Application Report

Drinking Water Treatment: No 3

Monitoring Natural Organic Matter (NOM) in Drinking Water Treatment

Introduction

This report explains the importance of monitoring and controlling organic load in drinking water.

The Spectral Absorption Coefficient UV 254nm (SAC) is a method for measuring dissolved organic material, and it is used to monitor and control the organic load in drinking water. Water treatment for removal of natural organic matter (NOM) minimises the formation of Trihalomethanes (THMs) and Haloacetic acids (HAAs) by reducing the amount of NOM available to react with chlorine.

Background

All surface water and ground water contains dissolved organic substances that are produced by the incomplete decomposition of the remains of vegetation and due to the products of the metabolism of microorganisms (and plankton). The organic load can also be further increased by human activity, e.g. pesticides.

Water with various concentrations of natural organic matter

Removing organic substances from drinking water is necessary because:

- Organics provide nutrients for microorganisms, bacteria and viruses and therefore encourage re-germination
- Organics in the water react with chlorine during the disinfection process and therefore lead to the formation of disinfection by-products such as Trihalomethanes (THMs), shown to be carcinogenic in laboratory studies
- Many organic substances such as Polycyclic Aromatic Hydrocarbon (PAH) and pesticides can be directly harmful to human health

NOM in drinking water is measured by the UV254nm absorption or transmission method, i.e. dissolved organic material that absorbs UV light at a wavelength of 254 nm.

This includes, for instance, aromatic organic compounds or those that have at least one double carbon bond in the chemical structure.

Purpose of Spectral Absorption Coefficient (SAC) measurement

The continuous measurement of SAC at a water works outlet has, in general, an alarm signaling function. It represents an important addition to the individual routine checks on substances. SAC measurements can further provide information about the condition of specific treatment steps such as activated carbon filtration.

A ground water-source water work installed a UVAS sensor in the outlet of the pure water tank, so that information on dissolved organic material content is always available.

Figure 1 shows SAC measurements at the water works outlet (pure water tank outlet). The SAC is, typically for a water works outlet, approx. 0.3 m^{-1} with correct functioning filtration or activated carbon filtration.

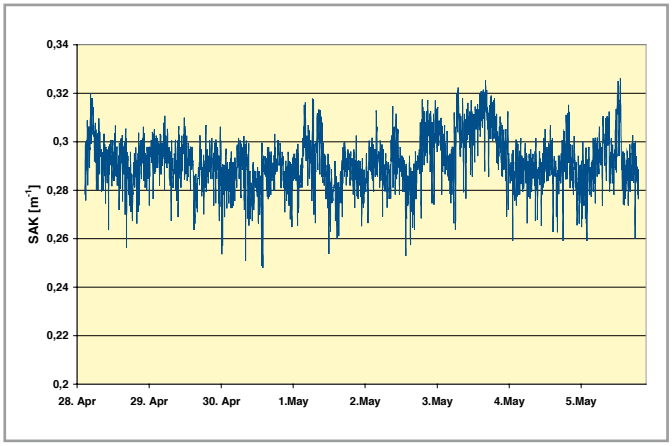

Fig. 1: Continuous measurements of SAC at ground water source

SAC measurement for activated carbon absorption monitoring

The technique of activated carbon filtration is used to remove undesirable organic materials in the water such as natural organic compounds:

- humic acid
- aromatic substances
- flavouring substances
- colourants

As well as synthetic halogenised hydrocarbons such as:

- pesticides
- solvents

Activated carbon is also suitable for the catalytic destruction of chlorine and ozone. The primary application is the treatment of organically loaded surface water and river filtrate, as well as ground water with an elevated organic load, e.g. as a result of pollution. Ground water wells in woodland or in regions with a high level of agricultural activity often have a high organic load as well.

Benefits of the measurement

The measurement of SAC before and after activated carbon filtration provides real-time information on the saturation of the activated carbon and suitable timing for a regeneration.

A German water works in Franconia treats river filtrate from a total of 18 deep wells and shallow wells (aeration, sand filter, ozonisation, activated carbon filtration). Due to the long-distance water supply network in Franconia, the difference in the SAC measurement before and after the activated carbon filtration is determined using UVAS plus sc sensors. The difference is used as a reference (timing indicator) for when a sample from the activated carbon is to be sent to the manufacturer for a more exact determination of the saturation.

The gradual reduction in the magnitude of the difference provides the first indication of the imminent need for a regeneration of the activated carbon.

The SAC measurement is also used for an additional check of the plant and its correct operation.

Suitable measuring technique

The difference in the SAC measurement before and after the activated carbon filtration can be determined by using UVAS plus sc process sensors, which provide a number of advantages:

- To raise the alarm about a malfunction at the outlet
- To assess the saturation of the activated carbon
- To identify regeneration timing of the activated carbon

UVAS plus sc sensor

Precise self-cleaning process sensor for continuous delay-free measurement of dissolved organic substances (SAC 254) in water in accordance with DIN 38404 C3. Reagent-free and sampling-free process for measuring directly in the medium or in bypass.

The UVAS plus sc measuring principle is based on a UV absorption measurement and determines SAC in a purely physical manner.

The sensor features high precision and high resolution measured values. In drinking water, a 50 mm layer is used to achieve the highest resolution for the measured values from 0.01- 60 m^{-1} SAC. The measuring cycle can be set between 1 and 30 minutes. The sensor can be connected to the controller SC 200 or SC 1000.

Controller SC 200

Universal controller for mounting on a wall, pipe or switch panel. Two digital sensors can be connected using splash-protected connectors. Two analogue current outputs, 3 floating change over contacts (5A 115/230 VAC, 5 A 30 V DC), digital interface for bus connection (ModBus RS232/RS485, ProfiBus DPV1 optional).

Controller SC 1000

Universal controller comprising a portable display module as well as a probe module for connecting up to 8 digital sc sensors using splash protected connectors. Several probe modules can be connected together to form a network. The modular system configuration is adapted to suit customer-specific requirements and can be expanded at any time with further measuring points, sensors, inputs and outputs as well as bus interfaces.

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