BEST MANAGEMENT PRACTICES AND WASTELOAD REDUCTION

newport craft brewing& distilling co. | newport, 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. Newport Craft Brewing and Distilling Co. is a craft brewery and distillery located in downtown Newport, RI. The brewery was founded in 1999 as Newport Storm Brewing and was granted a distilling license in 2006. An acquisition in 2018 resulted in the rebranding of the facility as Newport Craft Brewing and Distilling Company. Since opening in 1999, Newport Craft has steadily expanded their business to include a craft distillery, in addition to their brewing operation and taproom within their current 10,000 square foot facility. They are currently in the midst of constructing an entirely new 30,000 square foot brewery, distillery, and taproom facility allowing them to increase brewery production from 10,000 BBL/year to 100,000 BBL/year.

The existing brewhouse collects wastewater through a series of trench drains in the floor. This system discharges into a pump station wetwell which ultimately discharges into the Newport municipal wastewater collection system. Wastewater from patron restrooms and the bar sinks enter the 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, excluding stillage. Stillage is sent out with spent grains from the brewing operation as animal feed and has always been handled in this manner.

Newport has expressed concern about the potential for high-strength wastewater from the brewery, affecting capacity at the municipal wastewater treatment facility. Newport Craft learned about the P2 Grant and the Brewery Wastewater Assistance Program with RIDEM and volunteered to participate in the study.

Weston & Sampson and representatives from RIDEM met on-site to review brewing operations, identify sampling locations, and processes which contributed to the high-strength wastewater flows and developed 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 10,000 BBL per year, operating 50 weeks per year. Beer is brewed Tuesday through Thursday each week in three (3) double batches (six (6) batches per week). Water meter readings show water consumption (pre-COVID) averaged 22,700 gallons per week. Based on the size of the brewery, brewery production and typical industry averages for craft brewing, Newport Craft generates roughly 2.7 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 Newport Crafts's facility. RIDEM staff conducted sampling over the course of four (4) weekdays, which included a composite

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sampler set up to pull samples each hour from the pump station wetwell that all the trench drains discharged to. Sampling included all wastewater generated by the brewing, distilling, and cellaring operations but did not include the taproom wastewater.

Newport Craft opted to implement the following BMPs:

- Collect and sidestream spent yeast, hops and trub
- Collect and sidestream first rinse from brewing vessels
- Collect residual beer from keg returns, before connecting kegs to the clean-in-place (CIP) equipment
- Collect and sidestream bottoms from their fermenters
- Collect and sidestream the first rinse of the fermenters before connecting the clean-in-place (CIP) equipment
- Improve housekeeping to prevent milled grain from falling into the brewhouse wastewater pump station

Upon implementation, RIDEM obtained 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 reflect changes in loadings from brewing operations combined, however, brewhouse BMPs were only implemented.

While many wastewater constituents were monitored, the focus of this effort was on organic loading (BOD), Total Suspended Solids (TSS), and nutrients. BOD and TSS are the typical basis for wastewater billing surcharges. Of note there was a significant drop (85%) in Quaternary Ammonium *(Figure 3)* compounds between monitoring periods. Quats are used a sanitizer in breweries and food production. While this significant reduction in wastewater Quat concentrations had nothing to do with the sidestreaming, 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 decreased by nearly 22% from pre-BMP monitoring to post-BMP monitoring. Nitrogen (*Figure 2)* decreased by 78% and TSS dropped 87% *(Figure 1)*. BOD, however, increased by 13% from pre-BMP to post- BMP sampling.

After further discussion with the brewers and the technicians setting up the sampling equipment, we were able to determine that there was a significant deposition of solids the bottom of the pump station that likely contributed to this increase. The sampling technician noticed the solids when setting up the sampler for the post-BMP sampling. These solids are likely milled grain that fell into the wetwell and accumulated at the bottom around the perimeter of the pump station. The brewer noted that they periodically (several times per year) pump the solids out of the wetwell.

Figure 1: Total Suspended Solids (TSS)

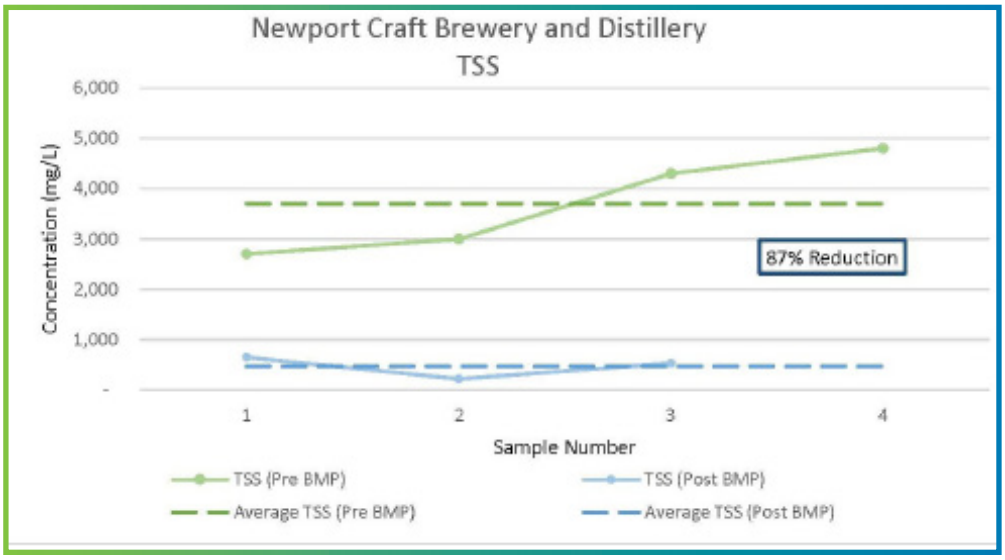

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Figure 2: Nitrogen

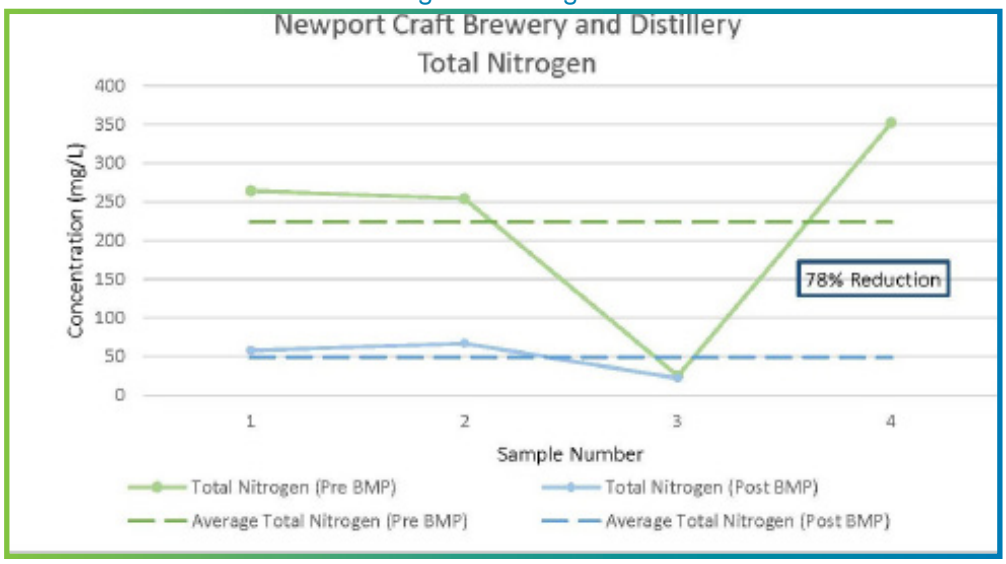
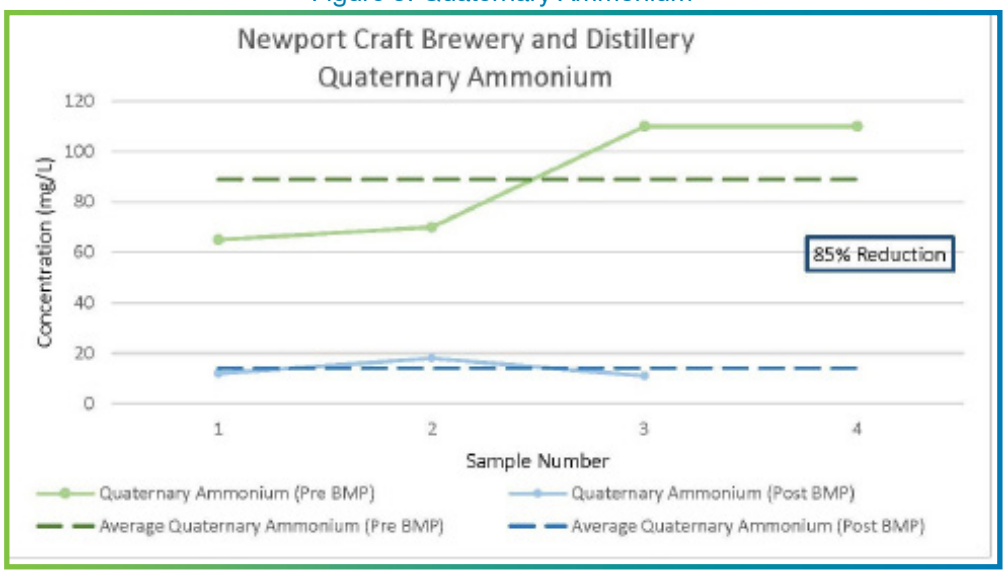


Figure 3: Quaternary Ammonium



From past similar situations in other breweries, we have found that the yeast in the brewhouse wastewater works on these solids and causes them to ferment, releasing alcohol and increasing BOD concentrations in the wetwell. There is some residual amount of wastewater that remains within the pump station wetwell above the pumps to keep the motors cool. Therefore, when the pump station cycles, some wastewater remains. Alcohol from fermenting solids in the pump station adds to the BOD load of the wastewater that flows into the pump station.

Cost Considerations. The pollution prevention measures and brewery brewhouse best management practices serve as low-cost operational improvements that should have a noticeable reduction in operating costs. The City of Newport lists 200 lb/day BOD and 1,000 lb/day TSS as the maximum load limits for industrial dischargers. Surcharges are imposed on dischargers that exceed 300 mg/L for either of these two (2) parameters.

Wastewater generators whose discharge characteristics exceed these limits are usually subject to a surcharge based on the cost of treating the additional organic load. BOD is surcharged at $0.17/lb/day above the base organic load resulting from 300 mg/L BOD concentration. TSS is surcharged at $0.06/lb/day above the base solids load resulting from 300 mg/L TSS concentration.

Weston & Sampson is providing the calculation below using average values to approximate the potential savings from the BMPs implemented. Newport Craft generates approximately 16,500 gallons of wastewater per week. Using the average pre-BMP wastewater BOD concentration of 9,725 mg/L, their BOD mass loading was likely 267 lb/day before they started sidestreaming (based on a 5-day brewing week).

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Since they ultimately would only pay a surcharge on loadings in excess of 300 mg/L, approximately 258 lb/day would be used in this BOD surcharge calculation. Using the Newport BOD surcharge rate of $0.17/lb/day, Newport Craft could see organic load surcharges in excess of $16,000 per year. Using the average pre-BMP wastewater TSS concentration of 3,700 mg/L, their TSS mass loading was likely 102 lb/day before they started sidestreaming (based on a 5-day brewing week). Since they ultimately would only pay a surcharge on TSS loadings in excess of 300 mg/L, approximately 94 lb/day would be used in the TSS surcharge calculation. Using the Newport TSS surcharge rate of $0.06/lb/day, Newport Craft could see TSS load surcharges in excess of $2,000 per year.

Due to the issues with fermentation in the brewhouse wastewater pump station, we were unable to determine the overall BOD reduction associated with the BMPs. From other BMP projects, we can assume a conservative 20% reduction in BOD from implementing the BMPs noted earlier, resulting in a $3,200/year reduction in organic load surcharge. Actual measured TSS reduction resulting from the implemented BMPs was 87%, equating to a surcharge reduction of $1,740/year.

While this may not seem like a lot, a small change in operation with no added pre-treatment equipment could result in a theoretical annual wastewater surcharge reduction of approximately 27%.

Conclusion. Implementing brewing and cellaring BMPs at Newport Craft facility resulted in a noticeable TSS load reduction. BOD load increased due to solid fermentation in the effluent pump station. An additional BMP would be more frequent cleaning of the brewery wastewater pump station. 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 any wastewater treatment equipment.

Acknowledgements. This project was funded by US EPA Region 1 through a pollution prevention grant. RIDEM would like to thank Newport Craft Brewing & Distilling Co. and Weston & Sampson for their collaborative efforts throughout this detailed study. This document was designed and written by Weston & Sampson.