

Technical Publication

Title: Project and Data Summary: Ammonia-Nitrate-Nitrite Monitoring

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Prepared for: City of Phoenix
91st Avenue Wastewater Treatment Plant
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Note: This document was originally published by Biotronics Technologies, Inc. in conjunction with the ChemScan Process Analyzer technology base, now owned by Applied Spectrometry Associates, Inc. Please direct all inquiries and correspondence to:

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ChemScan® UV-6100 Process Analyzer

PROJECT AND DATA SUMMARY

Ammonia - Nitrate - Nitrite Monitoring
City of Phoenix
91st Avenue Wastewater Treatment Plant

Published by:

Biotronics Technologies, Inc.
W226 N555B Eastmound Drive
Waukesha, WI 53186

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Plant Description

The City of Phoenix 91st Avenue Wastewater Treatment Plant is a 150 MGD capacity facility practicing primary and secondary treatment, with chlorine disinfection of a settled activated sludge effluent. During a pilot study, a controlled amount of primary effluent was added to the secondary effluent to provide a source of ammonia in order to produce chloramines during the disinfection process. The City was seeking a method to simultaneously monitor ammonia, nitrate and nitrite as separate parameters in sample collected from a point prior to chlorine addition. In full scale operation, the plan is to control the Biological Nutrient Removal (BNR) process such that a target concentration of ammonia and a minimized concentration of nitrite (NO₂) is delivered to the disinfection process.

ChemScan Approach

Prior to the Phoenix project, the ChemScan UV-6100 had already been demonstrated for simultaneous nitrate and nitrite analysis at several wastewater treatment facilities in the United States and for several U.S. Government research applications. A method for ammonia analysis using the UV-6100 system had also been tested in a laboratory environment, but had not previously been used in a field application.

A special sample conditioning system was designed and fabricated to inject a pH buffered hypochlorite solution into a quantity of sample and to transfer the mixed solution to the UV-6100 for analysis. Intermittently, a volume of unconditioned sample would be transferred by the sample conditioning unit to the UV-6100 for analysis of nitrite and nitrate based on the natural ultraviolet absorbance of these chemicals in wastewater. The reaction between the hypochlorite solution and the ammonia could be used to produce a sample with an ultraviolet absorbance signature able to be analyzed for ammonia, although the exact method employed is being held in confidence pending the filing of appropriate U.S. and foreign patent applications.

Results

Following a period of system calibration and adjustment in the fall of 1994, samples were extracted once each shift and delivered to the plant laboratory for analysis. Ammonia, nitrate and nitrite values as shown on the UV-6100 were recorded and compared to the laboratory results. The attached graphs show this comparison. Plant operating staff confirm that the excursions in ammonia concentration shown on September 10 and 11 do track with known events within the plant, even though no samples were extracted during the events. Overall, these data show excellent agreement between the on-line results from the UV-6100 and analysis of periodic grab samples by the laboratory.

Maintenance was limited to a weekly zeroing, with a physical cleaning every 3-4 months. Sample conditioning solutions require replenishment every 14 days at an overall cost to the plant of less than \$50.00 per month, despite an interval of 15 minutes between measurements.

A continuous output log was maintained by the plant computer system through dedicated 4-20 mA outputs for each parameter.

UPDATE

The pre-chlorination study was successfully concluded in 1998 and the UV-6100 was moved to a process sample point for a BNR process control study being planned. Three new ChemScan UV-

4100 Analyzers for pre-chlorination analysis of ammonia, nitrite and nitrate were ordered in 1999 and installed in early 2000 as a part of the plant's new Chlorination Process Improvement project. The UV-4100 uses analysis methods similar to the UV-6100, but without the external sample conditioning system, resulting in much faster analysis times, less sample volume for flushing and analysis, less reagent use for ammonia analysis, automatic zeroing at set intervals and automatic cleaning on demand. These improvements allow cycle time to be reduced to 5 minutes for all parameters and also reduce maintenance to a once per month replenishment of consumables.