Wessex Water
YTL GROUP

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TECHNOLOGIES

SENTRY™

SENTRY real-time platform monitors treatment system to improve plant performance efficiency.

2.0 03-2020

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February 2020

SENTRY™ Monitoring platform used to characterize wastewater stream influent.

Problem Statement

A Wessex Water wastewater treatment facility manages a combined influent wastewater flow from municipal and industrial clients. The combination and variation of municipal and high strength industrial wastewater flows makes it difficult to maximize aeration efficiency with all BAFF cells being operated to meet peak loading events.

Wessex Water is looking to validate that the SENTRY microbial electron transfer (MET) reading can be used to characterize the incoming wastewater stream and identify key biological imbalance triggers. Wessex Water will validate the MET reading can be used as a surrogate for organic carbon concentrations, with this reading then used to identify periods of time of lower organic loading to the facility and allow operators to maximize aeration efficiency.

Annual energy use on site is in the region of £500,000. These costs are primarily comprised of aeration energy required for the three treatment streams and UV disinfection. A target of a 10 - 20% energy savings provides a potential for £50,000 - 100,000 in savings per annum with improved aeration efficiency.

Introduction

The WWTP receives a combination of municipal and industrial wastewater streams. The treatment process combines an Activated Sludge (AS) treatment system with a Brightwater Biological Activated Flooded Filter (BAFF).

Figure 1: SENTRY sensors installed upstream of the Biologically Aerated Flooded Filter

- **55% of the flow is directed to a biologically activated flooded filter (BAFF) system**
- **45% of the flow directed to the activated sludge (AS) treatment system**

With the goal of better managing nutrient requirements the flow directed to the second ASP and BAFF treat the majority of municipal wastewater but they also receive around 15% of the industrial trade flow while a portion of the municipal flow is also directed to the first Vitox AS plant. All flows leaving the site pass through final UV treatment.

The SENTRY monitoring sensor is placed upstream of a Brightwater BAFF unit. The BAFF consists of 5 treatment cells that contain small pea sized plastic beads for biomass growth / retention. The key advantage of these treatment units is that they also incorporate filtration so do not require settlement and / or settlement tanks. These treatment cells take themselves offline each day to go into a backwash to remove captured solids.

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Project Objectives

- **Monitor incoming wastewater conditions and identify key biological imbalance triggers.**
- **Validate correlations between biological activity and organic loading to the facility.**
- **Develop historical data sets that show the weekly and daily biological activity trends for influent wastewater.**
- **Use the generated microbial activity data sets to predict low organic loading time periods and reduce aeration costs for the BAFF.**

Figure 2: SENTRY control system installed at the Wessex Water, Site A, WWTP.

SENTRY Solution

1. Event Detection

During a 3-month period the SENTRY platform identified 21 imbalance events for biological activity. Greater than 70% of events were triggered by high precipitation and resultant inflow and infiltration. This is typically represented by a drop in microbial activity and a more dilute wastewater stream entering the plant. 2 events were triggered by unknown cause but arrived with high flow to the facility and 4 events were triggered by unknown events and no significant change in flow. These 4 events were presumed to have been triggered by industrial trade discharge into the collection system.

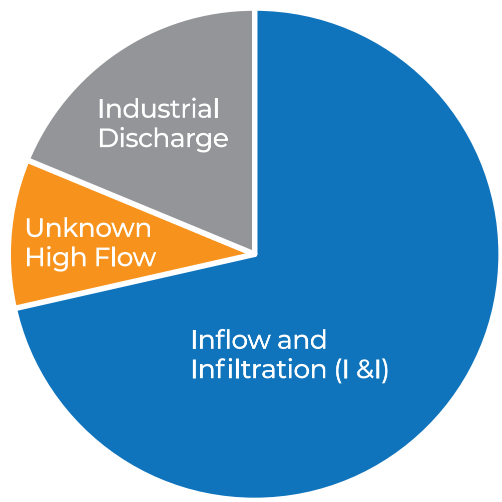

Figure 3: SENTRY sensors installed upstream of the Biologically Aerated Flooded Filter

2. Organic load correlation

The SENTRY platform is set to record a reading every minute with 1,440 readings in a 24-hour period. The MET readings are displayed on an online dashboard with a signal also sent to the on-site SCADA to integrate with other data being collected at the facility. Correlation to on-site manual BOD sample analysis (Figure 4) and in-line COD analysis (Figure 6) was carried out.

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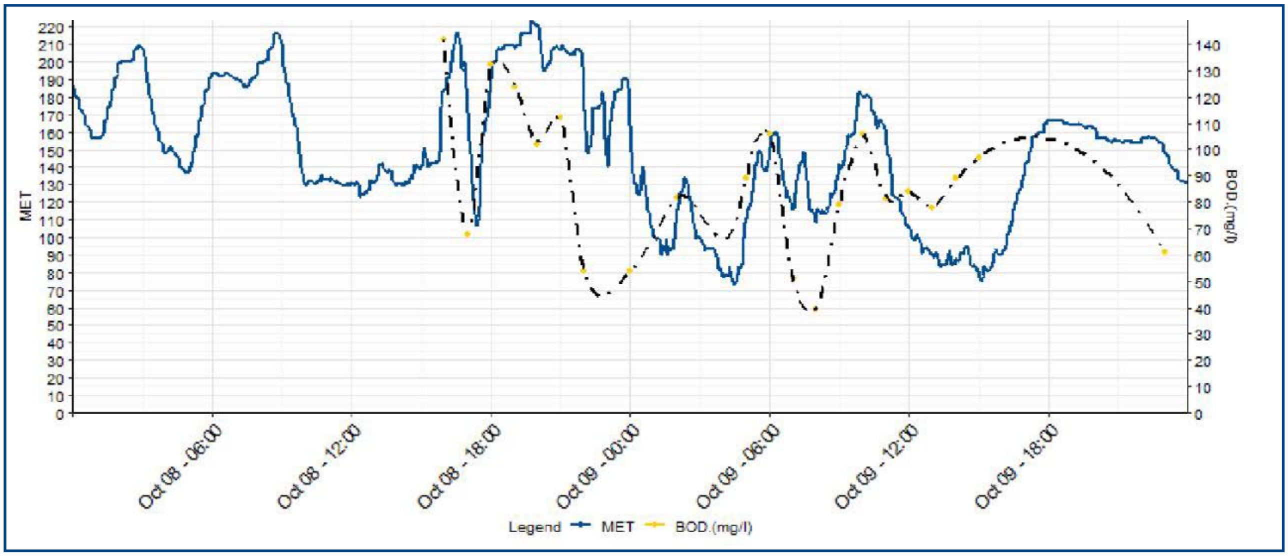

Figure 4 MET (blue line) tracking with manual BOD readings (yellow).

3. Daily and weekly trending

Data was collected from the SENTRY platform over a 3-month period. The bio-electrode sensor platform required only very minor maintenance over this period and generated reliable and robust data very limited signal drift.

This historical data set was statistically analyzed using a signal decomposition with key repeating trends identified. The weekly pattern of MET at this site shows a wider range compared to typical municipal sites, indicating the impact industrial discharge has on the facility. Highest loading to the system occurs late evening between 8 and 10 pm. MET shows a decreasing trend from midnight, with the lowest organic loading happening early afternoons between 12 and 3 pm. The duration of lowest organic loading is larger on Sunday and Monday (10am-3pm), while on Wednesday and Friday larger organic loads are observed.

Design information of the BAFF units combined with current and projected wastewater flowrates and strength should be considered before decreasing the quantity of BAFF units active at any time point. IWT believes that the SENTRY data combined with flow information can be used to pinpoint the historical time periods where the lowest periods of organic loading are coming into the system. These identified periods could be the starting point of efforts to decrease the number of functional BAFF units at any time.

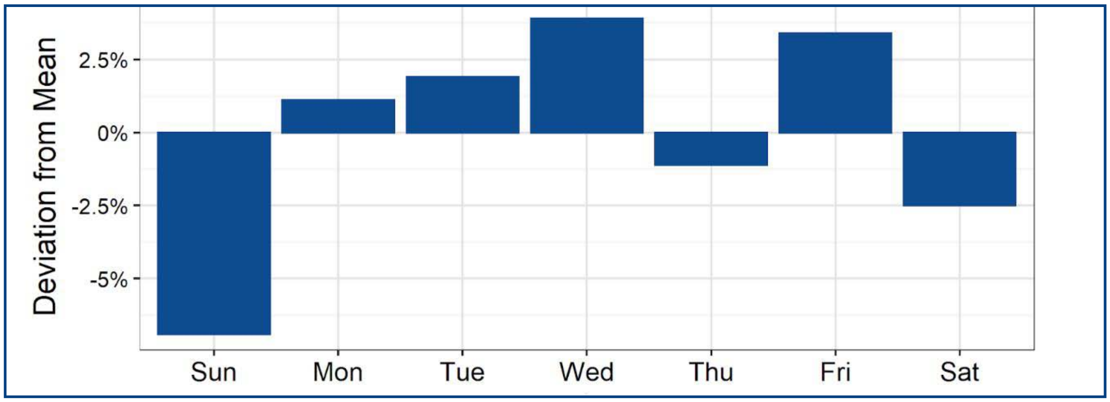

Figure 5. Daily variation of MET. Lower MET on Saturday and in particular on Sunday. Higher activity on Wednesday and Friday.

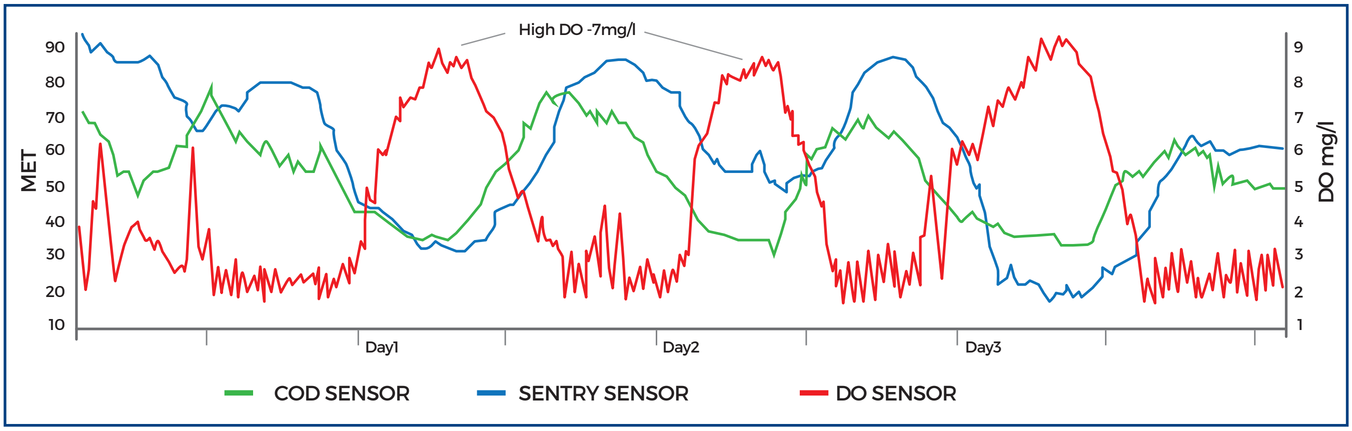

Figure 6. Daily change in organic loading to the facility resulted in clear daily response in MET readings that were inversely correlated to dissolved oxygen concentrations. Low MET periods (high DO) were selected as key periods for process optimization.

4. Organic load control and aeration optimization:

The historical trending from the SENTRY platform showed a consistent period of the day where we identified a lower MET reading. From the MET readings we identified the period from 12:00pm to 3:00pm as being the low-period of microbial activity. Overlay of this data with on-site dissolved oxygen readings from the AS plant clearly showed high dissolved oxygen readings that correlate to low periods of MET activity. These readings indicate periods of the day where the facility is being over aerated.

Based on these readings Wessex Water will divert more loading during the low organic loading periods from the BAFF reactor to the AS treatment system. This process optimization strategy allows for maximal aeration efficiency while allowing for a reduction in operating costs for the plant.

Economic Rationale

Annual energy use on site is in the region of £500,000. These costs are primarily comprised of aeration energy required for the three treatment streams and UV disinfection. A target of a 10 - 20% energy savings provides a potential for savings in the region of £100,000 - 50,000 per annum with improved aeration efficiency.

Based on the MET readings Wessex Water plans to divert more loading during the low organic loading periods from the BAFF reactor to the ASP. This flow re-direction will allow operators to minimize aeration requirements for the BAFF system (turning off blowers during low loading periods) and saving energy. The value of this strategy will result in a saving of £100,000 - 50,000 per annum with key savings in energy consumption as well as blower maintenace and cleaning.

Contact

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