IRmadillo™

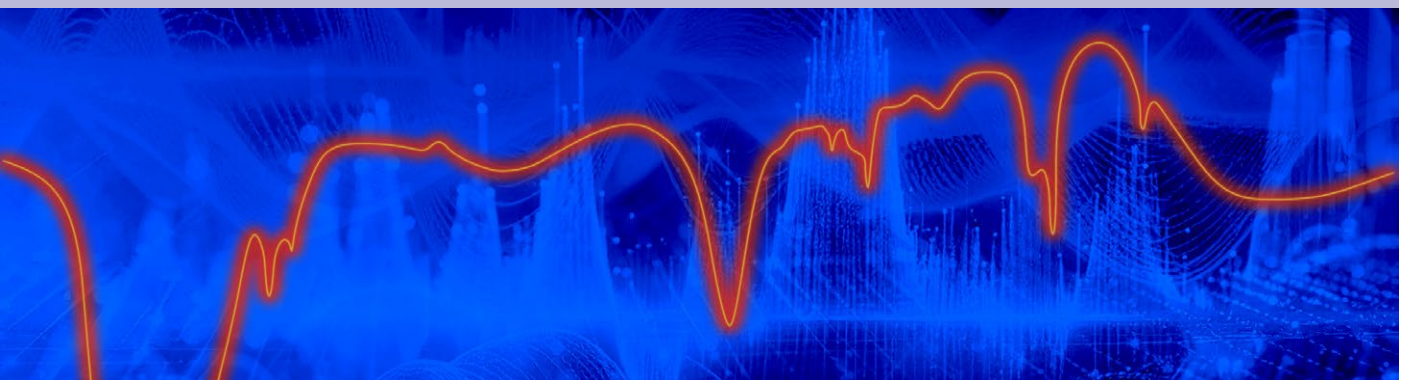
APN1009

CASE STUDY:

How continuous process control beats HPLC snapshots

KEY WORDS

- Ethanol fermentation
- HPLC
- Process monitoring
- Bacterial contamination
- Sugar profile
- Real-time measurement
- FTIR
- Spectroscopy
- NIR



The Problem

HPLC samples every 8 hours, taking 30 minutes to run. By the time you see a problem, you're already hours into a failing batch.

The Solution

Continuous measurement of all your HPLC analytes in real-time. Catch problems immediately. Optimize confidently. Build your golden batch.

What an Iowa ethanol plant discovered

After installing the IRmadillo in their fermenter recirculation line, the plant gained continuous visibility into eight key chemicals - everything they were measuring with HPLC, but updated constantly instead of every 8 hours.

Immediate benefits

Problem detection in real-time:

- Lactic acid spikes (bacterial contamination) visible immediately - dose antibiotics before the batch fails
- Enzyme activity issues show up in the sugar profile (DP4, DP3, DP2, DP1) as they happen
- Glycerol levels track yeast stress continuously, not hours after it starts

Process optimization with confidence:

- Test new heat exchanger setpoints and see results in real-time
- Experiment with enzyme dosing rates and track the response immediately
- If an experiment starts going wrong, you know early enough to stop it and revert to standard operation

What they're building towards

The plant is now documenting their "golden batch" - the ideal fermentation profile that maximizes ethanol per bushel. With continuous data, they can:

- Define what the perfect batch looks like at every stage
- Guide every fermentation toward that golden batch profile
- Reduce batch-to-batch variation
- Increase yields across the entire operation

The economics:

More ethanol per bushel, consistently, across every batch. That's the real ROI.

Measurement Performance

All eight analytes measured simultaneously, continuously:

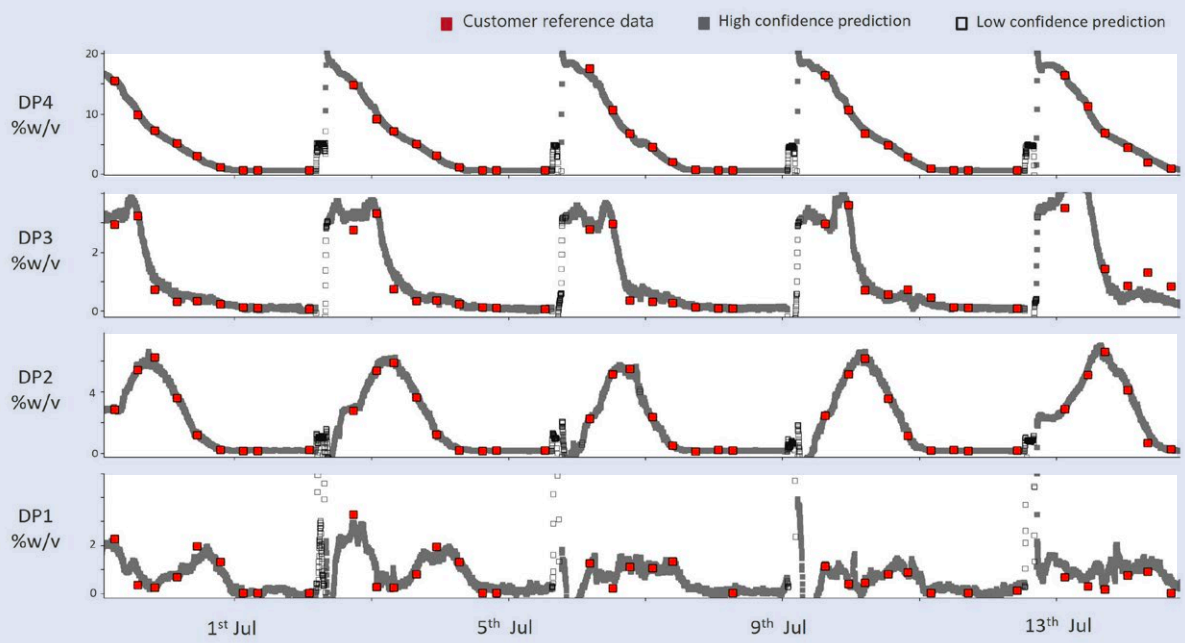


Figure 1: Measurements of DP4, DP3, DP2 and DP1

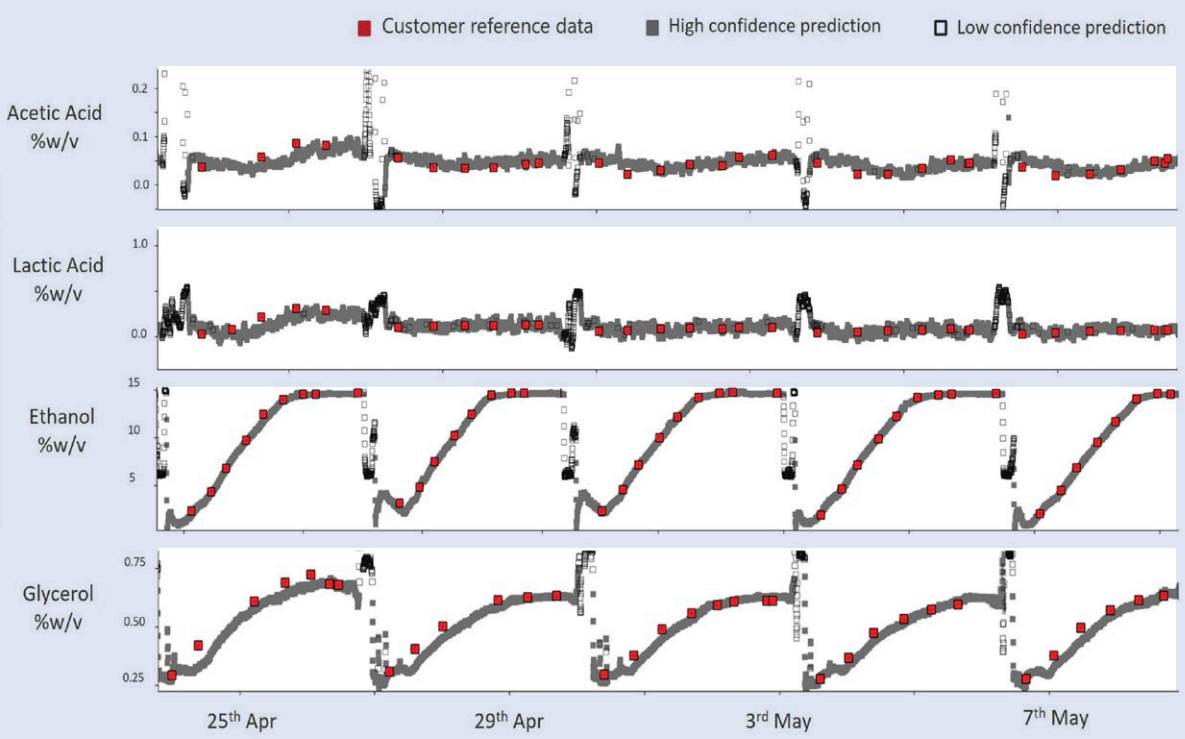


Figure 2: Measurements of ethanol, acetic and lactic acids and glycerol.

What this means for your operation

Stop flying blind between HPLC samples.
Eight hours is a long time in a fermentation. Problems that start in hour 2 don't show up until hour 8. By then, you're trying to save a batch instead of preventing the problem.

Optimize without fear.
Want to test a new enzyme supplier? A different temperature profile? You'll see in real-time if it's working or if you need to abort. No more waiting 8 hours to find out your experiment failed.

Build institutional knowledge.
Document what excellence looks like. Train your expert system. Reduce dependence on operator intuition and tribal knowledge.

Additional Capabilities

The same instrument also measures FAN, PAN, and fusels - all simultaneously. One installation gives you complete fermentation visibility.

Installation

Installs in your fermenter recirculation line. Calibrated using your existing HPLC lab data. Once calibrated, it runs continuously with no moving parts and no maintenance.

Chemical	Range (% w/v)	Accuracy (% w/v)
DP4	0 - 18	±0.384
DP3	0 - 5.5	±0.212
DP2	0 - 8	±0.354
DP1 (Dextrose)	0 - 6.2	±0.359
Ethanol	0 - 15	±0.227
Glycerol	0 - 1.3	±0.048
Lactic Acid	0 - 1.48	±0.050
Acetic Acid	0 - 0.31	±0.013

Accurate enough for process control decisions, not just monitoring.

The Bottom Line

HPLC tells you what happened. The IRmadillo tells you what's happening - in time to do something about it.

The path to your golden batch starts with knowing what's actually going on in your fermenters, all the time, not just three times a day.

The answers might change how you run your plant.

Ready to move beyond HPLC sampling?

Contact **Keit** to discuss how continuous monitoring works in your facility.

Real-time analysis for total process control

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