

Analysis Systems for Environmental Applications



ICP and XRF spectrometers for the analysis of heavy metals and other elements in environmental samples

Besides the heavy metals like

- arsenic,
- cadmium,
- chromium,
- mercury,
- lead and
- thallium,

the environmental analyzers from SPECTRO determine other elements of importance, including aluminum, silver, boron, cobalt, copper, iron, potassium, lithium, molybdenum, nickel, antimony, selenium, vanadium and zirconium.



With the SPECTRO XEPOS X-ray fluorescence spectrometer and the SPECTRO GENESIS and SPECTRO CIROS VISION ICP spectrometers, SPECTRO provides unrivaled solutions for the analysis of heavy metals in environmental samples such as water, soil, sludge and waste. These instruments are robust, reliable and sensitive analytical systems, that are able to deal with diverse material types as well as wide spread element concentrations in full compliance with the regulations.

Heavy metals include the elements arsenic, cadmium, chromium, mercury, lead and thallium. They typically enter the body via the food chain, ambient air or drinking water. Unfortunately, since the beginning of the industrial revolution, waterways and coastal waters have been polluted with these elements and others. Contaminants have also been introduced into the soil with negative consequences not only for the food chain, but also for drinking water.

To safeguard the environment, strict regulations have now been drawn up both in Europe and the United States as well as in many other countries around the world. These new regulations specify the maximum amounts of toxic elements, notably heavy metals, that can be released into the environment. As a consequence, contamination levels in – for example - urban and industrial waste water and soils need to be monitored as do levels in sludge from sewage treatment plants.

The SPECTRO XEPOS simultaneous XRF spectrometer provides a fast, precise, accurate and economic solution for the monitoring of soil, sludge and waste. Measurements require little or no sample preparation and are non-destructive. In addition to heavy metals, all of the other elements from Na to U can be determined simultaneously in solids, powders and liquids. Operation can be easily automated using an integrated autosampler. Analyses are largely matrix independent, as the software corrects for this type of influence. This and many additional instrument and software characteristics make operation simple and safe.



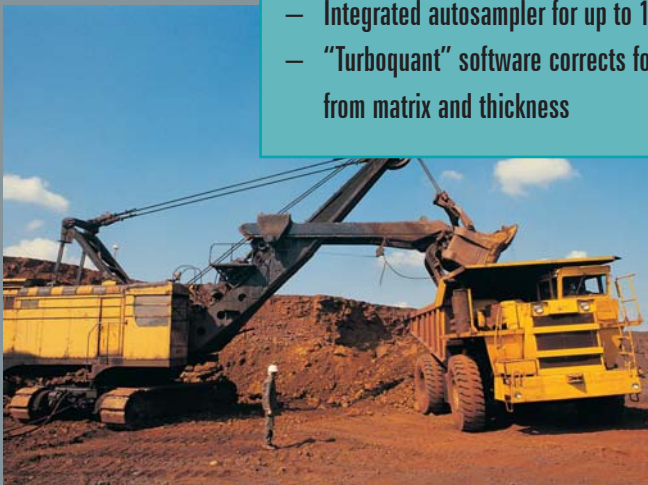
SPECTRO XEPOS is a particularly powerful XRF analyzer with exceptional multifaceted capabilities. Compared to conventional benchtop instruments, it achieves decidedly better detection limits. A very low powered X-ray tube with a power of only 50 W serves as the radiation source. The extreme sensitivity is obtained with an extended polarization system by which the primary tube radiation is bundled in luminously intense polarization and secondary target optics. With this technique, it is not necessary to utilize radiation filters that lead to heavy losses in sensitivity. A high-resolution, Peltier-cooled, Si drift detector is used as a detection system, eliminating the need for liquid nitrogen cooling.

For the analysis of unknown samples the SPECTRO XEPOS provides a rapid, reliable and economic solution by using a special expert system-based software package called "Turboquant". The matrix in unknown samples is detected and the resulting inter-element effects are automatically taken into consideration, significantly reducing analytical errors.



SPECTRO XEPOS

- Element range Na - U
- Low detection limits due to polarized excitation and secondary target optics
- Analysis of solids, powders and liquids
- Integrated autosampler for up to 12 samples
- "Turboquant" software corrects for influences from matrix and thickness

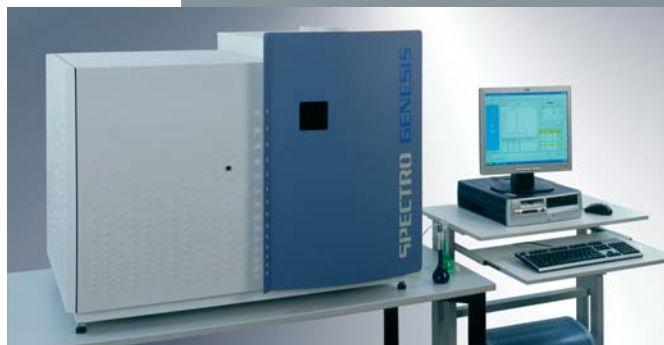


SPECTRO GENESIS

The new SPECTRO GENESIS inductively coupled plasma (ICP) optical emission spectrometer with axial plasma observation has been specially designed for environmental applications. It offers all of the required analytical capabilities in terms of sensitivity, precision and accuracy and thus is ideally suited to perform analysis of water, waste water, soil, sewage sludge and filter dust in compliance with EPA and international norms. The instrument features a Paschen-Runge spectrometer mount. Employing the proprietary Optimized Rowland Circle Alignment (ORCA) technique, the complete spectrum between 175 and 777 nm is captured. Over 70 elements can be determined simultaneously. A complete analysis can be performed in less than 4 minutes regardless of the number of lines and elements.

Utilizing SPECTRO's patented Intelligent Calibration Logic (ICAL), not only optimum operating conditions are ensured all the time, but also factory methods can be transferred to individual instruments, making method development redundant and the instrument literally "Plug and Analyze".

The SPECTRO GENESIS offers a simple, fast, accurate, precise and cost efficient method for the analysis of environmental samples, determining trace, minor, and major elements with excellent recoveries. In conjunction with an autosampler, the SPECTRO GENESIS can be fully automated.



SPECTRO GENESIS

- Pioneering CCD optical system design
- Proven generator technology
- Minimum installation and training requirements
- ICAL-supported automatic system control
- Factory-calibrated methods conforming to international standards for water/waste-water, soil, sewage sludge and filter dust
- Seamless integration into the laboratory environment
- Excellent price/performance ratio





SPECTRO CIROS VISION

- Pioneering CCD optical system design
- Proven generator technology
- OPI and SPI capable
- Post-processing of samples
- Fully automatic analysis
- Self-monitoring
- Numerous accessories

The SPECTRO CIROS VISION is a truly versatile high performance laboratory instrument. Both axial and radial plasma observation can be performed: the Optical Plasma Interface (OPI) enables extremely low detection limits and practically eliminates matrix effects; the Side-on Plasma Interface (SPI) provides high precision and stability for less extreme sensitivity requirements.

With its robust construction, minimal maintenance requirements and novel software, the SPECTRO CIROS VISION is perfectly suited to automatic operation. Water cooling of the free-running generator is not necessary; the argon-filled UV-PLUS system prevents contamination of the optics due to a vacuum or flushing gas. All instrument parameters are monitored and logged by the software. An optional combination of autosampler and autodiluter even provides automatic dilution of samples that have exceeded measurement ranges so that they can be analyzed correctly. This all increases measurement accuracy while reducing operational expenses.

The innovative high performance readout system allows measurement of the complete spectrum in less than 3 seconds. The raw data for the entire spectrum is stored and is available for post-processing. A sample can be re-analyzed for new elements and even with different parameters without having to be measured again.

The SPECTRO CIROS VISION is a powerful ICP-OES instrument with many accessories and innovative technology for the analysis of a very wide range of elements and concentrations. It is suited to routine and difficult tasks in nearly any laboratory and is especially capable of automated analysis.

SPECTRO CIROS VISION

Table of Applications

Common environmental analysis applications and suitable instrumentation.

Application	SPECTRO XEPOS	SPECTRO GENESIS SPECTRO CIROS VISION
Water		X
Waste Water		X
Soil		
- monitoring	X	
- analysis		X
Sewage Sludge		
- monitoring	X	
- analysis		X
Filters	X	X
Solid Waste	X	
Slurries		X
Liquid streams		X

Table of Accuracy - SPECTRO XEPOS

Comparison of the sediment standard GSS6 prepared as loose powder with TURBOQUANT using the SPECTRO XEPOS (not all elements are displayed)

El.	Certified Conc.	Meas. Conc.	Abs. Error (1 sigma)
Al	11.23 %	13.03	± 0.1 %
Si	26.61 %	23.09	± 0.06 %
Cr	75 mg/kg	51	± 6 mg/kg
Mn	0.1472 %	0.1417	± 0.0012 %
Fe	5.658 %	5.627	± 0.007 %
Co	7.6 mg/kg	<24	mg/kg
Ni	53 mg/kg	52.5	± 1.8 mg/kg
Cu	390 mg/kg	405.5	± 3.3 mg/kg
Zn	96.6 mg/kg	90.3	± 1.5 mg/kg
Ga	29.5 mg/kg	29.7	± 1 mg/kg
Ge	3.2 mg/kg	<5	mg/kg
As	220 mg/kg	214.2	± 2.2 mg/kg
Se	1.3 mg/kg	1.3	± 0.5 mg/kg
Cd	0.1 mg/kg	<4.5	± 0 mg/kg
Sn	72.4 mg/kg	80.7	± 3.6 mg/kg
Sb	60 mg/kg	67.2	± 5 mg/kg
Tl	2.4 mg/kg	3.8	± 0.8 mg/kg
Pb	314 mg/kg	321.7	± 2.7 mg/kg
Bi	49 mg/kg	57.6	± 1.5 mg/kg

Table of Accuracy - SPECTRO GENESIS

Comparison of certified and measured concentrations for NIST SRM 1640 (Trace Elements in Natural Water)

El.	Certified Conc. [µg/L]	Meas. Conc. [µg/L]	Recovery [%]	
Al	52 ± 1.5	50.7	97.5	
Ag	7.62 ± 0.25	7.34	96.3	
As	26.67 ± 0.41	26.14	98.0	
B	301.1 ± 6.1	298.1	99.0	
Ba	148.0 ± 2.2	137.6	92.9	
Be	34.94 ± 0.41	34.8	99.5	
Cd	22.792 ± 0.96	21.9	96.1	
Co	20.28 ± 0.31	19.3	95.2	
Cr	38.6 ± 1.6	40.2	104.1	
Cu	85.2 ± 1.2	85.6	100.4	
Fe	34.3 ± 1.6	30.6	89.2	
K	994 ± 27	1013	101.9	
Li	50.7 ± 1.4	51.7	101.9	
Mn	121.5 ± 1.1	116.5	95.9	
Mo	46.75 ± 0.26	47.3	101.2	
Ni	27.4 ± 0.8	29.8	108.7	
Pb	27.89 ± 0.14	30.8	110.4	
Sb		13.79	13.7	99.3
Se	21.96 ± 0.51	22.4	101.9	
Sr	124.2 ± 0.7	116.7	93.9	
V	12.99 ± 0.97	12.4	95.6	
Zn	53.2 ± 1.1	54.4	102.2	

Comparison of the certified with the measured concentrations for BCR 141R (Soil)

El.	Certified Conc. [mg/kg]	Meas. Conc. [mg/kg]	Recovery [%]
Cd	14.0 ± 0.5	13.68	97.7
Co	9.2 ± 0.5	9.6	104.3
Cr	138 ± 5	139.6	101.1
Cu	46.9 ± 1.8	47.08	100.4
Hg	0.24 ± 0.03	0.25	104
Mn	653 ± 16	640	98
Ni	94 ± 5	89	94.7
Pb	51.3 ± 2	47.8	93.1
Zn	270 ± 8	278.8	103.3

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AMETEK
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