Food analysis

Quality control in the food and beverage industry

Metrohm

Metrohm...

- is the global market leader in titration
- is the only company to offer a complete range of ion analysis equipment – titration, voltammetry and ion chromatography
- is a Swiss company and manufactures exclusively in Switzerland
- grants a 3-year instrument warranty and a 10-year warranty on chemical suppressors for ion chromatography
- provides you with unparalleled application expertise
- offers you more than 1300 applications free of charge
- supports you with expert service through local representatives and regional support centers
- is not listed on the stock exchange, but is owned by a foundation.
- gives the interests of customers and employees priority over maximizing profit

Metrohm – customized analysis for the food and beverage industry

The law sets high standards

The food industry is subject to particularly strict regulations on the quality and safety of its products. This is not without reason: If contaminated food reaches the retail market, the consequences can be serious – and not just for the consumers.

Regulatory compliance

In order to guarantee the industry's strict quality and safety standards, reliable instruments and methods are needed in the laboratory. These instruments and methods must meet highest standards. Regulatory compliance is the catchword here.

Count on our support

As a leading manufacturer of instruments for chemical analysis, we are quite aware of these challenges you face. For this reason, we offer you not just the most advanced equipment, but rather complete solutions for the particular tasks at hand. Your partners at Metrohm are experienced professionals who develop customized applications for you and support you in every aspect of regulatory compliance with our expert service.

On the following pages, discover the solutions Metrohm offers the food industry in general and you in particular, to ensure the quality and safety of your products. Challenge us!

Metrohm instruments comply with numerous official standards, including the FDA regulation Title 21 CFR Part 11.

Methods available from Metrohm for the food industry

The following table is organized according to product areas and lists relevant parameters that can be determined using methods developed by Metrohm. Moreover, you can see which standards these methods fulfill. If you cannot find your sample matrix or a parameter that is important for you, please contact your local Metrohm representative. We are continuously expanding our range of applications and will gladly assist you in solving your specific analytical problem.

Sample	Parameters for titration	Parameters for voltammetry	Parameters for stability measurement	Parameters for ion chromatography	Parameters for ProcessLab
Meat products, meat extracts, bouillon preparations, spices, soups, sauces	Chloride (NaCl) Kjehldahl nitrogen Sulfurous acid	Pb in fish (AOAC 972-24)		- Anions: nitrite, nitrate (DIN EN 12014-4:2005), chloride, phosphate - Polyphosphates - Organic acids - Cations: Na^+, NH_4^+, K^+, Ca^{2+},Mg^{2+}, - Biogenic amines in fish - Monosaccharides and disaccharides - Sugar alcohols	Chloride (NaCl)
Table salt, spices, pickling salt, herbs and aromatic salts	Chloride (NaCl) Total iodine Fluoride Tricalciumphosphate Nitrite	Iodide, iodate		- Anions: sulfate, sulfite, bromide, iodide, chloride, iodate, fluoride, phosphate, molybdate - Polyphosphates - Organic acids - Cations: Na^+, K^+	Chloride (NaCl) Total iodine Fluoride Tricalcium phosphate Nitrite
Canned fruit, vegetables and mushrooms, dried fruit and vegetables	Oxalic acid Total sulfurous acid Acid content Salt content	Sn, other heavy metals		- Anions: phosphite, nitrite, nitrate (DIN EN 12014-2:1997), chloride, phosphate, sulfate, perchlorate - Organic acids - Cations: K^+, Mg^{2+} - Monosaccharides and disaccharides	Chloride (NaCl)
Sweeteners, gelling and thickening agents	Methoxy and ethoxy groups Cyclamate Saccharin			- Anions: fluoride, chloride, bromide, nitrate, phosphate, sulfate - Organic acids - Cations: Na^+, K^+, NH_4^+, Ca^{2+}, Mg^{2+}, Fe^{2+} - Mono-, di-, oligo- and polysaccharides - Sugar alcohols - Glycerol - Sucralose, saccharin, cyclamate	
Coffee, cocoa, chocolate, tea	pH value and acidity Ash alkalinity Chloride Direct reducing sugars Kjehldahl nitrogen Free fatty acids Iodine value Saponification value			- Anions: fluoride - Organic acids - Cations: Na^+, K^+, Ca^{2+}, Mg^{2+} - Monosaccharides and disaccharides in instant coffee (ISO 11292) - Arabinose, fructose, galactose, glucose, mannose, sucrose, xylose, maltose, lactose - Sugar alcohols - Glycerol - Caffeine	pH value and acidity Ash alkalinity Chloride Direct reducing sugars Free fatty acids Iodine value Saponification value
Beer, vinegar, spirits and wine	pH value and total acid CO_2 content Ascorbic acid Free and total sulfurous acid Volatile acids Ash alkalinity Chloride Sulfate Total ester content	Heavy metals (Cd, Pb, Cu, ...) (Swiss Fruit Assn.)		- Anions: fluoride, chlorite, chloride, bromide, nitrate, sulfite, sulfate, phosphate, oxalate - Organic acids - Cations: Na^+, K^+, NH_4^+, Ca^{2+}, Mg^{2+} - Transition metals: Cu^{2+}, Zn^{2+}, Fe^{2+}, Mn^{2+} - Biogenic amines - Monosaccharides, disaccharides and oligosaccharides - Sugar alcohols - Glycols	pH value and total acid CO_2 content Ascorbic acid Free and total sulfurous acid Volatile acids Chloride Sulfate Total ester content

Sample	Parameters for titration	Parameters for voltammetry	Parameters for stability measurement	Parameters for ion chromatography	Parameters for ProcessLab
Fruit and vegetable juices, fruit nectars and jams	pH value and titratable total acid Ascorbic acid Sulfurous acid (sulfite) Chloride Total phosphorous Sulfate Cations: Ca^{2+}, Mg^{2+}, K^{+} Ash alkalinity Formol number Reducing sugars	Ascorbic acid Pb (AOAC 979-17) Fumaric acid (AOAC 968-16) Saccharin (SLB 41-2.5)		- Anions: chloride, phosphate, sulfate, nitrite, phosphite - Organic acids - Cations: Na^{+}, K^{+}, Ca^{2+}, Mg^{2+} - Monosaccharides and disaccharides	pH value and titratable total acid Ascorbic acid Sulfurous acid (sulfite) Chloride Total phosphorous Sulfate Calcium and magnesium Potassium Formol number Reducing sugars
Milk and dairy products	pH value and titratable acid Chloride Calcium Ascorbic acid Kjehldahl nitrogen	Pb (AOAC 974-13; AOAC 979-17)		- Anions: iodide, chloride, phosphate, sulfate, nitrate, nitrite, thiocyanate, perchlorate, cyanurate - Organic acids - Cations: Na^{+}, NH_4^{+}, K^{+}, Ca^{2+}, Mg^{2+} - Monosaccharides and disaccharides - Choline - Melamine	
Nuts			Oxidation stability		
Fruit and vegetables	Oxalic acid Total sulfurous acid Chloride	Zn (ISO 6636-1)			pH value and titratable total acid Ascorbic acid (e.g., oranges)
Grains		Cd, Pb (AOAC 983-23)			
Animal and plant fats and oils	Acid value and free fatty acids Hydroxyl number Iodine value Peroxide value Saponification value		Oxidation stability (AOCS Cd 1b-92, ISO 6886)	- Anions: phosphate, bromate - Cations: Ca^{2+}, Mg^{2+}	Hydroxyl number Iodine value Peroxide value Saponification value Native olive oils: Acid value Free fatty acids Water content
Crackers, baked goods			Oxidation stability	- Monosaccharides and disaccharides	
Instant noodles			Oxidation stability		
Table and mineral water, drinking water	pH value and acid capacities Ca^{2+}, Mg^{2+} and total hardness Chloride, sulfate Sulfides/hydrogen sulfide Total and residual chlorine Permanganate index CO_2 content Oxygen content according to Winkler	U (DIN 38406-17), CN^{-} (sample preparation according to DIN 38405-13)		- Anions: fluoride, chloride, nitrite, bromide, nitrate, phosphate, sulfate, iodide, silicate, carbonate, chromate ASTM D 4327-03 EPA 300.1 ISO 10304-1:2007 - Oxyhalides: bromate, chlorite, chlorate ISO 10304-4 ASTM D 6581-08 - Cations: Na^{+}, NH_4^{+}, K^{+}, Ca^{2+}, Mg^{2+} ISO 14911:1998 - Phenols	Conductivity Alkalinity pH value and acid capacities Ca^{2+}, Mg^{2+} and total hardness Chloride, sulfate Sulfides/hydrogen sulfide Total and residual chlorine Permanganate index CO_2 content
Soft drinks	Citric acid/citrate Phosphoric acid (cola drinks) Potassium Total phosphorus			- Anions: chloride, nitrate, phosphate - Organic acids - Cations: Na^{+}, NH_4^{+}, K^{+}, Ca^{2+}, Mg^{2+} - Monosaccharides and disaccharides - Sugar alcohols - Phenylalanine, aspartame, caffeine - Glucoronolactone	Acid content
Rinsing, cleaning and disinfection processes in the beverage industry					Ingredients in rinsing and cleaning solutions, acids, such as peracetic acid, pH value and conductivity

pH measurement

pH measurement is one of the most important parameters in the quality control of foodstuffs. pH provides information on the quality of natural products such as citrus fruits, juices or dairy products for example. Furthermore, pH is an important parameter in the use of acidity regulators as preservatives.

The requirements of the pH electrode that is used for measurement are just as varied as the many foods to be analyzed. The selection of a diaphragm that is appropriate for the sample is especially important since otherwise the electrolyte bridge can quickly become blocked by the sample, which leads to erroneous measurements.

The following table shows examples of which Metrohm electrode is suitable for pH determination in which foods.

Sample	Electrode (Order Number)	Properties
Drinking water	Aquatrode plus (6.0257.000)	• Precise measurements and very rapid response even in low-conductivity, weakly buffered solutions • contamination-insensitive fixed ground-joint diaphragm • Maintenance-free reference electrolyte, variable outer electrolyte for special applications • Optimized length for sample changer applications
General, e.g., wine and spirits, fruit and vegetable juices, cereals confectioneries	Unitrode (6.0258.600)	• Universal use • Short response time after temperature changes • Contamination-insensitive fixed ground-joint diaphragm
Protein-containing samples (e.g., dairy products)	Porotrode (6.0235.200)	• Especially for highly contaminated and protein-containing or viscous samples • Low maintenance capillary diaphragm • Polymer electrolyte for uniform electrolyte flow
Penetration measurements (e.g., dough, cheese, meat)	Spearhead (6.0226.100)	• Robust electrode tip for measurements in semisolid samples • Maintenance-free reference electrolyte • Easy-to-clean pinhole diaphragm
Surfaces, small sample volumes	Flat membrane electrode (6.0256.100)	• For measurements on surfaces or in very small sample volumes

Rugged, reliable and easy to use: pH meters from Metrohm

pH determinations with the 826 pH mobile and 827 pH lab meters

Whether you are performing routine pH determinations in the laboratory or out in the field – with Metrohm pH meters you never have to do without GLP: three-point calibration, automatic buffer recognition, temperature compensation, sample identification, GLP-compliant printout and a large memory for storing measurement results – pH meters from Metrohm offer all of these features at a very attractive price.

pH, chloride, fluoride and ammonium determinations with the 780 pH Meter or 781 pH/Ion Meter

The 780 pH Meter is the top choice if you need to know everything exactly: nine-point calibration, stirrer control, electrode test for glass pH electrodes, method memory and RS232 interface.

Besides measuring pH, the 781 pH/Ion Meter can also determine the concentration of individual ions (e.g., Cl^-, F^- and NH_4^+) by either direct measurement or fully automatic standard addition.

Titration

Benefit from the know-how of the market leader

Metrohm is the leading manufacturer in the field of titration. Sixty years of experience and the most comprehensive and innovative program on the market are proof of our strength. Our collection of potentiometric applications that is available to you is huge. Benefit from more than 150 proven titration applications from the food industry sector that we have prepared based on the following publications:

- Deutsche Einheitsverfahren zur Wasser-, Abwasser and Schlammuntersuchung (German Standard Methods for the Examination of Water, Wastewater and Sludge)
- Official Methods of Analysis of the Association of Official Analytical Chemists (AOAC, U.S.A.)
- Schweizerisches Lebensmittelbuch (SLMB; Swiss Manual on Food Safety)
- U.S. Environmental Protection Agency (EPA)

An overview of some application examples

Total sulfurous acid in dried fruits	SLMB 553.1
Iodine value of edible fats and oils	AOAC 28.023
Sulfurous acid in wine	AOAC 940.20
pH value of beer	AOAC 945.10
Total hardness of drinking water	EPA 130.2
Salt (NaCl) in meat and meat products	AOAC 935.47
Total acid in nonalcoholic beverages	AOAC 950.15
Acidity of roasted coffee beans	AOAC 920.92
Oxalic acid in fruit and canned fruit	AOAC 974.24
Ascorbic acid (vitamin C)	AOAC 967.21

Electrodes for titration

The correct electrode for every application

Choosing the right electrode is crucial for successful titration. For combined electrodes, the correct diaphragm must be chosen because otherwise the electrolyte bridge can become blocked. The response behavior of the electrode is also important, in particular if the titration is to be carried out to a defined endpoint.

This is the case for many applications in the food industry. If the electrode reacts too slowly, the solution will be over-titrated and incorrect results are obtained. Metrohm offers an appropriate electrode for every need. The following table shows which Metrohm electrode is suitable for which application.

Area of application	Metrohm electrode	
General	Ecotrode plus	6.0262.100
Acid content of alcoholic beverages	Unitrode	6.0258.600
Carbonate hardness, acid capacity of water, p and m values	Aquatrode plus	6.0257.000
Determination of Ca^{2+}, Mg^{2+} (complexometric)	Ca^{2+} ISE	6.0508.110
Permanganate index	Pt Titrode	6.0431.100
Titratable total acid in dairy products	Porotrode	6.0235.200
Calcium content in dairy products	Cu^{2+} ISE	6.0502.140
Kjehldahl nitrogen in milk	Ecotrode Gel	6.0221.100
Vitamin C in fruit juice	Double Pt-sheet electrode	6.0309.100
Formol number	Unitrode	6.0259.100
Free fatty acids, hydroxyl number in oils	Solvotrode	6.0229.100
Iodine value, peroxide value	Pt Titrode	6.0431.100
Water determination according to Karl Fischer	Double Pt-wire electrode	6.0338.100
General chloride, table salt content in food	Ag Titrode	6.0430.100

Additional examples and practical tips on using Metrohm electrodes are given in the leaflets «Electrodes for Titration» and «Electrodes for pH Measurement». These can be downloaded for free at **www.metrohm.com**.

848 Food/Beverage Titrino plus – the economically priced titrator for routine analysis in the food laboratory. This all-inclusive package also comprises an USB stick with 100 methods stored for the most important applications in food analysis.

Titration with Metrohm: Solutions for every need and budget

With the 848 Food/Beverage Titrino plus, the 862 Food/Beverage Compact Titrosampler and the 905 Food Titrando, Metrohm offers you three complete titration packages. No matter which package you choose, simple and reliable work is guaranteed:

- intelligent exchange or dosing units ensure the use of the correct titration solution and permit their monitoring
- all important titration parameters are stored with the methods; this means that even unskilled users quickly obtain reliable results
- GLP-compliant data output either on a printer or by digital archiving

862 Compact Titrosampler – the automatic titration station for higher sample throughput. With the 862 Food/Beverage Compact Titrosampler and the 862 Salt Compact Titrosampler, Metrohm offers two all-inclusive packages that come with everything from the electrode and sample beaker to the method templates for the professional food analysis.

905 Food Titrando – the high-end titrator for the highest demands. Frequently used methods can be started with the push of a single button. Complete traceability of measuring results, central data management through the client-server option, method templates, individual method development, possibility for complete automation and much more.

Thermometric titration: the ideal complement to potentiometric titration

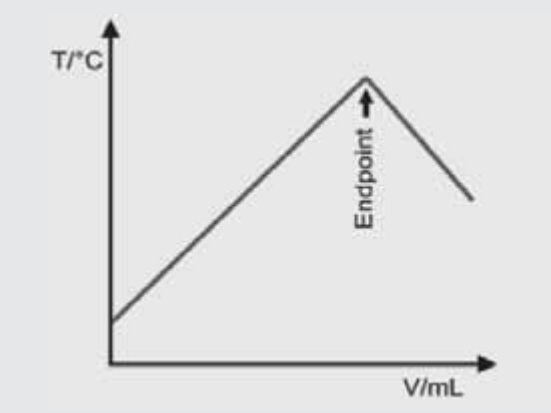
Thermometric titration is a highly versatile determination method and is the ideal complement to potentiometric titration. In principle, the method is suitable for every reaction that creates a sufficiently large temperature change in the sample solution. This method is particularly suitable in applications for which:

- an appropriate potentiometric sensor is not available
- an appropriate reference electrode is not available
- the sample matrix would compromise or even destroy the electrode
- an appropriate solvent for potentiometry is not available

Thermometric titration – the principle

Every chemical reaction is associated with a change in reaction enthalpy. This results in either an increase (exothermic reaction) or a decrease (endothermic reaction) of the sample solution temperature.

This principle is the basis of thermometric titration. In a thermometric titration, reagent solution (titrant) is continually added until the endpoint is reached. The endpoint is seen as a break in the titration curve if the temperature is plotted as a function of the volume of added titrant.



859 Titrotherm

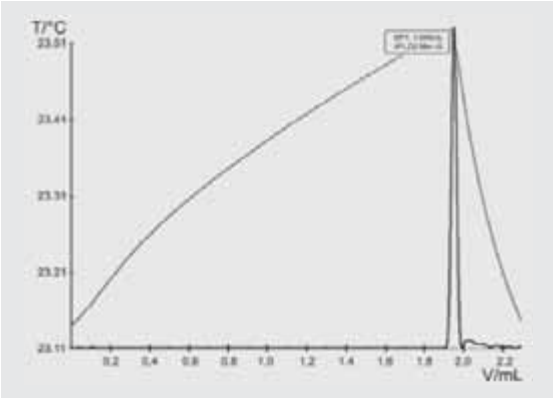
The 859 Titrotherm combines innovative, glass-free sensor technology and the unrivalled titration know-how of Metrohm. The instrument is automatically recognized when connected to a computer and hence, must not be manually configured. The software determines the endpoints based on the first and second derivatives of the titration curve; with additional optimization parameters, reproducibility can be further increased.

Advantage of thermometric titration: The temperature sensor (thermoprobe) of the 859 Titrotherm is almost maintenance-free and can be used immediately without prior conditioning.

Application examples

Unsaturated fatty acids in edible oil

Determination of the content of unsaturated fatty acids in edible oil is based on the titration of weak acids in nonaqueous solutions with a dilute solution of a strong base in alcohol. Problems that occur when performing potentiometric titrations on samples with low free fatty acid contents can be avoided with thermometric titrations. Thermometric titration is simple and employs a catalyzed indicator reaction.



Determination of sodium content in food

The sodium content of foods is usually determined indirectly through a precipitation reaction with silver nitrate. For this, it is assumed that the chloride and sodium ions are in a 1:1 molar ratio. However, this is not true if other chemical substances such as sodium benzoate and monosodium glutamate or compounds such as potassium chloride that contain sodium chloride are present in the matrix. This is often the case for sodium-containing foods.

Established methods for the direct determination of sodium such as AAS or ICP/MS have the disadvantage that the required instruments are very expensive. Thermometric titration is a cost-effective and easy-to-perform alternative. To carry out this method, the sample is first homogenized. Afterwards, the sample solution is titrated with an aluminum nitrate solution containing an excess of potassium ions in the presence of NH_4HF_2 at pH 3. Insoluble NaK_2AlF_6 is formed in an exothermic reaction.

Karl Fischer titration

Determination of water content in food, beverages, tobacco and pet food

The water content largely determines the quality and shelf life of many food products. The amount of water in food can be easily determined by means of Karl Fischer titration.

Water exists in food in different forms. They range from clearly defined forms (for example, as in sucrose and alcoholic beverages) to those in complex cellular structures (for example, as in dry fruits) in which the water is bound to the surface as well as between particles. Moreover, water can also be trapped within the cells and must be released through appropriate sample preparation before the measurement.

Simple sample preparation

For the latter types of samples, the use of a high frequency homogenizer is recommended. Homogenizing releases the water and at the same time, stirs the sample. Because the sample preparation takes place directly in the titration vessel, no additional water is absorbed and the water content determined is not biased.

In most food, water is not distributed homogeneously throughout the material. The sample to be measured must be taken so that it statistically represents the average. To this end, a larger amount of sample (if necessary) is comminuted and homogenized and the water content determined in an aliquot.

When to determine water volumetrically, when coulometrically?

The water content of food varies considerably. The water content of beverages varies between 40 and 98%. Because of these high water contents, weighing out the sample directly into the titration vessel is not feasible since the weighing error for small samples would be too large. Such samples are pre-diluted with methanol and measured by volumetric Karl Fischer titration. In contrast, pure fats and oils are measured preferably coulometrically due to their low water content.

Very few side reactions

In foods, very few chemical side reactions that release water or react with iodine are expected. Substances such as aldehydes and mercaptans are present in only small amounts if at all; their amounts can be disregarded in view of the usually high amounts of water present.

However, should side reactions occur, the oven method is an alternative. The sample is weighed into a vessel, which is then sealed airtight. Afterwards, the sample is heated and the moisture transferred with a stream of dry carrier gas to the titration cell, where the actual water determination takes place. Because the sample does not enter the titration cell, side reactions do not occur.

Application examples

The following table shows by which technique various foodstuffs can be analyzed. Detailed information and titration procedures can be found in the free Metrohm monograph «Water Determination by Karl Fischer Titration».

	Samples	Type of Titration
Non-alcoholic beverages	Fruit juices, vegetable juices, syrups, soft drinks	vol.
Fats and oils	Frying fat, deep-frying, olive, peanut, sunflower canola and safflower oils (AOAC 984.20, ISO 8534)	coul.
Dairy products, protein-containing products, meat products	Butter, milk, cream, yoghurt, cream cheese, curd cheese, cheese, milk powder, yeast, mayonnaise, egg yolk, protein, gelatin, meat, meat products	vol.
Honey, molasses, sugar	Various sugars	vol.
Confectionery	Candies, fruit gums, gumdrops, caramel, chewy candy, licorice sticks, toffee, gummi bears, marzipan, chewing gum, jam	vol.
Semi-luxury food (alcohol, coffee, tea, cocoa, tobacco, chocolate, spices)	Cognac, gin, fruit brandy, liqueur, whiskey, wine, chocolate, cocoa beans, cocoa powder, (AOAC 997.10), (instant coffee (ISO 20938), roasted coffee beans, green coffee ISO 11817), cappuccino powder, tobacco, pipe tobacco, cigarette tobacco (ISO 6488)	vol.
Nuts, dry fruits, dried vegetables	Dry fruits (AOAC 967.19), dried fruit, nuts, almonds, dried vegetables	vol.
Fruit and vegetables	Various fruits and vegetables	vol.
Grain products and starch	Barley, semolina, corn, rye, rice, soybean meal, wheat, cracked wheat, potato and rice starches, cornstarch, soy and wheat flours, glucose syrup, natural gums, breakfast cereals, oatmeal, popcorn	vol.
Baked goods, breads and pasta	Noodles, breadcrumbs, zwieback, bread, cakes, crackers, cookies, potato chips	vol.
Spices, other food	Seasoning mixtures, potato flour, mashed potatoes, baby food, instant soup, packaged soup mix	vol.
Pet food	Canned pet food, fish meal, dog biscuits, flaked dog food	vol.

901 Titrando plus Polytron: The samples are pulverized or homogenized directly in the titration cell. Thus, additional moisture cannot be absorbed during sample preparation. This guarantees unbiased results.

874 Oven Sample Processor plus 852 Titrando: Place sample vial on the rack, set the temperature, and water content determination can begin. With the 852 Titrando, you can carry out both volumetric and coulometric titrations.

Laboratory automation

The complete range of automatic sample preparation from a single supplier

Normally, for determining pH, total acid or chloride contents in liquid foods, accurate pipetting and dilution of the sample is sufficient. Metrohm offers you a wide range of products for the fully automatic preparation of liquid samples.

On the other hand, if you are dealing with solid samples, such as meat, fish, salads, jams or confectioneries to name a few, sample preparation is more demanding. As a specialist in laboratory automation, we offer you many solutions for the fully automatic preparation of solid samples, too.

Automation = time savings and higher accuracy

In food and pesticide analysis, primarily chromatographic methods such as IC, HPLC and GC are employed in addition to direct titration. These techniques require that the sample is available as a filtered liquid before it can be injected into the column. If carried out manually, preparation steps such as

- pulverization / homogenization
- filtration
- pipetting / dilution

are tedious and time-consuming. Furthermore, manual sample preparation always comes at the risk of biased results. In particular, for high sample throughput and if several different people are involved, consistent sample preparation quality can hardly be guaranteed.

Fully automatic titration of a homogenized sample:
With the 815 Robotic Titration Soliprep, sample preparation and titration can be completed in one process without filling out multiple copies of sample tables or shifting beakers around. Mix-ups are prevented and standing time before analysis is shortened.

The 815 Robotic Filtration Soliprep

Fully automatic filtration: The 815 Robotic Filtration Soliprep filters away remaining solid matter from the homogenized sample. A clear filtrate is the result that can be either directly injected into an analytical instrument or further diluted.

Robotic Soliprep – automatic sample preparation tailored to you needs

With instruments of the Robotic-Soliprep-family, deviation in results and time-consuming manually performed routines are no longer an issue. The solid substance is just weighed out and placed in the sample rack – everything else is done completely automatically. Depending on the model selected, different steps can be combined – including the direct connection to a chromatograph or the the titration of the homogenized sample.

	Robotic Titration Soliprep	Robotic Filtration Soliprep	Robotic Flexible Soliprep	Robotic Soliprep for LC
Homogenization	+	+	+	+
Titration	+			
Filtration		+	+	+
Filling HPLC/GC-Vials			+	
Connection to a LC system				+

Oxidation stability

A proven method

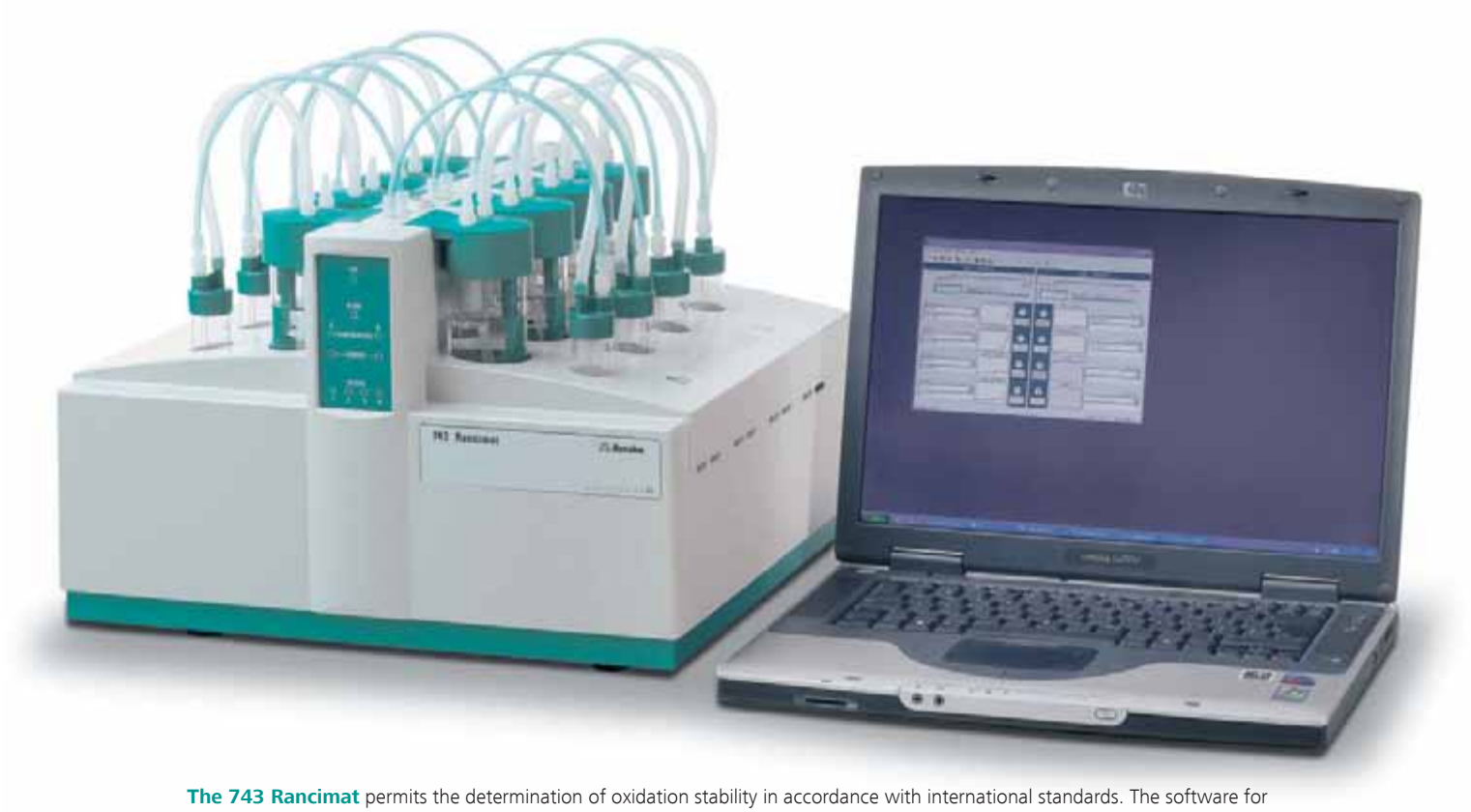
Oxidation stability characterizes the resistance of oils and fats and of fat-containing foods to oxidation. It is a standard parameter of quality control in the production of oils and fats in the food industry or for the incoming goods inspection in processing facilities.

For the determination of oxidation stability, a stream of air is passed through the oil or fat sample at elevated temperature. This causes the oxidation of fat molecules in the sample to volatile organic compounds and other products. The air stream carries these compounds to a second vessel containing distilled water. The conductivity of the water is continuously recorded. The time elapsed until these reaction products are formed and detected is called the induction time or Oil Stability Index (OSI).

743 Rancimat – analyze up to eight samples at the same time

Determination of the oxidation stability of oils and fats is the classic application for the 743 Rancimat. In addition to vegetable oils and fats, fats of animal origin can also be analyzed for oxidation stability using the 743 Rancimat.

Just as the pure substances oils and fats contained in foods are subject to oxidation, which contribute to food spoilage. The 743 Rancimat can also be used to determine the oxidation stability of fats and oils in foods.



The 743 Rancimat permits the determination of oxidation stability in accordance with international standards. The software for recording and archiving the data in a data base with automatic analysis of the curves is included with the instrument.

Application examples

Oxidation stability of fats and oils

If fats and oils are exposed to air and light for any length of time, they undergo oxidation and hydrolysis reactions. The fats and oils then develop an unpleasant taste and odor and are termed rancid. Oxidation stability is an estimate of how quickly a fat or oil will become rancid. Through the use of the 743 Rancimat, it is also possible to characterize the efficacy of added antioxidants.

Oxidation stability of instant noodles

An example of an application for the 743 Rancimat is the determination of the oxidation stability of instant noodles. The noodles are deep-fried during the manufacturing process to make preparation by the consumer faster. Due to the deep-frying step, instant noodles have a high fat content (up to 22%) and hence can become rancid after some time.

Oxidation stability of nuts

The microstructure of the fresh, intact nut prevents rapid oxidative spoilage. This microstructure is destroyed during the processing of nuts. As a result, fat oxidation is accelerated and the shelf life shortened. Before the oxidation stability of nuts can be determined, the fat-containing phase must be separated from the rest of the nut with petroleum ether. The isolated fat is analyzed in the 743 Rancimat.

Oxidation stability of crackers or other baked goods

The Rancimat method is a simple method for determining the oxidation stability of fats contained in cereals, crackers, biscuits and other baked goods.

Ion chromatography

Ion chromatography (IC) is a standard method for food analysis. Numerous main ingredients, minor ingredients that affect taste and nutrition as well as traces of contaminants can be reliably and precisely determined by IC.

Multicomponent determinations in a single analysis

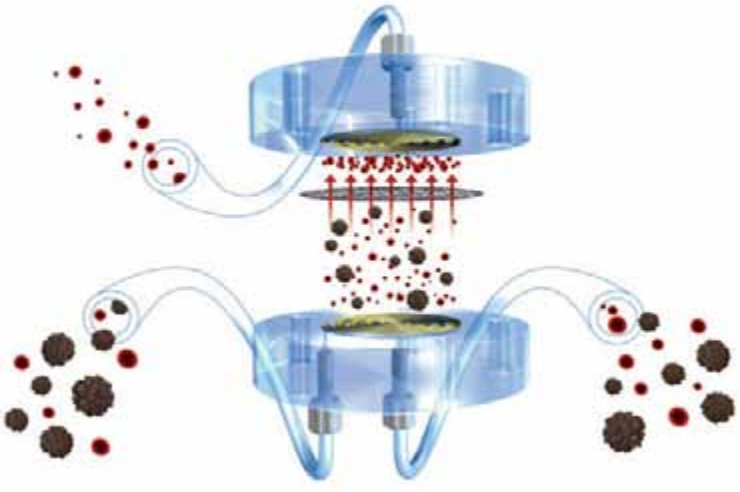
In addition to anions and cations, carbohydrates, organic acids and polar substances can also be quantified in a variety of foods or drinks. The advantage of ion chromatography is that chemically similar substances can be determined in parallel in a single analysis. Furthermore, the concentration of the analytes can vary from ng/L up to the percent range. Of course, all Metrohm IC instruments and the MagIC Net™ chromatography software comply with FDA regulations.

Save time and costs through automatic sample preparation

As in titration, sample preparation in ion chromatography is an important factor. Novel inline methods (some patented by Metrohm) permit the integration and complete automation of sample preparation into the analytical process. This increases safety, reduces the number of manually performed steps, improves reproducibility and guarantees the traceability of the entire analysis (including sample preparation).

Metrohm inline sample preparation methods for food analysis:

- Inline Ultrafiltration
- Inline Dialysis
- Inline Dilution
- Inline Extraction
- Inline Matrix Elimination
- Inline Enrichment
- Inline Degassing
- intelligent Partial Loop Injection



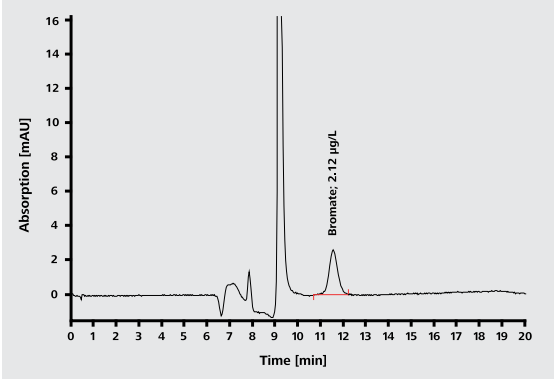
Inline Ultrafiltration reliably removes interfering particles from the sample solution and thus protects the separation column from contaminations.

Application examples

Analysis of mineral water

The anionic and cationic substances in table and mineral waters are analyzed by IC. National standards set binding limits for harmful ions such as bromate. The German drinking water ordinance originally stipulated a limit of 25 µg/L for bromate, but lowered it to 10 µg/L in 2008. The limit for mineral water is 3 µg/L. The EU and the U.S. Environmental Protection Agency (U.S. EPA) have set the same maximum bromate concentrations for their drinking water guidelines.

Other ions such as iodide affect the taste of water and for this reason, are monitored in mineral water as quality parameters.

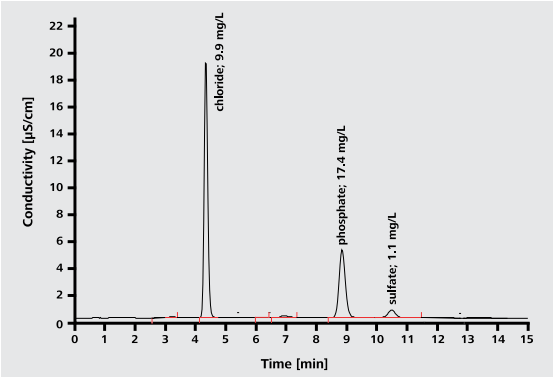


Analysis of a mineral water sample spiked with 2 µg/L bromate in the 844 UV/VIS Compact IC with post-column derivatization; Column: Phenomenex Star Ion A300 HC; eluent: 100 mmol/L H_2SO_4, 0.0193 mmol/L $(NH_4)_6Mo_7O_{24}\cdot 4H_2O$, 0.7 mL/min; injection volume: 1000 µL; post-column reagent: 0.27 mol/L KI; UV detection: 352 nm; Inline Degassing and Inline Ultrafiltration.

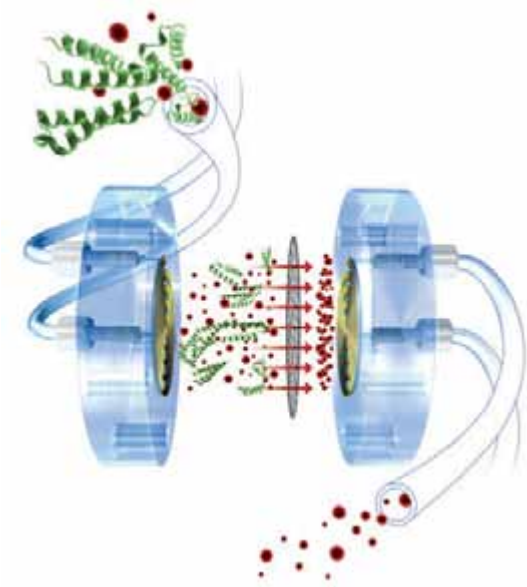
844 UV/VIS Compact IC with 838 Advanced IC Sample Processor. The ideal system for photometric determination of polar substances, anions and cations in the UV/VIS range.

Analysis of dairy products

For dairy products – be it baby food, yoghurt, milk or lactose-free foods – ion analysis is essential to quality control. Inline Dialysis is an efficient sample preparation technique for fully automatic removal of protein-containing matrices. Hence, it replaces the time-intensive, manually performed protein precipitation step with Carrez reagent. Ion chromatography permits the determination of anions (e.g., iodide, chloride, phosphate, sulfate, nitrate, nitrite, thiocyanate, cyanurate and perchlorate), cations (e.g. sodium, ammonium, potassium, calcium, magnesium and melamine) and also carbohydrates e.g., galactose and lactose).



Anion analysis of ultra-high temperature processed milk. IC with conductivity detection; column: Metrosep A Supp 5–100; eluent: 3.2 mmol/L Na_2CO_3, 1.0 mmol/L $NaHCO_3$, 0.7 mL/min; column temperature: 30 °C; injection volume: 20 µL.



Inline Dialyse – the ideal inline sample preparation for the removal of proteins, oils and particles prior to ion chromatography.

881 Compact IC pro with 858 Professional Sample Processor and 800 Dosino dosing system for ion analysis with integrated Inline Dialysis.

Carbohydrate analysis

How sweet is sweet? This question cannot be directly answered for many foods. The following table shows numerous sugar components in different food matrices that can be reliably analyzed by ion chromatography and pulsed amperometric detection (PAD). The type of sample preparation is also given.

Matrix	Sample Preparation	Propylene glycol	Inositol	Glycerol	Xylitol	Sorbitol	Mannitol	Ribose	Xylose	Arabinose	Mannose	Glucose	Fructose	Galactose	Maltose	Lactose	Sucrose	Cellobiose	Maltotriose	Raffinose	Maltotetraose	Maltopentaose	Maltohexaose	Maltoheptaose
Potato extract	P, D, F											+	+				+							
Functional food	P, D, F			+								+	+		+	+	+							
Food extracts	P, D											+	+		+	+	+							
Dairy products	Dialysis		+		+					+	+	+	+	+		+	+							
Baby food	Dialysis											+	+			+	+							
Instant tee	D, F											+	+			+	+							
Beer	U, D	+																						
Beer wort	F, D											+			+	+	+		+					
Malt extract	D											+			+				+		+	+	+	+
Vodka	D											+	+				+							
Apple juice	D																	+						
Cola	D											+	+				+							
Diet cola	D			+			+		+			+												
Orange juice	D, F		+									+	+				+							
Instant coffee	E, D, F						+		+	+	+	+	+	+			+							
Red beet extract	D		+			+	+	+		+		+	+	+			+			+				
Corn syrup	D											+			+				+					
Maple syrup	D											+	+				+							
Sugar-free chewing gum	E, D, F				+	+	+					+												
Candies	E, D, F											+	+		+	+	+							
Chocolate	E, D, F		+	+	+	+	+		+	+		+	+			+	+							

Polyols, sugar alcohols, monosaccharides, disaccharides, oligosaccharides
P: Pulverization, D: Dilution, E: Extraction, F: Filtration, U: Ultrasonic treatment

Voltammetry

High detection sensitivity for a low price

Voltammetry is an electrochemical analytical method that provides information on the type and amount of substances contained in a dissolved sample on the basis of a current-voltage relationship. The importance of voltammetry lies in its high accuracy and sensitivity, the possibility of performing a speciation analysis and its favorable price-performance ratio.

Heavy metal ions that are present as contaminants in food can be determined with high sensitivity by voltammetry. To this end, food samples must be digested prior to analysis. Several organic substances in food, for example, vitamin C, vitamins of the B group or quinine, can also be determined by voltammetry.

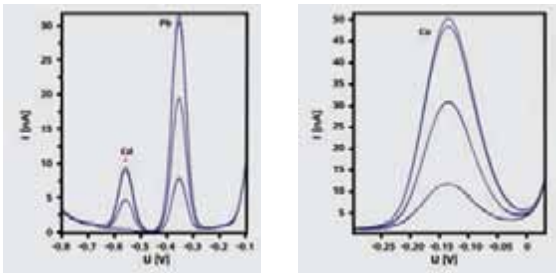
797 VA Computrace

The 797 VA Computrace is a state-of-the-art, computer-assisted voltammetric analysis system. The potentiostat/galvanostat built into the instrument guarantees highest precision with reduced noise. The included PC software controls the determination and calculates and archives the results.

Application examples

Cd, Pb and Cu (also Zn, Ni, Co, Cr, Fe, etc.) in wine and other foods

The analysis of heavy metals in wine and other foods provides information on the type and concentration of contaminants. In view of the importance of heavy metals, the exact determination of these elements by high-performance methods is essential. With the 797 VA Computrace, it is possible to perform the determination of heavy metals in wine and other foods after UV digestion.



Voltammetric determination of Cd, Pb and Cu in wine

Vitamin C in fruits, vegetables and juices

Commercially available fruit and vegetable juices can be directly and straightforwardly analyzed as liquid samples. Likewise, freshly pressed fruit juices can also be directly analyzed. Beverages containing carbon dioxide should be degassed prior to analysis.

Tin in canned foods

The metal used for making food cans is tin-plated steel which is then coated with plastic. If the plastic coating is omitted, acid-containing foods in combination with atmospheric oxygen can cause the tin to dissolve from the can metal and diffuse into the food. Tin, which is poisonous, can be determined with the 797 VA Computrace.

Iodide in table salt

Iodine is an important trace element for the human body and is added to table salt to prevent deficiency symptoms. Both iodide and iodate can be simply determined by voltammetry using the 797 VA Computrace.

Atline process analysis with ProcessLab

Process control in food production

It is a long way before a raw material becomes a finished product in the food industry. Numerous production steps, such as pulverization, filtration, fermentation as well as heating, cooking, pasteurization, sterilization or distillation, are involved in the preparation of a product and to make it storable.

In addition to the statutory final inspection and testing, control of the different production steps also has an important role, which is to maximize throughput and yield of a product. Valuable time is lost if the product cannot be further processed or packaged while samples from the various production steps are being tested in the laboratory. It is thus a great advantage if these analyses can be performed directly at the process site while production goes on uninterrupted.

ProcessLab – rugged and flexible design

This is exactly what the Metrohm ProcessLab makes possible – a robust and simple-to-operate analysis system that is set up directly on the production floor. The sample is brought to the Process Lab and the analysis started by the push of a single button. The system is based on proven Metrohm titration and voltammetric components. ProcessLab features a modular design; it is configured to meet the user's particular requirements and can be optimally integrated into process communications through inputs and outputs (typically 4...20 mA). Only a few minutes after taking the sample, the relevant process information is available to a LIMS or the master display.

Thus, ProcessLab is ideally suitable for rapid and independent process control in the production environment. A ProcessLab system consists of a TFT operating panel with touch screen and an analysis module that is tailored to the particular application. Due to its splashproof housing (protection class IP54), ProcessLab is well-suited for use in harsh production environments.

ProcessLab system with operating panel and analysis module: Each system is configured with the relevant modules according to the user's particular requirements.

Application examples

Determination of iodate and fluoride in table salt production

Iodized und fluoridated table salts are subject to strict statutory regulations and require very careful monitoring of the additives. The analysis of these parameters can be performed directly on site with ProcessLab, which means that the table salt can be immediately processed without costly temporary storage. This increases throughput and lowers production costs. Moreover, automated sample preparation means higher reproducibility and compliance with statutory regulations can be more accurately controlled. All requirements for comprehensive documentation and traceability of single batches are fulfilled.

Determination of table salt in instant soups

Table salt is an important flavor enhancer in the food industry and is used in numerous products. In the manufacture of instant soups, it is important that the table salt concentration in the finished product is exactly in accordance with the specifications. Additionally, the crude salt used in the manufacturing process is subject to an incoming goods inspection.

ProcessLab covers this broad range of applications in a single system permitting quality control of the complete manufacturing process. Specifications for the documentation of the entire process are met.

Online process analysis

Customized online process control

Production processes in the food industry must be continuously monitored. Online analyzers from Applikon Analytical optimally fulfill this requirement. Engineered for continuous operation, these instruments enable the fully automatic control of production processes – seven days a week, 24 hours a day. Moreover, it does not make a difference whether a single parameter is to be determined in a single sample stream or several different parameters are to be determined in complex, multiple sample streams – the Applikon Analytical engineers provide you with an appropriate system.

Proven wet chemistry methods

Applikon Analytical online analyzers are based on wet chemistry methods such as titration, colorimetry and measurements with ion-selective electrodes. For these methods, sampling and sample preparation are at least as important as the analysis itself. Applikon Analytical has great expertise in this field and configures the sampling system to exactly fit your application including, e.g. filtration, sample taking from pressurized containers or degassing.

Straightforward network integration

All Applikon Analytical online analyzers come with digital and analog data outputs. Thus, e.g. results can be transmitted via analog 4...20 mA signals and alarms triggered by digital outputs. Or digital inputs can be employed for remote start/stop commands.

Robust design in stainless steel

Applikon Analytical analyzers are constructed for the rigorous demands of the production environment. The housings meets the specifications of NEMA 4 and protection class IP66. Applikon Analytical offers two instruments with stainless steel housings, the ADI-201Y and the ADI-2040 Analyzers, for use in environments where even tougher requirements for hygiene and durability apply, such as in the meat processing industry.

applikon® ANALYTICAL

Applikon Analytical is a member of the Metrohm Group. The company manufactures instruments for online analysis.

www.applikon-analyzers.com

ADI 201Y analyzer in stainless steel version for the food industry

Application examples

Peracetic acid in beverage industry filling systems

Peracetic acid is used in the beverage industry to sterilize bottles before filling. Too much peracetic acid compromises the taste of the beverage, requires more rinsing and causes increased costs. On the other hand, if too little peracetic acid is used, mold can start growing in the bottles. Peracetic acid is determined by its reaction with iodide through which elemental iodine is formed. The iodine, in turn, can be determined colorimetrically. The entire analysis including sample preparation can be automated with an ADI 2019 analyzer.

Alkalinity of brewing water

The alkalinity of water is the overriding factor for deciding whether it is suitable for use as brewing water in the production of beer. Whereas water with a high degree of hardness is only suitable for the production of bock beer, the brewing of lager beer requires soft water. Therefore, beer manufacturers must constantly monitor the hardness of the brewing water. The alkalinity of water is determined by acid titration; the hardness of water is given in mg $CaCO_3$ per liter. The ADI 2040 analyzer is ideally suited for the fully automatic execution of this important analysis.

Sodium dihydrogen pyrophosphate in deep-frozen potato products

Sodium dihydrogen pyrophosphate is added to blanching water during the production of deep-frozen french fries to prevent a loss in color of the product. Too much sodium dihydrogen pyrophosphate compromises the taste of the product, while too little leads to a grayish coloring. The determination of the sodium dihydrogen pyrophosphate concentration requires thermal digestion of the sample followed by colorimetric determination of the orthophosphate content. Sample digestion and analysis can be automated with the ADI 2040 analyzer.

Salt and vinegar in mayonnaise

Salt and vinegar content are two of the most critical parameters in the manufacture of mayonnaise. Both ingredients not only affect the shelf life but also the taste and consistency of the product. Whereas the vinegar concentration can be determined by acid-base titration (as glacial acetic acid), the salt content is determined by titration with silver nitrate. Both applications including sample taking and preparation can be easily automated with on-line analyzers from Applikon Analytical.

Service that you can rely on: the Metrohm Quality Service®

Reliable results for the lifetime of the analytical instrument

Metrohm analytical instruments are engineered to deliver extremely precise measurements. As a result, leading international companies from the food industry also put their trust in us for our comprehensive services. These services ensure that laboratory managers can rely 100% on results produced during the entire lifetime of their Metrohm analytical instruments.

Regulatory compliance made easy

The food industry is required to comply with all effective laws and guidelines on food safety. Through Metrohm Compliance Service®, we ensure that your company complies with standards such as IFS, BRC, SQF and ISO 22000. If you want to put a Metrohm analytical instrument into operation, we take care of everything else.

This includes:

- competent assistance with Design Qualification (DQ)
- professional installation through compliant Installation Qualification (IQ)
- Operational Qualification (OQ) guaranteeing that Metrohm instruments meet the equipment specification
- all qualification and validation work, which is performed only by professionally trained and certified Metrohm service specialists
- user training taught by experts
- competent requalification and revalidation

Why Metrohm Quality Service®?

The Metrohm Quality Service® is available worldwide. Preventive maintenance carried out on a regular basis extends your instrument's lifetime while providing for trouble-free operation. All maintenance work done under the label Metrohm Quality Service® is carried out by our own certified service experts. You can choose between different types of service contracts. With a full service contract, for example, you can rely on the optimum performance of your Metrohm instruments at any time, incur no additional costs whatsoever and benefit from complete and compliant verification documentation. Thanks to our service, you are perfectly prepared for audits.

Metrohm Quality Service®

U.S. Food and Drug Administration
Protecting and Promoting Your Health

An overview of Metrohm Quality Service®

Our Services	Benefit for the Customer
Application support by means of our vast selection of Application Bulletins, Applications Notes, monographs, validation brochures, technical posters and articles Personal consultation by our specialists per telephone or e-mail	Quick and professional solution to all arising application questions and complex analytical challenges
Training courses	Competent users contribute substantially to reliable results
Certified calibrations, for example of dosing and exchange units	Accurate measurements Verification documentation for compliance with regulations and for efficient audits
Remote maintenance	Expeditious resolution of software questions
Back-up support	High data security
Emergency service, for example express on-site repairs	Short response times and thus, rapid problem resolution Minimization of downtime
Original spare parts, made in Switzerland and available world wide Guaranteed spare parts available for at least 10 years beyond instrument discontinuation date	Lasting, successful repair; short delivery times Minimization of downtime Protection of your investment through long-term availability of spare parts and accessories
Decentralized repair workshops located around the world and a central workshop in Switzerland	Quality repairs done quickly, so your instruments are ready for use again

Thanks to Metrohm Quality Service®, you can rely on your results for the lifetime of the analytical instrument. We look forward to a trustworthy partnership.

Ordering information

pH Measurement

2.826.0110	826 mobile pH meter with carrying case and electrode
2.827.021x	827 pH lab IrDA with Unitrode
2.780.0010	780 pH Meter, high precision pH meter with Unitrode
2.781.0010	781 pH/Ion Meter with Unitrode
2.867.0110	867 pH Module with touch control
2.867.0210	867 pH Module with ***tiamo***™ light

Titration

2.848.1010	Food/Beverage Titrino plus
2.136.0010	Titrotherm
2.848.1020	Food/Beverage Titrino plus with printer
2.848.2010	Salt Titrino plus
2.848.1020	Salt Titrino plus with printer
2.905.4010	Food Titrando with ***tiamo***™ light

Water Determination according to Karl Fischer

Coulometric KF Titration

2.851.0010	851 Titrando including titration vessel, generator electrode with diaphragm and 801 magnetic stirrer
2.851.0110	851 Titrando including titration vessel, generator electrode without diaphragm, without 801 magnetic stirrer
2.852.0050	852 Titrando including vol. and coul. titration vessel, generator electrode with diaphragm and 801 magnetic stirrer
2.852.0150	852 Titrando including vol. and coul. titration vessel, generator electrode without diaphragm, without 801 magnetic stirrer
2.801.0040	801 magnetic stirrer with titration stand

Volumetric KF Titration

2.890.0110	890 Titrando with 840 Touch Control
2.890.0210	890 Titrando with ***tiamo***™ light
2.870.1010	870 KF Titrino plus complete
2.901.0010	901 Titrando including titration vessel and indicator electrode

KF Sample Preparation

2.860.0010	860 KF Thermoprep
2.874.0010	874 Oven Sample Processor
2.136.0100	Polytron PT 1300 D

Automation

2.862.1010	862 Food/Beverage Compact Titrosampler
2.862.1110	862 Food/Beverage Compact Titrosampler with printer
2.862.2010	862 Salt Compact Titrosampler
2.862.2110	862 Salt Compact Titrosampler with printer
2.815.1110	815 Robotic Titration Soliprep
2.815.2110	815 Robotic Flexible Soliprep
2.815.3110	815 Robotic Filtration Soliprep
2.815.4110	815 Robotic Soliprep for LC

Ion Chromatography

2.850.3030	850 Professional IC AnCat – MCS for anion and cation determinations
2.881.0030	881 Compact IC pro Anion – MCS for the analysis of dairy products
2.844.0020	844 UV/VIS Compact IC with PCR for bromate determination in water samples
2.871.0010	871 Advanced Bioscan for pulsed amperometric detection of carbohydrates
2.858.0020	858 Professional Sample Processor for the automation of determinations
2.800.0010	800 Dosino for full automatic liquid handling of samples
6.5330.000	IC equipment for dialysis
6.5330.010	IC equipment for ultrafiltration
6.5330.020	IC equipment for dilution
6.6059.202	MagIC Net™ 2.0 Professional
6.1005.110	Phenomenex Star Ion A300 for bromate determination
6.1006.510	Metrosep A Supp 5 – 100 for anion determination

Oxidation Stability

2.743.0014	743 Rancimat for oils and fats (230 V) including software and accessories
2.743.0015	743 Rancimat for oils and fats (115 V) including software and accessories

Voltammetry

2.797.0010	797 VA Computrace for trace analysis (manual operation)
MVA-2	797 VA Computrace system for trace analysis with automatic standard addition (consisting of 797 VA Computrace with two 800 Dosinos for automatic addition of auxiliary solutions)
MVA-3	Fully automated 797 VA Computrace system for trace analysis (consisting of 797 VA Computrace with 863 Compact VA Autosampler and two 800 Dosinos for automatic addition of auxiliary solutions; automatic processing of up to 18 samples)

Process Analysis

2.875.0010	875 ProcessLab Base Unit with TFT operating panel, left-hinged door
2.875.0020	875 ProcessLab Base Unit with TFT operating panel, right-hinged door
2.875.0510	875 ProcessLab Base Unit with TFT operating panel including touch function, left-hinged door
2.875.0520	875 ProcessLab Base Unit with TFT operating panel including touch function, right-hinged door
2.875.0210	875 ProcessLab Base Unit VA with TFT operating panel including touch function, right-hinged door

food.metrohm.com

Subject to change without prior notice
Layout by Ecknauer+Schoch ASW; printed by Metrohm AG, 9101 Herisau, Switzerland
8.000.5023EN – 2009-11

Metrohm