



Application Note AN-V-232

Nickel and cobalt in drinking water with screen-printed carbon electrodes

Simultaneous low $\mu\text{g/L}$ determination with modified SPEs

SUMMARY

EU legislation specifies $20 \mu\text{g/L}$ as the limit value for nickel in drinking water. The current provisional guideline value for Ni in the World Health Organization's «Guidelines for Drinking-water Quality» is set to a maximum concentration of $70 \mu\text{g/L}$. The adsorptive stripping voltammetry (AdSV) technique performed on the ex-situ bismuth film modified Metrohm DropSens 11L screen-printed electrode (SPE) can be used to simultaneously detect concentrations as low as $0.4 \mu\text{g/L}$ for nickel and $0.2 \mu\text{g/L}$ for cobalt with a 30 s deposition time. These limits can be lowered even further by increasing the

deposition time. Another advantage of this method lies in the innovative and cost-effective SPE. 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 require any 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

EXPERIMENTAL

Prior to the first determination, an ex-situ bismuth film is deposited from a Bi solution. In the next step, the electrodes are cleaned with ultrapure water and the bismuth solution is removed. The water sample is placed into the measuring vessel. Ammonia / ammonium chloride buffer along with the complexing agent (dimethylglyoxime) are added, and the simultaneous determination of nickel and cobalt is carried out using the parameters specified in **Table 1**. The concentration is determined by two additions of a nickel and cobalt standard addition solution.



Figure 1. 946 Portable VA Analyzer (SPE)



Figure 2. 884 Professional VA semiautomated

Table 1. Parameters

Parameter	Setting
Mode	DP – Differential Pulse
Deposition potential	-0.9 V
Deposition time	30 s
Start potential	-0.9 V
End potential	-1.3 V
Peak potential Ni	-1.05 V
Peak potential Co	-1.175 V

ELECTRODES

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

RESULTS

With a 30 s deposition time, this method is suitable for the determination of both nickel and cobalt in

water samples in concentrations from $\beta(\text{Ni}) = 0.4\text{--}5 \mu\text{g/L}$ and $\beta(\text{Co}) = 0.2\text{--}8 \mu\text{g/L}$.

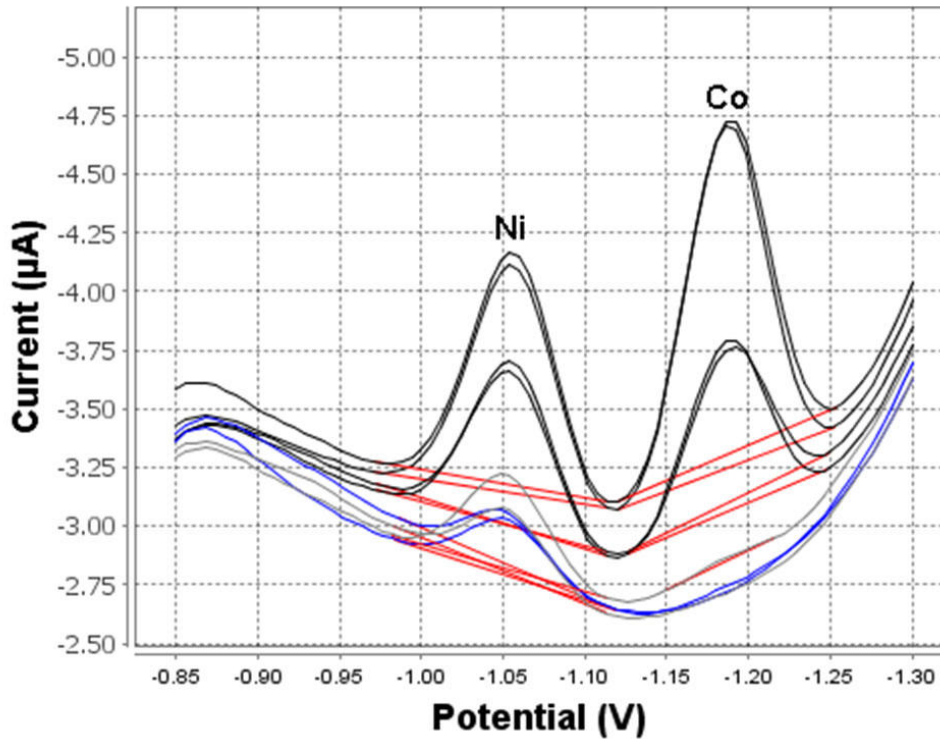


Figure 3. Determination of nickel and cobalt in tap water (946 Portable VA Analyzer; 30 s deposition time)

Table 2. Result

Sample	Ni (µg/L)	Co (µg/L)
Tap water	1.15	<LOD

Internal references: AW VA CH4-0597-062020; AW

VA CH4-0599-082020

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CONFIGURATION

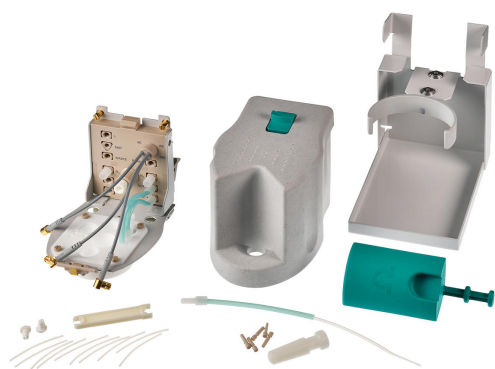


884 Professional VA

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.



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.



Screen-Printed Carbon Electrode

(Aux.:C;Ref.:Ag/AgCl)

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(Aux.:C;Ref.:Ag/AgCl)