

ChemScan[®]

PROCESS ANALYZERS

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ChemScan[®] Method Summary #56 Nitrate in Water or Wastewater

Standard Nitrate Analysis

Several standard methods are available for determination of nitrate in water or wastewater samples. One of these methods is typically used as the standard of comparison for calibration and evaluation of the ChemScan system. All methods require a prompt analysis, conducted within 24 hours of sampling, using samples stored at 4°C. If longer periods of storage are required, samples are generally "preserved" with acid and stored at 4°C. Acid preservation will convert all nitrate present in the sample to nitrite. Therefore, samples that have been preserved with acid will not permit nitrate and nitrite to be determined as individual species. Only total oxidized nitrogen, which is the sum of nitrate plus nitrite, can be determined in an acid preserved sample.

Standard analytical methods include ion specific electrode, ion chromatography, cadmium reduction, titanous chloride and hydrazine reduction.

Colorimetric methods such as cadmium reduction or hydrazine reduction convert nitrate to nitrite prior to analysis, using a reagent to create a colored nitrite complex which can be measured photometrically. Both reduction methods require 0.45 pore membrane filtered samples. These methods must be performed promptly if nitrate is to be determined separately from nitrite. Both methods can introduce toxic by-products into samples, which require controlled disposal of analytical samples. Although both methods can be automated, neither method is well suited for on-line analysis.

Titanous chloride reduction converts any nitrate in the sample into ammonia, then uses a gas sensing electrode to detect the ammonia. Any nitrite or ammonia also present in the sample will be co-determined, thus reducing the effectiveness of this method for on-line analysis of samples from biological processes.

Ion electrodes are subject to interference from chloride, bicarbonate, nitrite, and a number of other anions. Ion electrodes also may provide erratic responses under variable pH conditions. Buffer solutions must therefore be used to maintain a constant pH and ionic strength. These issues plus well known fouling and calibration problems make ion electrodes a poor choice for on-line analysis in most applications.

Ion chromatography can provide good theoretical separation of anions, but a high concentration of any one ion in the sample will interfere with the detection of other ions. Also, low molecular weight organic acids (which are commonly found in water or wastewater samples) may interfere. The method is generally used in a laboratory under supervision of a trained operator and may not be suitable for on-line analysis due to highly variable sample chemistry and the need for careful daily calibration.

Ultraviolet Spectrometry Method

Standard Methods for Examination of Water and Wastewater and other sources recognize a screening method for detection of nitrate in water using two wavelength ultraviolet spectrometry. An absorbance measurement is made at 220 nm and is corrected by subtracting a second measurement at 275 nm. Theoretically, this will compensate for the presence of organics. However, the method recommends prior 0.45 micron sample filtration to remove the effects of turbidity. The method is not recommended if significant correction for dissolved organic matter is required or if a variable organic content is expected, since the relative response of each organic substance is different at 220 nm and at 275 nm. Also nitrite, if present, will also be detected at 220 nm as if it were nitrate. This interference makes this method unsuitable for analysis of samples from biological processes. Other chemicals in water or wastewater such as metals, hypochlorite and permanganate can also significantly alter the results obtained with this method.

ChemScan Analytical Method

The ChemScan nitrate analysis method uses the measurement of light absorbance at multiple wavelengths across the ultraviolet wavelength range plus a reference wavelength in the visible range. No reagents or sample alteration is required. A real time analysis can be performed without creating a toxic sample discharge from the analyzer.

The use of multiple wavelengths (up to 30 wavelengths out of 256 wavelengths detected) provides sufficient information for pattern recognition software to accurately calculate nitrate while compensating for the presence of nitrite, metals, organics, oxidants and nutrients in the samples. The measurement of visible wavelengths is used to compensate for turbidity variations in the sample without the need for filtration of the sample. The ChemScan nitrate analysis method does require one time on-site calibration using site specific samples to characterize sample backgrounds and interactions with nitrate.

Monitoring System Requirements

Sample points and instrument location should be selected to minimize sample line distance. Surface water, groundwater and treated potable water samples will typically not require filtration prior to analysis if suspended solids are 150 ppm or less and if turbidity is 60 NTU or less. Wastewater samples extracted from points in the treatment process ahead of secondary clarification will generally exceed these specifications and will require filtration or settling prior to analysis. Wastewater samples extracted from points at or after the secondary clarifier will generally not require any filtration prior to analysis.

Multiple sample points can be monitored using one ChemScan analyzer plus a multiple sample line manifold.