



Application Note AN-V-224

Nickel and cobalt in drinking water

Simultaneous determination in low ng/L range on the GC-RDE modified with a bismuth film

Due to the toxicity and the detrimental effects of nickel and cobalt on human health, their concentrations in drinking water must be controlled. Therefore, EU the 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 $\mu\text{g/L}$. To monitor the concentrations of Ni and Co with the 884 Professional VA, a method for simultaneous determination on the glassy carbon electrode (GC-RDE) modified with a Bi film is used.

The simplicity of the bismuth film preparation step allows quick and easy regeneration of the sensing layer. The determination is based on adsorptive stripping voltammetry of both elements using dimethylglyoxime (DMG) as a complexing agent. This method results in

excellent performance in terms of sensitivity, reaching a limit of detection of 0.05 $\mu\text{g/L}$ for Ni and 0.03 $\mu\text{g/L}$ for Co. This non-toxic method is best suited for both manual and automated systems, allowing the determination in sample series with low to medium number of samples.

SAMPLE

Drinking water, mineral water, sea water

EXPERIMENTAL

Prior to the first determination, an ex-situ bismuth film is deposited from a bismuth 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. Ammonium buffer together with the complexing agent (DMG) are

added, and the simultaneous determination of nickel and cobalt is carried out with the 884 Professional VA using the parameters specified in **Table 1**. The concentration is determined by two additions of a nickel and cobalt standard addition solution.



Figure 1. 884 Professional VA fully automated for VA

Table 1. Parameters

Parameter	Setting
Mode	DP – Differential Pulse
Deposition potential	-0.8 V
Deposition time	30 s
Start potential	-0.85 V
End potential	-1.25 V
Peak potential Ni	-0.97 V
Peak potential Co	-1.12 V

ELECTRODES

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

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 $\beta(\text{Ni}) = 0.2\text{--}8 \mu\text{g/L}$ and $\beta(\text{Co}) = 0.1\text{--}10 \mu\text{g/L}$.

Using a 90 s deposition time, the limit of detection can be lowered to approximately $0.05 \mu\text{g/L}$ for nickel and $0.03 \mu\text{g/L}$ for cobalt.

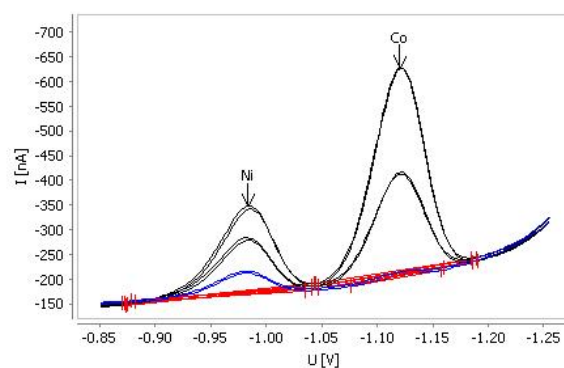


Figure 2. Determination of nickel and cobalt in tap water (30 s deposition time)

Table 2. Result

Sample	Ni ($\mu\text{g/L}$)	Co ($\mu\text{g/L}$)
Tap water	0.34	<LOD

Internal reference: AW VA CH4-0589-122019

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CONFIGURATION



884 Professional VA manual CVS

884 Professional VA manual CVS 仕様は、CVS (サイクリックホルタンメトリーストリッピング)、CPVS (サイクリックハルスホルタンメトリーストリッピング)、CP (クロノポテンシヨメトリー) による電気めっき浴内の有機添加物のハイエント測定、または回転ディスク電極によるホルタンメトリー重金属測定へのエントリーレヘル装置です。高性能のポテンシostat/カルハノスタットと、非常に柔軟な **viva** ソフトウェアとのコンビネーションにおける熟練した Metrohm の電極技術が CVS に新たな展望を開きます。性能が認証されたキャリフレータの付いたポテンシostatは、各測定前に自動的に新たに調整を行い、可能な限り高い精度を保証します。内蔵式温度電極インพุット口により、測定中の溶液温度のモニタリングが可能です。

この装置により、ホルタンメトリー測定を実施することも可能です。交換可能な測定ヘットにより、異なる電極を持つ様々なアプリケーション間の迅速な交換が可能となります。

コントロール、データ処理および評価のためにソフトウェア **viva** が必要となります。

884 Professional VA manual CVS仕様は、多数の付属品および回転ディスク電極のための測定ヘットを付属して納品されます。電極セットおよび **viva** ライセンスは別途ご注文ください。



VA electrode equipment with rotating disc 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.