

Automated wet chemistry analysis

IDEA Lab aims to improve speed and efficiency across Pace Analytical with Gallery Aqua Master Discrete Analyzers

“Our goal is to finish more work, faster, with more efficiency and sustainability, without compromising quality. The Thermo Scientific™ Gallery™ Aqua Master Discrete Analyzer provides equivalent or better data quality, while speeding up the determination process significantly. Adding this automation across Pace would significantly reduce the amount of reagent used and analysts’ bench time, resulting in reduced costs and increased productivity.”

—Timothy Traynor, Technical Specialist, IDEA Lab, Pace Analytical

Introduction

Pace is a fee-for-service analytical laboratory company specializing in environmental and pharmaceutical testing, with locations across the United States. Its laboratories rapidly and accurately test thousands of samples weekly. Like most other service laboratories, Pace is under pressure to reduce costs and improve turnaround times for its services, without compromising quality of results. An increasingly large part of testing costs is related to personnel costs. Minimizing use of analytical consumables such as solvents and reagents is another concern, not only to manage costs but to meet sustainability goals.

Due to these trends, companies like Pace are looking to adopt innovations which automate work to reduce costs and improve productivity and sustainability, while enhancing client service and making laboratory work easier. These are the objectives of the Innovation Team in Pace's Environmental Sciences Division.



Photo courtesy of the East Longmeadow Laboratory within Pace Analytical

Its IDEA Lab evaluates instruments and consumables for use, appropriateness, and best-practice standardization across all Pace laboratories. After evaluating the Gallery Aqua Master discrete analyzer, the IDEA Lab is advocating its implementation throughout the company for tests where it can replace manual wet chemistry methods to improve speed and efficiency without compromising accuracy or quality.

Limitations of traditional wet-chemistry analyses

Environmental testing laboratories need accurate, efficient, and easy-to-use analytical techniques to handle enormous sample loads quickly and cost-effectively. Timothy Traynor, Technical Specialist, IDEA Lab, Pace Analytical, pointed out, “our main challenge is the sheer number of samples we process because many of our labs run thousands of samples per week.”

Wet chemistry methods, including titrations, flow injection analysis, and other colorimetric techniques have been traditionally used for environmental testing. This has been the situation at Pace, where its laboratories have typically measured environmental analytes such as ammonia, nitrate, phosphate, cyanide and phenol using wet chemistry techniques and continuous-flow analysis, which provides some automation.

These traditional techniques often involve many sequential and complicated manual steps, resulting in lengthy workflows that require highly skilled technicians to perform. According to Traynor, “many of these tests involve manual addition of reagents and sequential determination in cuvettes on a spectrophotometer. Manual techniques can demand an analyst’s entire shift. By the time the results are obtained, the analyst is left with very little time to look at the data critically.”

“Many of our labs still use a manual test where you take the reagents and add it to the sample and then incubate it for a certain time. And you have to do everything sequentially one by one, whereas a discrete analyzer does all of the manual work for you.”

—Timothy Traynor

Manual steps are also significant sources of error that reduce overall measurement accuracy. In addition, the large quantities of reagents used in wet chemistry methods, and their associated high-volume waste streams, increase cost-per-sample. Traynor noted, “Manual determination requires several milliliters of reagent per sample, and even continuous-flow requires 1-2 milliliters of reagent per sample.”

The Gallery Aqua Master discrete analyzer solution

Gallery and Gallery Plus Aqua Master discrete analyzers are integrated and highly automated platforms that provide a faster and safer turnkey alternative to traditional wet-chemistry methods. The platform delivers high-throughput measurement of up to 20 parameters simultaneously from a single sample, and every test is performed in a precise and predefined way. No user intervention is required once the samples and the pre-mixed, ready-to-use reagents are loaded into the instrument.

The analyzers not only improve the reliability and sensitivity of results compared to manual techniques, but they also increase laboratory productivity by freeing staff to walk away and work on other value-added tasks. Automated workflows also eliminate the need to handle hazardous reagents, protecting the health and safety of laboratory staff.

For regulated analyses, the Gallery and Gallery Plus Aqua Master discrete analyzer workflows have been verified to meet the U.S. EPA-approved reference methods and international regulatory requirements for environmental wastewater and drinking water analysis. Advanced software provides sought-after features that enable laboratories to achieve a higher degree of automation and usability when following various regulated methods and international standards.



“The Gallery Aqua Master discrete analyzer changes the workflow in many ways to streamline operations. I would like to see discrete analysis implemented across our laboratories for certain tests, especially when it replaces manual processes. As this technology has improved, it has become better at eliminating repetitive tasks and human error and making analyses more efficient.”

—Timothy Traynor

The case for Gallery discrete analyzer deployment across Pace

Gallery discrete analyzer benefits

The IDEA Lab has realized several benefits since evaluating the Gallery discrete analyzer, notably the impact of increased automation on productivity and the quality of results, with less reagent consumption and chemical waste. Traynor highlighted the features that make the Gallery Aqua Master discrete analyzer an ideal choice for certain environmental analyses at Pace:

Automation increases productivity

- Fully discrete, automated sampling and dilution with customizable rinsing programs that eliminate repetitive manual tasks
- Ready-to-use reagents that can be placed in a rack where the barcode on each is automatically read
- Linked calibration curves per analyte that extend linear range
- Customizable programs that automatically dilute overrange samples according to user-specified parameters
- Barcode reader tracks racks both inside and outside the carousel
- For workflow simplicity, efficiency, and priority interrupt samples, each rack can be scheduled, allowing the analyzer to work on it as soon as it is placed in the carousel
- Extended walk-away time that frees up analysts to concentrate on other tasks

“The main reason to switch to discrete analysis is to free up the analyst to focus on other tasks such as sample prep or data reduction,” summarized Traynor. “The Gallery discrete analyzer

will quickly determine an analytical batch without the need for much analyst intervention. Ideally, automation like this allows the analyst to not only get more samples finished quickly and accurately, but to then focus more effort on whether the results make sense.”

Automation improves results quality by minimizing human error

- Robotic reagent addition provides consistency and reproducibility
- Reagents and sample racks are recognized by barcodes, reducing human error
- Electronic Incubation timing ensures each assay is read consistently

Traynor explained, “Real life gets in the way of even the most experienced and diligent scientist. Since all reagent additions are done robotically, there are fewer variations in volume dispensing.”

Low reagent consumption and chemical waste

- Reduced sample and reagent volumes (only 2–240 µL)
- Low waste generation and reduced cost-per-analysis (up to 20 times lower compared to manual techniques)

“A big push in Pace right now is sustainability and this is one area where discrete analysis excels,” said Traynor. “Here the benefit of discrete analysis is reduced reagent use, because with a flow injection analyzer you often use 1 to 2 milliliters of reagent per sample whereas with the discrete analyzer it’s often 2 to 300 microliters total. From a sustainability standpoint, a discrete analyzer is preferable where it can be used efficiently.”

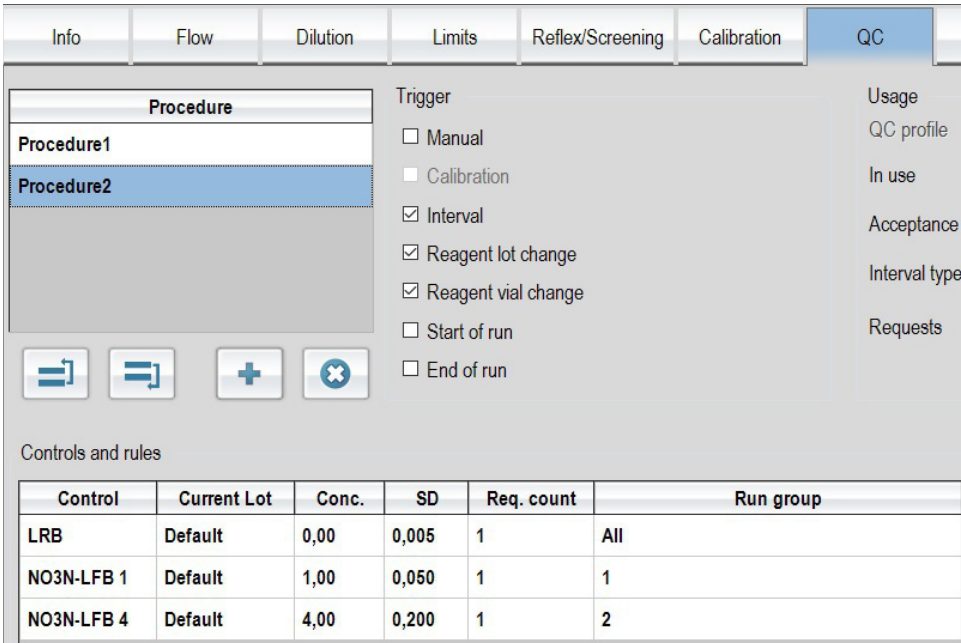


Figure 1. The “QC” tab is used to define the desired QC triggers, as well as controls and rules. If multiple QC procedures are triggered at the same time, their running order is set up in the “Procedure” list. “Move up” and “Move down” buttons make it easy to change the order of procedures or control runs.

“The new software with customizable QA/QC features and report generation gives it an edge over many other discrete analysis platforms. These features make the Aqua Master an excellent choice for environmental water analysis.”

—Timothy Traynor

Software streamlines environmental testing workflows

The walkaway productivity of the Gallery Aqua Master discrete analyzer is powered by software that performs the required calibration orders and relative standard error (RSE) calculations, routine quality-control (QC) schemes, automated spiking, flexible reporting, and easy rerun of samples requiring new dilution factors. Even the most complicated spiking, calibration, and QC procedures can be fully automated. These sought-after features enable laboratories to fully automate their testing workflows while following local regulations. Traynor described how the Gallery discrete analyzer’s software capabilities could streamline environmental testing workflows across Pace:

- RSE calculation with flagging: “Due to The NELAC Institute (TNI) recommendations, relative error and relative standard error are expected to be within certain limits. Automatic calculation and flagging of out-of-tolerance results allows for faster evaluation of the calibration curve.”
- Automated spiking procedure for easy identification of sample-matrix-related interferences: “Automatic spiking allows the analyst to simply load samples and not have to worry about whether a spike was included in the batch or whether a sample was spiked,” continued Traynor. Automated spiking saves time and reduces error compared to manual sample spiking.
- Flexible, automated QC procedures: “QC sample injections are fully customizable, and user-defined.”

- Flexible results reporting: “Reports are customizable, with plenty of user-defined and raw data display fields,” said Traynor. Reports can be sorted by tests and by batches.
- Easy rerun of multiple samples with a new dilution factor: Traynor added, “With the click of a button, samples can be rerun in duplicate, as a spike, or as a serial dilution.”

Complementary technique

Pace now uses the Gallery discrete analyzer for rapid determination of various anion and nutrient species such as orthophosphate, chloride, nitrate, and nitrite. The instrument is also used in one lab for final determination of cyanide, total phosphorus, and phenol following distillation or digestion. While the Gallery discrete analyzer offers many advantages, Traynor does still see a place for flow injection techniques. “In our environmental laboratories, we use both flow injection analyzers and discrete analyzers as complementary approaches because some analyses are best done on the flow injection analyzer; for example, when the preparation may require distillation or digestion prior to analysis. When the sample goes through the flow injection analyzer, some of those processes can be done automatically, whereas the Gallery discrete analyzer may be more appropriate for tests that don’t require those specific preparations. However, while traditional techniques have distinct advantages for certain tests, they consume far more reagent per test, and have fewer failsafe controls built in,” clarified Traynor.

“As long as I’ve worked for Pace, Thermo Fisher has been a really good partner to us. Our companies have built a good relationship over the years, and we hope to continue to contribute to each other’s success and sustainability in the future.”

—Timothy Traynor

Long-standing Thermo Scientific relationship Timely and knowledgeable training and support

Whether it's a large analytical services company or a single laboratory, access to a complete portfolio of services and support solutions is essential to enhancing productivity, reducing cost of ownership, and ensuring continued performance throughout. Traynor noted that, "Thermo Fisher Scientific has

long been a principal vendor meeting Pace's instrument and consumable needs. Their response is always very prompt, and the information provided is appropriate and useful. I've found their technical support and field service engineers to be committed to solving any problem quickly. Installation of and training on instruments is led by experienced and knowledgeable staff, and training is increasingly customized and application-driven.



About Timothy Traynor

Timothy Traynor has been a Technical Specialist in Pace's IDEA Lab since 2019. Prior to his current role, Traynor has worked as a Chemist and a Metals Analyst at Pace, and a Chemist at the North Dakota Department of Health, among others. Traynor has a bachelor's degree in Chemistry from Concordia College and a master's degree in Theology from Saint John's University.

Image courtesy of Pace Analytical.

About Pace Analytical

Pace® is a nationwide network of over 50 environmental laboratories, eight life-sciences labs, and over 40 service centers. Its size allows its clients to tap into an extensive network of services, facilities and instrumentation while still providing local service, quick response time and first-class customer service. The company's full-service environmental testing laboratories offer inorganic, organic and radiochemistry capabilities in a national network to deliver timely and reliable results. Pace is dedicated to delivering the highest standard of testing and scientific services in the industry. Its commitment to continuous improvement in the areas of green initiatives, new methodologies and instrument innovation means it can provide the most advanced solutions paired with the service and support that comes with four decades of experience.

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