

# CASE STUDY: the benefits of optimizing liquefaction



## KEY WORDS

- Ethanol
- Enzyme dosing
- Liqufaction
- Fermentation

### The Opportunity

Liquefaction sets up everything downstream. Get enzyme dosing, solids loading, and contamination control right here, and you improve efficiency across fermentation and distillation.

### The Challenge

Without real-time data, you're over-dosing expensive alpha amylase enzyme "to be safe," running conservative solids loading, and only catching contamination after it reaches fermentation.

### The Solution

Continuous measurement of sugars, acids, and nitrogen at the liquefaction exit. Optimize enzyme usage. Push solids loading higher. Catch contamination before transfer to fermentation.

### What an Iowa Ethanol Plant Achieved

**Real-time monitoring at the liquefaction tank exit enabled precise control of three cost-critical variables:**

#### 1. Enzyme Dosing Optimization

Alpha amylase breaks down starch into long-chain sugars (DP4, DP3, DP2, DP1). The IRmadillo tracks this breakdown in real-time, showing exactly how much enzyme is actually needed.

**Before:** Over-dose enzyme to ensure complete starch breakdown - expensive insurance against incomplete conversion.

**After:** Dose based on real-time sugar profiles. Use exactly what's needed, no more. Every percentage point reduction in enzyme usage drops straight to the bottom line.

#### 2. Solids Loading Maximization

Higher solids mean more ethanol per fermenter and less water to heat in distillation. But push solids too high and you risk incomplete starch breakdown or equipment problems.

**Real-time monitoring reveals:** The exact solids loading where starch conversion remains complete. Push to the optimal point without guessing - more ethanol production, lower distillation energy costs.

#### 3. Contamination Detection Before Fermentation

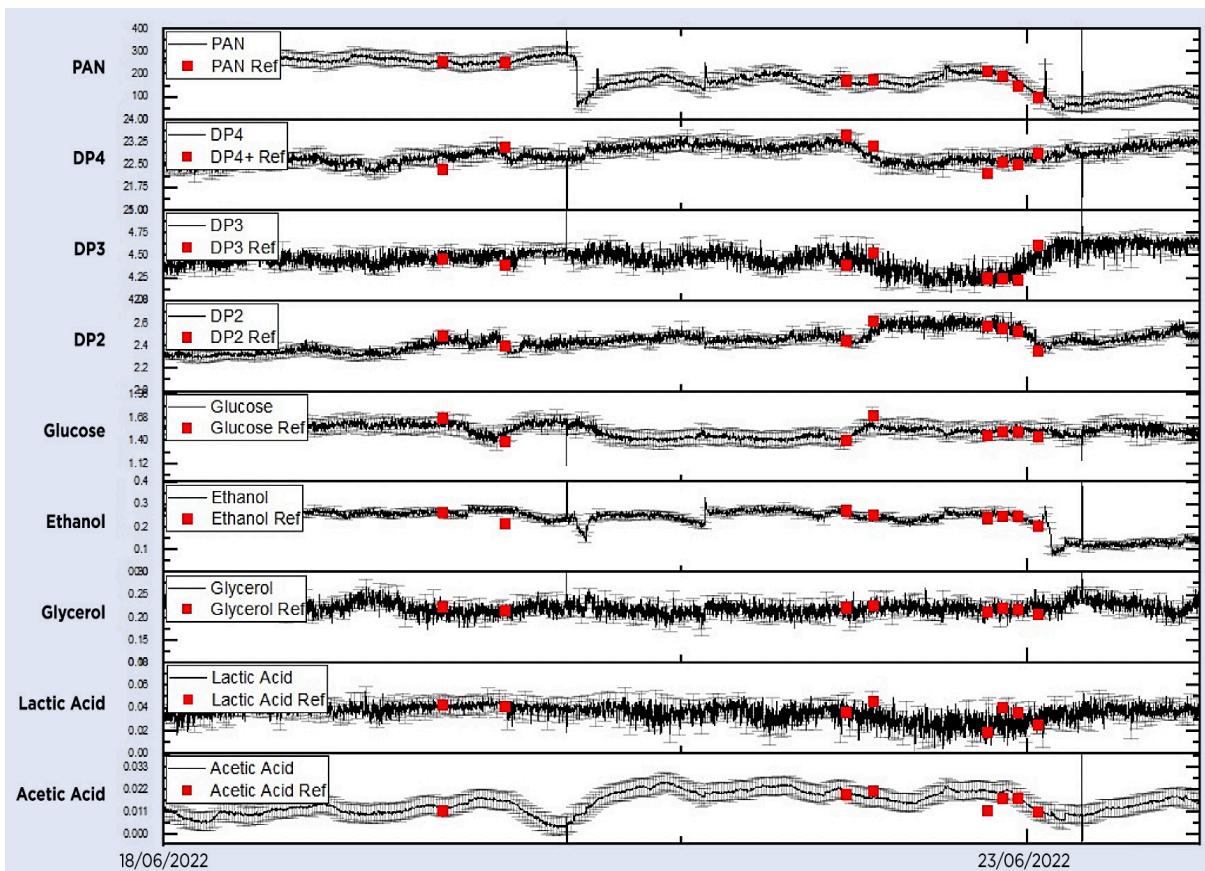
Lactic and acetic acid buildup signals bacterial contamination. Fusels from recycled backset water can constrain fermentation and reduce yields.

#### Catch contamination in liquefaction:

Treat it before transfer to fermentation. Don't let contaminated liquefaction ruin an entire fermenter batch.

## Measurement Performance

Nine components measured simultaneously at liquefaction exit



**Table 1:** Measurements of species of interest at the exit from the liquefaction tank showing the trend lines over time available to the process controllers. Grey points are the output of the IRmadillo spectrometer. The red points are the measured samples from HPLC

Chemical	Range (%)	Accuracy (%)
DP4	22.2 - 24.0% w/v	±0.254%
DP3	4.20 - 4.65% w/v	±0.070%
DP2	2.0 - 2.7% w/v	±0.046%
DP1 (Glucose)	0.9 - 1.7% w/v	±0.093%
Ethanol	0.02 - 0.60% w/v	±0.015%
Glycerol	0.2 - 0.3% w/v	±0.015%
Lactic Acid	0.02 - 0.06% w/v	±0.008%
Acetic Acid	0.01 - 0.03% w/v	±0.004%
PAN	100 - 350 mg N/L	±31.6 mg N/L

Plus detection of acetal, methanol, and propanol when needed.

Data frequency: Updated every 2 minutes, sent directly to your DCS.



## What this means for your operation

### Fill the blind spots between HPLC samples.

HPLC gives you snapshots every 8 hours. The IRmadillo shows what's happening continuously - catch deviations as they occur, not hours later.

### Reduce chemical costs.

Optimize both alpha amylase and urea (ammonia) addition based on actual process performance, not conservative safety margins. Increase ethanol per fermenter. Higher solids loading means more substrate per batch. Monitor sugar breakdown in real-time to confidently push solids to optimal levels.

### Lower distillation energy costs.

Less water in your liquefaction means less energy heating it during distillation. Higher solids loading pays dividends downstream.

### Prevent contaminated batches.

Bacterial infections caught in liquefaction don't spread to fermentation. Save entire fermenter batches by treating contamination at the source.

## Installation & Integration

Installs at liquefaction tank exit. Outputs concentration values directly to DCS every 2 minutes. No sampling systems, no moving parts, no fragile components.

## Plant-Wide Monitoring

The same IRmadillo platform measures across propagation, fermentation, and distillation. Connect liquefaction data to downstream performance and understand how changes ripple through your entire process.

## The Bottom Line

**Liquefaction optimization has multiplicative effects:** better enzyme efficiency saves money directly, higher solids loading increases production and reduces distillation costs, contamination prevention protects fermentation yields.



**Real-time monitoring turns liquefaction from a fixed cost into an optimization opportunity.**

## Ready to optimize liquefaction and reduce operating costs?

Contact **Keit** to discuss how continuous monitoring improves efficiency across your plant.



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**Real-time analysis for total process control**