IDENTIFY AND REDUCE PRODUCT LOSSES IN THE DAIRY INDUSTRY

Through real-time BOD, COD & TOC monitoring



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INTRODUCTION

Every drop of lost product in a dairy plant carries more than just waste, it carries costs.

Cream, whey and milk that slip through cleaning cycles or spill unnoticed don't just disappear. They end up in wastewater, driving up treatment complexity and triggering surcharge fees that quietly eat into margins.

Most facilities rely on traditional lab methods like Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Organic Carbon (TOC) to measure organic compounds. But these tests are limiting because of their long turnaround times as well as being labor intensive, often missing the moments when loss actually happens. On top of that, they require reagents and/or instrumentation with costly maintenance.

By the time results arrive, the moment to act has already passed.

Real-time UV-Vis monitoring gives operators a (nearly) live view into their wastewater stream, catching spills as they happen and identifies product loss before it becomes a problem.

Modern monitoring methodology in UV-Vis technologies help teams recover what would otherwise be washed away. Instead of reacting to yesterday's data, facilities can respond in the moment to save product loss and protect their operations. The key advantages of the UV-Vis method for monitoring organics are almost instantaneous results, and virtually zero maintenance and reagent costs.

For a more detailed look at these measurement technologies, refer to a recent white paper titled, The Need for Fast Real-Time BOD, COD & TOC Monitoring.

The focus in this paper is the application and value of real-time UV-Vis BOD/COD monitoring for dairy applications. The key benefits you can expect include:



- **Increased visibility:** Faster results enable a quicker response to process changes as well as revealing previously unknown process issues both within manufacturing and treatment operations. For example, we explain how ABB's UviTec™ UV-Vis technology can identify product leaks in seconds minimizing product loss to almost zero, saving significant production costs.



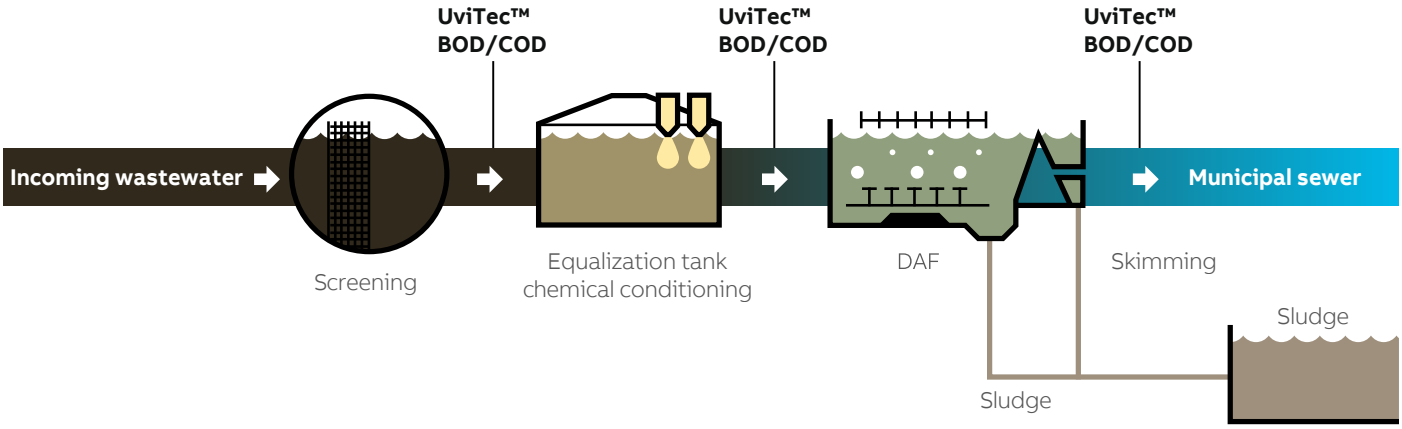
- **Optimal sensor placement:** The technology allows for matching the appropriate sensors and accuracy levels to specific objectives, such as monitoring trends, process control, or compliance assurance. ABB's UviTec™ UV-Vis sensors placed in strategic parts of the plant not only notify when BOD, COD or TOC increase but also help identify the cause, down to the product level.



- **Improved decision-making:** The speed of the data acquisition improves decision-making, which can positively impact profitability and success. Minimizing wastewater surcharge fees for industries discharging into municipal sewer systems.

HOW UV-VIS WORKS IN DAIRY APPLICATIONS

A UV-Vis monitoring system can be strategically installed at three key points within a dairy facility's wastewater stream:



Real-time monitoring enables rapid detection of spills and losses

Enables feedback to the production process to identify inefficiencies

Reduces wastewater treatment costs and drives more revenue to production

Before treatment:

A sensor used here primarily detects product loss and evaluates cleaning cycle efficiency. It provides rapid detection of spills and allows diversion of wastewater to a holding tank when loading is high. This prevents the treatment plant from being overwhelmed and helps trace the origin of spill events.

After the equalization (EQ) tank:

A sensor installed at this point tracks organic loading going into treatment and optimizes chemical dosage in processes such as dissolved air flotation (DAF).

Final effluent:

A sensor inserted at the end of the treatment train helps manage surcharges and avoid unexpected bills. It also optimizes treatment processes by providing feedback to upstream operations.

DAIRY APPLICATION EXAMPLE 1

Condensed Milk Producer

A condensed milk facility that previously discharged all its wastewater directly to the municipality installed an ABB UviTec™ bypass sensor, which provides updated readings every 10 seconds, and collected data over six months. This high-frequency data collection allowed the plant to fully capture temporal variations in wastewater quality.

As a result, the facility was able to properly size and design holding tanks to divert wastewater whenever the organic strength exceeded a set threshold. By diverting the worst-case 5% of their daily volume (about 10,000 gallons of 200,000), they reduced the organic load to the municipality by 30-40%. This led to a significant decrease in surcharge fees, justifying the investment in sensors and two 50,000-gallon holding tanks.

Surcharge fees are a common issue for industrial facilities discharging into municipal systems. Treating wastewater to required levels is costly, and occasional spikes in organic loading are inevitable. Surcharge rates have historically increased worldwide and are expected to continue rising (see Table A). The best tool for minimizing or eliminating these costs is real-time wastewater quality monitoring, which allows rapid remedial action when spikes occur.

Year	COD ($/lb)	TSS ($/lb)
2020	0.132	0.264
2021	0.138	0.276
2022	0.142	0.284
2023	0.146	0.292
2024	0.155	0.310
2025	0.165	0.330

TABLE A. Adopted from Metropolitan Council Environmental Services - COD and TSS surcharge rates per pound from 2020 to 2025. COD rates saw a 25% increase over this period alone.



DAIRY APPLICATION EXAMPLE 2

Cheese & Whey Producer

In a cheese and whey production plant, a multiple-wavelength ABB UviTec™ AUV 402 BOD probe was installed directly in the incoming wastewater before treatment to track spills and leakage. The AUV 402 probe measures absorbance at four distinct wavelengths to characterize the organic composition in addition to quantifying the total concentration of organics.

A key advantage of the UV-Vis technology shined in this instance, as it provided more than just a total organics concentration number, it offered a “fingerprint” of the organic matrix.

For example, as depicted in Figure A, the sensor data shows whether high COD loads are due to whey or cream, since proteins (whey) and fats (cream) exhibit distinct light absorption profiles.

In this application, the sensor provided multidimensional information and quantified the organic load in mg/L, and it also qualified it by breaking it down into its components. This information proved vital for quickly identifying the source of an unexpected event and determining which personnel to contact to rapidly remedy the problem within the manufacturing facility.

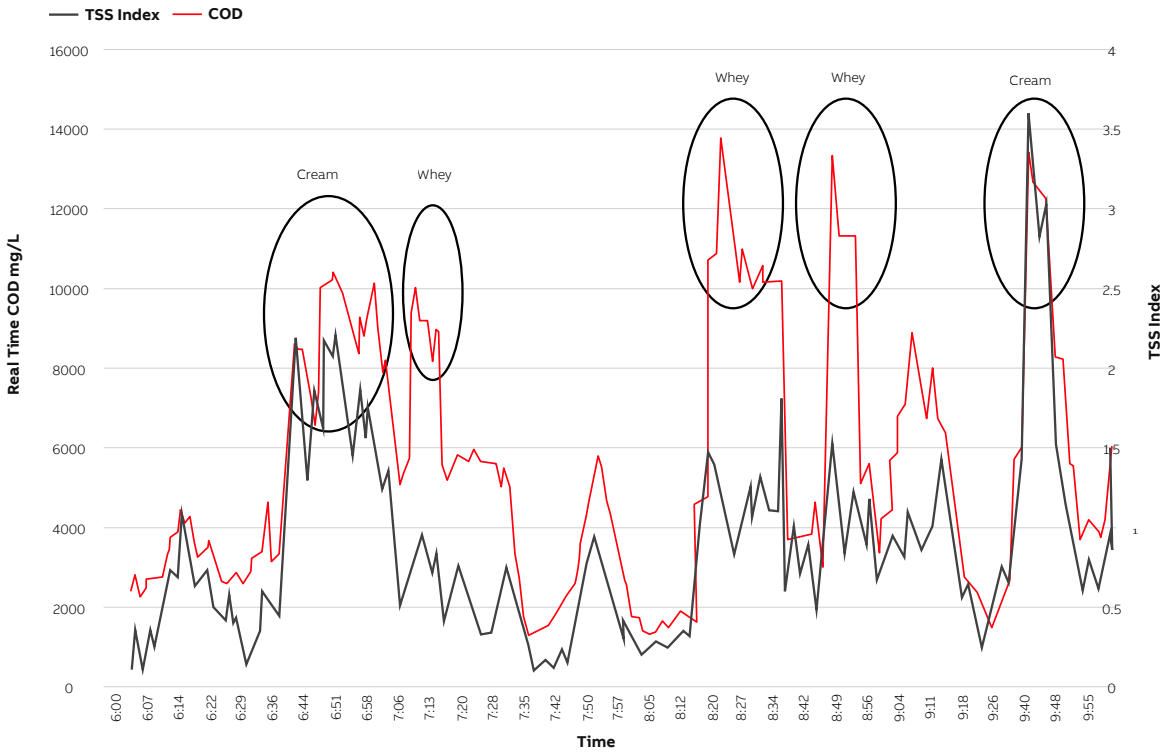


FIG. A. Real-time COD data indicated by “red line” versus TSS tracking device indicated by “grey line”. The graph shows that relying on TSS alone captures only spikes due to cream spills and misses spikes in COD due to whey spills. UV-Vis technology is capable of seeing both events and hence also identifying the source of the COD spike.

DAIRY APPLICATION EXAMPLE 3

Cheese Producer

Another cheese facility installed an ABB UviTec™ bypass sensor before their equalization tank to track product loss and direct high-strength wastewater to a more intensive treatment plant. Initial data showed consistent COD spikes during morning hours (note the “before” data between 9 and 10 am on the chart in Figure B). These spikes were unknown to operators, as daily grab samples collected before the real-time sensor was installed could not capture the full picture and the details that mattered, leading to them missing noteworthy changes in the wastewater’s organic strength.

Once aware, operators quickly correlated the spikes to the upstream Clean-in-Place (CIP) process, where valuable product was washing to drain during each cleaning cycle. Because of this insight, they were able to optimize the cleaning process and recaptured more product in the rinse cycle, and this flattened the COD curve (note the “after” data between 9 and 10 am on the chart in Figure B).

Recapturing valuable product provides savings in two ways. First, the value of the product saved can pay for the sensor quickly. Second, high-load wastewater is costly to treat and can lead to surcharges. The cheese production plant continues to use the sensor for product loss detection and spill monitoring. Site-specific thresholds have been established, and real-time data is displayed on operator screens. This allows staff to track effluent loading as well as being alerted when problems or upsets occur, paving a clear path to early warning signs that allow operators to respond fast and reduce loss to drain.

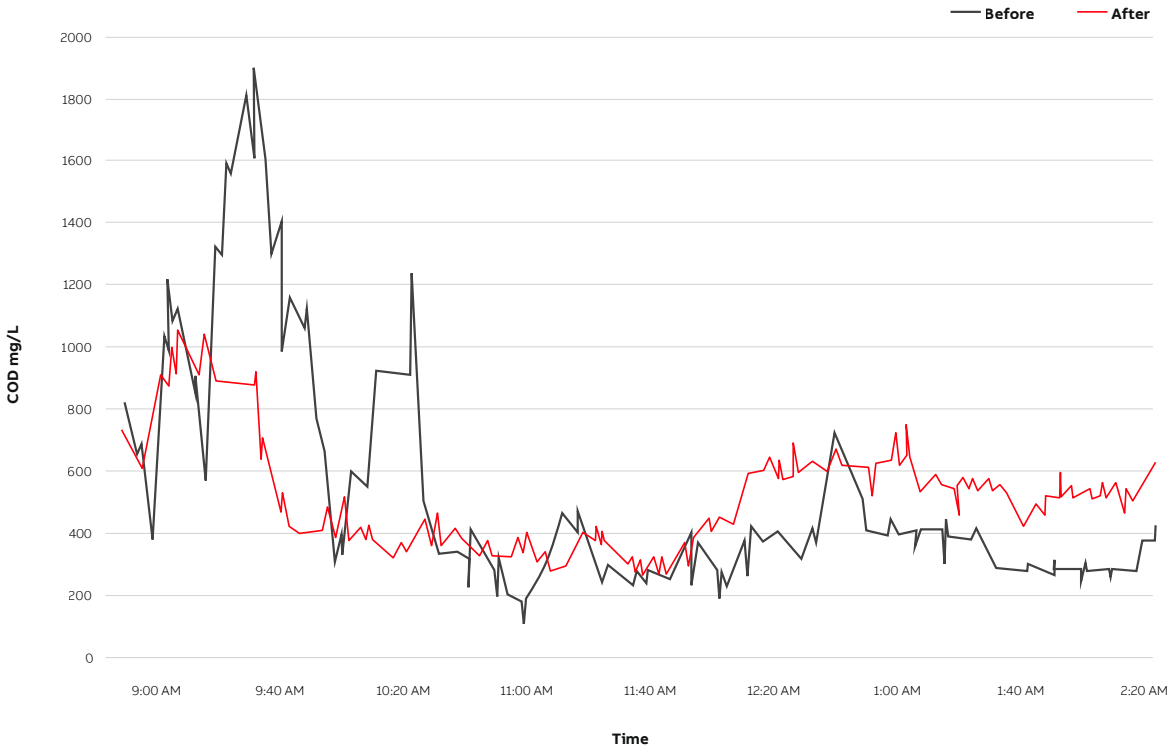


FIG. B. Real-time sensor data showing daily COD spikes in the mornings. The grey “Before” line reflects conditions prior to corrective action, while the red “After” line shows reduced product loss following optimization of rinsing operations.

SUMMARY OF UV-VIS VS. OTHER MEASUREMENT METHODS

Table B below compares the three most common real-time or rapid detection technologies used to measure organics and monitor wastewater quality in the dairy industry: UV-Vis, TOC and turbidity.

TABLE B. A comparison of UV-Vis, TOC and turbidity for wastewater quality monitoring in the dairy industry.

	UV-Vis	TOC	Turbidity
Measurement principle	Absorbance	Oxidation (Combustion or UV / persulfate)	Scattering of IR or visible light at 90°
Sampling time	Seconds	Minutes	Seconds
Parameter(s)	BOD, COD, TOC, TSS, Proteins, Whey, Cream, Raw Milk	TOC	Turbidity, TSS
Detection	Multi-dimensional (specific compounds of interest such as cream, whey protein)	Non-specific (all organic matter)	Single dimensional (suspended solids)
Interferences	Minor: suspended solids and temperature	Minor: inorganic carbon	Minor: bubbles
Instrument form factors	Field/Benchtop or Online (probe or bypass sensor)	Benchtop or Online (bypass analyzer)	Benchtop or Online (probe)
Reagents	No	Yes	No
Cost	$ - $$	$$$$	$

Key factors to consider when choosing among these technologies include:

1. Detection speed (sampling time)
2. Capital costs
3. Susceptibility to interferences
4. Ongoing maintenance expenses including reagents

Detection speed
This is particularly important when comparing TOC and UV-Vis analyzers. A typical TOC analyzer produces results in 10-15 minutes, during which an entire tank of cream can be lost to drain if a spill goes undetected. In contrast, UV-Vis analyzers deliver results within seconds, proving essential for effective spill detection and minimizing product loss.

Capital costs
While TOC analyzers are highly accurate and capable of detecting all types of organics, they come with significant capital and maintenance costs.

Susceptibility to interferences
Turbidity meters, on the other hand, are fast, and inexpensive to purchase and operate. However, they only detect suspended solids and product loss associated with high solids content, such as cream, and completely miss dissolved organics like lactose and protein.

Ongoing maintenance expenses including reagents
UV-Vis sensors provide a complete picture of organic loading, delivering results within seconds and operating without reagents or other ongoing maintenance. In addition, UV-Vis sensors can differentiate organic groups relevant to the dairy industry, such as protein and fat, offering greater value than TOC analyzers and traditional lab-based techniques.

UV-Vis advantage
ABB's UviTec™ UV-Vis sensors placed in strategic parts of the plant can notify operators of increases in BOD, COD, or TOC – and even help identify the cause down to the product level.

Contact ABB's Uvitec™ product team
ABB's Uvitec™ product team has over 20 years' experience applying UV-Vis technology to wastewater monitoring in the dairy industry. They help reduce environmental impact, minimize regulatory discharge fees, and quickly identify product leakage to maximize profits.

Learn more at solutions.abb/uvitec or email uvitec.info@ca.abb.com

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ABB Measurement & Analytics
For your local ABB contact, visit:
abb.com/contacts

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