



Application Note AN-V-231

Cadmium and lead in drinking water with screen-printed carbon electrodes

Simultaneous determination on Metrohm DropSens SPCEs

The provisional guideline values in the World Health Organization's (WHO) «Guidelines for Drinking-water Quality» are set to 3 µg/L for cadmium and 10 µg/L for lead.

The anodic stripping voltammetry (ASV) technique performed on the ex-situ mercury film modified Metrohm DropSens screen-printed electrode (SPE) can be used to simultaneously detect concentrations as low as 0.3 µg/L for both elements. This is suitable to monitor the WHO guideline values.

The main advantage of this method lies in the

innovative and cost-effective screen-printed electrode. It is a combined sensor consisting of a carbon working electrode, Ag/AgCl reference, and carbon auxiliary electrode on a ceramic substrate. The disposable sensor does not need maintenance such as mechanical polishing or mechanical cleaning. It can be used conventionally in the laboratory with the 884 Professional VA, or alternatively in the field with the 946 Portable VA Analyzer. This method is best suited for manual systems.

SAMPLE

Drinking water, mineral water, sea water

EXPERIMENTAL

Prior to the first determination, the ex-situ mercury film is deposited in a separate step on the screenprinted electrode. The water sample and the supporting electrolyte are pipetted into the measuring vessel. The simultaneous determination of cadmium and lead is carried out with the 884 Professional VA or with the 946 Portable VA Analyzer using the parameters specified in **Table 1**. The concentration of both elements is determined by two additions of a cadmium and lead standard addition solution.



Figure 1. 946 Portable VA Analyzer (SPE)



Figure 2. 884 Professional VA, semiautomated system

Table 1. Parameters

Parameter	Setting
Mode	SQW – Square wave
Deposition potential	-1.3 V
Deposition time	60 s
Start potential	-1.0 V
End potential	-0.4 V
Peak potential Cd	-0.72 V
Peak potential Pb	-0.52 V

ELECTRODES

- Screen-printed carbon electrode (Metrohm DropSens 11L)

RESULTS

With a 30 s deposition time, the limit of detection is around 1 µg/L, and the linear working range is up to

20 µg/L in the measuring solution for both elements.

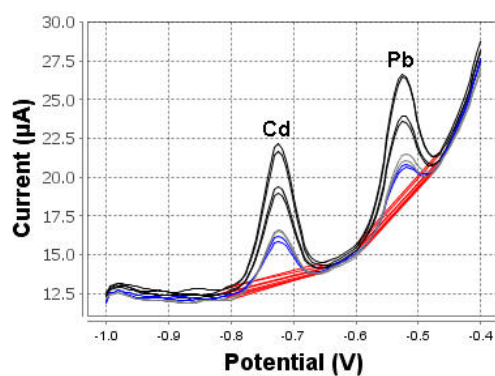
**Figure 3.** Determination in mineral water spiked with 2 µg/L cadmium and lead

Table 2. Result

Sample	Cd (µg/L)	Pb (µg/L)
Mineral water spiked with 2 µg/L Cd and Pb	2.04	1.81

Internal references: AW VA CH4-0593-042020; AW VA CH4-0594-042020

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CONFIGURATION



884 Professional VA

884 Professional VA is the universal entry-level instrument in the Professional VA/ CVS instrument series. In conjunction with the compatible measuring head and compatible electrode set, you can perform trace analysis determinations with voltammetry and polarography using the Multi-Mode Electrode pro, the scTRACE Gold, the Bismuth drop electrode or determinations of organic additives in electroplating baths, with "Cyclic Voltammetric Stripping" (CVS), "Cyclic Pulse Voltammetric Stripping" (CPVS), and chronopotentiometry (CP). The proven Metrohm electrode methods combined with a high-performance potentiostat/galvanostat and the extremely flexible **viva** software open up new perspectives. The potentiostat with a certified calibrator readjusts itself automatically before each measurement, thus guaranteeing maximum precision. The replaceable measuring head enables rapid changes between the various applications with different electrodes.

The **viva** software is required for control, data collection, and evaluation.

The 884 Professional VA is supplied with reduced accessories, without measuring head and electrodes. Electrode set and **viva** license need to be ordered separately.



SPE measuring head for Professional VA instruments

Measuring head for operation with *screen-printed electrodes* (SPE) or the scTRACE Gold.



VA accessory equipment with SPE electrode shaft for professional VA instruments

Accessory equipment for use with *screen-printed electrodes* (SPE). Contains electrode shaft for screen-printed electrodes, stirrer, and measuring vessel. Without electrodes.



946 Portable VA Analyzer (SPE)

Portable metal analyzer for the determination of heavy metals. Device version for *screen-printed electrodes* (SPE). The system is comprised of potentiostat and separate measuring stand with integrated stirrer and replaceable electrode. The instrument is operated with the Portable VA Analyzer software. The power is supplied via the USB connector and via the integrated rechargeable battery. The device is supplied with all required accessories in a carrying case. Screen-printed electrodes are not included in the scope of delivery.