NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Nanyang Environment and Water Research Institute

HIGH-END EQUIPMENT

FEATURED EQUIPMENT FROM 2019

NEWRI
Analytics Cluster

A featured catalogue of the high-end equipment
in a world class research organisation

NEWRI
ANALYTICS
CLUSTER

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Agilent
Trusted Answers

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CHROMATOGRAPHY AND SPECTROSCOPY

Focused on novel approaches to testing and monitoring in environmental sciences, these new equipment will largely enhance NEWRI's capability to do chemical analysis of pollutants for environmental quality assessment in different environmental matrixes. These will also prove useful for the expansion of environmental database and library solutions.

LIQUID CHROMATOGRAPHY-ION MOBILITY-MASS SPECTROMETER (LC-IM-MS)

Agilent 6560 Ion Mobility LC/Q-TOF

SPECIFICATIONS

Agilent 1290 INFINITY II LC SYSTEM

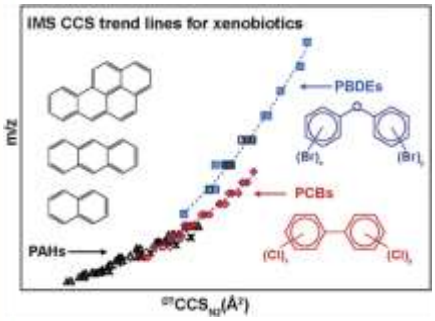
1290 Infinity II High-Speed Pump
- UHPLC system with 1300 bar pressure limit
- Integrated degasser

1290 Infinity II Multisampler
- Controlled temperature from 4 to 40 °C
- Capacity of up to 6,144 samples
- Mutliwash option for multiple solvents wash with reduced carryover

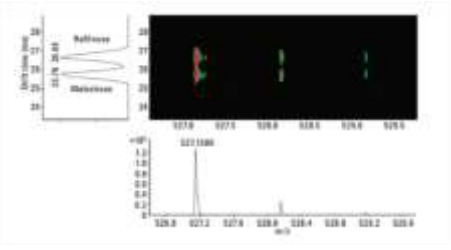
1290 Infinity II Multicolumn Thermostat
- Broad temperature range with cooling to 20 degrees below ambient and heating up to 110 °C
- Up to four 30 cm or eight 10 cm columns
- Quick-change valve head for automatic column selection

6560 Ion Mobility LC/Q-TOF
- ESI jet stream technology ion source (Agilent Jet Stream) – (Nanospray source also available at NEWRI)
- Mass range: 100 – 1000 *m/z* extended mass range, 50 – 1,700 or 100 – 3,200 *m/z* for both high resolution and extended dynamic range modes, quadrupole up to 4,000 *m/z*
- Mass accuracy: < 1 ppm
- Mass resolving power: > 42,000 at 2,722 *m/z*
- Dynamic range: 10^5
- Maximum spectral acquisition rate: 50 spectra/second
- Drift Resolution: Greater than 50
- Collisional cross section accuracy: <2%

NEWRI's novel Drift-Tube Ion Mobility Quadrupole Time-of-Flight (IM-QTOD) LC/MS system was manufactured in Singapore and it is the first of its kind to be deployed in the country. This configuration enables direct measurement of accurate collision cross sections (CSS) while the low field drift tube design preserves labile targets. The system is coupled to a high-performance liquid chromatography (HPLC) system as well as a high-resolution mass spectrometer (QTOF).



IMS CCS trend lines for xenobiotic (Zheng et al 2018)



Separation of isobaric tri-saccharides using the IM-QTOF (Zheng et al. 2018)

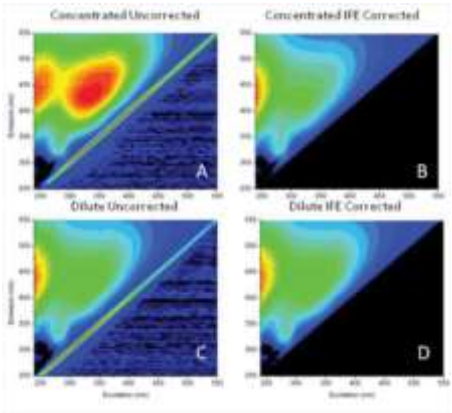
FEATURES & APPLICATIONS

- Entire new dimension of separation with direct collision cross sections (CSS) measurements
- Multiplexed, 8-bit data acquisition for high resolving power of CCSs while still in full data scan mode
- Separation of complex isobaric classes such as lipids and glycans
- Characterization of structural conformations and isomeric compounds
- Profiling and identification of environmental and water contaminants
- Comprehensive analysis and characterization of biopharmaceuticals
- Characterization of complex mixtures (oil industry) for isobaric molecules (not possible with (ultra) high-resolution mass spectrometry)
- Ultrafast method for compressive analysis of nation security molecules (e.g. explosives, controlled drugs and biological toxins)

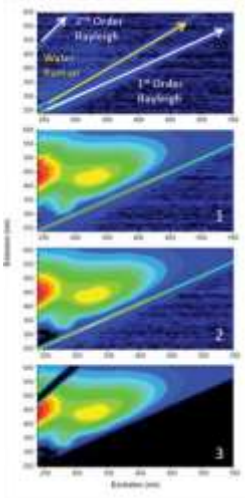
FLUORESCENCE SPECTROPHOTOMER

HORIBA Aqualog® UV-800-C with Sipper

The HORIBA Aqualog® A-TEEM spectrometer is a powerful tool to identify and quantify both high and low concentrations of dissolved compounds in environmental biology and water analysis. It is the only instrument in the world that is able to simultaneously measure both the absorbance spectra and 3D fluorescence Excitation-Emission matrices (EEMs) with extreme accuracy. Its data processing software boasts of time-saving one-click functions used to eliminate Inner Filter Effects (IFE), Rayleigh masking, and conduct normalization. The WS-10 Sipper also enables automatic extraction of up to 4 samples from 4 different tubes.



EEMs of Pony Lake fulvic acid sample – with (B&D) and without correction (A&C) (Gilmore, 2011)



1.Uncorrected EEM

2.Blank subtracted EEM

3.EEM with 1st and 2nd Order Rayleigh masking correction (Gilmore, 2011)

FEATURES & APPLICATIONS

- Monitoring regulated dissolved organic matter and disinfection by-products (e.g. for EPA stage 2 disinfection compliance)
- Monitoring cell culture media variability
- Qualitative and quantitative composition analysis of components (e.g. key flavour and colour determinants in wine and spirit)
- Identification and classification of species or compounds (e.g. freshwater planktonic algal species, milk compounds)
- Analysis of stability and aggregation of insulin

SPECIFICATIONS

HORIBA Aqualog® UV-800-C with Sipper

A-TEEMS Spectrometer

- Subtractive double monochromator on excitation with stray light rejection better than 10^{-7}
- Cooled, back-illuminated, low-noise CCD detector with >70% quantum efficiency
- Signal to noise greater than 20,000:1 by water Raman RMS
- Simultaneous measurement of all emission wavelengths
- 150 W non-ozone free lamp with ozone scrubbing housing

Aqualog/Datastream Software

- Simultanous Absorbance and Excitation-Emission Matrix measurements (A-TEEM)
- Single-button routines to automatically correct EEMs for Inner Filter Effects (IFE) & automatic background removal and masking Rayleigh and Raman in EEMs
- Automatic normalization of the intensity scale in either Quinine Sulfate or water Raman units
- Spectrally corrected Xenon Lamp for true EEMs maps
- Seamlessly transfers data to a multivariate modelling and analysis package that uses the industry standard Parallel Factor Analysis (PARAFAC Method)

WS-10 Sipper

- Automatically extract up to 4 samples from 4 different tubes

TWO DIMENSIONAL LIQUID CHROMATOGRAHY MASS SPECTROMETER (2D-LC-QQQ)

Agilent 2D-LC coupled with 6495C Triple Quadrupole

SPECIFICATIONS

Agilent 2D-LC SYSTEM WITH 6495C TRIPLE QUADRUPOLE

1290 Infinity II High-Speed Pump and 1290 Infinity II Flexible Pump
- UHPLC system with 1300 bar pressure limit
- Integrated degasser

1290 Infinity II Multisampler
- Controlled temperature from 4 to 40 °C
- Capacity of up to 6,144 samples
- Mutliwash option for multiple solvents wash with reduced carryover

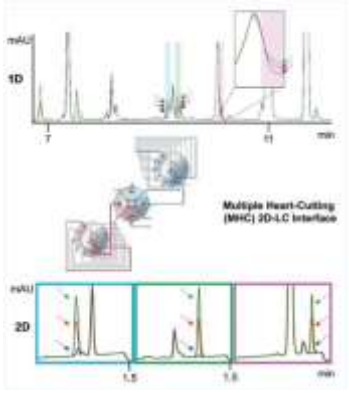
Multiple Heart Cutting Valve
- 6-column selector valve head with 2 modules of multiple heart cutting valve

1290 Infinity II Multicolumn Thermostat
- Broad temperature range with cooling to 20 degrees below ambient and heating up to 110 °C
- Quick-change valve head for automatic column selection

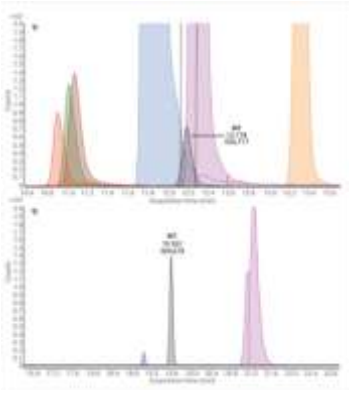
1260 Infinity II Diode Array Detector
- Multiple wavelength and full spectral detection up to 240 Hz data rates

6495C Triple Quadrupole LC/MS
- ESI jet stream technology ion source (Agilent Jet Stream)
- Mass range: m/z 5 – 3,000
- IDL sensitivity: <0.6 fg Reserpine on-column, <600 ppq
- MRM speed: 500 MRM transitions/s
- Scan speed: 17,000 Da/s
- Polarity switch speed: <25 ms
- Minimum MRM dwell time: 0.5 ms
- Collision cell clearance time: <0.5 ms
- Dynamic range: 10^6

2D LC can eliminate co-elution, thereby reducing signal suppression and the risks of cross talk, which can occur in one-dimensional analysis of complex samples. The second dimension of a 2D-LC/MS/MS analytical method can be used to enhance the signal intensity of mass spectrometric detection by introducing the analytes to the MS source in a more suitable eluent.



Resolving co-elution problems of components in complex mixtures by multiple heart-cutting 2D-LC (Pursch et al., 2017)



Separation of metabolite M1 from co-eluting substrates and inhibitors in a cell supernatant (Agilent App Note 5991-8839EN)

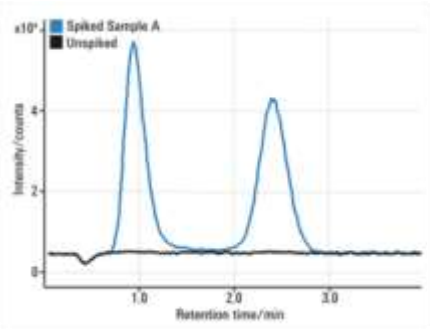
FEATURES & APPLICATIONS

- Chemical characterization of sewage treatment plant effluents
- Analysis of peptide glucagon in accordance with USP 39 in the first dimension, using an MS-incompatible mobile phase; followed by automated desalting and mass selective detection in the second dimension
- Multiple heart-cutting (MHC) in 2D-LC to resolve challenging peak co-elutions in a pesticidal natural product-derived extract
- Achiral-chiral 2D-LC-QQQ as a powerful tool in bioanalysis to identify and quantify isomers simultaneously
- Separation of metabolite that co-elute with higher concentrated substrates and inhibitor
- Characterization of anthocyanins and their derived pigments by utilizing hydrophilic interaction chromatography (HILIC) x reversed phase liquid chromatography (RP-LC) separation coupled to triple quadrupole mass spectrometer

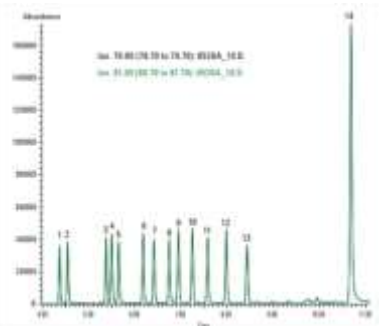
HYPHENATED INDUCTIVELY COUPLED PLASMA TRIPLE QUADRUPOLE

Agilent 8900 GC/LC-ICP-QQQ

Applications of hyphenated Inductively Couple Plasma-Mass Spectrometry (ICP-MS) fall into the general category termed speciation analysis. In all cases, the fractionation device (chromatography or other) is used to separate the species from each other and the matrix, and the ICP-MS used to detect the species of interest. The analyte species may be as simple as elemental ions of various oxidation states in solution, or as complex as mixtures of pesticides or biomolecules. In all cases though, the ICP-MS is simply acting as an elemental detector. The fractionation device serves to separate the various components in the sample before detection as well as providing additional information in the form of retention time. Often this combination is sufficient to identify and quantity the target analytes. However, analysis of standards or the use of additional mass spectrometric techniques can provide further confirmation of identification.



LC-ICP-MS chromatogram: unspiked (black) and spiked 10 ppb Cr(III) and Cr(VI) (blue) (Agilent App Note 5990-9366EN)



GC-ICP-MS chromatogram of PBDE standard mix (Agilent App Note 5990-9473EN)

FEATURES & APPLICATIONS

- Single nanoparticle application provides combination of particle size distribution and sample concentration information
- Accurate determination of TiO_2 nanoparticles in complex matrices
- Single nanoparticle analysis of Asphaltene solutions
- Accurate sulfur quantification in organic solvents
- Accurate trace level arsenic analysis in complex samples
- Avoidance of spectral overlaps on reaction product ions with O_2 cell gas
- LC-ICP-QQQ enable speciation analysis of arsenic in urine and water and chromium in water
- Determination of pesticides in foods using phosphorus and sulfur detection by GC-ICP-QQQ
- GC-ICP-QQQ delivers superior sensitivity for high-ionization-potential elements such as Hg, As, Se and the halogens
- Analysis of Polybrominated Diphenyl Ether (PBDE) flame retardants by GC-ICP-QQQ

SPECIFICATIONS

AGILENT 8900 GC/LC-ICP-QQQ

Agilent Infinity II Bio-Inert LC 1260 Infinity II Bio-Inert Pump
- High salt tolerance (2 M) and wide pH range with active seal wash and quartenary solvent blending
- Bio-Inert with up to 600 bar pressure limit

1260 Infinity II Bio-Inert Multisampler
- Low carryover using multiwash capability
- Metal free sample flow path

1260 Infinity II Diode Array Detector
- Multiple wavelength and full spectral detection up to 240 Hz data rates

AGILENT 7890BGC Multimode Inlet with Flame Ionization Detector

PAL3 RTC 120 Autosampler
- Headspace sampling
- SPME with fiber conditioning module

AGILENT 8900 TRIPLE QUADRUPOLE ICP-MS
- Single nanoparticle application module
- Organic solvent introduction kit
- Four-channel cell gas control
- Unique precursor/product ion scan modes clarify reaction processes
- Powerful ICP-MS MassHunter software simplifies workflow and automates method development

GAS CHROMATOPGRAHY SPECTROMETER QUADRUPOLE TIME-OF-FLIGHT (GC/Q-TOF)

Agilent 7250A GC/Q-TOF

SPECIFICATIONS

Agilent 7250A GC/Q-TOF

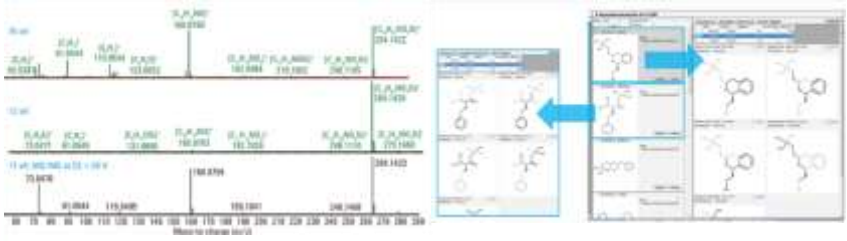
8890 Gas Chromatography Oven
- Operating temperature up to 450 °C
- Retention time repeatability <0.008% and area repeatability < 0.5% RSD

Multimode Inlet
- Temperature range of -160 °C to 450 °C and able to program up to 900 °C per minute
- Capable of different Injection modes; hot or cold split/splitless, pulsed split/splitless, solvent vent and direct injection
- Large volume injection capabilities

PAL 3 Sampler
- Capable of Solid Phase Micro-extraction (SPME-arrow), direct liquid injection and headspace
- Injection modes includes standard, sandwich technique using air or solvent and large volume
- Precision < 0.6 % RSD

7250A Quadrupole Time-of-Flight
- LE-EI ion source; standard (7o eV) or low energy (9 eV – 30 eV) and CL source
- Proprietary monolithic hyperbolic gold-coated quartz quadrupole with linerar hexapole collision cell
- High efficiency EI Source (HES) and CL source
- Dynamic range: > 10^5
- Quadrupole isolation mass range: 20 to 1,050 *m/z*
- Mass range: 20 – 3,000 *m/z*
- Data acquisition: 1-50 Hz
- EL IDL: < 60 fg OFN
- TOF mass resolution: > 25,000 at *m/z* 271.9867
- TOF mass accuracy: <2ppm RMS

The Agilent 7250A GC/Q-TOF system delivers full-spectrum, high-resolution, accurate mass data with a wide dynamic range for identifying and quantifying GC-amenable compounds. It enables accurate mass screening by GC/MS and enhanced compound identification through MS/MS, simplifies ambiguous data with Low-Energy Electron Impact (LE-EI) for softer ionization and molecular ion enhancement (application dependent) and complimentary Chemical Ionization (CI) techniques for both positive and negative modes. GC/Q-TOF, equipped with the PAL 3 autosampler, is automated with sample preparation and introduction system and is capable of running multiple techniques in a single GC run.



Metabolic changes in lung tissue of tuberculosis-infected mice using GC/Q-TOF with Low-Energy EL (Agilent App Note 5991-8199EN)

FEATURES & APPLICATIONS

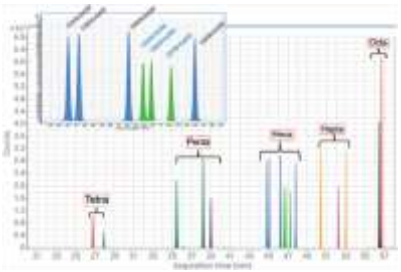
- Non targeted and suspect screening of water and wastewater sample using SPME fibre/SPME arrow
- Analysis of volatile compounds from *Siraitia grosvenorii*
- Suspected-target pesticide screening using GC/QTOF with high resolution deconvolution
- and retention index/mass spectrum library
- Comprehensive profiling of environmental organic micro pollutants in surface water
- Metabolic changes in lung tissue of tuberculosis-infected mice
- Analysis of combustion by-products on firefighter protection equipment
- Short Chain Chlorinated Paraffin (SCCP) analysis using negative CI and LE-EI

TRIPLE QUADRUPOLE CHROMATOGRAPHY MASS SPECTROMETER (GC-QQQ)

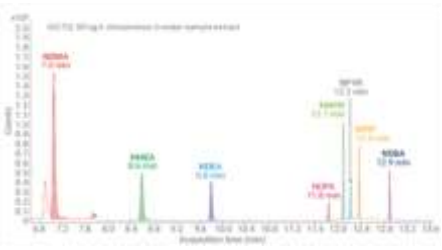
Agilent 7010B Triple Quadrupole GC/MS

The Agilent 7010B triple quadrupole GC/MS is the most sensitive Agilent triple quad (MS/MS) systems, providing lower level detection limits in Electron Ionization (EI) mode by using High Efficiency Source (HES). It produces at least 20 times as many ions as the previous generation. The breakthrough in sensitivity allows you to optimize sample preparation and achieve new detection limits. The Dynamic Multiple Reaction Monitoring (dMRM) mode of acquisition provides ease of use and efficiency.

With the PAL 3 Robotic Tool Change (RTC) auto sampler, sample preparation and introduction system has become fully integrated on a single auto sampler allowing for unprecedented flexibility and automation, maximising lab productivity. Multiple techniques like Solid Phase Micro-extraction (SPME), headspace and liquid injections can be run in a single GC run.



Determination of ultratrace polychlorinated dibenzo-p-dioxins and dibenzofurans using GC/MS/MS (Agilent App Note 5994-1412EN)



Nitrosamines analysis in water using GC/MS/MS (Agilent App Note 5994-1412EN)

FEATURES & APPLICATIONS

- Nitrosamines disinfection by products in drinking water
- Determination of ultratrace polychlorinated dibenzo-p-dioxins and dibenzofurans in waste incineration fly ash samples
- Fast analysis of pesticide residues in food samples
- Headspace injection for analysis of disinfection by-products in water
- Analysis of Polychlorinated biphenyls (PCB), Polycyclic Aromatic Hydrocarbons (PAHs) in drinking water using SPME
- Determination of off-odor substances in drinking water using SPME
- Tetra-through octa-chlorinated dioxins and furans analysis in water by isotope dilution
- Analysis of VOCs, SVOCs in water samples
- Analysis of Polybrominated Diphenyl Ethers (PBDE) and novel brominated flame retardants in soil

SPECIFICATIONS

AGILENT 7010B TRIPLE QUADRUPOLE GC/MS

8890 Gas Chromatography Oven
- Operating temperature up to 450 °C
- Retention time repeatability <0.008% and area repeatability < 0.5% RSD

Multimode Inlet
- Temperature range of -160 °C to 450 °C and able to program up to 900 °C per minute
- Capable of different Injection modes; hot or cold split/splitless, pulsed split/splitless, solvent vent and direct injection
- Large volume injection capabilities

PAL 3 Sampler
- Capable of Solid Phase Micro-extraction (SPME-arrow), direct liquid injection and headspace
- Injection modes includes standard, sandwich technique using air or solvent and large volume
- Precision < 0.6 % RSD

7010B Triple Quadruple
- ESI jet stream technology ion source
- Proprietary monolithic hyperbolic quadrupole with gold coating with a linear hexapole with liner linear acceleration collision cell
- High efficiency EI Source (HES) and Chemical Ionisation source
- Mass Range: m/z 10-1050
- Minimum MRM Dwell time: 0.5 ms
- Scan Speed: ≤ 20,000 Da/s
- Multiple Reaction Monitoring (MRM) speed: 800 transitions/sec
- Collision energy: Up to 60eV
- EI ionisation MRM IDL: <0.5fg OFN

MEMBRANE INLET MASS SPECTROMETER (MIMS)

Hidden Analytical HPR-40 DSA

SPECIFICATIONS

HIDEN ANALYTICAL HPR-40 DSA

Mass Spectrometer

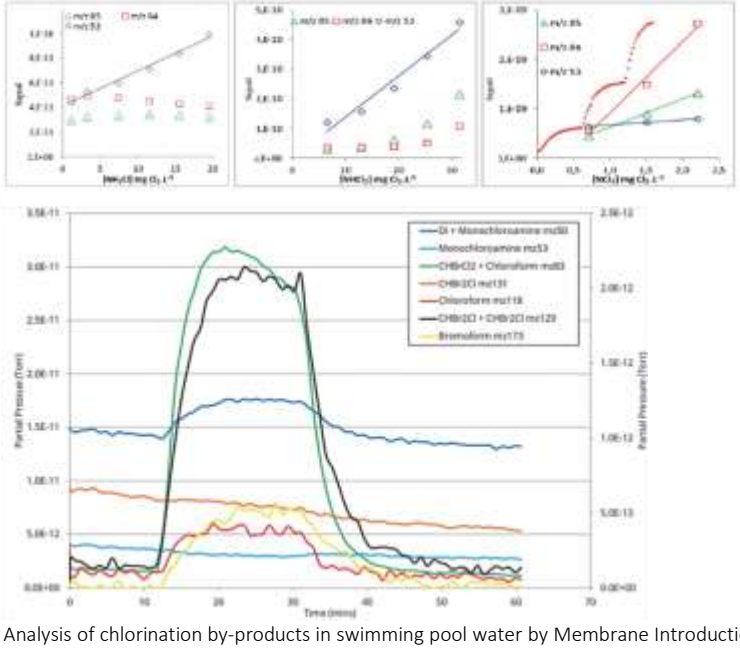
- Mass range, amu: 1-300
- Sensitivity: 100% to 60 ppt (species dependent) subjected to spectral interference
- Speed: Up to 650 measurements/second
- Detector: Dual Faraday/channeltron electron multiplier

Inlet

- Flow through probe (circular carrier) with liquid flow connections and membrane
- Thermocouple conditioning module

Membrane Inlet Mass Spectrometry is a technique used for resolving dissolved gas species from liquid samples using a semi-permeable membrane to isolate the mass spectrometer from the aqueous media and preferentially transmit the dissolved gases and organic vapors for analysis.

Hiden Analytical HPR-40 DSA MIMS is versatile, robust and portable for use in laboratory and field-based applications. This bench-top system allows for in-situ mass determination of dissolved species with real time quantitative analysis and monitoring at sub-parts per billion (ppb) level.



Analysis of chlorination by-products in swimming pool water by Membrane Introduction Mass Spectrometry- Influence of water physicochemical parameters (Tsamba et al., 2019)

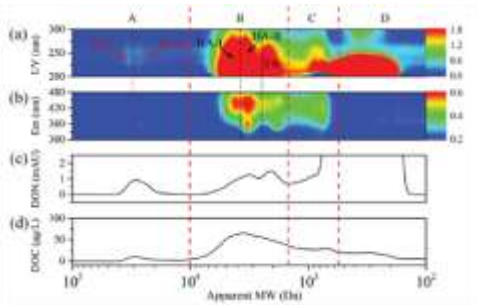
FEATURES & APPLICATIONS

- Ground water study of 5 biologically/chemically inert gases - He, Ne, Ar, Kr, Xe
- Dimethylsulfide study in oceanic and surface water studies
- Denitrification study in streams and waste activated sludge
- Fermentation process analysis
- Analysis of disinfection by-products (DBPs) in water
- Microbiological/enzyme activity studies
- Environmental monitoring
- Methane production control
- Soil core analysis

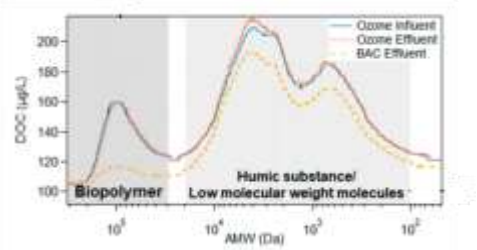
LIQUID CHROMATOGRAPHY – ORGANIC CARBON DETECTION – ORGANIC NITROGEN DETECTION SYSTEM (LC-OCD-OND)

Agilent 1260 Infinity II LC-DAD-FLD System, Suez Sievers M9 SEC TOC Analyzer, DON-Lab Organic Nitrogen Detector

NEWRI's LC-OCD-OND system is a novel integrated system consisting of a high-performance liquid chromatography (HPLC) system with multiple detectors – namely, a diode array detector (DAD), a fluorescence detector (FLD), an organic carbon detector (OCD) system and an organic nitrogen detector (OND) system. It is able to separate and quantify all organic fractions in complex environmental samples by the size exclusion chromatography technique (SEC).



Chromatogram obtained by DAD, FLD, OCD and OND showing different compounds (Li et al., 2020)



SEC chromatograms of the ozone influent, ozone effluent, and BAC effluent using LC-OCD (Synder et al., 2020)

FEATURES & APPLICATIONS

- Bacterial regrowth in water distribution system
- Membrane fouling potential for given raw water
- Detection and quantification of anti-scalants at low ppm concentrations in the presence of natural organic matter (NOM)
- Power plant problem diagnosis related to biopolymers, low-molecular-weight, neutral and other NOM.
- Screening of tap water, drinking water and ground water
- Contaminant investigation in chemical industries

SPECIFICATIONS

AGILENT, SUEZ SIEVERS, DON-LAB LC-OCD-OND
AGILENT 1260 INFINITY II LC-DAD-FLD SYSTEM

1260 Infinity II Flexible Pump
- Quaternary UHPLC pump
- Power range up to 800 bar and 5 ml/min flow

1260 Infinity II Multisampler
- Controlled temperature from 4 to 40 °C
- Sample size: 100 uL – 1.5 mL
- Multiwash option for multiple solvent wash with reduced carryover

1260 Infinity II Multicolumn Thermostat
- Broad temperatures with cooling to 10 °C below ambient and heating up to 85 °C
- Up to four 30 cm columns

1290 Infinity II Diode Array Detector
- Multiple wavelength detection with full spectra at sampling rates up to 240 Hz
- Programmable slit from 1 to 8 nm

1260 Infinity II Fluorescence Detector
- Single wavelength detection
- High-speed detection with up to 74 Hz data rates form narrow LC peaks

SUEZ SIEVERS M9 SEC TOC ANALYZER
- Sample temperature: 5-60 °C
- Data sampling: Every 4s
- Inorganic carbon remover
- Non-purgeable organic carbon obtained via UV persulfate oxidation and membrane conductivity detection

DON-LAB ORGANIC NITROGEN DETECTOR
- 5 UV oxidation cases in tandem to allow high oxidation
- UV oxidation device pressure range: 5-10 bar
- Organic nitrogen detected with UV-Vis lamp at 220 nm

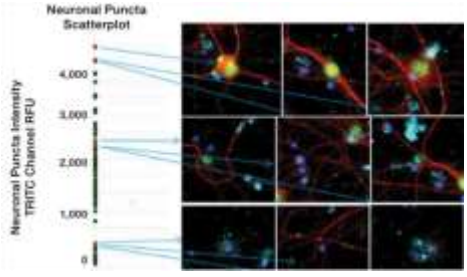
IMAGING AND CELL ANALYSIS

These imaging and cell analysis instruments empower NEWRI to conduct both routine and advanced cell analysis, end point, interval and real time measurements, as well as 2D and 3D high quality imaging with multiplexing capacities, programmable functions, and automation options for high throughput

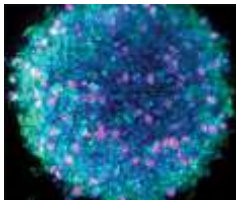
HIGH-CONTENT SCREENING PLATFORM

Thermo Scientific™ CellInsight CX7 LZR High-Content Screening Platform

Expanding NEWRI's capacity in imaging and bioassays, the CellInsight CX7 LZR HCS Platform is a fast, laser-based, automated cellular imaging and analysis platform for quantitative microscopy and phenotypic screening. Its automatic features can help speed up confocal or 3D imaging for samples in different vessel formats to give information at the single-cell level.



Neuronal Puncta imaged and measured by fluorescence intensity. Cell-level data can link to the corresponding images within the HCS Studio Software (Thermo Fisher, 2020)



HeLa spheroids imaged with three fluorescent channels using a 10x objective. The image is a maximum-intensity projection of 200 Z sections at 1 micron each (Thermo Fisher, 2020)

FEATURES & APPLICATIONS

- Automated widefield and fast confocal imaging
- 7–laser based excitation (multiplexable-expandable with near-IR (785 nm) laser excitation)
- Multiplexing of up to 5 channels simultaneously in a single experimental protocol
- >30 validated built-in applications for common biological assays such as apoptosis,
- Comet assay, in situ hybridization, mitotic index, translocation and transfection efficiency
- Cell-by-cell motility measurements calculated based on time sequenced imaging
- Single software for control & analysis
- On-the-fly phenotyping-parallel image capture and analysis
- Go from image collection to tabulated results and population statistics—and backtrack each event/cell to perform analysis at the single-cell level

SPECIFICATIONS

THERMO SCIENTIFIC™ CELLNSIGHT CX7 LZR HIGH-CONTENT SCREENING PLATFORM

Laser Confocal Imaging
- 7 solid-state lasers (405, 450, 488, 561, 594, 647 & 785 nm)
- Imaging in the UV range through near-IR range
- 5-position emission filter wheel
- High-speed spinning-disk confocal
- LED brightfield imaging
- 2-40x objectives
- Software-based and laser-based autofocus
- 4MP cooled CCD camera
- Widefield, confocal or brightfield imaging within the same experimental protocol

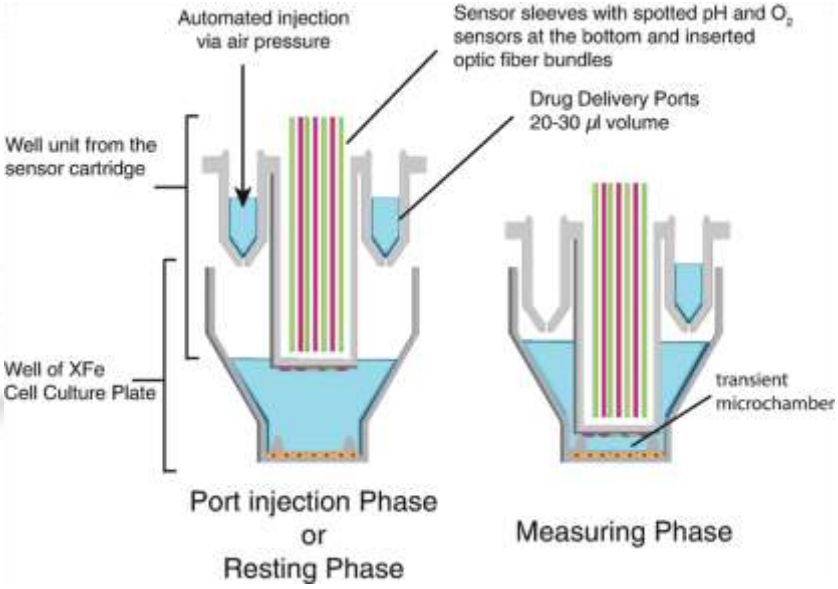
Stage & Sample Handling
- Automated X/Y and Z stage
- Z stage resolution ≤ 0.1 micron
- Multiple vessel formats (multi-well plates & slides of SBS standards
- Option to add robotic handling capabilities

Live Cell Module
- Temperature control: ambient to 42 °C
- CO2 control: 1 to 20%
- O2 control: 0 to ambient
- Humidity: ≥60% at 37 °C

HCS Studio Software
- On-the-fly phenotyping
- Icon-base guidance
- With >30 preset bioapplications
- Fully customizable for experienced users from image collection to tabulated results and population statistics
- Z-prime assay performer
- Single-cell level analysis possible

EXTRACELLULAR FLUX ANALYZER

Agilent Seahorse XFe96 Analyzer

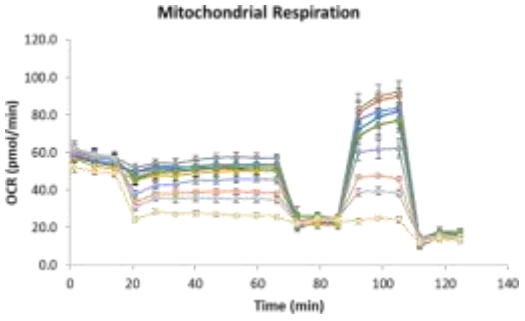


SPECIFICATIONS

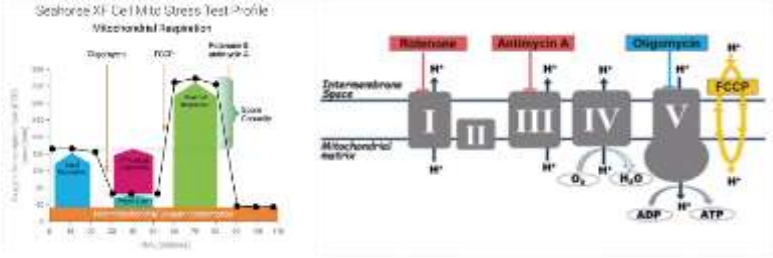
AGILENT SEAHORSE XFE96 ANALYZER

- Precision-controlled heating tray
- Sample temperature: 16-42 °C
- Assay running volume: 150-275 µL/well
- Sample requirements: 5000 – 500000 cells/well
- Assay types: Mito stress, real-time ATP rate, glycolytic rate, substrate oxidation and energy phenotype

NEWRI's extracellular flux analyzer measure the oxygen consumption rate (OCR) and extracellular acidification rate (ECAR) of live cells in a 96-well plate format. OCR and ECAR rates are key indicators of mitochondrial respiration and glycolysis as well as ATP production rate. Together these measurements provide a systems-level view of cellular metabolic function in cultured cells and small organism samples.



Measured mitochondrial respiration (Marques dos Santos et al., 2020, unpublished work



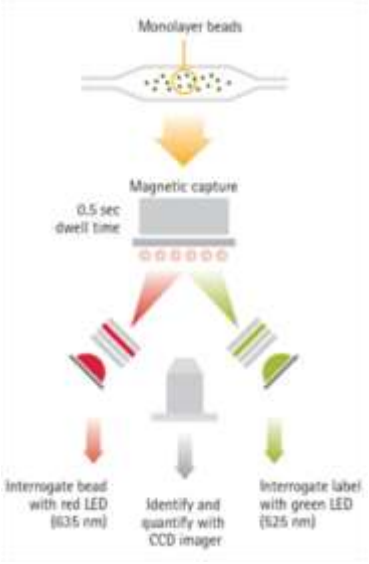
OCR and ECAR principles ("Seahorse XFE96 Analyzer," 2019)

FEATURES & APPLICATIONS

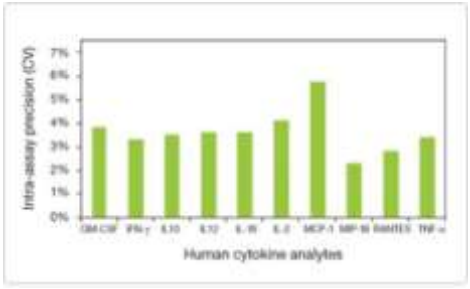
- 96-well plate format accommodates many conditions in a single run, for flexible assay design, dose-response studies, and screening
- Reports real-time metabolic rates in minutes, without sample extraction or labelling
- Four-port injection system with automated mixing function, for detection of live-cell responses to substrates, inhibitors, and other compounds in real time
- High-sensitivity analysis of as few as 5,000 cells per well using the custom 96-well plate

MULTIPLEXING SYSTEM

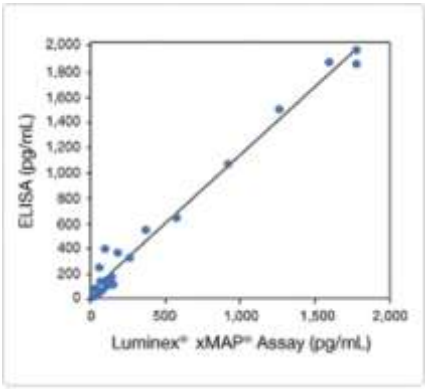
Luminex MAGPIX® Multiplexing System



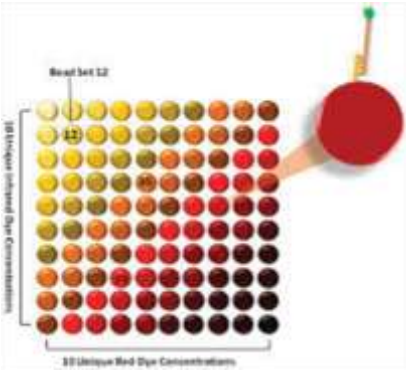
The Luminex MAGPIX® multiplexing unit performs up to 50 different tests in a single reaction volume and reads a 96-well plate in just 60 minutes. It features self-cleaning routines and magnetic bead compatibility. This instrument provides a platform for simple, cost-effective multiplexing of immunoassays, with reproducibility like that of ELISAs and western blotting.



Intra-assay precision for different cytokines using magnetic multiplexing system (ThermoFisher, 2020)



Correlation of real sample measurements values of traditional ELISA assays and magnetic bead assay using multiplexing system (ThermoFisher, 2020)



Different labeled bead regions available for multiplexing (ThermoFisher, 2020)

FEATURES & APPLICATIONS

- Simultaneously measure up to 50 analytes in as little as 25 µL of sample
- Alternative to protein detection methods such as enzyme-linked immunosorbent assays (ELISA) or western blotting

SPECIFICATIONS

LUMINEX MAGPIX® MULTIPLEXING SYSTEM

- Multiplexing: Up to 50 analytes per sample
- Sensitivity: Approximately 106 copies of DNA or single-digit picogram levels of protein
- Dynamic range (typical): ≥3.5 logs
- Read time: 96-well plate in ≤60 min (up to 4,800 tests/hour)
- Daily start-up/shut-down: ≤15 min

AUTOMATED LIQUID HANDLING PLATFORM

Agilent Bravo Automated Liquid Handling Platform

SPECIFICATIONS

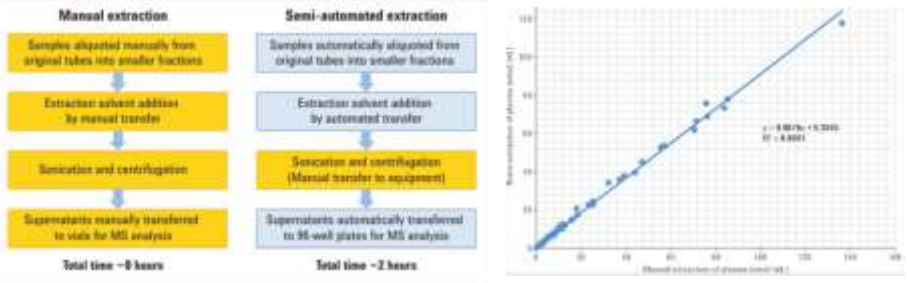
AGILENT BRAVO AUTOMATED LIQUID HANDLING PLATFORM

Bravo Head
- 96 and 384 pipette heads
- Low volume single-well, column, row, array, and full plate transfers support automated hit-picking and serial dilutions
- High-precision, rapid-swap pipette heads match liquid handling performance to the application

Bravo Deck Layout Components
- Nine pipettable deck positions provide locations for tips and plates
- Optional plate gripper relocates labware, removes lids, stacks tips and plates, automates vacuum filtration, and facilitates integration with automation-friendly devices

VWorks Control Software
- Execute multiple protocols simultaneously
- Monitor a Gantt Chart for real-time status of processes, plate instances, and devices
- Reduce operation costs
- Maximize walkaway time
- Set time constraints to minimize delays
- Advanced looping
- Increase reliability and walkaway time through intelligent routing of plate processing tasks to appropriate operating devices
- Customize protocols and task parameters, skip or repeat a task if certain conditions are met

The Bravo Automated Liquid Handling Platform is a flexible liquid handling platform that automates your sample preparation for screening applications such as compound management, cell-based assays, and biochemical assays. With this robotic liquid handling system, time is freed up and consistent data are achieved across samples and users.



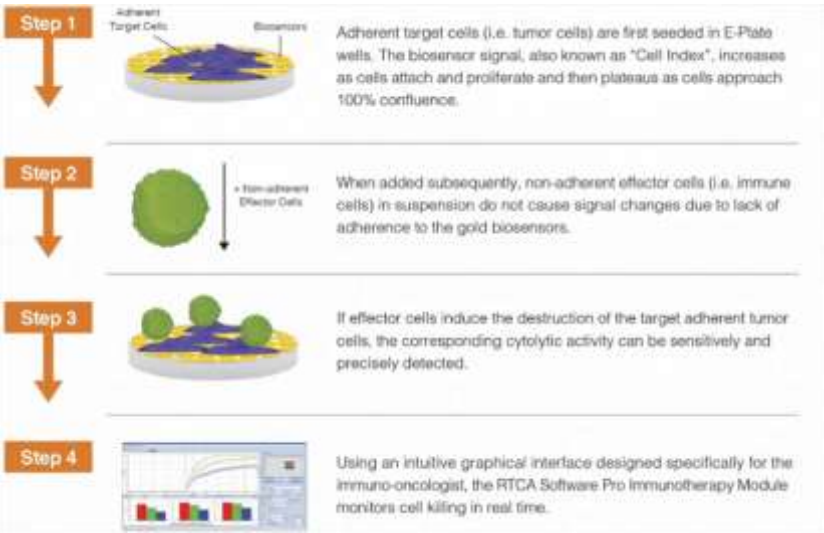
Semi-automated lipid extraction using Bravo (M.Wenk et al., 2015)

FEATURES & APPLICATIONS

- Precise – The Bravo Platform uses proven high-accuracy pipette heads for dispensing from 100 nL to 200 µL in 96- and 384-well microplates with either disposable or fixed tips for consistent and reproducible results in a wide range of applications
- Versatile – Liquid can be transferred in in minutes, and numerous platepad options are available to enable a wide range of assays and time saving
- Functional – Unique open design permits access from all sides for simple system integration as well as for standalone use
- Applications:
  - Automatic sample preparation in metabolomics
  - Next-generation sequencing
  - Cell and protein analysis
  - High-throughput screening drug discovery
  - Plasma proteomic preparation
  - Lipid Extraction

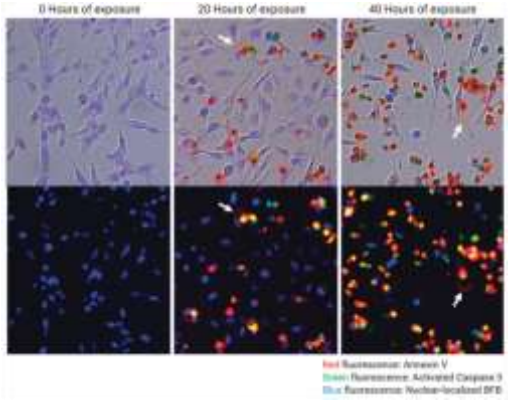
REAL-TIME QUANTITATIVE CELL ANALYSIS (RTCA)

Agilent xCELLigence RTCA eSight - Imaging & Impedance



xCELLigence RTCA used for killing assays, simple and high throughput workflow ("Cancer Immunotherapy", Agilent, 2020)

The xCELLigence RTCA eSight- Imaging & Impedance enables life science researchers and drug discovery research scientists better insights into cellular function. The Agilent cell analysis portfolio covers many measurement modalities, including energy metabolism, real-time cell viability, contractility, movement (impedance), and flow cytometry.



Corroborating the impedance response with live cell images. Image panels demonstrate the progression of apoptosis 20 and 40 hours after treating A549-Blue cells with 5.5 µm MG132. White arrows denote large membrane blebs that contain phosphatidylserine in their outer leaflet (Agilent Application Note 5994-1212EN, 2019)

FEATURES & APPLICATIONS

- Combines label-free xCELLigence real time cell analysis technology with live cell imaging in red, green, and blue
- Simple workflow adapts to differing experimental protocols to deliver physiologically relevant data while monitoring cell health, strength of adhesion, changes in morphology, proliferation, and cytolysis in primary cell cultures or standard tissue culture cell lines
- Flexible live cell imaging utilizes brightfield capabilities, three fluorescence channels, a multitude of well plate formats, and the capability of user-defined schedules
- RTCA provides a continuous readout of cell number, proliferation rate, cell size/shape, and cell-substrate attachment quality
- Applications:
    - Cancer immunotherapy
    - Virology & infectious diseases
    - Cell barrier function
    - Cell adhesion
    - Apoptosis
    - Cell characterization
    - Live cell imaging

SPECIFICATIONS

AGILENT XCELLIGENCE RTCA ESIGHT - IMAGING & IMPEDANCE

Microplates (E-Plates)

- Gold biosensors embedded in the bottom of each well continuously and noninvasively monitor changes in cell number, cell size, and cell-substrate attachment quality
- Six 96-well plant can operate and monitor simultaneously

xCELLigence software

- Automatically acquires data with the proprietary xCELLigence biosensor technology
- Label-free xCELLigence RTCA technology with live cell imaging in 3 colors (red, green, and blue)

AUTOMATED IMAGING SYSTEM

Invitrogen™ EVOS™ M7000 Automated Imaging System

SPECIFICATIONS

INVITROGEN™ EVOSTM M7000 AUTOMATED IMAGING SYSTEM

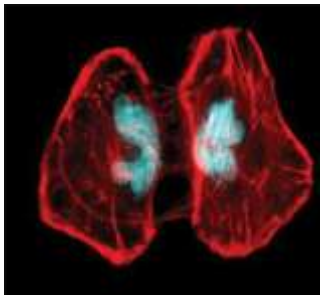
Optics, illumination & objectives
- Infinity-corrected, 45 mm parfocal distance
- 1.25X to 100X objectives
- 5-position objective turret
- Both LWD and coverslip-corrected objectives
- Single, interchangeable unit of fluorescent light cubes
- 5-position illumination chamber (bright field + 4 fluorescence)
- Automatic recognition of cubes
- Independent intensity control for LED illuminators within the same automated scan

Stage
- Fully automated and motorized X/Y scanning stage with submicron resolution
- Option to add onstage incubator for temperature, humidity and gas control
- Compatible with various vessels (6-1536 well plates, Petri dishes, slides, T-25 flasks)

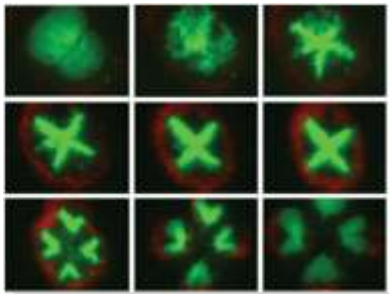
Imaging
- 4 imaging modes: fluorescence, colour brightfield, brightfield, and phase contrast
- 3.2 MP CMOS cameras (color & monochrome)
- Movie capturing
- Z-stacking
- Fixed/Autofocus in automation
- High-resolution tile scanning
- Time-lapse/area scan modes

Invitrogen™ Celleste™ Image Analysis Software
- Automated analysis of 2D and 3D

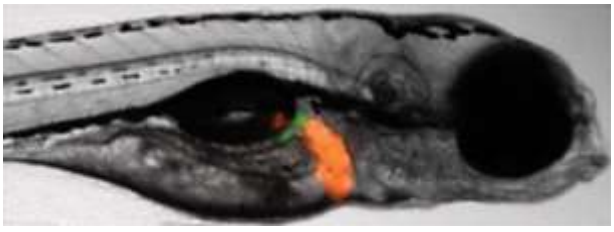
The M7000 automated imaging system is NEWRI's newest addition for rapid imaging of 2D or 3D samples. It is a high-performance, fully automated, inverted, multi-channel fluorescence and transmitted light imaging system. High-quality images can be generated by automated scans in a consistent setting and time-saving manner.



Excellent multiplexing images of HeLa cells captured using M7000 with an Olympus 60X Aprochromat Oil objective (Thermo Fisher, 2020)



Time-lapse series of HeLa cells undergoing cell division. Cells were imaged every 30 min for 16 hr using a 20x objective and EVOS on stage incubator. (Thermo Fisher, 2020)



Semi-automated lipid extraction using Bravo (M.Wenk et al., 2015)

FEATURES & APPLICATIONS

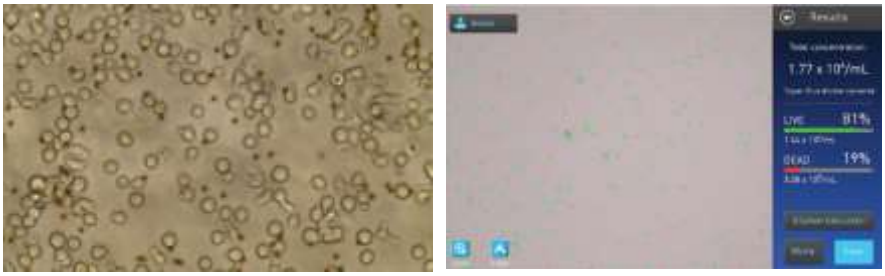
- Newest model of the EVOS series of imaging system, as of 2020 (previous: EVOS FL Auto & M5000)
- High-speed scan that generates high-quality images
- 96-well, fixed focus protocol with 3 channels, 1 image/well can be finished within 5 minutes
- Live cell imaging for various types of fluorescence assays with multiplexing flexibilities
    - Applications:
    - Fluorescent labeled assays
    - Immunohistochemistry
    - Neurobiology
    - Immuno-oncology
    - Basic 3D cell imaging
    - Monitoring growth

CELL CULTURE FACILITIES

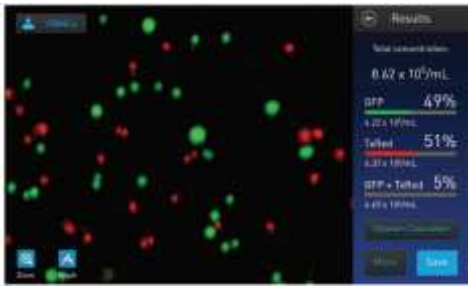
Invitrogen™ EVOS™ XL Core microscope & Countess™ II cell counter

Countess™ II with two EVOS™ Light cubes (left) & EVOS™ XL Core Imaging system (right)

NEWRI's cell culture room is equipped with facilities that provide quality support to routine cell culture activities. EVOS™ XL Core imaging systems allows convenient quick check of cell status as well as high-resolution, full-colour image documentation of cells in different types of vessels. Countess™ II FL automated cell counter provides fast and accurate cell count, dilution calculations, and rapid analysis of staining or fluorescence.



EVOS™ XL was used to examine the isolated T-cells in presence of magnetic beads (left) ; while Countess™ II could determine T-cell viability even in presence of magnetic beads (right) (Thermo Fisher, 2019)



Viability assay using 2-coloured fluorescence it and examined by Countess™ II, Single and double positive cells are automatically counted. Image and statistics can be saved and exported (Thermo Fischer, 2017)

FEATURES & APPLICATIONS

- Cell count and dilution for seeding; confirmation of seeding uniformity
- Monitoring of cell growth and density
- Quality examination and control for downstream assays
- Quick viability and apoptosis screening
- Quick examination of transduction efficiency
- Wide selection of light cubes for targeted channels
- Rapid documentation for archives and publications

SPECIFICATIONS

NVITROGEN™ EVOS™ XL CORE MICROSCOPE & COUNTESSTM II CELL COUNTER

EVOS™ XL Core Imaging System
Compact & all-in-one essentials

- Fits in biosafety cabinets
- On-screen display
- 12.1" high-resolution colour monitor with adjustable tilt
- Stages for common types of sample vessels
- Minimal handling and maintenance
- Output to USB drive (2 port)

System Highlights

- Adjustable-intensity LED
- Infinity-corrected optical system
- 4-position objective turret
- Bright field and phase contrast
- 4 objective turrets equipped (4x, 10x, 20x & 40x)
- Chromogenic & colorimetric detection
- Colour camera, 24-bit full colour detection
- Manual & on-screen control

Countess II automated cell counter

- State-of-the-art optics, auto-lighting
- Autofocus/manual focus
- Adjustable gating
- Brightfield & 2 user-definable FL channels (allows multiplex)
- Capacity of one 2-chamber slide (disposable/reusable)
- 7in Capacitive touch screen
- Image analysis software for rapid assessment of cells
- Cell size: 4-60 µm (detection), 7-60 µm (viability)
- Concentration: 1x104 - 1x107 cells /mL
- Total count, viability, average cell

BACTERIAL QUANTIFICATION

IDEXX Quanti-Tray Sealer PLUS

SPECIFICATIONS

IDEXX QUANTI-TRAY SEALER PLUS

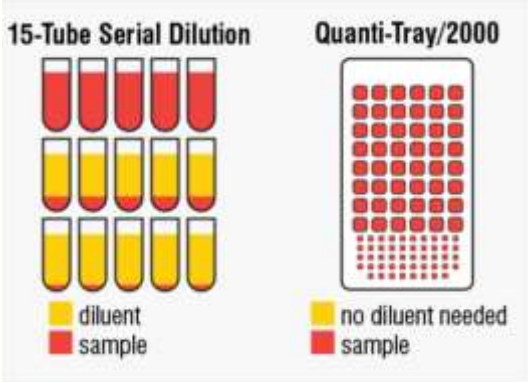
Accuracy
- Detection of up to one organism per
- 100ml
- 95% confidence limits better than 5 – or 10 – tube Most Probable Number (MPN) technique.

Ease of Use
- No media preparation required
- No pipetting required
- No dilutions required (up to 200 for Quanti-Tray, and up to 2419 for Quanti-Tray/2000)

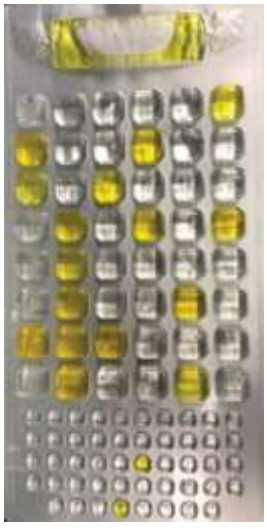
Rapid Assessment
- Results in 24 hours or less for Quanti-Tray and Quanti-Tray/2000

Cost Effective
- Minimal equipment and accessories required

The Quanti-Tray Sealer PLUS is the latest model in the Quanti-Tray system applications that can be used to seal both 51-well Quanti-Trays and the 97-well Quanti-Tray/2000. With a warm-up time of just 2-3 minutes, this latest model is capable of fast sealing, high energy efficiencies, and have easily accessible components for cleaning to ensure quality control and assurance.



Comparison of traditional 15-Tube Serial Dilution versus Quanti-Tray/2000 (IDEXX, 2020)



Total coliforms and E. Coli assessment of one river water sample (Snyder et al., unpublished work)

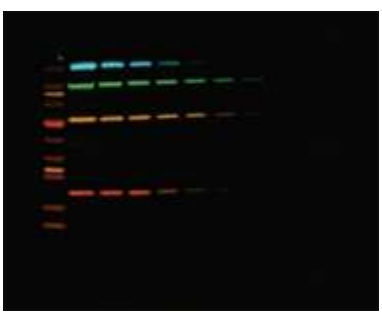
FEATURES & APPLICATIONS

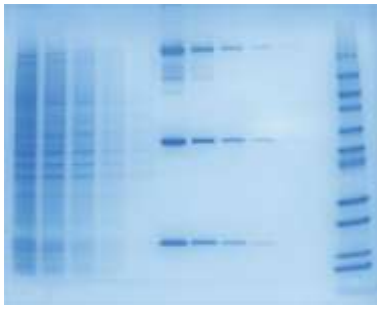
- Using the standard method's Most Probably Number (MPN) statistical approach, the Quanti-Tray yields a counting range of 1 – 200 (Quanti-Tray) and 1 – 2419 (Quanti-Tray/2000) with a confidence limit of 95%
- Unlike traditional 15-Tube Serial Dilution techniques, Quanti-Tray does not use test tubes nor Durham tubes, and does not require any dilutions, increasing the overall ease of use for researchers.
- Quantify coliforms, E. coli, enterococci, Pseudomonas aeruginosa, and Heterotrophic Plate Counts (HPC)

PROTEIN ELECTROPHORESIS, WESTERN BLOTTING & IMAGING SYSTEM

Invitrogen™ iBright™ FL1500, iBlot Dry Blotting & iBind western device

NEWRI's protein electrophoresis, western blotting and imaging system includes the iBright™ FL1500 Imaging System supports the main imaging applications of fluorescent, chemiluminescent, and colorimetric western blots, in addition to fluorescent stained nucleic acid gels, fluorescent stained protein gels, colorimetric stained protein gels, and colorimetric membrane stains. Protein transfer and western blotting procedures are also accelerated by dry blotting and an automated sequential lateral flow (SLF) device.





Multiplexed fluorescent western blot (left); colorimetric stained protein gel (right) (ThermoFisher, 2020)

Colony plate (ThermoFisher, 2020)

FEATURES & APPLICATIONS

- Cell count and dilution for seeding; confirmation of seeding uniformity
- Monitoring of cell growth and density
- Quality examination and control for downstream assays
- Quick viability and apoptosis screening
- Quick examination of transduction efficiency
- Wide selection of light cubes for targeted channels
- Rapid documentation for archives and publications

SPECIFICATIONS

INVITROGEN™ IBRIGHT™ FL1500, IBLOT DRY BLOTTING & IBIND WESTERN DEVICE

iBright™ FL1500 Imaging System
- 9.1 MP cooled CCD camera
- Five fluorescence channels
- 22.5 x 18.0-cm field of view
- Smart Exposure technology

iBind Flex Western Device
- Automated western-processing device that performs every step from blocking to washes to antibody incubation via sequential lateral flow (SLF)

iBlot 2 Dry Blotting System
- Compatible with different protein gel chemistries (tris-glycine, bis-tris, tris-acetate, and tricine).
- Complete transfer of proteins from the gel to the blotting membrane is accomplished in approximately 7-8 minutes

iBlot Mini gel tank and 300W power supply
- Vertical mini-gel electrophoresis system

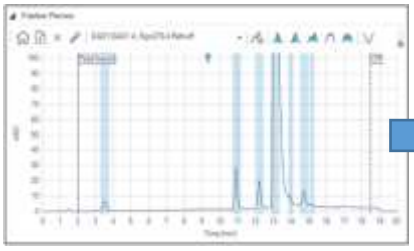
AUTOMATED SAMPLE PREPARATION

NEWRI's new range of automated sample preparation equipment offer high-throughput, cost and time saving solutions for sample purification, concentration, drying, and processing. Automation eliminates human errors, and gives the user flexibility in mixing and matching the most ideal and efficient configuration for sample preparation – greatly benefitting users with larger sample volumes. Overall solvent consumption is also reduced, improving recovery and reproducibility

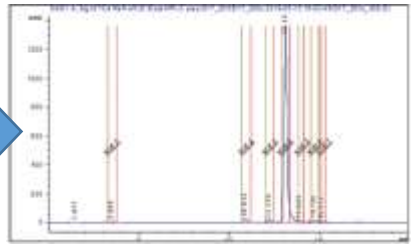
PREPARATIVE LIQUID CHROMATOGRAPHY SYSTEM

Agilent 1260 Infinity II Preparative LC System

The Agilent 1260 Infinity II Preparative LC system's dynamic pump flow range, multi-wavelength detection, high purity fraction collection, and automated protocols make it an ideal equipment for routine & high-throughput purification of both small and large sample volumes. Coupled with an auto sampler and a manual injector, it also gives users a wide range of sample injection volumes to choose from.



Fraction preview of a commercial "1010" additive powder sample (Boborodea & Brookes, 2018)



7 fractions collected in 7 vials obtained by fraction collection (Boborodea & Brookes, 2018)

FEATURES & APPLICATIONS

- Fractionation of samples for effect-directed (EDA), useful for identification of toxicant(s) that occur in mixtures in the environment, especially those that are causative agents of specific adverse effects
- Sample clean-up/preparation of challenging environmental/biological samples (e.g. removal of lipids, proteins, and nucleic acids)
- Natural products/reaction purification for downstream analysis (e.g LC-MS and NMR)

SPECIFICATIONS

AGILENT 1260 INFINITY II PREP LC SYSTEM

1260 Infinity II Preparative Binary Pump
- Dynamic flow range between 0.01-50mL/min at 0.01mL/min increments at 420 bar
- 2 solvent lines can be used concurrently

1260 Infinity II Preparative Auto Sampler & Manual Injector
- Auto Sampler: injection capability between 0.1 to 3.6mL with high precision (1uL: <5%; 5uL: <2%; 10uL, 50uL: <1%; 500-3600uL: <0.25% precision).
- Manual Injector enables up to 20mL injection volumes
- Maximum capacity of 132 sample vials

1260 Infinity II DAD
- Full spectral detection at up to 120 Hz sample rate
- Wavelength range of 190 to 950 nm
- Able to acquire 8 wavelengths simultaneously
- Spectral resolution and signal to noise optimization possible with slit width options (1, 2, 4, 6, 16 nm)
- Wavelength bunching 1-400nm
- Standard flow cell withstands up to 120 bar

1260 Infinity II Preparative Fraction Collector
- Integrated fraction delay sensor (patented) for optimum recovery & delay volume calibration – guarantees highest purity of collected fractions
- Maximum flow rate of 100mL/min

1260 Infinity II Column Organizer
- Up to 30mm ID columns

AUTOMATED SOLID PHASE EXTRACTION (SPE)

Thermo Scientific™ Dionex™ AutoTrace™ 280 SPE Instrument

SPECIFICATIONS

THERMO SCIENTIFIC™ DIONEX™ AUTOTRACE™ 280 SPE

- Extracts up to 6 samples simultaneously
- Allows use of at least 5 distinct solvents
- Positive pressure to ensure controlled flow of liquids for improved analytical precision
- Compatible with 1, 3, 6mL cartridges or 47mm SPE disks
- Preloaded with 24 operational methods
- Ability to process sample volumes from 20mL to 4L sample volumes
- Closed system with vent to ensure no exposure of solvent vapors to operator
- Accuracy of sample pump: ± 2.5%

SPE is one of the simplest, cost effective and versatile methods of sample preparation. It is widely used in many environmental laboratories to pre-concentrate and clean-up samples. The system automates all four steps of SPE (conditioning, loading, rinsing, and eluting), reducing solvent consumption and improving recovery and reproducibility. It boosts productivity and reduces cost of analysis by processing up to six samples simultaneously in 2- 3 hours with minimal user intervention. In addition, it eliminates human error due to variation between operators, batches and samples in manual SPE.

	Dionex AutoTrace 280 SPE		Vacuum Manifold SPE	
Compound	Recovery %	%RSD	Recovery %	%RSD
Atrazine	88	1.8	54	12.2
Propazine	91	1.5	80	7.3
Alachlor	99	3.4	96	4.1
Metachlor	99	4.3	96	2.9

N = 6

Pesticide recovery study: Thermo Scientific™ Dionex™ AutoTrace™ 280 Solid-Phase Extraction Instrument workstation versus vacuum manifold SPE (M.J.M. Wells, 2000)

FEATURES & APPLICATIONS

- Meets requirements of US EPA 500 methods; designed to identify and quantify organic compounds in municipal drinking water
- Meets requirements of US EPA 600 methods; designed for monitoring organic pollutants in industrial and municipal waste discharges
- Supports SPE preparation for chromatography methods such as GC, GC-MS, LC, and
- LC-MS, and cover the following sample matrices:
  - Pesticides (OCPs, OPPs, diquats, and urea ionic pesticides)
  - Pollutants (phenols, PCBs, nitrosamines, and dioxins)
  - Personal care products (pharmaceuticals, steroids, and endocrine disruptors)
  - Total petroleum hydrocarbons (diesel-range organics)
  - Beverages and flavor components

ACCELERATED SOLVENT EXTRACTOR (ASE)

Thermo Scientific™ Dionex™ ASE™ 350

ASE is a technique for extraction of organic compounds from solid or semisolid samples using liquid solvents in short periods of time. Dionex™ ASE™ 350 automates the extraction process including filtration and clean up. Combinations of solvents are used at elevated temperatures and pressures leading to increased productivity and cost savings as extraction times and solvent consumption are reduced. It also replaces other extraction techniques such as Soxhlet, sonication and shaking.

FEATURES & APPLICATIONS

- Meets requirements of US EPA Method 3545A for Pressurized Fluid Extraction (PLE) or equivalent methods
- Supports PLE of following matrices:
  - Base/ neutrals and acids (BNA)
  - Organophosphorous pesticides (OPP)
  - Chlorinated pesticides and herbicides
  - Polychlorinated biphenyls (PCB)
  - Polychlorinated dibenzo-dioxins (PCDD)
  - Polychlorinated dibenzofurans (PCDF

SPECIFICATIONS

THERMO SCIENTIFIC™ DIONEX™ ASE™ 350

- Chemically inert pathways support acid/ alkaline sample matrices and solvents
- 24 position sample carousel
- 12 x 22mL Stainless Steel (SS) sample cells with PEEK seals and SS frits (Max of 100mL cells available in market)
- Temperature control during extraction: bup to 200°C, with precise control of cell & contents: ± 5 °C from set point
- Extraction pressures up to 1500psi
- Pump delivers up to 70mL/min for fast extraction
- Mixing and delivery of up to 3 solvents in variable volume ratios
- Multiple sequential extractions per cell possible
- Extracts are ready for direct injection or final clean up
- Sensors for temperature, pressure and liquid leaks trigger automatic shut-off when required

REACTOR MODULE WITH EVAPORATOR

Thermo Scientific™ Reacti-Therm™ with Reacti-Vap™ Evaporator

SPECIFICATIONS

THERMO SCIENTIFIC™ REACTI-THERM™ WITH REACTI-VAP™ EVAPORATOR

Reacti-Therm™ modular base

- Triple block module
- Blocks with capacity of 8 x 25mm OD vials or 8 x 17mm OD test tubes
- Temperature range: 10 °C above ambient to 200 °C
- Temperature uniformity: ± 0.5 °C
- Stirrer operation range: 150- 700 ± 100 rpm

Reacti- Vap™ Evaporator

- 27-ports for delivery of pressurized N2 gas (max 2psi)
- Leak proof attachment between needles & manifold
- 4-inch Stainless Steel needles

NEWRI's Thermo Scientific™ Reacti-Therm™ with Reacti-Vap™ Evaporator combines heating, stirring and evaporation in a modular system which can be configured to required applications. With Reacti-Therm™'s heating and stirring capability, users can perform derivatization or small-scale reactions such as alkylation or silylation. Interchangeable dry block heaters provide a wide selection to suit users' needs and ensure uniform and stable heating to vials, test tubes or microcentrifuge tubes. Together with the Reacti-Vap™ Evaporator, a gas manifold that delivers pressurized gases, users can evaporate solvents with the same system.

FEATURES & APPLICATIONS

- Derivatization reactions:
  - Silylation, alkylation, and acylation derivatization reactions for GC sample preparation
  - Esterification of fatty acid to fatty acid methyl esters
  - Protein hydrolysis and vacuum hydrolysis reactions for amino acid analysis by HPLC
- Small scale reactions
- Sample incubation
- Sample evaporation

VACUUM CONCENTRATOR

Thermo Scientific™ Savant™ SpeedVac™ SPD300DDA

The SpeedVac™ SPD300DDA vacuum concentrator effectively removes a broad range of aggressive and volatile solvents to concentrate or dry solutes, analytes, and residues while providing complete sample recovery. It combines with ultralow temperature refrigerated vapor traps to enable fast removal of solvents. It is ideal for drying aggressive organic solvents and combinatorial chemistry solvents, and is capable of drying larger quantities of samples at one time and can support high-volume sample preparation needs.

FEATURES & APPLICATIONS

- Drying both high boiling points and low boiling point solvents, such as strong acids, DMSO, DCM, ammonium hydroxide, methanol, & toluene
- Solid-phase extractions
- Drying lipid extracts
- Flash chromatography fractions
- Solid-phase synthesis cleavage solutions such as protein hydrolysates and evaporating synthesis solids

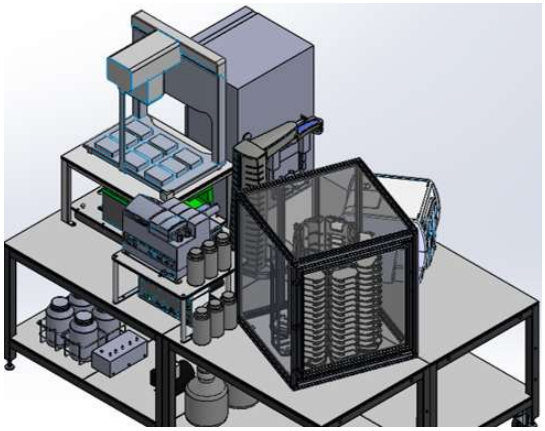
SPECIFICATIONS

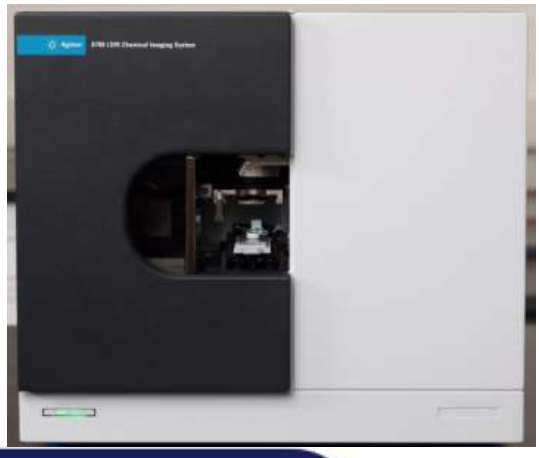
THERMO SCIENTIFIC™ SAVANT™ SPEEDVAC™ SPD300DDA VACUUM CONCENTRATOR

- 4 preset programs and 8 user defined programs to set heat, run time, ramp rate and vacuum level for efficient operation
- 4 IR heat lamps, and PTFE-coated chamber and tubing for aggressive solvent evaporation
- 4-place flask/plate rotor accessory
- Chamber temperature: 35°C to 80°C, 5°C increments

RVT5105-115 Ultralow-temperature refrigerated vapor trap

- Capacity: 4L
- Temperature: -105°C





NEWLY ADDED EQUIPMENT

REAL-TIME PCR AND DIGITAL PCR INSTRUMENTS

Quanstudio™ 7 Pro real-time PCR system & QIAcuity One digital PCR system

QuantStudio™ 7 Pro Real-Time PCR System

QIAcuity One Digital PCR system

In real-time PCR, the amplification of targeted DNA molecule is monitored in real-time, with which targets can be quantitatively/semi-quantitatively analysed. Applied Biosystems' Quanstudio (QS) 7 Pro allows standard and fast cycles with exceptional reproducibility and application versatility. Digital PCR is a refinement of conventional PCR where each sample is split into partitions of nanolitres prior to PCR. Digital PCR is quantitative and a more precise method than conventional PCR. Qiagen's QIAcuity One is a fully integrated digital PCR system that offers flexible sample throughput and advanced multiplexing capabilities.

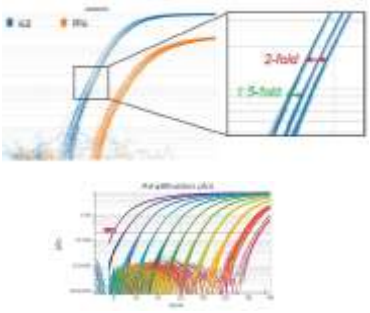


Fig 1. Detection sensitivity of 1.5 fold (top) and dynamic range of 10 logs (bottom). (From Thermo Fisher, Quanstudio Pro white paper and brochure)

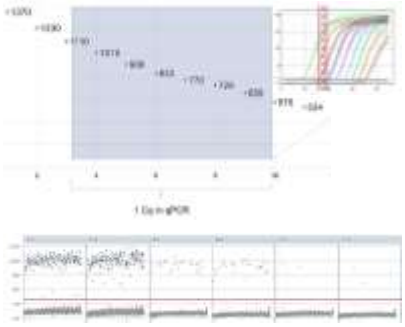


Fig 2. (Top) Detection of small changes within 1 Cq (insert) in qPCR (From Qiagen). (Bottom) 1D scatterplot of 3-log dilutions in duplicates with clear signals (Li et al. unpublished data)

FEATURES & APPLICATIONS

- Both systems allow use of intercalating dyes and probe-based assays.
- Both systems are compatible with 5 common detection channels: FAM, VIC/HEX, TAMRA, Texas Red and Cy5.
- QS7 also allows Cy5.5 detection (customized calibration required)
- QS 7 Pro allows applications including relative quantitation, standard curves, high resolution melt, genotyping, and presence/absence determination.
- Both 384-well and 96-well (0.2mL) blocks are available for use with QS 7
- QIAcuity One allows applications including gene expression and miRNA analysis, mutation detection, copy number variation, microbiome analysis and pathogen detection, NGS validation and GMO detection.
- QIAcuity has an additional independent reference channel for QC and calculation.
- QIAcuity One is compatible with 96-well (8.5K) and 24-well (8.5K or 26K) plates.

SPECIFICATIONS

QS7 Pro Real-time PCR

- Six decoupled excitation and emission filter channels with 21 filter combinations
- Multiplex of 5-6 targets
- Interchangeable block system
- Temperature range is 4-99°C and uniformity is 0.4°C
- Up to 6 different temperature zones across 96-well block
- Detect changes down to1.5-fold in single-plex reactions and obtain 10 logs of linear dynamic range.
- Standalone free analysis software for individual users

QIAcuity One Digital PCR

- Up to 26K partitions
- Absolute quantification without the need of standard curves
- Multiplex up to 5 dye channels
- With an independent reference channel
- Allows re-cycling and re-imaging
- Time to result 2-3 hours
- Standalone free analysis software for individual users

LASER DIRECT INFRARED (LDIR) CHEMICAL IMAGING SYSTEM

Agilent 8700 LDIR

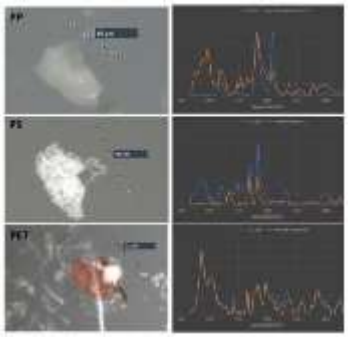
SPECIFICATIONS

Agilent 8700 LDIR system

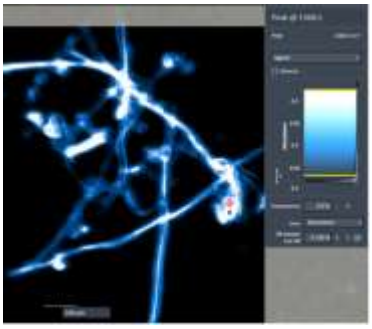
- **Operating Temperature: 20 – 30 °C.**
- **Light Source:** Agilent Technologies, Quantum Cascade Laser (QCL)
- **Spectral range:** 1800-975 cm-1
- **Pixel Size Range:**
  Reflection 1 - 40 µm
  ATR 0.25 - 2 µm
- **Spatial Resolution:**
  Reflection Down to 5.5 µm
  ATR Down to 1.5 µm
- **Speed of Spectra Collection:** 1s
- **Laser Polarization:** Linearly polarized with fully automated 360-degree rotational control
- **Maximum Sample Size**
  Width: 25 mm
  Depth: 75 mm
  Height: 20 mm
- **Detector**: MCT Detector (Thermoelectrically Cooled, does not require liquid nitrogen)
- **Physical Dimension**
  Width: 420 mm (16 inches)
  Height: 378 mm (15 inches)
  Depth: 615mm (24 inches)
- **Laser Class:** Class 1 (eye safe)
- **Clarity software key features:**

1. Purpose built and modern, image centric user interface
2. Fully automated processes for sample profiling, visual and IR focus, scans etc.
3. Fully Automated ATR approach
4. Integrated library search
5. Optional fully automated microplastics workflow

NEWRI's new Laser Direct Infrared (LDIR) provides a sophisticated new approach to chemical imaging and infrared spectral analysis. Designed to be used by experts and nonexperts alike, the LDIR provides a simple, highly automated approach for obtaining reliable high-definition chemical images of constituents on surfaces. Agilent 8700 LDIR enables more samples, in greater detail, in minutes vs. hours. With automated workflows for pharmaceutical tablets and microplastics in environmental samples, as well as capabilities for analyzing tissues, laminates, polymers, and fibers, the LDIR can help to make better, faster decisions in product development, reducing costs and analysis time.



Different types of microplastics (PP, PE & PET) detected in water samples by LDIR. (Agilent App Note 5994-2421EN)



The IR single peak image at $\tilde{\nu}$ = 1368.5 cm-1 of the aggregate of the cellulose fibers and natural particles detected by LDIR (Agilent App Note 5994-2421EN)

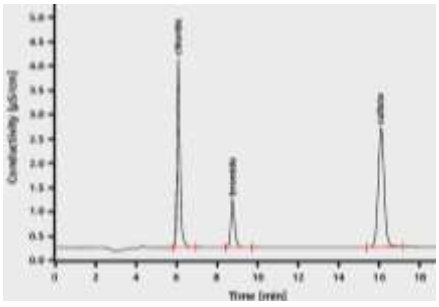
FEATURES & APPLICATIONS

- Highly automated workflow for characterizing surface distribution of components in pharmaceutical tablets
- Automated chemical imaging workflow for microplastics in environmental samples and drinking water
- Ability to survey and image large sample areas and then interrogate smaller areas of interest in more detail without changing any optics
- Change the field of view from microns to centimeters or the pixel size from 1 to 40 µm, and acquire ATR imaging data with pixel size as small as 0.1 µm for unmatched image detail and spectral quality
- Rapidly identify unknowns using either commercial or custom libraries via ATR capabilities
- Obtain relative quantitative information of sample constituents without complex method development
- Quantum cascade laser (QCL) and thermoelectrically cooled detectors eliminate the need for liquid nitrogen, reducing operating costs and simplifying maintenance

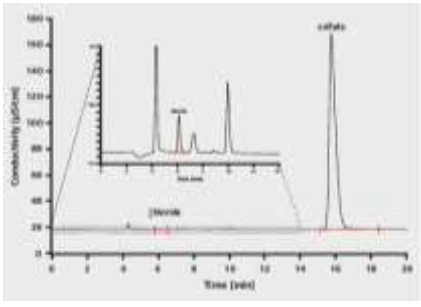
COMBUSTION ION CHROMATOGRAPHY (CIC)

Metrohm 940 CIC with Autosampler

Combustion Ion Chromatography (CIC) extends the range of ion chromatography to all types of combustible samples. It allows for simultaneous determination of the various halogens and sulfur in widely differing matrices. The system is ideal for analysis in a variety of fields, as the nature of the sample matrix need not be known nor complicated method development is necessary.



Determination of halogens, sulfur in certified polyethylene pellets ERMEC681k: chloride: 102.4%, bromide 95.4%, sulphur 100.3%
(Metrohm app note AN-CIC-003)



Determination of halogens and sulfur in coal reference material NIST 2682b: chloride, 103.4%, sulfur 96.8%
(Metrohm app note 8.000.6091)

FEATURES & APPLICATIONS

- Total Fluorine, Chlorine and Sulfur in Aromatic Hydrocarbons and Their Mixtures
- Analysis of Halogens in Palm oil, polymer sample
- Total Fluorine in Coal and Coke by Pyrohydrolytic Extraction and Ion Selective Electrode or Ion Chromatograph Methods
- Total Fluorine, Chlorine, and Sulfur in Liquid Petroleum Gas (LPG)
- Chlorine, bromine and sulfur in low-density polyethylene (ERM®-EC680k)
- Fluorine determination from Fluorochemicals in fabrics
- Test of basic material for printed circuit boards for absence of halogens
- Analysis of Organic bound fluorine in Ezetimibe (Drug)

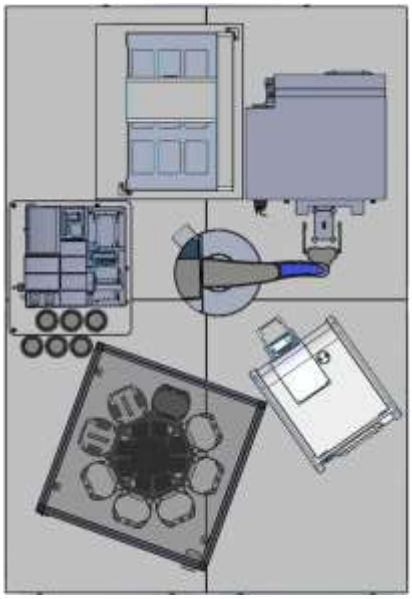
SPECIFICATIONS

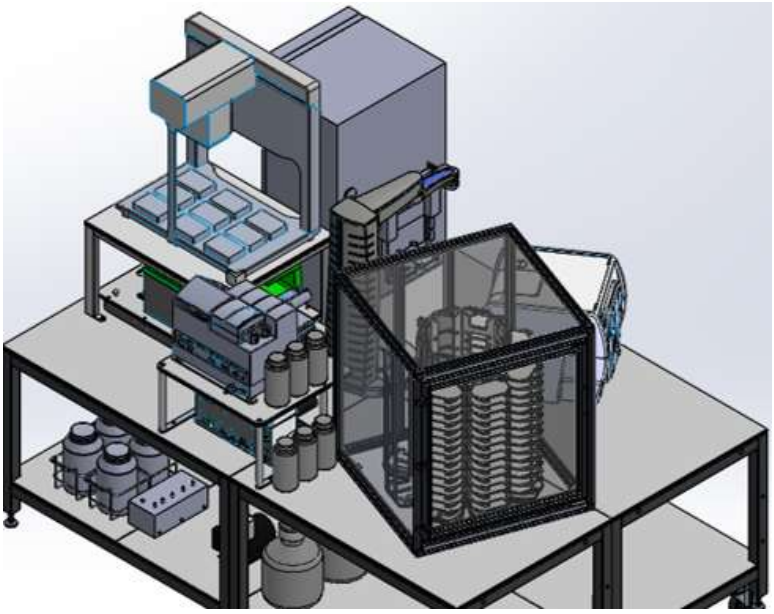
METROHM 940 CIC

- **Combustion module (Analytik Jena)**
- Enables the sample digestion of flammable samples of all types under pyrolysis and oxidation.
- **Full automated Liquid/Solid Autosampler MMS 5000 (Analytik Jena)**
- **920 Absorber Module (Metrohm)**
- Ensures that the gaseous compounds of the analytes are dissolved and channeled to the IC. It is responsible for the entire Liquid Handling.
- **940 Professional IC Vario**
- Does suppressor regeneration and has eluent production module.
- Has Conductivity detector system for 7 common anions detection.
- Has Ampherometric detector for Cyanide and Sulfide analysis
- **IC Autosampler**
- Has the following functions: Ultrafiltration, Preconcentration, Autodilution, Solid sample extraction.

AUTOMATED HIGH-THROUGHPUT SCREENING (HTS) PLATFORM

Custom design (Instruments by ThermoFisher Scientific, Agilent Technologies, and Biotek)





SPECIFICATIONS

Automated liquid handling platform (Agilent Bravo) - 96LT head (2.0 to 250 µL) and 96ST head (0.3 to 70 µL), available with magnetic bead plate, heating shaking station and 2x Peltier thermal station.

Digital dispenser (ThermoFisher Multidrop Pico-8) - Dispensing of 11 pL to 20 µL (8-well dispensing head) or 1 nL to 200 µL (4-well dispensing head).

Imaging/multi-mode reader (BioTek Cytation 5).

- **Automated Imaging** - Fluorescence, phase contrast, brightfield, high contrast brightfield, color brightfield and phase contrast, 4x, 10x, 20x, objectives, DAPI, GFP, Texas Red and RFP light cubes.
- **Multi-mode microplate reader** - UV-Vis absorbance, fluorescence, luminescence, fluorescence polarization, time-resolved fluorescence.

Multi-mode dispenser (Biotek MultiFlo FX) - dispensing (peri pump and syringe) 96-, 384- and 1536-well; microplate washing 96- and 384-well.

Microplate washer (Biotek 405 LS) - 96- and 384-well.

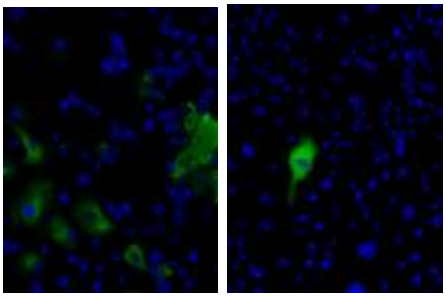
Incubator (Thermo Fisher Cytomat 2 C-LiN) - automated incubator, 10° to 50°C, with high humidity up to 95% r.H. stable CO2 conditions.

Carousel microplate/accessory hotel - dark incubation, 3 random access hotels and 5 sequential stackers.

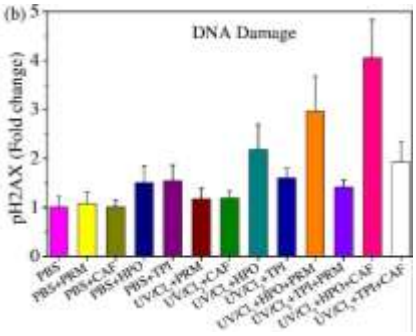
Microplate robot (ThermoFisher Spinnaker) - 4-axis SCARA-type robot.

System enclosure - enclosure with two FFU units, equivalent to ISO5 cleanroom classification.

NEWRI's automated High-throughput Screening (HTS) Platform is designed for cell-based assays, automated cell culture and biochemical assays. It can handle all steps of cell-based protocols from cell seeding to microplate reading or imaging. Automated incubator allows for long time experiments and the processing of different assays at the same time. Comprehensive liquid handling devices are used for sample processing, dilution and dosing into 96, 384 or 1536 well plate formats starting from 11 pL.



Cell-based focus forming assay (FFA) for viral titer determination



DNA damage HTS assay for evaluation of drinking water treatment process disinfection by-products formation (Wang, Marques dos Santos et al. 2021)

FEATURES & APPLICATIONS

- Start to end assay automation of different bioassays from different endpoints from cytotoxicity to gene reporter cell lines endpoints (e.g., estrogen receptor - ERα, glucocorticoid receptor - GR, CYP1A1, NFkB and AP1)
- Generation and long-term culture of 3D cell structures (spheroids, tumoroids) with gentle media exchange module.
- Automation of biochemical assays including ELISA, also capable of magnetic beads handling.
- Advanced liquid handling for digital titration, combinatorial studies, plate randomization and volume normalization.
- Compatible with 96,384 and 1536-well plate formats with up to 44 incubated plates for a total of more than 60,000 tests processed simultaneously.
- ThermoFisher's Momentum™ Workflow Scheduling Software for process monitoring and scheduling with intelligent data-driven decision-making capabilities

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