

Flow Injection Analysis Throughput Advancements

Current commercial FIA systems typically run assays such as phosphate at around 25-30 seconds per sample. Older systems may take 60 seconds or longer per sample. This assumes the system is loading the next sample into the sample loop while simultaneously measuring the current sample.

There are three main criteria that have limited the system from running faster:

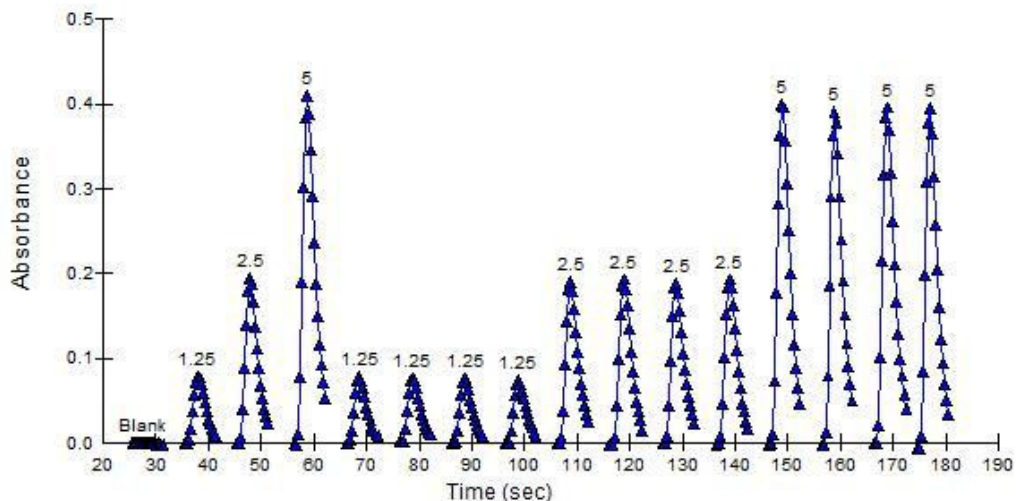
- 1) Getting the sample from the autosampler to the sample loop, while simultaneously measuring and clearing out the previous sample. This typically takes 10-15 seconds for a typical four rack autosampler.
- 2) Color development time, e.g., for phosphate at room temperature is around 30 seconds for mid level agricultural soil samples where medium sensitivity is required. Phosphate dedicated manifolds are often heated to, e.g., 40 C, which decreases this time to 10-15 seconds.
- 3) Passing the color forming sample through two mixing coils and flowcell typically takes 20-30 seconds, depending on the size of the coils, ID of the tubing, volume of flowcell, and pump speed.

So the question arises, is there a way to drastically increase the throughput without degrading quality?

We configured the FIAlab-2500 system for Bray phosphate, but with a few changes to the manifold.

- a) Added a separate fast sampling pump that can bring the sample from the autosampler to and through the sample loop in less than six seconds, including washing the line of the previous sample.
- b) Removed the first mixing coil, replacing it with a short 0.02" ID 4" long piece of tubing.
- c) Shortened the heated 2nd coil to 1/5th the normal length, to only 15" of 0.02" ID tubing.
- d) Increased the temperature to 70 C.
- e) Added a back pressure regulator to the flowcell output to prevent sample outgassing during heating.
- f) Since the sample has such a short distance to travel, the pump was slowed down to around half the normal speed.

The results (shown on the next page) demonstrated a throughput of 10 seconds per sample. Further, since the pump is set to half speed and the throughput is doubled, the reagent consumption is only around 25% per sample of standard FIA runs for phosphate. The savings should apply to tubing. Though not yet verified, one might expect the peristaltic tubing to last four times longer.



Phosphate at 10 seconds per sample with the Fast FIA manifold - concentration ranges 1.25, 2.5, 5 PPM

We also tested nitrite and nitrate in a similar fashion, and found we could also measure these analytes significantly faster than demonstrated with standard FIA, see table below.

High Range (1 cm flowcell)

Assay	Typical Throughput	Concentration Range
Phosphate	360 samples/hour	0.1 to 20 mg (N)/L
Nitrite	360 samples/hour	0.02 to 50 mg (N)/L
Nitrate	240 samples/hour	0.02 to 50 mg (N)/L

Mid Range (10 cm flowcell)

Assay	Typical Throughput	Concentration Range
Phosphate	240 samples/hour	0.01 to 2 mg (N)/L
Nitrite	240 samples/hour	0.002 to 2 mg (N)/L
Nitrate	180 samples/hour	0.002 to 2 mg (N)/L

Please contact FIAlab (fialab@flowinjection.com) for additional information.