



Application Note AN-V-221

Cadmium and lead in drinking water with a Bi drop electrode

Simultaneous determination by voltammetry

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

The completely mercury-free Bi drop electrode takes the next step towards converting voltammetric analysis into a non-toxic approach for heavy metal detection. Using this environmentally friendly sensor

for anodic stripping voltammetry (ASV) allows the simultaneous determination of cadmium and lead in drinking water. With a 60 s deposition time, a limit of detection (LOD) of 0.1 µg/L for Cd and 0.5 µg/L for Pb can be reached. This outstanding sensitivity is more than sufficient to monitor the provisional WHO guideline values.

This method is best suited for automated systems or process analyzers, allowing the fully automatic determination of cadmium and lead in large sample series.

SAMPLE

Drinking water, mineral water

EXPERIMENTAL

The water sample and the supporting electrolyte are pipetted into the measuring vessel. The simultaneous determination of cadmium and lead is carried out with a 884 Professional VA 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.

The Bi drop electrode is electrochemically activated prior to the first determination of cadmium and lead.



Figure 1. 884 Professional VA fully automated for VA

Table 1. Parameters

| Parameter | Setting |
|----------------------|-------------------------|
| Mode | DP – Differential Pulse |
| Deposition potential | -1.1 V |
| Deposition time | 60 s |
| Start potential | -1 V |
| End potential | -0.35 V |
| Peak potential Cd | -0.7 V |
| Peak potential Pb | -0.5 V |

ELECTRODES

- Working electrode: Bi drop
- 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 water samples in concentrations up to 15 µg/L. The limit of detection of the method is

0.1 µg/L for approximately cadmium and 0.5 µg/L for lead.

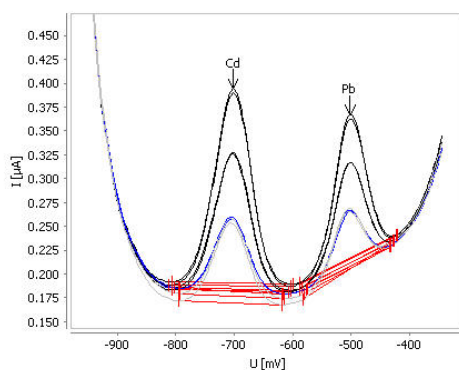


Figure 2. Determination of cadmium and lead in tap water spiked with $\beta(\text{Cd}) = 2 \mu\text{g/L}$ and $\beta(\text{Pb}) = 2 \mu\text{g/L}$

Table 2. Results

| Sample | Cd ($\mu\text{g/L}$) | Pb ($\mu\text{g/L}$) |
|---|------------------------|------------------------|
| Tap water spiked with $\beta(\text{Cd}) = 2 \mu\text{g/L}$ and $\beta(\text{Pb}) = 2 \mu\text{g/L}$ | 2.0 | 2.3 |

REFERENCES

Application Bulletin 438: Determination of cadmium and lead in water samples by anodic stripping voltammetry with a Bi drop electrode

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CONFIGURATION



884 Professional VA manual for Multi-Mode Electrode (MME)

884 Professional VA manual for Multi-Mode Electrode (MME) is the entry-level instrument for high-end trace analysis with voltammetry and polarography with the Multi-Mode Electrode pro or the scTRACE Gold or the Bismuth drop electrode. The proven Metrohm electrode methods in combination with a high-performance potentiostat/galvanostat and the extremely flexible viva software open up new perspectives for the determination of heavy metals. The potentiostat with a certified calibrator readjusts itself automatically before each measurement, thus guaranteeing maximum precision.

Determinations with rotating disc electrodes can also be performed with the instrument, e.g. determinations of organic additives in electroplating baths with "Cyclic Voltammetric Stripping" (CVS), "Cyclic Pulse Voltammetric Stripping" (CPVS), and chronopotentiometry (CP). 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 MME is supplied with extensive accessories and a measuring head for the Multi-Mode Electrode pro. Electrode set and **viva** license need to be ordered separately.



VA electrode equipment with bismuth drop electrode for Professional VA instruments

Complete electrode set for voltammetric determinations of heavy metals. Contains bismuth drop electrode, reference electrode, glassy carbon auxiliary electrode, measuring vessel, stirrer, electrolyte solution, and additional accessories.