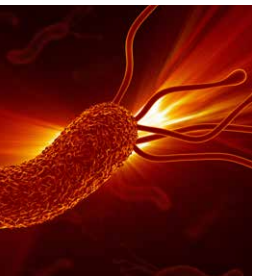
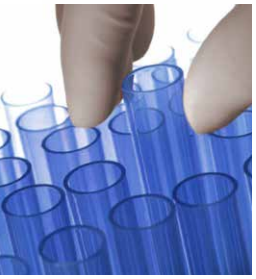
Decade Elite

Electrochemical detector





Electrochemical Detection in High Performance Liquid Chromatography (HPLC-ECD)

Why?

In terms of sensitivity and selectivity no optical detector (UV, Fluorescence, RI) nor aerosol based detector (ELSD, NQAD, CAD) can compete with the electrochemical detector. Whenever an analyte is electroactive, i.e., can undergo oxidation or reduction, electrochemical detection (ECD) can be applied.
For the analysis of small sample volumes or samples with small quantities of analyte in complex matrices, ECD is the detector of choice.

For sensitive and selective detection in (U)HPLC
Electrochemical Detection is the best choice!

When?

Liquid chromatography such as HPLC or UHPLC with electrochemical detection provides a more sensitive and selective alternative to most other detection techniques with the following additional benefits:

- Direct measurement to femtogram levels
- Very low sample volume requirement
- Easily eliminates matrix interferences
- Selectively detects analytes of interest
- Ideal for quantification due to linear response
- Low cost of operation and ownership

Typical applications are the measurement of neurotransmitters in µ-dialysates, antibiotics including their by-products and contaminants in drugs or bulk, clinical applications (vitamins, polyphenols, thiols, amino acids in urine or plasma), carbohydrates from different origin (food and beverages, natural products, plants, lactose free products, FDG radio tracer) to name a few.

DECADE™ Elite – Electrochemical Detector

- Most sensitive electrochemical detector
- Versatile – fits any (U)HPLC system
- ADF for highest S/N ratio
- Different flow cells to cover every application

Highest Sensitivity

To achieve the highest detection sensitivity with the DECADE Elite several factors have been taken into account:

- Use of supreme quality electronics and printed circuit boards throughout the entire instrument
- Development of a highly stable Faraday-shielded oven compartment accommodating the column and the flow cell for highest baseline stability
- Integration of an Advanced Digital Filter (ADF) for best S/N ratio
- Different flow cells for optimal performance, i.e., SenCell™ (highest sensitivity), FlexCell™ (various electrodes)

Supreme electronics

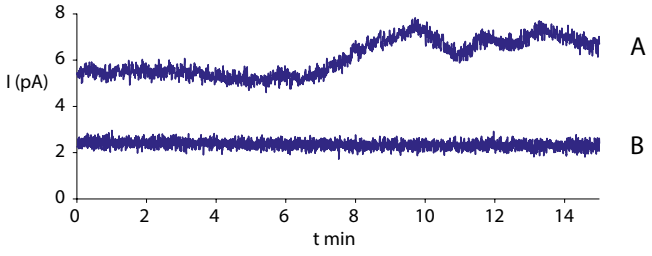
To assure the highest sensitivity the electronic noise generated by detector must be lower than the chemical noise. All electronic components used in the DECADE Elite are of supreme quality and the total noise value is ≤ 2 pA with a dummy cell (load of 300 MΩ/0.5 µF).

Oven compartment

For highest stability and sensitivity in ECD it is essential that both the column and the flow cell are kept at a very stable temperature. The oven compartment of the Decade Elite can easily accommodate several HPLC columns and flow cells with a temperature stability of 0.1 °C. Additionally the compartment is Faraday shielded to eliminate electrical interferences.

Integrated temperature control

Baseline without temperature control (A)
and baseline of DECADE Elite with temperature control (B).
Separation and Detection in one compartment.



Advanced digital filter (ADF)

The DECADE Elite is equipped with an ADF low-pass digital filter specially developed by Antec Scientific. The ADF algorithm has been optimized for suppressing noise originating from HPLC and electrochemical flow cells. It passes signals with a frequency lower than a selected cut-off frequency (chromatographic peaks) and attenuates higher frequencies (i.e. noise reduction). By selecting the appropriate filter settings signal to noise (S/N) ratio can be improved substantially, up to 100 fold.

SenCell™ – for highest sensitivity

To achieve highest sensitivity the flow cell is an essential part of the HPLC-ECD system. The so called wall-jet flow cell provides highest sensitivity in terms of S/N ratio and is the cell of choice for the detection of small volume and low concentrated samples. Antec's proprietary SenCell is based on this concept.
For more information see *www.AntecScientific.com/SenCell*

Selectivity

In electrochemical detection the selectivity can be controlled by several parameters:

- Mode of operation, DC, Pulse and Scan
- Applied potential
- Type of working electrode material
- Mobile phase: composition, pH, ion pair, etc.
- Enzymatic, chemical or electrochemical activation of target substances

Mode of Operation

The DECADE Elite supports 3 modes of operation: DC, Scan and Pulse. The mode of operation depends on the type of application and detectable analyte. The DC mode is mainly used for high sensitivity applications such as neurotransmitters, vitamins, phenols. The pulse mode (PAD, Pulsed Amperometric Detection) is used for the detection of carbohydrates, antibiotics, etc. The scan mode is used to obtain a voltammogram in method optimization.

Applied potential

The required potential depends on the analyte of interest and the possible interference of matrix substances and can be easily determined via a scanning or hydrodynamic voltammogram. In addition a surplus of literature data is available.

FlexCell™ - for flexibility in working electrode selection

A variety of working electrode materials are available for optimal selectivity and to cover every thinkable electrochemical application such: as glassy carbon (GC), Au, Ag, Pt, BDD (Boron doped Diamond), etc. Antec's FlexCell is specially designed for this purpose. For more information see *www.AntecScientific.com/FlexCell*.

Mobile phase

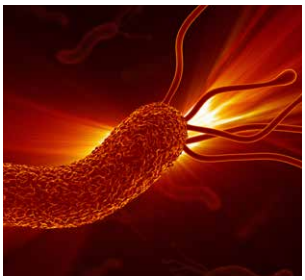
In HPLC the selectivity is strongly influenced by the mobile phase composition. In ECD the mobile phase can have an addition strong influence on the selectivity and sensitivity. Therefore, pH, ion strength, ion pair and mobile phase composition must be carefully selected.

Applications

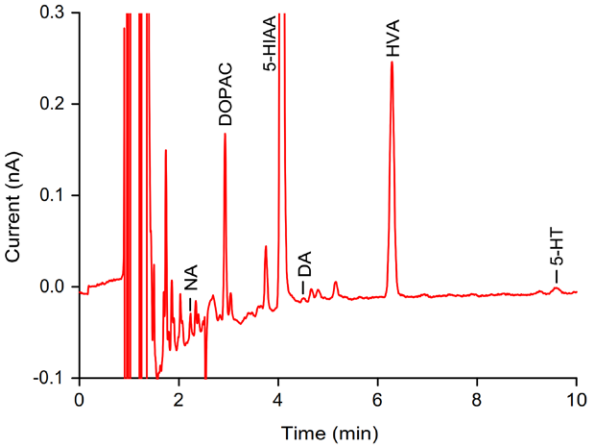
Neurotransmitters

For the analysis of monoamines such as noradrenaline (NA), dopamine (DA) and serotonin (5-HT), and their acidic metabolites, i.e., homovanillic acid (HVA), 5-hydroxyindole acetic acid (5-HIAA), and 3,4-dihydroxyphenylacetic acid (DOPAC) from microdialysates or cerebrospinal fluid (CSF) and brain tissue homogenates, electrochemical detection is by far the most sensitive and selective. Concentrations of NA, DA and 5-HT can be below 100 pmol/L. In combination with a dedicated HPLC system LOD's of 0.1 - 0.5 fmol on-column (< 100 pmol/L in less than 10 µL sample) become possible. Other neurotransmitter that can be easily detected by ECD: GABA, glutamate, histamine and other LNAAs, and, ACh and choline.

Antibiotics



HPLC with electrochemical detection (HPLC-ECD) is an excellent technique fulfilling all of the US and European Pharmacopeia criteria for the analysis of aminoglycosides and macrolide antibiotics in bulk products and pharmaceutical formulations. HPLC-ECD is thereby the best technique for composition analysis, impurity profiling and detection of by-products.
Dedicated application notes are available for the analysis of aminoglycosides such as amikacin, framycetin, gentamicin, kanamycin, lincomycin, neomycin, netilmicin, spectinomycin, streptomycin, tobramycin and for the analysis of macrolide antibiotics such as azithromycin, clarithromycin, erythromycin, and roxithromycin.

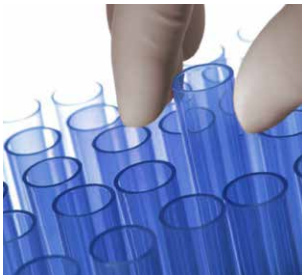


UHPLC-ECD chromatogram of rat prefrontal Cortex µ-dialysate (after administration NA re-uptake inhibitor). Injection volume 2 µL. Column: UPLC, BEH C18, 1.7 µm, 1 x 100 mm (Waters), Flow rate: 50 µL/min. Mobile phase: buffer with 8% ACN. DECADE Elite equipped with SenCell and 2 mm GC working electrode. Potential 640 mV vs Ag/AgCl ISAAC REF (8 mmol/L KCl. ADF 0.5 Hz. Other conditions see Application note 213_028. Sample provided by Gerdien Korte-Bouws, University of Utrecht, Utrecht, The Netherlands

Carbohydrates

For the analysis of carbohydrates in food, beverages, plants, etc., high-performance anion exchange chromatography (HPAEC) with pulsed amperometric detection (PAD) provides the sensitivity and selectivity to fulfil all the analytical requirements. Potential and time can be programmed as traditional E/t steps (up to 5 steps), or in a table with freely programmable coordinates (up to 30). From the detection of carbohydrates in coffee to the analysis of mono-, di- and trisaccharides in plant ecology (leafs, root exudate) or the analysis of lactose in 'lactose-free' labelled dairy products, all is possible routinely fulfilling the new labeling requirements of the food industry routinely.

Clinical/Diagnostic

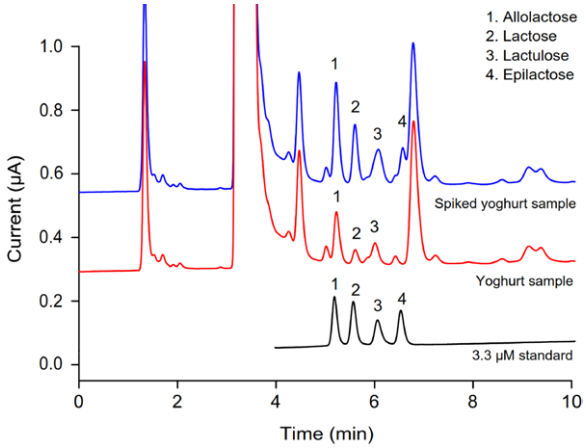


For the quantitative analysis of the catecholamines norepinephrine, epinephrine, and dopamine in urine and plasma HPLC-ECD is the preferred analytical method for initial diagnosis of several rare cancer tumor diseases in the body. ECD offers fast and accurate analytical results for the routine analysis of catecholamines, metanephrines and other metabolites such as VMA, HVA and 5-HIAA. In the diagnostic field, fluorodeoxyglucose, [^{18}F]FDG, is one of the most common radiolabeled sugars for PET imaging and the assessment of glucose metabolism in the heart, lungs, and the brain as well as for imaging tumors in oncology. A short half-life of [^{18}F]FDG makes it necessary to perform a purity check prior to the administration. HPAEC-PAD is the analytical method of choice for purity and by-product analysis as described by the US Pharmacopeia (USP) and European Pharmacopoeia (EP).

Other Applications

The DECADE Elite can be used in many other (U)HPLC applications for the detection of: aminothiols (cysteine, cysteinylglycine, glutathione and homocysteine) and their disulfides (cystine, di-glutathione and homocystine); amino acids, e.g., Tyr, Val, Met, Orn, Leu, Ile, Phe, Lys, Trp; iodide in milk and urine; phenols in (waste)water and soil; polyphenols in food and beverages; vitamins (water soluble C, fat soluble A, D, E and K) in plasma; Q10, ubiquinols and ß-carotene in LDL; QC of pharmaceuticals, e.g., Clozapine, Olanzapine, etc.

For a complete listing of all applications visit *www.AntecScientific.com*



HPLC-ECD chromatogram of yoghurt sample (red), spiked yoghurt sample (blue) and 3.3 µM standard (black) confirming lthat the lactose content (peak nr. 2) is below the regulatory labeling requirements (lactose-free). Injection volume 2.5µL. Column: CarboPac PA210G-4µm column, 150 x 2.0 mm (Thermo-Fisher). Flow rate: 0.2 mL/min. Mobile phase: water with 200 mM KOH gradient. DECADE Elite equipped with SenCell, Au working electrode and HyRef. Potential: PAD 4 step waveform. ADF 0.5 Hz. Other conditions see Application note 220_009

Specifications

Environmental, dimensions, weight & power requirements

Working temperature	10 - 40°C (indoor use only)
Safety and EMC	According to EC-directives; Emission Group I Class A; cMETus approved
Dimensions	43 (D) x 22 (W) x 44 (H) cm = 16.9" (D) x 8.7" (W) x 17.3" (H)
Weight	max 14.4 kg (32 lbs) without flow cell and column
Power requirements	100-240 VAC, 50/60 Hz, 260 VA, auto-sensing

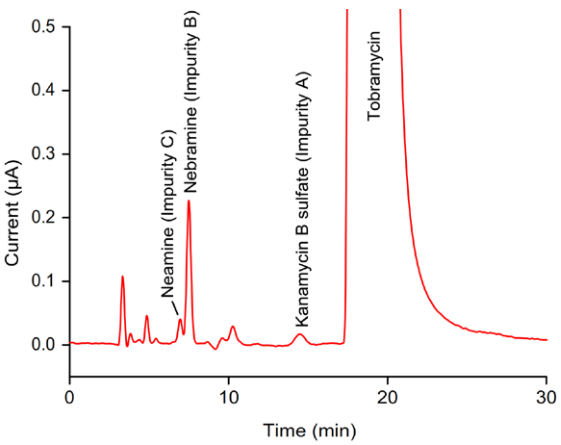
For optimum analytical performance it is recommended that the ambient temperature of the laboratory be between 20-25 °C and be held constant to within ± 2 °C throughout the entire working period. Note: that for optimal performance of the oven the oven temperature should be set at least 7 degrees higher as ambient temperature.

General

Operating modes	DC, PULSE, SCAN
Other mode	CONFIG, DIAG and SERVICE
Sensors	Up to 3 flow cells
Autozero	triggered by keyboard, rear panel TTL, or remote PC control (LAN)
Max. current compensation (Autozero)	25 nA - 2.5 mA in DC and PULSE mode dependent on range setting
Offset	+50% to - 50% of max. output voltage, 5% steps
PC control	Parametric control and data-acquisition via LAN port (USB service port)
Embedded software	Flash technology, upgradeable via PC (USB)
Oven	+7°C above ambient to 60°C, accuracy 0.5°C, stability 0.1°C; accommodates column and flow cell(s)
Rear panel connectors	1x IEC inlet (Mains), 1x USB B, 1x RJ45 LAN, 1x 9-pins sub-D Male (Valve), 1x 9-pins sub-D Female (Analog output), 1x 25-pins sub-D Female (Digital I/O)
Analog output (DAC)	-1 to +1 V full scale (via 16-bit D/A converter)
Analog output (I/E)	-2.5 to +2.5 V full scale (unprocessed I/E con-verter signal)
Digital I/O (HW)	2x Relay, 5x TTL outputs (CMOS 3.3V logic), 13 TTL inputs (programmable), 1x GND
Programmable I/O functionality	Cell on, Cell off, Autozero, Start, Overload, Relay, Auxiliary
Valve control	VICI valco 2-pos electrically-actuated valve (E2CA, EHCA) via serial cable, Manual valve, 1x inject marker output

CDS control drivers

CDS	Clarity, OpenLAB 2, Chromeleon For latest developments see: *https://antecscientific.com/cds-drivers*



HPLC-ECD chromatogram of Tobramycin antibiotic, composition and impurity analysis according EP monograph. Column: 4.6 mm x 25 cm SDB copolymer. Injection vol.: 20 µL. DECADE Elite equipped with SenCell with Au working electrode and Ag/AgCl reference. Potential: PAD 3 step waveform. ADF 0.5 Hz. Other conditions see Application note 217_032

Specifications (cont.)

DC mode

Range	10 pA - 200 µA in 1, 2, 5 increments
Filter (ADF)	10 - 0.001 Hz in 1, 2, 5 increments RAW and OFF: for unprocessed data
Potential (Ec)	-2.50 V to + 2.50V with 10 mV increments
Data Rate	1 - 100 Hz in 1, 2, 5 increments, dependent on filter setting
Noise	< 2 pA with dummy cell (load of 300 MΩ/470 pF) in 1 nA range, filter off, Ec +800mV and temperature of 35 °C.

PULSE mode

Range	10 nA - 200 µA in 1, 2, 5 increments
Filter (ADF)	0.5 - 0.001 Hz in 1, 2, 5 increments OFF: for unprocessed data
Potential (Ec)	-2.50 V to + 2.50 V with 10 mV increments
Data Rate	1/(pulse duration) Hz

Type 1: E/t steps

Waveform	Max 5 potential steps
Pulse times (t1-t5)	t1: 100 - 2000 ms; t2, t3, t4, t5: 0 - 2000 ms in 10 ms increments
Sampling times (ts)	20 - [t1 - 60] ms in 20 ms increments

Type 2: E/t table

Waveform	Up to 30 potential/time coordinates, 10 mV and 10 ms increments
Sampling times (ts)	Free selectable interval between 2 coordinates

SCAN mode

Range	10 nA - 200 µA in 1, 2, 5 increments
Potential (Ec)	-2.50 V to + 2.50V with 10 mV increments
Data Rate	1 Hz
Scan rate	1 - 100 mV/s in 1, 2, 5 increments
Cycle	Half, Full, Continuous

Part no	Description
176.0035A	DECADE Elite SCC (2019 version)
176.0035DA	DECADE Elite DCC (2019 version)

For the ordering information of a flow cell, see the dedicated SenCell or FlexCell product flyer.

Antec Scientific (USA)
info@AntecScientific.com
www.AntecScientific.com
T 888 572 0012

Antec Scientific (worldwide)
info@AntecScientific.com
www.AntecScientific.com
T +31 71 5813333