909 UV Digester

Sample preparation for trace analysis of heavy metals

Metrohm

909 UV Digester in brief

The 909 UV Digester is a modern digestion unit for sample preparation by UV photolysis. Organic molecules in the sample interfere with the determination of heavy metals, particularly in voltammetric or spectroscopic methods such as ICP and AAS. Based on the proven UV technology, the new 909 UV Digester effectively eliminates organic constituents in liquid samples. UV digestion provides fast and elegant sample preparation, particularly with slightly contaminated samples.

Digestion of samples in the 909 UV Digester is fully automatic. The centerpiece of the digester is a UV lamp that provides the necessary UV radiation. The heat generated by the lamp is dissipated via an air-cooling system. To ensure that digestion takes place under controlled conditions, a Pt1000 temperature sensor is used to measure the digestion temperature in a reference sample. An integrated microprocessor controls the digestion temperature and the digestion time.

Standards that recommend sample preparation using UV photolysis include

- DIN 38406, Part 16: Determination of zinc, cadmium, lead, copper, thallium, nickel, cobalt by voltammetry
- DIN 38406, Part 17: Determination of uranium – method using adsorptive stripping voltammetry in surface water, raw water and drinking water

The key advantages

- Controller and wet section in a single housing
- Digital input of digestion temperature and digestion time
- Microprocessor-controlled regulation of digestion temperature and digestion time
- Air cooling, does not need a cooling water supply
- Simultaneous digestion of up to 12 samples
- Short digestion times
- The blank values are practically zero because only very small amounts of reagents are needed
- Also suitable for elements that form volatile compounds, e.g. mercury, arsenic, and selenium

UV digestion

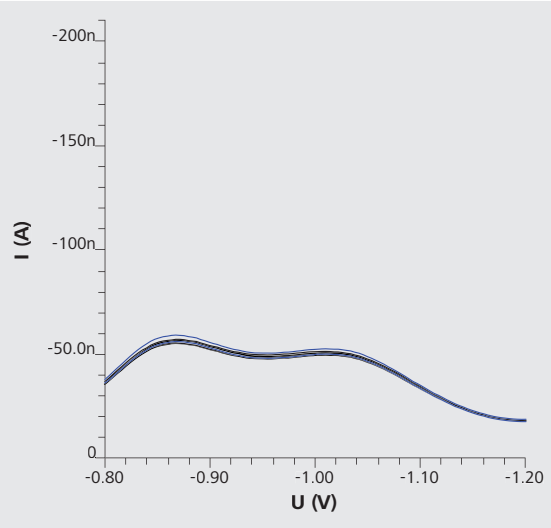
Organic constituents in the sample can interfere with the analysis in many ways. For example, a complexing agent can mask the analytes during determination or a compound can generate an interfering analytical signal. UV digestion is a fast and clean method of decomposing such organic compounds. The actual reagent in the digestion process is UV radiation. Thus the blank values are practically zero, which is particularly advantageous for trace analysis.

UV digestion is based on the principle of photolysis. This can be described in simple terms as breaking down molecules with light. The 909 UV Digester uses UV radiation with a wavelength of 200-400 nm to produce OH radicals in the sample. This is facilitated by adding a small amount of H_2O_2 as a radical initiator. The OH radicals are very reactive and spontaneously react with the organic molecules. The resulting radical chain reaction breaks down all the organic molecules to low molecular-weight compounds such as CO_2, H_2O, N_2, or NH_3. These decomposition products do not interfere with the subsequent analysis.

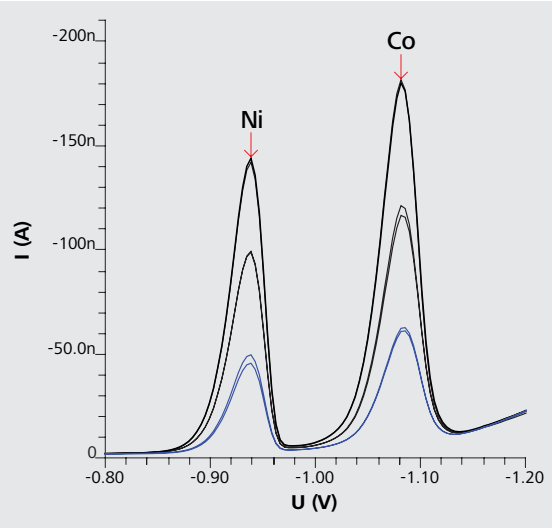
UV digestion is suitable for transparent samples with low-to-medium organic contamination (up to approx. 100 mg carbon/L). The classical application field for UV digestion is processing of all types of water samples, e.g. surface waters or wastewaters. However, liquid biological samples (e.g. urine) or foods (e.g. juices and alcoholic beverages) too can be digested using an adapted procedure.

Application examples

Nickel and cobalt in wastewater

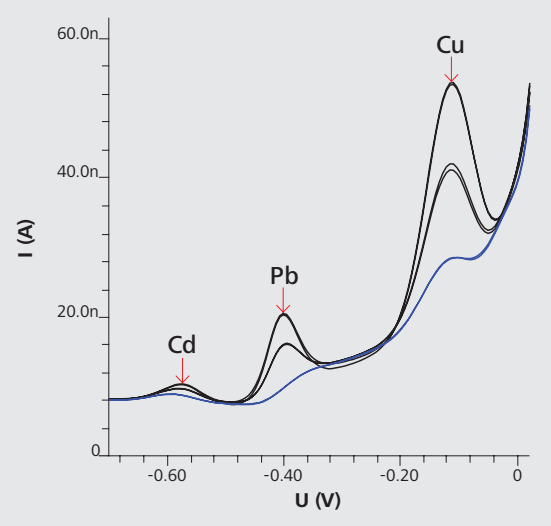


Voltammogram for a determination of nickel and cobalt in wastewater without UV digestion

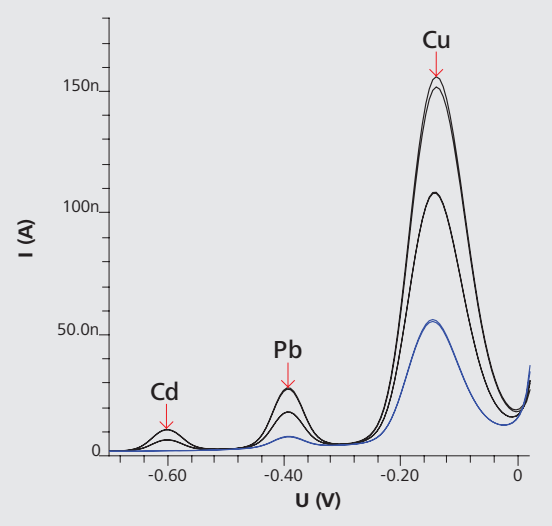


Determination of nickel and cobalt in the same wastewater after UV digestion. Concentration of each: 1.8 µg/L

Cadmium, lead, and copper in red wine



Voltammogram for a determination of cadmium, lead, and copper in red wine without UV digestion



Determination of cadmium (concentration < detection limit), lead (17.7 µg/L), and copper (192.8 µg/L) in the same red wine after UV digestion.

Speciation

Another application field for the 909 UV Digester is speciation analysis. Voltammetric measurements can usually detect only one oxidation state of a metal and only if the metal is not complexed. However, UV radiation can easily oxidize chromium(III) to chromium(VI) without reagents. This is an elegant way of determining the contents of free chromium(VI), total chromium and thus chromium(III) as the difference. A similar method can be applied to the reduction of selenium(VI) to selenium(IV) and to the analysis of free tin and organotin compounds.

Volatile analytes

The 909 UV Digester is also highly suitable for the analysis of samples containing mercury, arsenic, or selenium. These elements are volatile at elevated temperatures or readily form volatile compounds. No losses of these elements occur during processing in the 909 UV Digester.

The 909 UV Digester in detail

Wet section

The samples are arranged concentrically around the UV lamp. A fan located in the base dissipates the heat generated by the operating lamp. A red shield protects the user's eyes against harmful UV radiation.

Controller

This is used to enter the digestion temperature and the digestion time. The clearly arranged display provides information on the current digestion status, the setpoint and actual temperatures as well as the remaining digestion time. It can also be used to call up the operating time of the UV lamp. This means that the lamp can be replaced before the diminishing radiant power influences the digestion efficiency.

Pt1000 temperature sensor

The glass-jacketed temperature sensor is placed into a reference sample. In this way the digestion temperature, controlled by the instrument, is directly measured.

Sample holder with quartz sample vessels

The sample is digested in a UV-transparent quartz vessel. A PTFE stopper acts as a condensation finger and prevents evaporation of the sample during digestion. However, it allows release of gaseous reaction products such as CO_2 and N_2. The rack holds 12 samples.

Technical data

Digestion	
Digestion temperature	80...100 °C
Control accuracy	± 3 °C
Lamp power (controlled)	300...600 W
Cooling	Air cooling
Ambient temperature (operating range)	5...35 °C
Digestion time	1...999 min

UV lamp	
Type	Medium-pressure mercury lamp
UV-A (315...400 nm)	35 W
UV-B (280...315 nm)	40 W
UV-C (200...280 nm)	70 W
Discharge tube temperature	700...900 °C
Length	137...139 mm
Outer diameter	approx. 16 mm
Useful life	500...1'000 h

Temperature measurement	
Sensor	Pt1000

Measuring input	
Accuracy	± 0.2 °C (under reference conditions)
Measuring range	-20...+150 °C

Power supply	
Voltage	220...240 V (± 10%)
Frequency	50...60 Hz (± 3%)
Power consumption	630 W

Dimensions	
Width	330 mm
Height	290 mm
Height (with UV shield)	500 mm
Depth	310 mm
Weight	10.9 kg

Ordering information

2.909.0014	909 UV Digester (230 V) Digestion instrument for UV photolysis of water samples with low to medium organic load. For sample preparation in trace element determination by means of voltammetry, ion chromatography and spectroscopy (AAS, ICP). Instrument for 220...240 V and 50...60 Hz.

Scope of delivery also includes

6.1110.010	Pt1000 temperature sensor
6.1446.100	PTFE stopper for UV quartz sample vessel (12 ×)
6.2041.240	Sample holder for 12 quartz sample vessels
6.2414.000	Quartz sample vessel 12 mL (12 ×)
6.2745.100	UV protective shield
6.2804.090	UV mercury vapor lamp

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Subject to change
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