Well, cheers!

Figure 1: The AA-6300 fully automatic atomic absorption spectrometer

AAS in drinking water analysis

Since January 1st 2003 the new European Drinking Water Regulation (TVO 2001) has been in effect in Germany. The goal of this regulation is to protect human health from the adverse effects which can result from the consumption of polluted water. This law applies to all types of water used for drinking, cooking, food and beverage preparation as well as for personal hygiene and cleaning of objects that come into contact with foods. For these applications, water may not contain any chemical compounds in concentrations regarded as hazardous to human health. For many classes of compounds, especially heavy metals, there are well-defined maximum contaminant levels which may not be exceeded and which as a result need regular monitoring.

Atomic absorption spectroscopy (AAS) is an important technique for the quantitative determination of element concentrations. AAS in the flame- and graphite furnace mode enables accurate determination of extremely low concentrations of metals down to the ultra-trace range. Fully automatic multi-element analysis of sample series for up to 20 elements, as well as the optimisation of system parameters is possible using Shimadzu's AA-6300 atomic absorption spectrometer (Figure 1).

The use of sophisticated background compensation techniques guarantees a high quality of the analytical results even for complex sample matrices and spectral interferences and allows, in this way, secure monitoring during routine analyses.

All of Shimadzu's atomic absorption spectrometers from AA-6200 to AA-6800 model series feature the highly sensitive GFA-EX7i graphite furnace with digital control, and can be used for electrothermal atomisation. During fully automated operation, calibration from stock solutions in the desired concentration range is carried out using the ASC-6100 autosampler and the ASK-6100 dilution station. Programming of the analysis sequence is performed via the WizAArd system software, which already contains all element-specific parameters and functions for recalibration and quality control. Automatic data storage after each measurement, as well as export functions from the system computer into the network or database are integrated as standard.

Element	Pb	Cu	Ni
Wavelength [nm]	283.3	324.8	232.0
Slit width [nm]	0.7	0.7	0.2
Atomisation	Graphite furnance	Flame	Graphite furnance
Lamp current D_2 BGC*[mA]	10	6	12
Lamp current SR BGC*[mA]	8/300	10/500	10/400

Table 1: Instrumental parameters for the determination of the elements lead, copper and nickel

The determination of lead, copper and nickel in drinking water

Appendix 2 Part II of the drinking water regulation that was ratified on January 1st 2003, includes lead, copper and nickel under toxicological aspects. The presence of these metals, therefore, needs to be monitored frequently. These parameters are now much stricter in comparison with the previous version of the drinking water regulation. The maximum contaminant level for lead has been decreased in the new EC guideline from 0.05 to 0.01 mg/L. The reason for this is the known high toxicity of lead, especially for children and adolescents as well as for pregnant women.

The assessment of copper in drinking water is also stricter under the new regulation. The previous maximum contaminant level of 3 mg/L has been reduced to 2 mg/L. Even though copper is a widely distributed metal and is a trace element for humans, it can, after longer exposure, lead to severe health problems in infants and small children even at concentration levels of 10 mg/L.

Lowering the maximum contaminant level for nickel in the new drinking water regulation from 0.05 mg/L to 0.02 mg/L, should prevent nickel pollution levels of drinking water that could lead to further increase of the already frequently occurring nickel allergies in humans.

For the quantitative determination of these metals, the AA-6300 atomic absorption spectrometer was used. This system operates in the wavelength range of 185 - 900 nm and consists of a Czerny-Turner monochromator with a holographic grating (1800 lines/mm). The detector system consists of a photomultiplier for the 185 - 600 nm range and a Si-detector for the 600 - 900 nm range and is therefore extremely powerful for the determination of ultra-trace level concentrations. The double-beam optics ensure excellent stability during long time operation. With this system configuration, concentrations of heavy metals such as lead, copper and nickel can be determined in drinking water according to the new drinking water regulation. The AA-6300 enables the atomisation of these elements in the flame mode (copper) or the electrothermal atomisation in combination with the GFA-EX7i graphite furnace (lead and nickel). Table 1 shows the instrumental parameters used.

For the elements copper and nickel, background compensation was carried out using the deuterium technique. For the determination of lead, the high speed self reversal technique was used to compensate for spectral interferences. Calibration of the elements was carried out in the linear range, as shown in Figure 2 for the element lead in concentrations of 0.005 up to 0.02 mg/L. Using the ASC-6100 autosampler enables fully automatic multi-element analysis sequences.

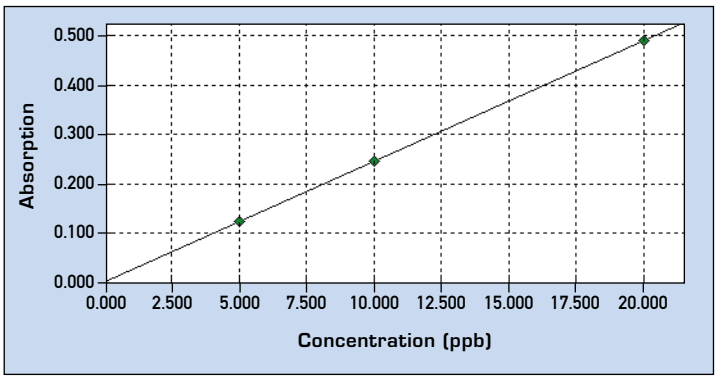

Figure 2: Calibration curve for the element lead

Water for human consumption must be free from impurities, be pure and fit for consumption. This requirement will be met when the generally accepted state of the technologies are applied during water treatment-, purification, and distribution and when water for human consumption meets the requirements of paragraphs 5 through 7 of the drinking water regulation. Continuous monitoring according to international standards, for instance the regularly updated drinking water regulation will provide the consumer with the greatest possible assurance.

In this application area, Shimadzu offers a complete product range consisting of hardware and software for the accurate determination of all relevant parameters as well as the competence and know-how of a market leader in instrumental analysis.

We will gladly send you further information. Please note the appropriate number on your reader reply card.
Info 290