Reagecon

A CALIBRE SCIENTIFIC COMPANY

Cation and Anion Standards

Contents

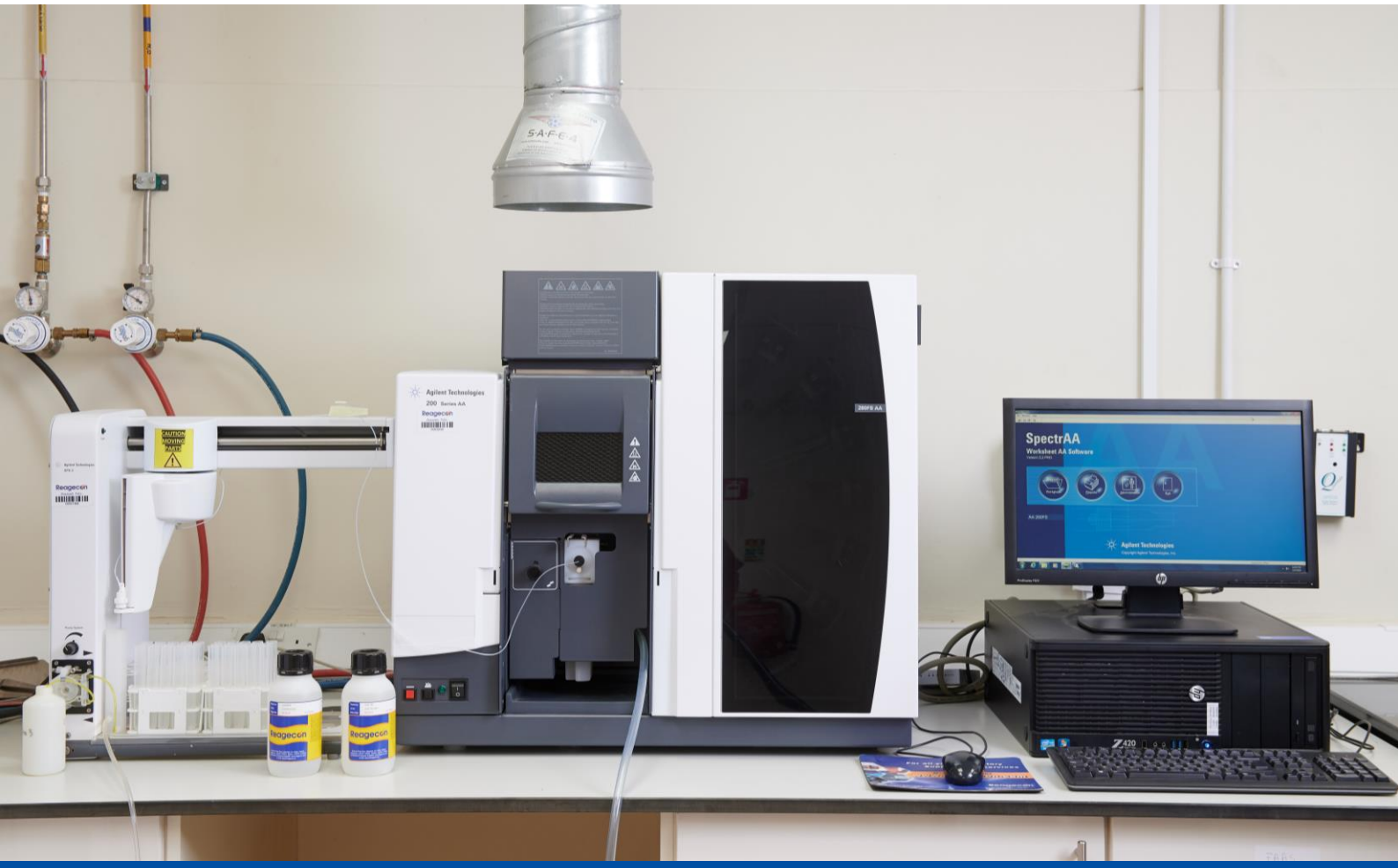
About Reagecon

Reagecon, part of the Calibre Scientific Group of companies is one of the largest producers of Physical and Chemical Standards. The company is based in an 8,000 sq. metre facility that includes a large suite of manufacturing, quality control and research and development laboratories in Shannon, Ireland with sales offices in Shanghai and North America, Europe and the UK through our Calibre Scientific sister companies. Reagecon employs 100 people, 50% are chemistry or science graduates and most are involved in the development, production, testing, quality control and sales & marketing of over 6,000 product references that we currently produce. We have a very active R&D programme and develop and bring to market many hundreds of new standards, every year.

All Reagecon manufactured products are underpinned by and demonstrate our position as a centre of excellence in the science of Metrology. Product is manufactured, tested, and certified under the applicable ISO/IEC 17025 (A2LA Ref: 6739.03) or ISO/IEC 17034 (A2LA Ref: 6739.01) accreditation or ISO/IEC 17025 (A2LA Ref: 6739.02) for Calibration, in one of our 20 specially equipped laboratories.

The resulting product is classified within one of 54 product families, these families are then grouped and promoted under 7 main product headings, as listed below:-

- Electrochemistry Standards
- Cation and Anion Standards
- Pharmacopoeia Reagents and Standards
- Physicochemical Standards
- Total Organic and Inorganic Carbon Standards
- Volumetric Solutions for Titration
- Customised Standards and Reagents



ICP-MS / ICP-OES Standards

Summary of Features & Benefits

- Inductively Coupled Plasma (ICP) Standards, covering up to 70 single element ICP Standards
- Range comprises of Standards for Verification, Tuning, Spiking, Interference, Compliance and Calibration.
- This product is produced in a highly controlled cleanroom (ISO 7) environment, using ultra-pure water (specially treated for the production of mass spectroscopy standards), triple distilled acids and triple leached pre-cleaned bottles.
- The titrimetry and spectroscopy are controlled and calibrated using separate standards, so the product comes with two layers of traceability including NIST Standards, where available.
- Uncertainties of measurement are calculated according to Eurachem/CITAC guidelines and reported as expanded uncertainties at the 95% confidence level.
- Suitable for any make or model or instrument
- Manufactured to exacting specifications with an extended shelf life & stability
- Consistency of product - Independent, Traceable, Certified
- Certificates of Analysis and Safety Data Sheets available online

Reagecon have been manufacturing Inorganic Standards, Controls and Calibrators for Spectroscopy for nearly three decades. During that time, the company has established itself as the most reliable primary producer of top quality standards. Our customer base in over 80 countries is testament of our efforts to be leaders in a changing field where limits of detection and purity are becoming ever more demanding. Whether your application is ICP-MS, ICP-OES or whether you require a single element or multi-element mixture, our products are manufactured, tested and stabilised to such a high level, that they can be used on all of these instruments.

Quality Control

All metal raw materials are assayed by titration and ICP-MS prior to manufacture. Separate CRM's are used to control or calibrate the titration and ICP-MS respectively. This dual process enables the assays to be cross-checked against each other, provides two layers of traceability and quantifies the combined level of impurities in the starting material. The product is then manufactured gravimetrically using the mass balance approach: 100% - sum of all impurities (w/w). The assay of the final product is certified using the gravimetric result corrected for density. Prior to bottling, the finished product is again tested and verified using an ICP-MS instrument calibrated with appropriate CRM's.

Certification

Reagecon's ICP-MS and ICP-OES Standards are prepared gravimetrically on a weight/weight basis from the purest available raw materials on the market. Both solute and solvent are weighed on balances calibrated by Reagecon's engineers using OIML traceable weights. Reagecon holds ISO/IEC 17025 accreditation for calibration of laboratory balances. The resulting Balance Certificate of Calibration is issued in accordance with the requirements of ISO/IEC 17025.

Traceability

The content of the starting material for each single element or multi-element standard is established by titration. The resulting analysis is directly traceable to a relevant NIST standard where available. All of the resulting uncertainties of measurement are calculated according to EURACH/CITAC guidelines and reported as expanded uncertainties at the 95% confidence level. Reagecon has ISO/IEC 17025 accreditation for several classes of titrimetric analysis relevant to the assay of Raw Materials, for the manufacture of ICP-MS and ICP-OES standards.

Verification of Raw Materials

The concentration of the target element of each raw material is then verified using a high performance state of the art calibrated ICP-MS instrument. The calibration of the ICP-MS is completed using high purity ISO 17034 certified reference materials or other internationally accepted materials (e.g. BAM from Germany). This verification procedure serves three distinct but critical purposes.

- It provides a completely independent check of the accuracy and validity of the titration assay.
- It provides traceability by comparison to a second reference, which is independent from the first Reference Material.
- It determines the level of trace elemental impurities in the starting raw materials.

Elemental Metallic Impurities

All Reagecon Standards are manufactured from the purest available raw materials. At least thirty-three starting materials are metals of > 99.999% purity. Several others are at least 99.995% pure. Most of the remaining metals or salts of metals are at least 99.99% pure. The level of impurities are quantified using ICP-MS and are measured and reported both on the starting materials and on the finished product. All Reagecon's ICP-MS standards are manufactured in a Class 10,000 (ISO 7) clean room environment.

Final Assay & Result

Each batch of Reagecon's finalised ICP-MS standards are subjected to an assay on the instrument prior to bottling. This assay verifies the target element assay and verifies that the level of impurities have not changed significantly during the manufacturing process. The results are then reported and certified in mg/Kg and mg/L on the basis of weight and the density measurement of the standard. All the volumetric, titrimetric and gravimetric functions are carried out under a highly regulated temperature regime, using equipment calibrated by Reagecon's engineers. Reagecon holds ISO/IEC 17025 accreditation for temperature calibration in the range of -90°C to +650°C. The density measurements are also highly temperature dependent and are carried out in Reagecon's specialised Density Laboratory. Reagecon is ISO/IEC 17025 Accredited, for density measurement using an Oscillating U-Tube Method in accordance with the ASTM D4052 method. The company is an extensive producer of density standards.

Ion Chromatography Standards

Summary of Features & Benefits

- At least 18 anion and 18 cation standards available
- Many Multi Element mixes available
- Manufactured to exacting specifications with an extended shelf life & stability
- This product is produced in a highly controlled cleanroom (ISO 7) environment, using ultra-pure water (specially treated for the production of Ion Chromatography Standards) and triple leached pre-cleaned bottles.
- The titrimetry and spectroscopy are controlled and calibrated using separate standards, so the product comes with two layers of traceability including NIST Standards, where available.
- Uncertainties of measurement are calculated according to Eurachem/CITAC guidelines and reported as expanded uncertainties at the 95% confidence level.
- Suitable for any make or model or instrument
- Manufactured to exacting specifications with an extended shelf life & stability
- Consistency of product - Independent, Traceable, Certified
- Certificates of Analysis and Safety Data Sheets available online

These standards are prepared, tested, certified and verified by following the exact same regime as already presented for ICP-MS Standards. The raw material specifications are in most cases identical to the materials used for ICP-MS.

Additionally, the elemental cations are also analysed by ICP-MS. All results are verified on a state of the art Ion Chromatograph, which is calibrated using high purity ISO 17034 accredited standards, similar in concentration to the products listed below.

Controlled Environment

Reagecon's standards are manufactured in a highly controlled clean room environment using:

- High purity starting materials
- Ultra-pure water, specially treated for Mass Spectroscopy Standards
- High purity matrix materials
- Pre-leached and pre-cleaned bottles

Options

Reagecon offers more options than almost any other manufacturer.

- At least 18 anion and 18 cation standards
- Many multi - element mix's
- Concentration options
- Pack size options
- Customised Standards

All at the highest quality and at an affordable price.

Verification of Raw Materials

All metal raw materials are assayed by titration and ICP-MS prior to manufacture. Separate CRM's are used to control or calibrate the titration and ICP-MS respectively. This dual process enables the assays to be cross-checked against each other, provides two layers of traceability and quantifies the combined level of impurities in the starting material. The product is then manufactured gravimetrically using the mass balance approach: 100% - sum of all impurities (w/w). The assay of the final product is certified using the gravimetric result corrected for density. Prior to bottling, the finished product is again tested and verified using an ICP-MS instrument calibrated with appropriate CRM's and a state of the art Ion Chromatograph.

Certification

Reagecon's Ion Chromatography Standards are prepared gravimetrically on a weight/weight basis from the purest available raw materials on the market. Both solute and solvent are weighed on balances calibrated by Reagecon's engineers using OIML traceable weights. Reagecon holds ISO/IEC 17025 accreditation for calibration of laboratory balances. The resulting Balance Certificate of Calibration is issued in accordance with the requirements of ISO/IEC 17025.

Atomic Absorption Standards

Summary of Features & Benefits

- Extensive range of aqueous AA Standards
- Multi Element mixes available
- Manufactured to exacting specifications with an extended shelf life & stability
- This product is produced in a highly controlled cleanroom (ISO 7) environment, using ultra-pure water (specially treated for the production of mass spectroscopy standards).
- The titrimetry and spectroscopy are controlled and calibrated using separate standards, so the product comes with two layers of traceability including NIST Standards, where available.
- Uncertainties of measurement are calculated according to Eurachem/CITAC guidelines and reported as expanded uncertainties at the 95% confidence level.
- Suitable for any make or model or instrument
- Manufactured to exacting specifications with an extended shelf life & stability
- Consistency of product - Independent, Traceable, Certified
- Certificates of Analysis and Safety Data Sheets available online

Reagecon manufacturers and extensive range of aqueous AA Standards. These include standards for the measurement of the most common alkali and transition metals.

There are two types of Atomic Absorption Spectrometry, (AAS). Flame Atomic Absorption Spectrometry, (FAAS) and Graphite Furnace Atomic Absorption Spectrometry (GFAAS).

Flame Atomic Absorption Spectrometry

Flame Atomic Absorption Spectrometry, (FAAS) either an air/acetylene or a nitrous oxide/acetylene flame can be used to evaporate the solvent and dissociate the sample into its component atoms. When light from a hollow cathode lamp (selected based on the element to be determined) passes through the cloud of atoms, the atoms of interest absorb the light from the lamp. This is measured by a detector, and used to calculate the concentration of that element in the original sample. The use of a flame limits the excitation temperature reached by a sample to a maximum of approximately 2600°C (with the Nitrous Oxide / acetylene flame). For many elements this is not a problem. However, there are a number of refractory elements like V, Zr, Mo and B which do not perform well with a flame source. This is because the maximum temperature reached, even with the N_2O/acetylene flame, is insufficient to break down compounds of these elements. As a result, flame AAS sensitivity for these elements is not as good as other elemental analysis techniques.

FAAS is an inexpensive technique that is rapid for a few selected elements however it has poor sensitivity (high detection limits), is limited to single element determination each time and requires a large amount of sample. It has a narrow linear range.

Graphite Furnace Atomic Absorption Spectrometry

Graphite Furnace Atomic Absorption Spectrometry (GFAAS) - This technique is essentially the same as FAAS, except the flame is replaced by a small, electrically heated graphite tube, or cuvette, which is heated to a temperature up to 3000°C to generate the cloud of atoms. The higher atom density and longer residence time in the tube improve furnace AAS detection limits by a factor of up to 1000x compared to flame AAS, down to the sub-ppb range. However, because of the temperature limitation and the use of graphite cuvettes, refractory element performance is still somewhat limited.

GFAAS is relatively inexpensive and requires small sample volume, it has excellent sensitivity (low detection limits) however it is also limited to single element determination and has a narrow linear range.

Flame Photometry Standards

Summary of Features & Benefits

- Extensive range of values and elements
- Single and Multi Element mixes available
- Manufactured to exacting specifications with an extended shelf life & stability
- This product is produced in a highly controlled cleanroom (ISO 7) environment, using ultra-pure water (specially treated for the production of mass spectroscopy standards).
- The titrimetry and spectroscopy are controlled and calibrated using separate standards, so the product comes with two layers of traceability including NIST Standards, where available.
- Uncertainties of measurement are calculated according to Eurachem/CITAC guidelines and reported as expanded uncertainties at the 95% confidence level.
- Products are non hazardous, non toxic
- Manufactured to exacting specifications with an extended shelf life & stability
- Consistency of product -Independent, Traceable, Certified
- Certificates of Analysis and Safety Data Sheets available online

The Principle of Flame Photometry

The benefits of measuring electromagnetic radiation emitted by atoms subjected to flame excitation has been recognised for over 150 years in analytical chemistry. In the intervening period instrumentation capable of exploiting this principle has been developed, refined and commercialised by several companies using a number of technologies.

Flame photometry is particularly suitable for measuring the concentration of Alkali and Alkaline Earth metals in several matrices by exploiting a characteristic of such metals whereby, their atoms reach an excited state at a lower temperature than most other metals.

The instrument operates on the principle that the metals are thermally dissociated into atoms and the electrons in some of these atoms are excited by the flame. When the excited atoms return to their normal state, they emit electromagnetic radiation which lies mainly in the visible region. The wavelengths of this radiation are easily isolated by an optical filter from those of most other elements and then converted to an electric signal. This signal is a direct function of the concentration of the particular metal in the sample, control or standard. The spectra produced are simple, free of interference and well suited to quantifiable measurement.

Calibration & Control

Flame Photometry Standards may be used to:

1. Calibrate the instrument in preparation for testing

2. Control the entire testing process to include:

   - The flame photometer
   - Sample
   - Operator
   - Measuring environment
   - Any of these four factors can influence the accuracy and precision
   - of the analysis and give erroneous results

   .

3. Perform instrument qualification

4. Assist in method validation of a particular flame photometry technique

Ion Selective Electrode Standards and Ionic Strength Adjustors

Summary of Features & Benefits

- Extensive Range
- Many different values
- NIST traceable
- Compatible with any instrument
- Used for Calibration, Control, Validation or Qualification
- Certificates of Analysis and Safety Data Sheets available online

Ion Selective Electrode Standards (ISE's)

Ion Selective Electrode (ISE) Standards can be used at suitable concentrations to calibrate or control measurements using Ion Selective Electrodes as the sensing technology. Additionally suitable for Method Validation or Instrument Qualification.

Ionic Strength Adjusters (ISA's)

Reagecon's Ionic Strength Adjusters (ISA's) are used in conjunction with Ion Selective Electrodes and Ion Selective Electrode Standards to adjust pH, adjust Ionic Strength and suppress interference during measurement.

Introduction

Ion Selective Electrodes, (ISEs) allow specific and quantitative measurement of a wide range of cations, anions and some dissolved gases. These ions can be measured directly like pH measurement, indirectly (see below) or by titrimetry. ISEs respond selectively to the relevant ion activity exactly like pH electrodes respond to hydrogen ion activity. Like pH electrodes, they require a suitable reference electrode, preferably a double junction system. They also require a pH or ion meter and a selection of filling solutions for the outer and inner chambers of the reference electrode. In some instances the reference and sensing electrodes may be combined into one unit.

Types of Measurement

Direct measurement is performed exactly like the measurement of pH. The electrode is calibrated using two concentrations of the relevant standard which are chosen to bracket the expected value of the sample. More than two calibration standards may be used for better linearity or more accurate measurement and a standard curve of mV reading versus concentration of various standards can be constructed.

However, the measurement technique deviates from pH in that both sample and standards require the addition of an Ionic Strength Adjustor (ISA). The addition of this solution confers the following benefits:

- The ionic strength of the adjustor is much higher than the ionic strength of the sample or standard so it
- keeps the ionic strength of both high, constant and similar and thus enables what is effectively activity measurement to be read as concentration.
- The ionic strength adjustor (which should never react with the sample or standard chemically) also keeps the pH value constant in some instances. This combined with high ionic strength and the chemistry of the ISA suppresses or eliminates interfering ions.
- The ISA when added to sample and standard eliminates any matrix, hysteresis or erroneous liquid junction potentials that might affect the accuracy of the test result.
- Indirect measurement methodologies include the use of standard addition, sample addition, standard subtraction and sample subtraction. Such methods offer advantages that include:
- Calibration need only be performed occasionally or not at all, therefore only ISA needs to be added to the sample.
- The possibility of error due to a temperature co-efficient of variation between the sample and standard is largely eliminated.
- The ion concentration of solid samples can be measured.
- The range of types of ions measured and the versatility of the technique is greatly enhanced by careful and considered selection of the optimal indirect method. This is true, in particular, with standard or sample subtraction, where precipitation or complexation may be performed, or where the counter ion to that contained in the standard is measured.

Use of Controls

As with all analytical measurements, no test should be performed without the use of control material. The control should be treated in exactly the same way as the sample including the addition of ISA, thereby picking up any error in the measurement technique, whether it be due to the analyst, environment, meter, sensors or sample in line with the execution of good laboratory produce. Reagecon's ISE Standards diluted to a suitable concentration, are particularly suitable for use as control material.


ilent Technologies
0 Series AA
gecon

Reagecon

A CALIBRE SCIENTIFIC COMPANY

For further information or enquiries, please contact us:

Tel: +353 61 472622
Email: sales@reagecon.ie
www.reagecon.com