What is better for automating wet chemical analysis? Integrated discrete analyzer or flow analyzers?

Technology selection considerations should be based on various factors:

- Current and future sample analysis load

- Additional costs incurred by adding additional tests

- Number of parameters per sample

- Complexity of wet chemistry parameters testing for each sample

- Detection limits

- Reagent consumption

- Waste generation

- Cost per analysis

- User's skill level

- Regulatory requirements

- Maintenance and bench space requirement of equipment

- Total cost of ownership and Return on Investment (ROI)

In general, Flow Injection Analyzers (FIA), Segmented Flow Analyzers (SFA) or Continuous Flow Analyzers (CFA) are batch analyzers, meaning they are particularly suitable for analyzing few parameters for large number of samples. Flow systems use specific detector modules, reagents delivery and mixing, that limits the number of parameters that they can test per sample. Typically, flow systems test 2 to max 6 different parameters per samples. If a laboratory is looking for an easy to use high throughput, expandable, multiparameter, wet chemistry analyzer for large numbers of samples, then integrated discrete analyzers are better suited than FIA, SFA or CFA.

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Technology comparison

Features	Gallery/Gallery Plus discrete analyzers	FIA/SFA/CFA
Instrument type	Fully integrated discrete analyzer	Open and modular type
Operator skill level	Low	Advanced
Number of measuring channels	Freely selectable 12 filter positions (channels)	Maximum 4-6 channels; Need two 2 to 3 instruments to match channel capabilities
Sample sequence	Random access — parallel and batch: sample can be loaded for several tests while a calibration for another is being processed	Medium to high; impacts results reliability; requires intense maintenance to minimize carryover
Cross contamination	Minimal — discrete, fully disposable reaction cells	Medium to high; Impacts results reliability; requires intense maintenance to minimize carryover
Method stability	Very high; long calibration stability and reproducible results	Low; detector signal drifts; adjust data due to baseline drift throughout a batch run
Reagent delivery	Fully automated micro liquid handling; robust system	Peristaltic pump; requires frequent maintenance
Number of tests/hr	200-350	60-120
Number of chemical parameters/sample	Up to 20 different chemical parameters for a sample	Typically, from 2 to 5; limited by number of channels
Reagent consumption	Very low (µL) Typically <100 µL	Large (mL) 8-10 mL
Instrument startup time	<5 minutes	15-45 minutes
Change over time between chemistries	None	15-30 minutes
Sensitivity	ppb	ppb
Source lamp	Long life Xenon; savings on consumable cost over the instrument lifetime	Tungsten. Requires frequent change
Number of reagents addition per tests	Maximum four + a matrix matching reagent; easy to transfer FIA, SFA or CFA methods	Typically 2 reagent additions per test
Reagents	Ready to use system reagents kits or in-house reagents	In-house reagents
pH & conductivity	Electrochemical Unit (ECM) module	Additional 2 channels

What are the advantages of discrete analyzers over FIA, SFA and CFAs?

Integrated discrete analyzers, such as the Thermo Scientific™ Gallery™ discrete analyzers, can automate photometric (enzymatic, colorimetric, turbidimetric) and electrochemical (pH and conductivity) measurements providing fast, reproducible results in a compact, benchtop design. The discrete, fully disposable, cuvette technology allows laboratories to measure multiple analytes, up to 20 different chemical parameters, simultaneously while reducing total analysis and operator time. The unique low-volume cuvette design accommodates small reagent volumes, minimizes reagent waste, and as a result reduces overall cost per anlaysis.

What are the advantages of FIA, SFA, and CFA over discrete analyzers?

Continuous Flow Injection analyzers, being modular, can add additional sample preparation blocks for difficult sample matrices. Some of the FIA, SFA, and CFAs can perform inline heating, distillation, dialysis, filtration and digestion. Users could change the measuring pathlength to enhance detection limits. They are suitable for few parameters for many samples.

Although FIA, SFA, and CFA is a well-established technique for environmental applications, many laboratories successfully transferred the methods from FIA, SFA, and CFA to discrete analyzers to reduce testing, maintenance, and consumable costs, and improve the ease of operation.

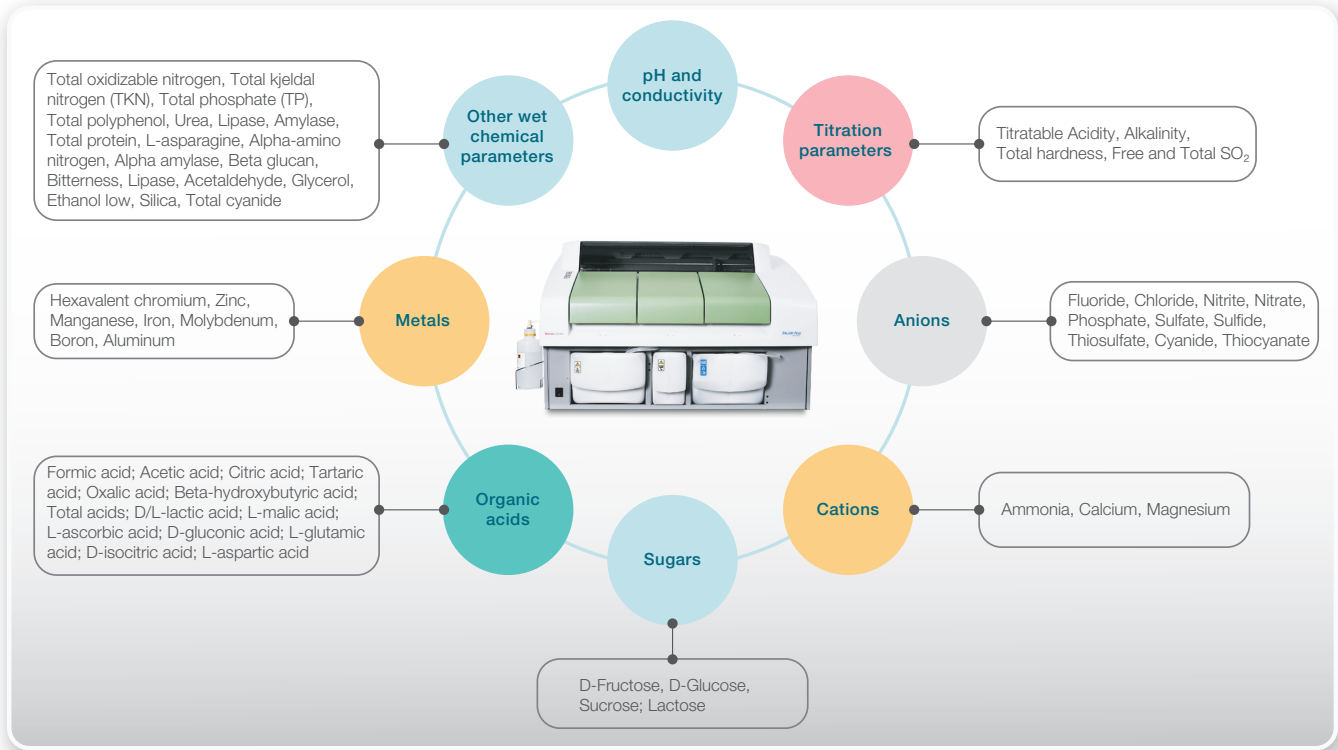**Single Instrument - Single Operator - Many Parameters**

pH and conductivity

Other wet chemical parameters
Total oxidizable nitrogen, Total kjeldal nitrogen (TKN), Total phosphate (TP), Total polyphenol, Urea, Lipase, Amylase, Total protein, L-asparagine, Alpha-amino nitrogen, Alpha amylase, Beta glucan, Bitterness, Lipase, Acetaldehyde, Glycerol, Ethanol low, Silica, Total cyanide

Titration parameters
Titratable Acidity, Alkalinity, Total hardness, Free and Total SO_2

Metals
Hexavalent chromium, Zinc, Manganese, Iron, Molybdenum, Boron, Aluminum

Anions
Fluoride, Chloride, Nitrite, Nitrate, Phosphate, Sulfate, Sulfide, Thiosulfate, Cyanide, Thiocyanate

Organic acids
Formic acid; Acetic acid; Citric acid; Tartaric acid; Oxalic acid; Beta-hydroxybutyric acid; Total acids; D/L-lactic acid; L-malic acid; L-ascorbic acid; D-gluconic acid; L-glutamic acid; D-isocitric acid; L-aspartic acid

Cations
Ammonia, Calcium, Magnesium

Sugars
D-Fructose, D-Glucose, Sucrose; Lactose

Figure 1. Consolidated wet chemical analysis.

Flow Analyzer
(Large bench space)

Reagent 1   Reagent 2   Reagent 3   Waste

Gallery integrated discrete analyzer
(Compact concealed bench top)

The best thing to do when using a Gallery discrete analyzer is to simply walk away.
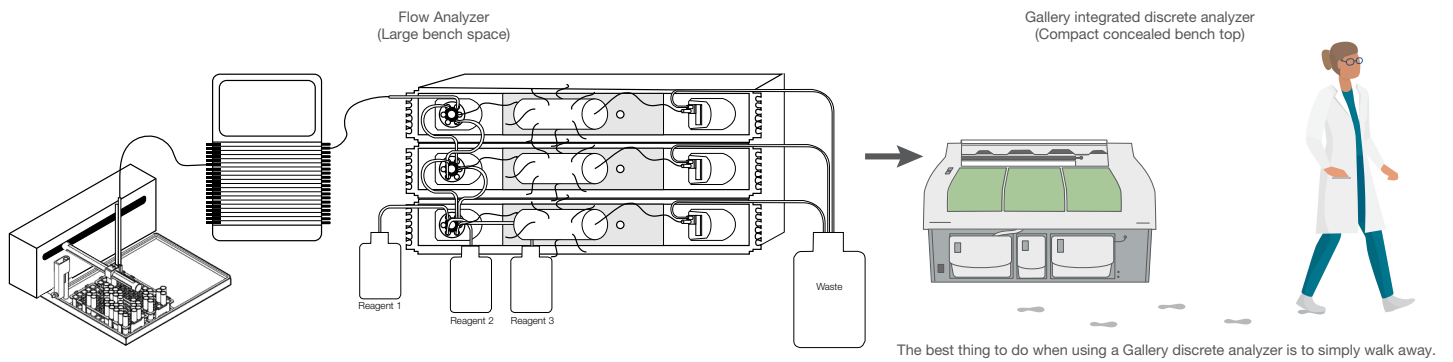
Figure 2. Method Transfer: From complex to convenient.

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Can a FIA, SFA, and CFA method be transferred to the Gallery discrete analyzer?

The Gallery discrete analyzer is an open system and easy to transfer FIA, SFA or CFA method conditions. The Gallery platform allows up to 4 reagent additions, as well as, matrix matching reagents, per measurement in a flexible sequence. The incubation temperature is variable and can be defined based on the chemistry needs. In addition, users have the method development freedom to use their own reagents that are defined in their standard operating procedure. Open software allows the user to edit and optimize the method. This flexibility makes transitioning the methods from FIA, SFA, and CFA to the Gallery platform smooth and easy for many wet chemical testing.

Find out more at **thermofisher.com/discreteanalysis**

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