



Application Note AN-V-225

Cadmium and lead in drinking water with a glassy carbon electrode

Simultaneous determination on a mercury film modified GCE

To reduce the toxic effects of cadmium on the kidneys, skeleton, and the respiratory system, as well as the neurotoxic effects of lead, the provisional guideline values in the World Health Organization's (WHO) «Guidelines for Drinking-water Quality» are set to a maximum concentration of 3 µg/L for cadmium and 10 µg/L for lead.

The powerful anodic stripping voltammetry (ASV) technique on the ex-situ mercury film modified glassy carbon electrode is more than sufficient to monitor the proposed WHO guidelines for Cd and Pb in

drinking water. The main advantage lies in the ultrahigh sensitivity of this method. With a deposition time of 30 s, a limit of detection for $\beta(\text{Cd}) = 0.02 \mu\text{g/L}$ and $\beta(\text{Pb}) = 0.05 \mu\text{g/L}$ can be reached. The linear range for both elements goes up to approximately 50 µg/L using the same deposition time. The ability to re-plate the mercury film allows a quick and easy regeneration of the sensor. This method is best suited for both manual and automated systems, allowing the determination in a sample series comprised of a low to medium number of samples.

SAMPLE

Drinking water, mineral water, sea water

EXPERIMENTAL

Prior to the first determination, the ex-situ mercury film is deposited on the freshly polished glassy carbon electrode. In the next step, the electrodes are cleaned with ultrapure water and the measuring vessel is emptied. Then 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 using the parameters specified in **Table 1**. The concentration of both elements is determined by two additions of a cadmium, lead standard addition solution.



Figure 1. 884 Professional VA, fully automated for VA analysis

Table 1. Parameters

Parameter	Setting
Mode	DP – Differential Pulse
Deposition potential	-1.0 V
Deposition time	90 s
Start potential	-0.85 V
End potential	-0.25 V
Peak potential Cd	-0.65 V
Peak potential Pb	-0.48 V

ELECTRODES

- Working electrode: Glassy carbon (GC-RDE)
- Reference electrode: Ag/AgCl/KCl (3 mol/L)
- Auxiliary electrode: Glassy carbon rod

RESULTS

The method is suitable for the determination of cadmium and lead in concentrations up to 25 µg/L. The limit of detection for 30 s deposition time is

approximately 0.02 µg/L for cadmium and 0.05 µg/L for lead.

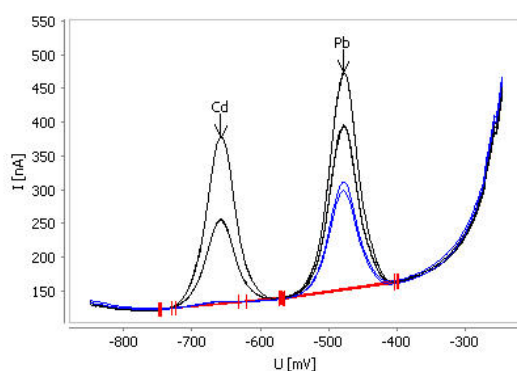


Figure 2. Determination of cadmium and lead in tap water

Table 2. Result

Sample	Cd ($\mu\text{g/L}$)	Pb ($\mu\text{g/L}$)
Tap water	0.02	1.76

REFERENCES

Application Bulletin 241: Determination of cadmium and lead by anodic stripping voltammetry at a mercury film electrode

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CONFIGURATION



884 Professional VA manual for CVS

884 Professional VA manual for CVS applications is the entry-level for high-end determinations of organic additives in electroplating baths with "Cyclic Voltammetric Stripping" (CVS), "Cyclic Pulse Voltammetric Stripping" (CPVS), and chronopotentiometry (CP), or voltammetric heavy metal determinations with rotating disk electrodes. The proven Metrohm electrode methods combined with a high-performance potentiostat/galvanostat and the extremely flexible **viva** software open up new perspectives in CVS. The potentiostat with a certified calibrator readjusts itself automatically before each measurement, thus guaranteeing maximum precision. The integrated temperature measurement input allows you to monitor the solution temperature during the measurement.

The instrument can also be used to perform voltammetric determinations. 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 manual for CVS applications is supplied with extensive accessories and a measuring head for rotating disk electrodes. Electrode set and **viva** license need to be ordered separately.



VA electrode equipment with rotating disk electrode (RDE) made of glassy carbon for Professional VA instruments

Complete electrode set for voltammetric determinations, e.g. using mercury film method. Includes drive for rotating disk electrode, glassy carbon electrode tip, reference electrode, glassy carbon auxiliary electrode, measuring vessel, and electrolyte solution.