VALIDATING A REAL-TIME MONITORING PLATFORM TO DETECT PULP AND PAPER BLACK LIQUOR DISCHARGE EVENTS

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The pulp and paper industry utilizes a procedure known as the Kraft process, where wood is converted into wood pulp and then into paper. In the process, about half of the wood is dissolved, and together with the spent pulping chemicals, forms a liquid called black liquor.

Black liquor is separated from the pulp by washing, and is then sent to a recovery boiler, where inorganic pulping chemicals are recovered for reuse and the organics are used as fuel to make steam and power. However, due to certain process controls, there are times when all of the black liquor is not recovered. This can lead to accidental spills of this potentially toxic byproduct to the wastewater treatment system (WWTS).

Such spills, whether large or small, can have a profound effect on the biological health and overall ability of the system to treat the incoming BOD load. Black liquor consists of wood lignins, tannins, resin acids, fatty acids, excess sodium, sulfur and other toxic compounds. It is highly caustic, releases hydrogen sulfide when interacting with acids, and is characterized by high inorganic and organic loads.

For these reasons, black liquor spills can subject a system to periods of upset conditions and could potentially push the total BOD loading beyond the plant's aeration capacity, leading to potential permit violations. While these accidental spills by their nature are impossible to predict, being able to immediately identify a change in loading is critical to maintaining optimal treatment plant performance. As such, a study was done to quantify the impact of a black liquor spill on the microbial electron transfer (MET) output from a SENTRY monitoring platform and to validate it as a real-time solution to detect black liquor spill events.

The Kraft process is used to convert wood pulp into paper.

PROJECT SYNOPSIS

Prior to simulating the black liquor spill, two 95-litre tanks were fed pulp and paper wastewater influent at a flow rate of 46 litres per day each, in order to simulate an aerobic stabilization basin with a retention time under aeration of approximately two days. The two tanks were operated under stable conditions (loading and flow) for one month prior to initiating the simulated black liquor spill.

During this time, total and soluble chemical oxygen demand (COD) and BOD were analyzed and compared with the MET value to get baseline data and to help understand what "normal" loading is. Once the baseline was established, a simulated black liquor spill was run to determine the response of the SENTRY probes to the additional load that pulp and paper WWTSs are often prone to receiving.

RESULTS

For this analysis, weak black liquor from a pulp and paper mill was added directly to Tank A (EBS05) to simulate a black liquor spill entering the WWTS. The control tank (EBS06) maintained normal flow rates and was not altered during the study. Following the introduction of black liquor, the soluble COD and MET immediately increased, triggering a response to the additional load entering the system. The spike in COD and MET remained elevated, before slowly returning to the "normal" baseline data that was observed throughout the duration of the study.

The quick response detected from the probes, along with the real-time viewing capabilities from the SENTRY monitoring platform can provide an early warning of system imbalance. This platform can allow operators and personnel to take immediate action to avoid BOD

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breakthrough to the effluent and limit any potential permit violations.

ECONOMIC BENEFITS

The economic benefits for the identification and limitation of black liquor spill events are compelling. It is estimated that the costs required for a thorough upgrading of pulp and paper facilities to implement best management practices (BMP) for spent pulping liquor management, spill prevention and control, range from US$2.1 million for single lane mills to over US$4 million for complex mills.

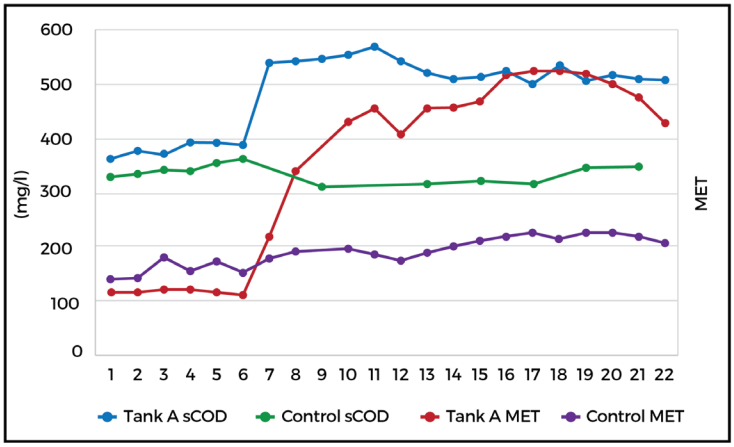
For these facilities, it is estimated the use of SENTRY for spent pulping liquor BMP implementation, shows annual net savings in the range of US$500,000 to US$750,000, and payback periods from four to eight years.

The savings projections are based on validated bench-scale and industrial work where the ability to identify these spill events the moment they happen has been shown.

The impact of a black liquor spill can range dramatically, with smaller events triggering action that results in costs relating to some of the following factors:

- Increased organic loading to downstream biological wastewater treatment facilities. This can include discharge loadings of colour, oxygen-demanding substances and non-chlorinated toxic compounds. The immediate impact is to require additional aeration energy for treatment.
- Toxic shock. A significant spill event could trigger a biological toxic shock event, potentially requiring additional biological seed to be added to the process.
- More demand for replacement pulping liquor make-up chemicals.

Pilot units used for bench scale analvsis.



Soluble COD (sCOD) vs MET for Control and Spike Tanks

- Operator labour cost and spill control.

The SENTRY monitoring platform can be installed at a pulp and paper facility and set to provide an always-on notification system to identify key black liquor spill events the moment they happen. Real-time notification of discharge events reduces the risk of long-term effluent discharge impacts. ■

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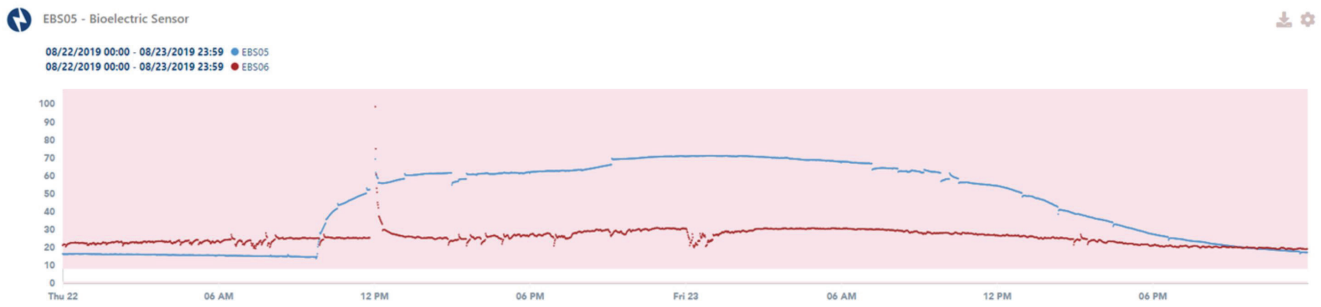

Dashboard view of MET response to black liquor. The black liquor 385% increase in MET and lasted 27 hours.