# BREWERY CASE STUDY:
## REDUCING WASTEWATER POLLUTION FROM A LOCAL CRAFT BREWERY

beer'd brewing company | groton, connecticut

***Connecticut has approximately 120 operating breweries. The recent growth in this industry is a welcome addition to CT's economy. The brewing process however comes with potential environmental impacts. This case study focuses on one specific issue of concern, the discharge of large volumes of high strength wastewater. There can be problems if wastewater and associated wastes are not managed properly. This study is an example of how implementing best management practices can help reduce wastewater pollutants and may also lower business costs.***

**The Issue.** Breweries typically generate between 5-8 gallons of wastewater per gallon of beer produced. Due to the ingredients used to produce beer, highly concentrated pollutants end up in the wastewater, much higher than levels typically found in domestic sewage. Sources of high-strength wastewater include spent grains, mash runoff, hops, trub, bad batches of product, first rinses of process tanks, or wasted product from fill stations and bottling lines when the waste product is washed down the drain. It contains high levels of biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), wide pH swings, high temperatures, and slug loading from batch discharges which can damage the biological balance at a wastewater treatment plant if certain limits are exceeded.


**The Brewery.** Beer'd Brewing Company (Beer'd) is a small craft brewery which opened its original facility in Stonington, CT in 2012. Expanding to a second location in Groton, Beer'd opened a brewery and taproom, sharing its facility in a building with a cheese manufacturer. In October 2019, the Town of Groton's Water Pollution Control expressed concern over the high strength nature of the wastewater leaving the building. Due to the current building wastewater system infrastructure, the brewery wastewater quality could not be separated from that of other businesses located on the property. Beer'd applied for ARPA Grant Funds, which have been awarded, and will be used for the installation of flow metering and water quality monitoring. Additionally, some of these funds will be used to purchase a trailer for hauling sidestreamed wastes for composting.

Beer'd became aware that the Connecticut Department of Energy & Environmental Protection (CT DEEP) was offering pollution prevention assistance to breweries. They volunteered to take part in a project to identify and implement practices to lower the strength of their effluent and serve as a model for other breweries in the state, they had a keen interest in participating.

Continued Next Page

The Beer'd Groton facility consists of a 20-barrel (BBL) brewhouse with 60-BBL fermenters that provide an average production rate of 4,300 BBL per year. In addition to the brewhouse, the facility has a taproom which discharges to the same building drainage. Water consumption averages 2,800 gallons per day, five days per week, most of which becomes finished product or is driven off through evaporation. Based on Beer'd Brewing's own calculations, they generate approximately 4.5 to 5-BBL of wastewater for every BBL of beer that they produce. This is a common ratio for many craft brewing operations.


**The Study.** A site visit was arranged to review brewing operations, pinpoint locations and processes which contribute to high strength wastewater flows, and to develop a list of pollution preventions practices for implementation within the brewhouse to reduce overall organic load.

Phase One of the study consisted of identifying potential locations and taking representative composite samples of industrial effluent from Beer'd Brewing's facility. After the initial site visit, the following potential BMPs were identified:

- Collect and divert first rinse from brewing vessels and fermenters before the CIP system is connected
- Collect and sidestream wastewater from the canning line (containing beer foam)
- Collect and sidestream bottoms from the fermenters
- Collect and sidestream keg purge before CIP equipment is connected
- Collect and divert beer and yeast from racking and transfer
- Sidestream taproom waste beer
- Collect and divert drainage when disconnecting hoses from vessels
- Collect and divert line purge when beer is sent to canning

Due to challenges in obtaining representative wastewater samples from the brewery's existing drainage infrastructure, no sampling was undertaken on the "hot side", or the brewhouse. All background sampling was done downstream of the brewhouse and represented wastewater strength from Beer'd Brewing's cellaring operation. Wastewater generated included drainage specifically from the canning line and from racking and cleaning the fermenters. Background sampling took place over a three-day period, during which each of the cellaring processes which generate wastewater were operated. This allowed for calculation of approximate average overall cellaring wastewater loadings during a typical brewing week.

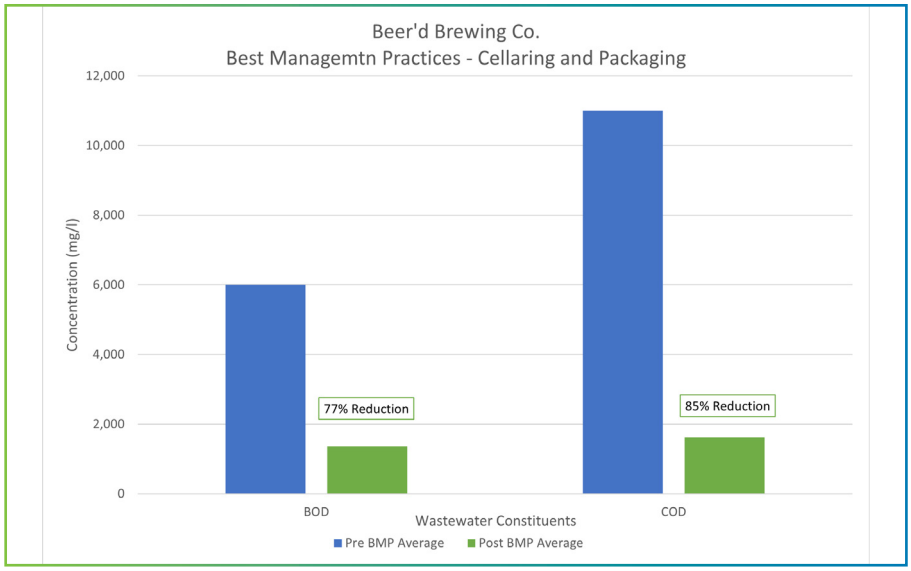
In light of the sampling limitations, Beer'd opted to implement the following BMPs from the list above:

- Collect and sidestream wastewater from the canning line (containing beer foam)
- Collect and sidestream bottoms from the fermenters
- Collect and sidestream the first rinse of the fermenters before connecting the clean-in-place (CIP) equipment
- CIP equipment discharge from fermenter cleaning

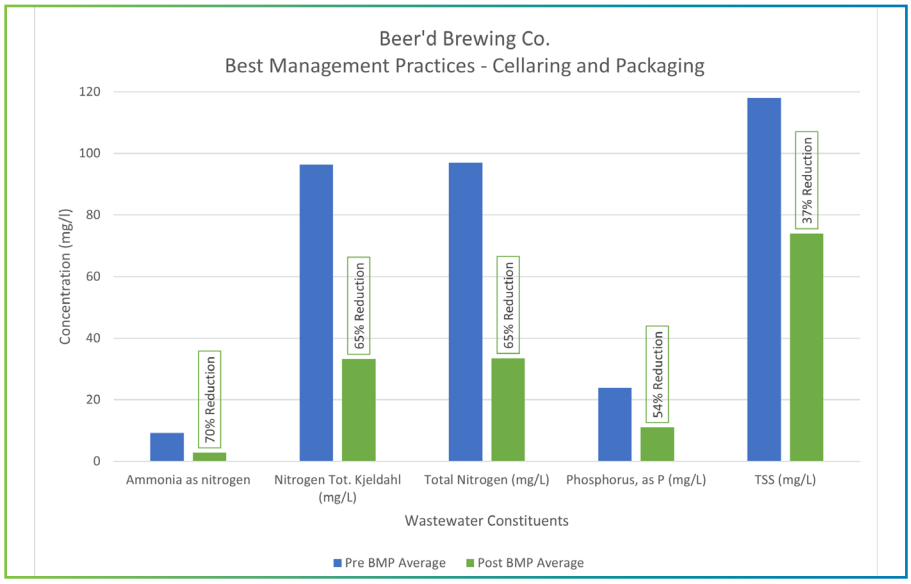
Upon implementation, additional composite samples were taken representing the same operations that were occurring during the background sampling. The graphs below depict the difference in effluent quality between pre- and post-implementation of the above BMPs. While the reductions and loadings are significant, keep in mind that the graphs depict reduction in loadings from the cellaring operations only.

Continued Next Page

Biochemical Oxygen Demand (BOD) & Chemical Oxygen Demand (COD)




Wastewater Constituents




Beer'd had already been side streaming all spent grains from the brewhouse and sending them to a local farm for animal. As a result, Beer'd is now side streaming from the cellaring operation described above. This is collected on site in polyethylene IBC totes and hauled by Blue Earth Compost to Quantum Biopower in Southington, CT, an anaerobic digester that turns organic material into renewable energy and compost.

**Cost Considerations.** The pollution prevention measures, and brewhouse best management practices, serve as low-cost operational improvements and should have a significant reduction in impact and 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

Continued Next Page

a surcharge based on the cost of treating the additional organic load. In Connecticut, industrial dischargers must abide by each POTW Authority's local ordinances and regulations. The Town of Groton's sewer use ordinance states that loadings over those based on a domestic strength of 200 mg/L will be the basis for a surcharge.

Beer'd Brewing occupies a space adjacent to a specialty cheese manufacturer who also discharges a high-strength wastewater. In April 2022, Groton sampled the combined industrial effluent from the site but due to the configuration of the wastewater infrastructure on this property, there wasn't a way to obtain separate samples for each of the two facilities. The town pro- rated the total surcharge for both businesses using only their total monthly water use and applied their surcharge formula (which calculates a total surcharge value using BOD, TSS and COD). Beer'd Brewering was accessed wastewater discharge fees of over $9,000 /month. It is possible that the brewery's wastewater loadings are at lower concentrations than those of the cheese manufacturer, potentially resulting in a higher than necessary surcharge to Beer'd.

The sampling from this project may be useful in helping to more accurately quantify Beer'd's wastewater constituents and surcharges. The brewery is currently working with the town on this issue.

For all brewing operations, a dedicated sampling/metering location should be installed on the industrial discharge line, not only for process monitoring, but for accurate calculation of wastewater surcharges. Without a dedicated effluent sampling location, the receiving wastewater systems may be forced to approximate surcharges.

**Conclusions.** Based on the pre- and post-BMP sampling data, there was a 77% reduction in BOD concentrations in wastewater from cellaring operations, which occurs two days out each week. This reduction is equivalent to a reduction in concentration of 4,620 mg/L. Typical craft brewing operations utilize approximately 55% of their water in packaging and cellaring operations. These were the operations where Beer'd implemented their BMPs. 55% of their approximated wastewater generation of 11,440 gal/week is 6,290 gal/week from cellaring and packaging. Therefore, 6,290 gal at 4,620 mg/L (reduction in concentration) yields a reduction of 242 lb/week of BOD (just from these two operations).

Implementing cellaring and packaging BMPs at Beer'd Brewing's Groton facility resulted in a significant organic 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 throughout the brewery and taproom, we expect that much greater reductions in waste load, and wastewater disposal expense, could be achieved.

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For More Information, visit CT DEEP's Sustainable Breweries (ct.gov) webpage.