New & Improved

There are many samples that are generated by a laboratory during the course of product testing to the NSF/ANSI standards. Numerous water samples are generated by performance testing for filters and reverse osmosis (RO) tanks.

By Emily Bolda

A tank is prepared with the contaminant to be challenged, and effluent samples are generated during the course of the test. All of these samples are analyzed for the contaminant of interest as well as other analytes in the challenge water. These samples are analyzed to determine compliance to the standard and percent reduction for lead, arsenic and other contaminants.

Analysis Instrument

The Water Quality Association (WQA) laboratory has recently acquired a new tool for analysis—an ICP/MS instrument. The ICP/MS instrument is an improvement over the technology that is currently being used, which is a graphite furnace atomic absorption spectrometer (GFAA) instrument.

New instrument provides many benefits

The way the two instruments measure concentrations is fundamentally different. The GFAA measures how much light is absorbed by the sample to determine concentration, while the ICP/MS functionally weighs ions in the sample to determine concentration.

The lab currently uses a GFAA to measure concentrations of metals in water samples, a technique that follows the Environmental Protection Agency's (EPA) Method 200.9. This instrument measures concentrations of a contaminant by relating the amount of light of a certain element that is absorbed by the sample to amounts of light absorbed by known concentrations of a contaminant. In this technique, a small amount of sample is heated to a very high temperature inside a small tube made of high-purity graphite and is turned into an atomic vapor.

The atomized sample is placed in a path of light, the source of which is a lamp made of the contaminant that is to be analyzed. The concentration is then determined by how much light is absorbed by the sample. Analysis by using this technique produces results that are low enough for certain applications in the laboratory, but not for all. The technique is also slow and only one element can be analyzed at a time.

The ICP/MS uses two technologies: inductively coupled plasma (ICP) and mass spectrometer (MS). It is a combination of these two technologies that creates a tool that is powerful and different from the GFAA instrument that is currently used in the lab. The ICP/MS technique follows EPA Method 200.8. The idea is that each element will become ions of known mass in ICP/MS conditions and can thus be measured and related to concentration.

The ICP is argon plasma that is maintained by the interaction of a radio frequency field and ionized argon gas. This creates extremely high temperatures, around 6,000°C. The plasma is created when the argon is made to be conductive by exposing it to an electrical discharge. The sample is first introduced to a nebulizer, which causes the sample to become aerosolized. The fine droplets pass through a spray chamber and are introduced into the plasma field. The aerosolized sample becomes energized in the plasma field and becomes ionized.

These ions then exit the plasma and enter an interface region. Here the ions pass through a focusing lens and are pulled toward the mass spectrometer by a high vacuum. The mass spectrometer has four long metal rods, which are collectively called a "quadrupole."

The quadrupole acts as a mass filter by using voltage changes to separate ions of different mass. The quadrupole allows only one mass to pass through to the detector at any time and sorts the ions on the mass-to-charge ratio. This is done by setting up the voltages and radio frequencies in the instrument to guide the ions with selected masses between the four rods of the quadrupole and toward the detector. These settings change rapidly throughout the run, allowing different masses to pass through.

After the ions are sorted they reach the detector at the end, which generates an electronic signal. This way the detector counts individual ions passing through the quadrupole and relates it to concentration.

Counting the Benefits

There are three main benefits of the ICP/MS that will improve operations in the lab: It is faster, more sensitive and can analyze up to 40 elements simultaneously. The ICP/MS is able to run a sample in as little as three minutes, while the GFAA generally takes about 10 minutes to run a sample. The ICP/MS can see sub-part-per-trillion levels, whereas the GFAA can only see low part-per-billion levels and some sub-part-per-billion levels. The greatest benefit is that it can analyze many elements at once. Running several metals for one sample would take several days by GFAA, but only a few hours by ICP/MS.

This new instrument will enable the lab to see contaminants at lower concentrations, analyze samples faster and see up to 40 elements at a time, improving efficiency and turn-around time on sample analysis. *wqp*

Emily Bolda, CWS VI, is laboratory supervisor for the Water Quality Association. Bolda can be reached at 630.929.2534 or by e-mail at ebolda@wqa.org.

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