

Automatic Trace Metal System (ATMS)

The Aquaco Automatic Trace Metal System (ATMS) is an instrument for detecting and measuring metals in water. The principal use is in the detection of pollutants such as mercury, copper, cadmium, lead, thallium and zinc, in the flow of water from, for example, rivers, drinking water and effluents. The principle is based on electrochemical voltage-current measurements. The ATMS can also measure other compounds such as pesticides.



Unlike competitive monitoring systems, the ATMS does not use chemicals and therefore does not pollute the sample water further. The result of this is that the sample can be returned to the water course and does not have to be disposed of separately.

This is crucial in the U.K. where it is unlawful to add even a small amount of pollution to a water course even for the purpose of testing contaminants.

The ATMS was invented, developed and patented by Professors Øyvind Mikkelsen and Knut Schröder of Trondheim University.

Several analytical methods are available for monitoring of the environment and industrial processes. Most frequently used is atomic absorption spectrometry (AAS) and inductively coupled plasma mass spectrometry (ICP-MS). However, very few methods can be adapted for use on-line in the field due to the fact that they are not sufficiently sensitive.

To date, the alternative solution has been to bring samples to laboratories to be analysed with sophisticated equipment. This is inconvenient, expensive and gives an undesirable time lag from the appearance of an accidental or illegal pollutant to the detection of it.

This summary paper describes an online monitoring system for heavy metals in normal water, seawater, waste and process water. The system is fully automated, and can be set up for remote transfer of the results via the internet.

Due to the low concentrations of the actual metal ions experienced in the field, the only suitable on-line analytical method that is sufficiently sensitive for this purpose is voltammetry or related dynamic electro-analytical techniques. Use of automatic methods will also enable one to act immediately upon environmental accidents or illegal effluents.

Voltammetry has some advantages compared to other techniques. It is a fast and easy analytical technique to carry out. The instrument is relatively inexpensive, and the operating costs are low. The system may be operational for several weeks or months without any maintenance. The high level of sensitivity allows for the detection limit of many important heavy metals to be as low as 0.5 – 1 µg/L and even lower. Voltammetric methods cover concentration ranges down to drinking water requirements.

The introduction of silver based alloy electrodes has created new possibilities for constructing voltammetric apparatus for use in the field. It is now possible to construct apparatus with good stability over long periods of time for continuous remote surveillance of the level of heavy metals.

Description of the ATMS system

The ATMS 600 system consists of the following essential parts:

The cell system with the electrodes (sensor)

The microprocessor card

Pumps, magnetic stirrer etc.

A PC for input, output and graphical presentation.

The system needs 12 V DC.

In brief the system works as follows;

- A sample is automatically pumped into the measuring system through a non-metallic filter system
- Supporting electrolytic non-toxic salts are added to improve the measurement
- The sample is analysed by use of a new environmentally friendly and patented sensor system (based on a well established electro-chemical technique, voltammetry, but improved by new technology)
- After measurement, the computed results are automatically sent over the internet or local area network for immediate analysis
- Sample cells are automatically emptied and a new sample routine is carried out

The voltammetric sensor system consists of three electrodes implemented in two connected circuits. The electrolysis circuit which consists of the counter electrode and the working electrode is used for controlling the potential over the working electrode. By applying a more negative or more positive voltage the environment over the working electrode surface will be respectively more reducing or oxidising and the resulting current flowing from any redox reaction can be recorded.

The second circuit, the reference circuit, is used to measure the potential of the working electrode. This circuit consists of a high impedance circuit connection between the working electrode and the reference electrode, to ensure that no current flows through the reference electrode in order to stabilise the voltage and make it independent of the cell impedance.

What is new in the ATMS 600 series?

The chemical principles for the ATMS 600 series and the previous ATMS500 series are the same. This also means that the measuring cell and the electrode system are unchanged. The ATMS 500 uses 230V AC and the ATMS 600 use 12V AC. The latter is advantageous if electricity is not



available and solar cells or other sources are used.

On the ATMS 600 series, all electronics are included on a microprocessor card and a PC is only needed for input and output data and graphical presentation. Normally a laptop or network is used for such purposes. The ATMS 600 consists of one cabinet only, with the cell system and a metal enclosure with the microprocessor card inside.

An extension of the ATMS 600 is an ATMS using a dual measuring cell system, called ATMS 600D. This enables one to measure two systems using different experimental conditions.

The advantages of the ATMS 600 are:

- Higher stability over time by using a micro processor card instead of the PC-processor
- Simpler maintenance as the micro processor card is the only part that may need to be replaced

- Increased sensitivity because Square Wave Voltammetry is used
- Less weight with one cabinet only
- No computer is needed except for input and output of data and data analysis. For that purpose a laptop PC is included in the system, but this can be removed during installation
- The use of 12V DC is convenient if electricity is not available. If electricity is available, a simple adapter to 12V DC can be used

Learn more

The Aquaco ATMS is distributed in the UK exclusively by Aquaco Water Recycling Ltd (www.aquaco.co.uk).

Aquaco will demonstrate the system at WWEM in Telford on 10 and 11th November 2010 on stands 43/44. Professor Oyvind Mikkelsen will make a presentation at the workshop on 10th November at 2.30pm.

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