EBS ENVIRONMENTAL BUSINESS SPECIALISTS, LLC

Island Water TECHNOLOGIES

SENTRY™

EBS and SENTRY validate real-time monitoring platform to detect Black Liquor discharge events for Pulp and Paper facilities

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Introduction

SENTRY™ Monitoring platform used to detect spike in Biochemical Oxygen Demand (BOD_5) loading from black liquor spill.

Problem Statement

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 Kraft process, about half of the wood is dissolved, and together with the spent pulping chemicals, forms a liquid called black liquor. The black liquor is separated from the pulp by washing, and is then sent to the Recovery Boiler, where the 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 the black liquor is not recovered leading to accidental spills of the potentially toxic byproduct to the wastewater treatment system (WWTS). These 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 aeration capacity leading to potential permit violations. While these accidental spills by nature are impossible to predict, being able to immediately identify a change in loading is critical to maintaining optimal performance of your WWTS.

Figure 1: Aerated Stabilization Basin (ASB) Treatment System

Purpose

- To quantify the impact of a black liquour spill on the microbial electron transfer (MET) output from the SENTRY platform
- Validate SENTRY as a real-time solution to detect black liquor spill events

Project Synopsis

Prior to simulating the black liquor spill, two 25-gallon tanks were fed pulp and paper (P&P) wastewater influent at a flow rate of ~12 gpd to each tank to simulate an ASB with a retention time under aeration of ~ 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 P&P WWTS's are often prone to receiving.

Figure 2: Pilot units used for bench scale analysis

Results

For this analysis, weak black liquor from a P&P 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 (Figure: 3) and MET (Figure: 4) 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 shown in red. 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 breakthrough to the effluent and limit any potential permit violations.

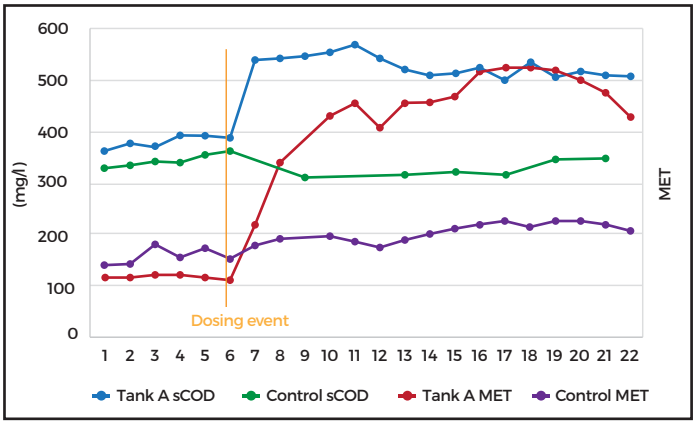

Figure 3: Soluble COD (sCOD) vs MET for Control and Spike Tanks

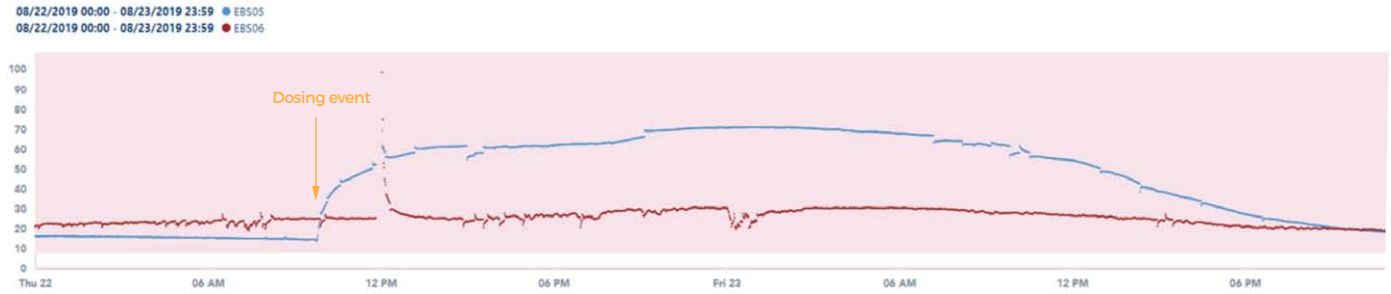

Figure 4: Dashboard view of MET response to black liquor. The black liquor 385% increase in MET and lasted 27 hours.

Economic Rational and Benefit

The economic benefit for the identification and limitation of black liquor spill events is compelling. Based on the US EPA 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 $2.1M for single lane mills to over $4M for complex mills.

For these facilities it is estimated the cost for spent pulping liquor BMP implementation show annual net cost savings in the range of $500,000 to $750,000, and payback periods of less than 4 to 8 years. The cost 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 color, 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.**
- **Less demand for pulping liquor make-up chemicals**
- **Operator labor cost and spill control**

One discharge incident that occurred at kraft pulping mill in the Southeastern U.S. in July of 1993 resulted in a significant amount of foul condensate and spent pulping liquor being sewered. Within two days, the treatment plant outfall exhibited depleted oxygen levels and, shortly thereafter, suspended solids in the effluent exceeded permit levels. This resulted in a subsequent fish kill downstream of the plant outfall. State officials ordered a shutdown of the mill while measures were taken to clean up and restore the WWTP to effective and consistent operation. The key outcome of the event was a 7.5 day plant shut-down and total cost to the mill of $2,997,730. The company was also required to spend an additional $500,000 on plant improvement measures aimed at pollution prevention.

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

The low-cost alert system provided by SENTRY is a novel tool that can be leveraged by operations to rapidly identify and mitigate the impact of spill events before they become significant liabilities for the facility.

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