

Monitoring and Control of Material Losses Using the Biotector B7000 TOC Online Analyzer

Problem

The dairy industry has faced the challenge of controlling material losses for years. Dairy plants with onsite wastewater treatment plants (WWTPs) are governed by waste regulations. However, dairy manufacturers are not happy with this because the term 'waste' encompasses lost raw material, which represents nearly 80% of dairy finished product.

Solution

The Biotector B7000 online TOC analyzer was developed specifically for the dairy industry. In a trial lasting several months, a dairy manufacturer tested the B7000's TOC (total organic carbon) against traditional COD (chemical oxygen demand) to determine the best method to limit lost raw materials and to test the analyzer's reliability in a challenging industrial setting.

Benefits

After adjusting some of the procedure parameters, the amount of milk thrown out in the effluent was significantly reduced thanks to the Biotector B7000, thus reducing processing costs at the WWTP.

Background

The issue is decades old: Compliance requires WWTPs within dairy manufacturing plants to adhere to waste regulations. This is particularly problematic for dairy plants, as waste technically includes raw material, which is a major component of dairy goods. In response, dairy manufacturers search for all possible sources of loss and made efforts to reduce the quantity of COD lost in the effluent. The unfortunate truth is that the loss of several pounds a day adds up to several tons by the end of the month. By the end of the year losses can be substantial.



Figure 1: A Biotector analyzer monitors TOC on this dairy wastewater pond, with an uptime greater than 99.7%

Manufacturers prefer to use raw materials to create finished products rather than throw them away and process them in the WWTP. The cost of reprocessing is insignificant compared to the cost of the material itself. The impact on the business's performance is felt through reduced raw material losses, which in the case of dairy products represent more than 80% of the value of the finished product. These material losses can also cause the resulting waste to fall short of regulations. In the case of milk, there can be a direct impact on phosphorus regulations, as each liter of milk in the effluent equates to 1 g of phosphorus.

Faced with this regulatory problem, many dairy manufacturers seek operation improvements that help locate sources of lost raw materials. Adhering to regulations does not do enough to recuperate material losses, so finding the most effective solution for identifying the sources of material loss is crucial for cost reduction and optimizing operations.

Technological Challenges

Several technologies and process improvements have helped reduce material losses. But, because of issues such as reprocessing bottlenecks, manufacturers struggle to further mitigate losses. Manufacturers continued to experiment to push forward, but achieved little success. The proposed solutions did not provide reliable measurements, or the solutions were not suitable for an industrial environment.

For any final product, including 100% fat, cheese curds, or liquid effluents with higher or lower concentrations, the Biotector B7000 can identify and quantify material losses to find the source.

Solution and Improvements

The Biotector B7000 analyzer underwent a trial lasting several months. The test examined:

- Whether or not TOC was a suitable measure compared to traditional COD testing.
- The analyzer's reliability in an industrial setting.

Biotector B7000

Typically, lost product levels can be reduced by a conservative 15% using reliable TOC monitoring. There is a direct correlation between levels of lost product and wastewater loading. Clients regularly report greater than 15% reduction to wastewater loading as a result of using reliable TOC monitoring, with some clients achieving as much as a 40% reduction. Given this scenario, typical dairy plants could save \$670,000 each year by reclaiming only 15% of product that was once lost in wastewater.

The unique Biotector TSAO (Two-Stage Advanced Oxidation) technology gives consistent accuracy and reliability so that clients can have confidence in the TOC measurements. TSAO eliminates build up problems from salts (up to 30% w/w), calcium sludge (up to 12% w/w), particulates, sludge and FOGS that lead to analyser drift.

The typical industry sampling tube has an inner diameter of less than 0.8 mm, whereas Biotector B7000 sampling tubes have an interior diameter of 3.2 mm. The powerful TSAO oxidation method allows particulates measuring up to 2 mm to be taken into the measurement for more representative sampling, and allows sample volumes up to 1000 times bigger than conventional technologies to be used, for reliable and representative sample measurement. Hach Biotector analyzers can also be modified to monitor the following data: TOC+ TN, TOC + TN + TP, or even COD/BOD.

Biotector analyzers automatically self-clean all parts of the analyzer, thus preventing clogging, sample contamination and inaccurate results. The B7000 analyzer, developed specially for the dairy industry, only requires calibration and preventative maintenance at six-monthly intervals. These analyzers have delivered consistently high performance in dairy applications, meeting MCERTS required up-time of 99.86% and result accuracy and repeatability of better than ±3% of reading.

Table 1: Correlation of TOC to BOD and to COD

Factor for Whole Milk	TOC	BOD	COD
Analysis Cycle Time	<7 minutes	5-7 days	2-3 hours
Accuracy	±3%	±20%	±5%
TOC Factor	1	~2	~3

Dairy Plant Test

Hach made sure that trial conditions allowed the manufacturer to conduct simple tests and monitor results. The idea was to achieve a fully-equipped, ready-to-use cabinet with the option of testing different effluents. To successfully test the B7000, it was crucial for the manufacturer to operate the B7000 to guarantee correct use of the data and to identify sources of pollution in the manufacturing process. The manufacturer commented that setting up the B7000 was simple, quick, and provided constant and relevant data monitoring. Because of the ease-of-use, it wasn't long before site operators were able to operate the B7000 with minimal assistance.

One of the manufacturer's concerns was if the B7000 could handle the rigors of dairy processing and the resources required to maintain it. After the first few weeks, the manufacturer noted that the Biotector B7000 does not require frequent maintenance. In fact, during the seven-month trial, the analyzer did not require any maintenance. This is due to the Biotector's patented two-stage advanced oxidation (TSAO) technology.

While analysing results, the manufacturer identified a perfect correlation between the TOC and the COD measurements. This opened up the possibility for in-depth investigation into the sources of pollution in the production unit. It should be noted that TOC measurement is the only parameter which gives an exact measurement of the quantity of organic matter in the effluent; whereas COD is influenced by chemicals in some cleaning products.

The manufacturer was surprised to be able to identify a continuous low level of TOC, which bore no relationship with a production event. Peaks in pollution can be easily identified and associated with events on the production line thanks to the analyzer's real-time measurements (complete TOC measurement every 6 minutes with an optional predicted signal every 3 minutes).

Conclusion

The Biotector B7000 analyzer is a unique industrial solution that helps identify sources of pollution and provide unquestionably reliable, continual measurements. This enables manufacturers to implement targeted actions to improve its processes. During the trial, the Biotector identified the existence of a continuous low level of pollution over and above incidents tracked in real time. After adjusting some of the procedure parameters, the amount of milk thrown out in the effluent was significantly reduced, thus reducing processing costs at the WWTP.

A key benefit of this analyzer is its ability to be close to the production line, meaning material losses can be identified as quickly as possible, allowing the manufacturer to identify and eliminate the source of these losses. Further, because of the B7000's TSAO technology, the facility benefits from maximum uptime and minimal time spent on maintenance and repairs.

As an added benefit, the trial revealed an unexpected advantage: The B7000 measures dissolved organic carbon with no effect from the chemical products that are frequently used in the dairy industry.



Figure 2: Biotector B7000 Online TOC Analyzer

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