BEST MANAGEMENT PRACTICES AND WASTELOAD REDUCTION

grey sail brewing | westerly, rhode island

The Rhode Island Department of Environmental Management (RIDEM) was awarded a US Environmental Protection Agency (EPA) Region 1 Pollution Prevention (P2) Grant to study the effectiveness of brewhouse best management practices (BMPs) for reducing wastewater loadings from craft breweries. Upon receiving confirmation of the P2 Grant award, RIDEM reached out to craft breweries in RI to gauge interest in participating in this beneficial study. Weston & Sampson partnered with RIDEM to provide technical assistance on brewery BMPs.

The Brewery. Grey Sail Brewing in Westerly, RI is a small craft brewery located in the former Westerly Macaroni Factory, an industrial building constructed in the 1920s. Since opening in 2011, Grey Sail has expanded their business to include a craft distillery in addition to their brewing operation and taproom. The brewhouse collects wastewater through a series of trench drains in the floor. This system discharges into a large sump which ultimately gets pumped into the Westerly municipal wastewater collection system. Wastewater from patron restrooms and the bar sinks enter the wastewater collection system through a dedicated sewer service connection, not combined with the brewery wastewater. Wastewater from the distillery consists primarily of clean-in-place (CIP) system rinse, but no stillage. Stillage is sent out with spent grains from the brewing operation as animal feed, and always has been handled in this manner.

In 2020, the town expressed concern about the potential for high-strength wastewater from the brewery, affecting capacity at the municipal wastewater treatment facility. During this time, Grey Sail learned about the P2 Grant and the Brewery Wastewater Assistance Program with RIDEM and volunteered to participate in the study.

Weston & Sampson, along with representatives from RIDEM met on-site to review brewing operations, identify locations and processes which contributed to the high-strength wastewater flows, and develop a list of suggested BMPs to help the brewhouse reduce overall organic load. The facility consists of a 30-barrel (BBL) brewhouse, which has an average production rate of 9,000 BBL per year, operating 50 weeks per year. Meter readings show water consumption (pre-COVID) averaged 7,200 gallons per day, five (5) days per week. Based on reported wastewater generation and brewing production throughout this study, Grey Sail generates an average of 3.0 BBL of wastewater for every BBL of beer that they produce, which is more efficient that the average craft brewery wastewater generation rate of 5 BBL of wastewater for every BBL of beer produced.

The Study. Phase I of the study consisted of identifying potential locations and taking representative composite samples of industrial effluent from Grey Sail's facility. RIDEM staff conducted sampling over the course of four (4) weekdays, which included a composite sampler set up to pull samples each hour from the brewhouse trench drains. Sampling included all wastewater generated by the brewing, distilling, and cellaring operations but did not include the tap room wastewater or the growler filling station.

Grey Sail opted to implement the following BMPs:

- Collect and sidestream wastewater from their canning line (containing beer foam)
- Collect and sidestream residual beer from keg returns, before connecting kegs to the clean-in-place (CIP) equipment

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- Collect and sidestream bottoms from their fermenters
- Collect and sidestream the first rinse of the fermenters before connecting the clean-in-place (CIP) equipment

After implementation, RIDEM took additional composite samples representing the same operations that occurred during the background sampling. The purpose of this was to determine the direct effect of these specific BMPs on brewery effluent loadings. The graphs presented below depict the difference in effluent quality between pre- and post-implementation of the above BMPs. The graphs show reduction in loadings from brewing and distilling operations only. While many wastewater constituents were monitored, the focus of this effort was on Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS), which are the typical basis for wastewater billing surcharges. Of note was the significant drop (70%) in Quaternary Ammonium compounds between monitoring periods. While this significant reduction in wastewater Quat concentrations were not related to the sidesstreaming, brewers found out that they were able to keep the trench drains and wastewater sump clean and sanitized with pressure washing and less frequent use of Quats. This will ultimately be beneficial to the receiving WWTF as Quats have a long half-life and can adversely impact the biological treatment processes at the receiving wastewater treatment facilities.

The average total Phosphorus, while small in concentration, increased by nearly 25% from pre-BMP monitoring to post-BMP monitoring. Grey Sail believes that this was likely due to an increase in the number of brew cycles that occurred at the time of the post-BMP sampling. Phosphorus is likely from detergents used in the CIP system and increasing the brew cycles, increased the amount of detergent used.

Brewing residuals and wastewater which were side streamed during this study were taken off site and composted with other materials at a lot owned by the brewery proprietors. While great in the short-term, this was not a sustainable practice. Grey Sail has been exploring composting options in Rhode Island.

Cost Considerations. The pollution prevention brewhouse best management practices serve as low-cost operational improvements that should have a noticeable reduction in operating costs. The New England Interstate Water Pollution Control Commission (NEIWPCC) states that the average concentrations of BOD and TSS in domestic wastewater are approximately 250 milligrams per liter (mg/l) and 300 mg/l, respectively. Wastewater generators whose discharge characteristics exceed these limits are usually subject to a surcharge based on the cost of treating the additional organic load. The Town of Westerly is not currently assessing loading surcharges to Grey Sail but has issued a permit with monthly monitoring requirements which will likely be used to establish a baseline for future surcharges.

As Grey Sail has no actual sewer surcharges to use as a starting point, Weston & Sampson is providing the calculation below using regional average values to approximate the potential savings from the BMPs implemented. Grey Sail currently generates approximately 27,900 gallons of wastewater per week.

Using the average pre-BMP wastewater BOD of 16,000

Figure 1: Biochemical Oxygen Demand (BOD)

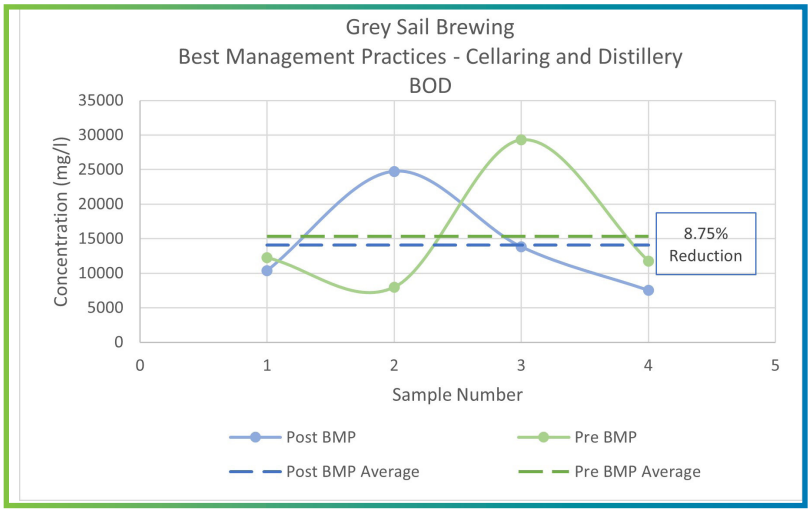

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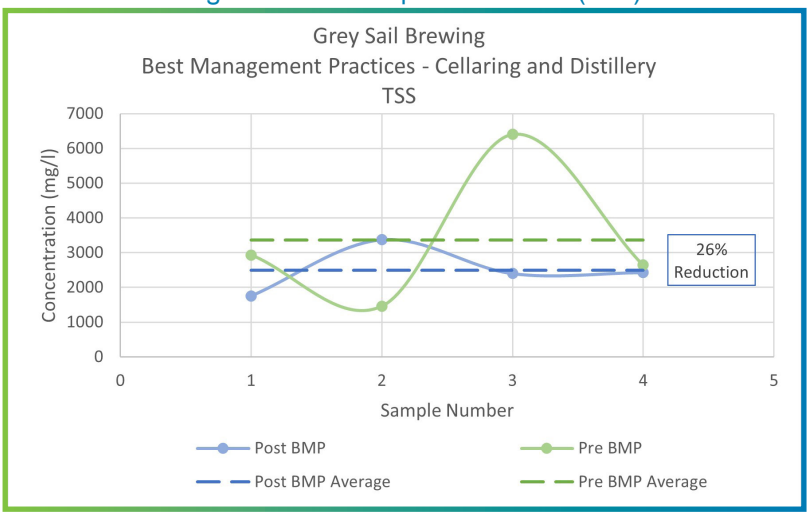
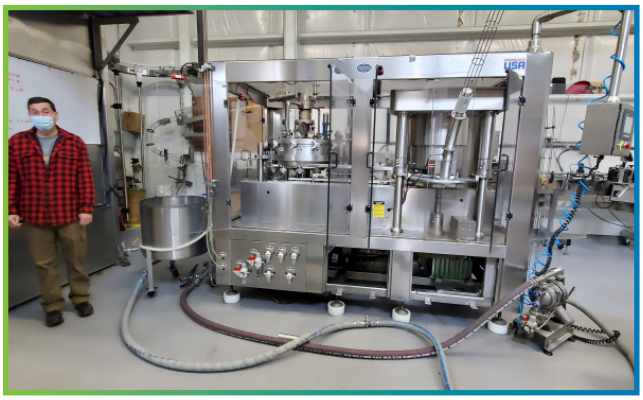
Figure 2: Total Suspended Solids (TSS)



mg/L, their BOD mass loading was likely 600 lb/ day before they started sidestreaming. Since they ultimately would only pay a surcharge on loadings in excess of 250 mg/L, approximately 591 lb/day would be used in this BOD surcharge calculation. Using a low regional average BOD surcharge of $0.15/lb/day, Grey Sail could hypothetically see surcharges in excess of $32,200 per year. Performing a similar calculation for TSS loadings, an additional surcharge of $7,740 per year could be assessed (using regional average surcharges) for a total annual high-strength surcharge of $39,940, on top of the base sewer use rate.

From our evaluation of the pre- and post-BMP sampling data, we saw 8.75% and 26% reduction in BOD (*Figure 1*) and TSS (*Figure 2*) concentrations, respectively, resulting from the four (4) BMPs that Grey Sail implemented. While this does not seem like a lot, a small change in operation with no added equipment could result in a theoretical annual wastewater surcharge reduction of 13%.

Conclusions. From the time background wastewater sampling was undertaken at Grey Sail to the time that the recommended BMPs were implemented, Grey Sail increased brewing production by 18%, and increased cellaring and canning operations by over 100%. In spite of these production increases, implementing cellaring and packaging BMPs at Grey Sail's facility resulted in a noticeable load reduction. Additional BMPs in the brewhouse and control of waste beer discharge from the taproom were unmeasured as part of this study. Should additional BMPs be implemented, we expect that greater reductions in wasteload, and wastewater disposal expense, could be achieved; without adding additional wastewater treatment equipment.



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