulometric A	500 ml	AQ00220500
Aquagent® coulometric GC	100 ml	AQ00230100
Aquagent® coulometric AG	500 ml	AQ00240500
Aquagent® coulometric AG	1 l	AQ00241000

## Standards

To determine the factor of the reagents, standards of a known water content have to be used.

Our Aquagent® sodium tartrate dihydrate is a stable non-hygroscopic compound with a stoichiometric water content of 15,66%. These characteristics make it suitable as a volumetric standard in Karl Fischer determinations. However, this product does not easily dissolve in methanol, which is why some users prefer to use liquid standards such as our **NEW** Aquagent® Standard 1.0 for coulometric Karl Fischer and Aquagent® Standard 10.0 for volumetric Karl Fischer.

We pack our 1.0 and 10.0 standards in ampoules to maintain optimum conditions until they are opened.

Our 5.0 standard is suitable for daily titer control as well as for equipment validation

Description	Capacity	Art. no.
Sodium tartrate dihydrate	25 g	AQ00300025
	100 g	AQ00300100
<b>NEW</b> Aquagent® Standard 1.0	10x4 ml	AQ00190040
<b>NEW</b> Aquagent® Standard 10.0	10x8 ml	AQ00200080

#### Traceables to NIST

Aquagent® Standard 5.0	100 ml	AQ00210100
	500 ml	AQ00210500

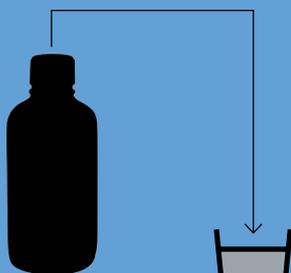


## AQUAGENT® QUICK SELECTION GUIDE

### VOLUMETRIC

#### ONE-COMPONENT SYSTEM

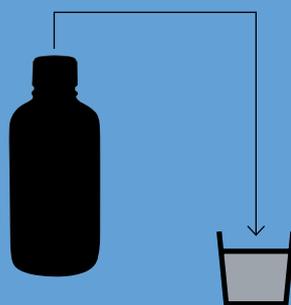
##### GENERAL ANALYSIS



METHANOL

Aquagent® Complet 5	AQ0003
Aquagent® Complet 2	AQ0007
Methanol, dry, reagent grade	ME0304
Additional solvents to methanol	
Aquagent® buffer acid	AQ0009
Formamide, dry	FO0028

#### KETONE AND ALDEHYDE ANALYSIS

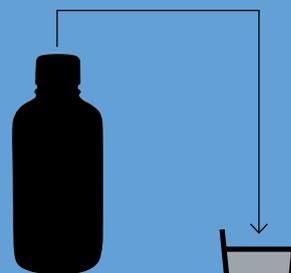


WORKING MEDIUM K

Aquagent® Complet 5K	AQ0004
Working Medium K	AQ0005

#### TWO-COMPONENT SYSTEM

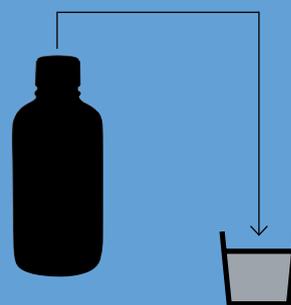
##### GENERAL ANALYSIS



AQUAGENT® SOLVENT

Aquagent® Titrant 2	AQ0006
Aquagent® Titrant 5	AQ0001
Aquagent® Solvent	AQ0002

#### FAT AND OIL ANALYSIS

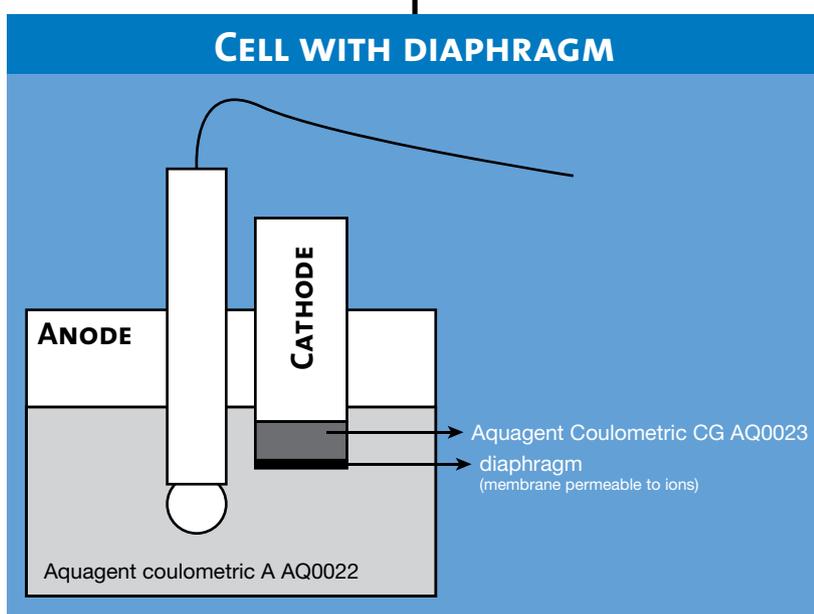


AQUAGENT® SOLVENT

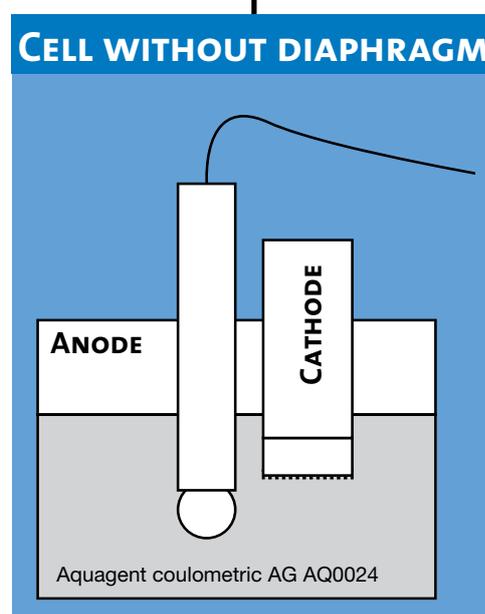
Aquagent® Titrant 2	AQ0006
Aquagent® Titrant 5	AQ0001
Aquagent® Solvent CM	AQ0008
Aquagent® Solvent Oil	AQ0010

**COULOMETRIC**

**CELL WITH DIAPHRAGM**



**CELL WITHOUT DIAPHRAGM**



In cells with a diaphragm, the anode chamber, where oxidation of  $I^-$  to  $I_2$  takes place, is separated from the cathode chamber, where protons are reduced to  $H_2$ .

Cells without a diaphragm also have an anode and a cathode, but they are not separated.

**ADVANTAGES OF AQUAGENT®**

- Less toxic →
- Stable titration end-points →
- Fast titration →
- Doesn't contain pyridine →
- Suitable for a wide variety of samples →

**BENEFITS OF AQUAGENT®**

- Increases safety
- Accurate and reliable results
- Saves time
- No unpleasant odour
- Many applications

Quick titration and stable end-points are the features highlighted by the users of Aquagent®.

## Ordering information

### Volumetric KF

#### One-component system

Description	Capacity	Art. no.
Aquagent® - Complet 2 (1 ml = 2 mg H <sub>2</sub> O approx.)	500 ml	AQ00070500
	1 l	AQ00071000
	2,5 l	AQ00072500
Aquagent® - Complet 5 (1 ml = 5 mg H <sub>2</sub> O approx.)	500 ml	AQ00030500
	1 l	AQ00031000
	2,5 l	AQ00032500
Aquagent® - Complet 5K	500 ml	AQ00040500
	1 l	AQ00041000
Methanol, dry, reagent grade (max. 0,005% H <sub>2</sub> O)	1 l	ME03041000
	2,5 l	ME03042500
Aquagent® Medium K (to be used with Aquagent® Complet 5K)	1 l	AQ00051000
Aquagent® Buffer Acid	500 ml	AQ00090500
	1 l	AQ00091000
Formamide, dry (max. 0,02% H <sub>2</sub> O)	1 l	FO00281000

#### Two-component system

Description	Capacity	Art. no.
Aquagent® Titrant 2	500 ml	AQ00060500
	1 l	AQ00061000
Aquagent® Titrant 5	500 ml	AQ00010500
	1 l	AQ00011000
Aquagent® Solvent	1 l	AQ00021000
	2,5 l	AQ00022500
Aquagent® Solvent CM	1 l	AQ00081000
	2,5 l	AQ00082500
Aquagent® Solvent Oil	1 l	AQ00101000

### Coulometric KF

<b>NEW</b> Aquagent® coulometric A	500 ml	AQ00220500
<b>NEW</b> Aquagent® coulometric GC	100 ml	AQ00230100
<b>NEW</b> Aquagent® coulometric AG	500 ml	AQ00240500
<b>NEW</b> Aquagent® coulometric AG	1 l	AQ00241000

### Dry solvents

Description	Capacity	Art. no.
Acetone, dried, r.g. (max. 0,01% H <sub>2</sub> O)	1 l	AC03161000
Acetonitrile, Multisolvent® (max. 0,03% H <sub>2</sub> O)	1 l	AC03331000
Benzene, dried, r.g. (max. 0,01% H <sub>2</sub> O)	1 l	BE00341000
Chloroform, Multisolvent®, stabilized with ethanol (max. 0,01% H <sub>2</sub> O)	1 l	CL02181000
Cyclohexane, Multisolvent® (max. 0,01% H <sub>2</sub> O)	1 l	CI00391000
Dichloromethane, dried, r.g. stabilized with approx. 50 ppm of amylene (max. 0,005% H <sub>2</sub> O)	1 l	CL03381000
N,N-Dimethylformamide, dried, r.g. (max. 0,01% H <sub>2</sub> O)	1 l	DI10711000
Dimethylsulfoxide, dried, r.g. (max. 0,01% H <sub>2</sub> O)	1 l	SU01571000
1,4-Dioxan, dried, r.g. (max. 0,005% H <sub>2</sub> O)	1 l	DI12901000
Ethanol, absolute, Multisolvent® (max. 0,1% H <sub>2</sub> O)	1 l	ET00151000
Ethyl acetate, Multisolvent® (max. 0,03% H <sub>2</sub> O)	1 l	AC01550000
n-Hexane, 96%, Multisolvent® (max. 0,005% H <sub>2</sub> O)	1 l	HE02341000
Methanol, dried, r.g. (max. 0,005% H <sub>2</sub> O)	1 l	ME03041000
Petroleum ether, Multisolvent®, boiling range 40-60°C (max. 0,01% H <sub>2</sub> O)	1 l	ET00951000
2-Propanol, dried, r.g., ACS, ISO (max. 0,01% H <sub>2</sub> O)	1 l	AL03161000
Tetrahydrofuran, dried, r.g., stabilized with 250 ppm of BHT (max. 0,005% H <sub>2</sub> O)	1 l	TE02231000
Toluene, dried, r.g. (max. 0,0075% H <sub>2</sub> O)	1 l	TO00741000

### Standards

Description	Capacity	Art. no.
Sodium tartrate dihydrate	25 g	AQ00300025
	100 g	AQ00300100
Aquagent® Standard 1.0	10x4 ml	AQ00190040
Aquagent® Standard 10.0	10x8 ml	AQ00200080

*Traceables to NIST*

Aquagent® Standard 5.0	100 ml	AQ00210100
	500 ml	AQ00210500



### Quality

Our company has an integrated management system according to ISO 9001: 2008 and ISO 14001: 2004.

A copy of the certificate is available on our website.

### Availability

All Aquagent® products are available from stock.

### www.scharlab.com

You can access to our catalogue on line and get copies of COA, TDS and MSDS whenever you need.