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

back east brewing company | bloomfield, 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. Back East Brewing Company (Back East) is a small craft brewery which opened its facility in Bloomfield, CT in July 2012. The brewing facility and associated taproom, discharges its wastewater (industrial and domestic) to the Hartford Metropolitan District (MDC) wastewater collection and treatment system. This utility system is large and as such, hydraulic and organic loadings from Back East typically does not significantly impact operations. Through their involvement with the Connecticut Brewers Guild, Back East became aware that the Connecticut Department of Energy & Environmental Protection (CTDEEP) had issued new Industrial Wastewater Discharge General Permits. They volunteered to take part in a project to identify and implement pollution prevention practices to lower the strength of their effluent and be a model for other breweries in the state.

The brewery consists of a 20-barrel (BBL) brewhouse with 20, 40 and 60-BBL fermenters, averaging a production rate of 10,000 BBL per year and water consumption of 112,000 gallons per month. Based on Back East's own recorded data, and accounting for water evaporation during the brewing process, they generate approximately 5-BBL of wastewater for every BBL of beer that they produce.

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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 prevention practices for implementation.

Phase One of the study consisted of identifying potential sampling locations and taking representative composite samples of industrial effluent. Since there was no single location for a complete representative sampling, one wastewater sampler was used to pull wastewater from trench drains for the brewhouse every hour and an additional sampler was used to collect wastewater from the taproom. Both sampling locations ultimately joined together before discharging to the Hartford MDC collection system. During background sampling, wastewater generated by the canning operation was manually collected prior to entering the trench drain in the brewhouse area for independent consideration as this point source involved finished product. Background sampling took place over a three-day period, during which each of the brewing processes which generate wastewater were operated. This allowed for calculation of approximate average overall wastewater loadings during a typical brewing week.

Back East sidestreams all spent grains from the brewhouse; these grains go to local farms to be used as animal feed and soil amendments. Batches of beer that are out of specification are discharged to the sewer or are saved and trucked to a local distiller to be processed into distilled spirits. Tank bottoms are segregated, stored in 330-gallon IBC totes, and hauled offsite by a food and organics collection service (Blue Earth Compost) to an anaerobic digestion facility that produces energy and compost.

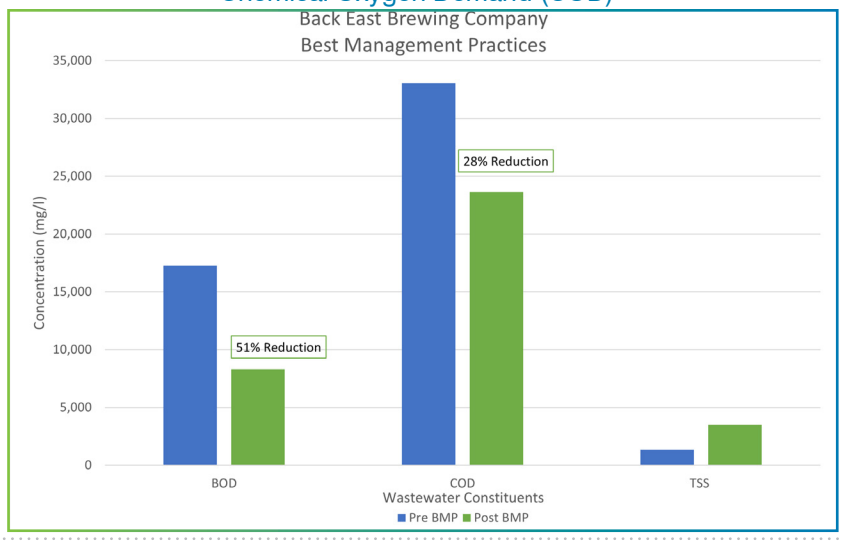
After the initial site visit, the following potential BMPs were identified at this brewery:

- Collect and divert first rinse from brewing vessels and fermenters before the CIP system is connected
- Collect and sidestream wastewater from their canning line (containing beer foam)
- 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

All of these recommended BMPs were implemented except for the last two due to operational complexities.

Upon implementation, additional composite samples were obtained over another 3-day period. The graphs below depict the average difference in effluent quality between pre- and post-implementation of the above BMPs.

Chemical Oxygen Demand (COD)



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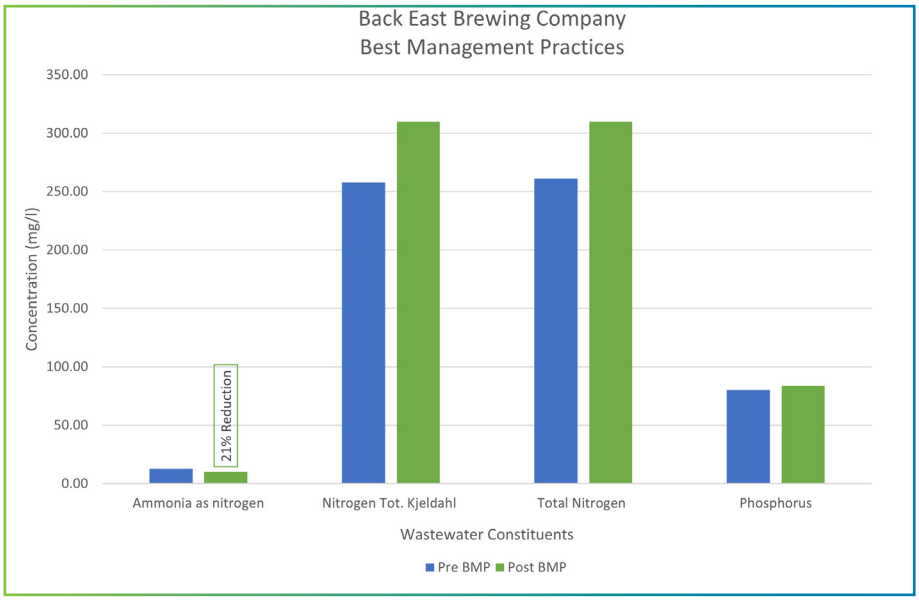
Wastewater Constituents



From a comparison of the pre- and post-BMP implementation sampling, we observed a significant reduction in BOD and COD (organic loading). Ammonia was also reduced significantly and there was an unexpected increase in TKN, total nitrogen and total phosphorus. After discussing these results with Back East, it was discovered that the brewery had recently passivated some of their stainless-steel vessels using nitric acid and phosphoric acid. The slight increases in these constituents may have been a residual result of this infrequent passivation process.

Total suspended solids concentrations also increased unexpectedly, likely due to an incidental release of solids in the brewhouse. Based on the BMPs that were implemented by Back East, we would expect a significant reduction and suspended solids, commensurate with the reductions in organic load that were observed.

Cost Considerations. The pollution prevention measures and brewhouse best management practices, serve as low-cost operational improvements and should result in a significant reduction in wastewater loading with minimal increase in operating costs.

The New England Interstate Water Pollution Control Commission (NEIWPCC) states that the average concentrations of BOD and SS in domestic wastewater are approximately 250 milligrams per liter (mg/l) and 300 mg/l, respectively. Wastewater generators that exceed these limits are usually subject to a surcharge based on the cost of treating the additional organic load.

The calculation below represents regional average values, not those of MDC, in order to show the approximate savings from the few BMPs that were undertaken at this brewery. Using the 5:1 wastewater to beer production ratio noted above, Back East generates approximately 25,600 gallons of wastewater per operating week. Assuming an average wastewater BOD of 17,270 mg/L (Back East's

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pre-BMP average), their BOD mass loading was likely 737 lb/day before they started sidestreaming. Since they ultimately would only pay a surcharge on loadings in excess of 200 mg/L, approximately 729 lb/day would be used in this BOD surcharge calculation. Using a low regional average BOD surcharge of $0.15/lb/day, breweries of similar size in other communities could hypothetically see surcharges in excess of $39,900 per year.

From our evaluation of the pre- and post-BMP sampling data, we saw a 51% reduction in BOD concentrations in wastewater from all brewing operations. This reduction is equivalent to an average reduction in concentration of 8,970 mg/L. Reduced BOD loading yields a reduction of 357 lb/day of BOD. At $0.15/lb/day, it is equivalent to a savings of $55/day ($20,300/year) based on BOD alone.

In addition to the monitoring in the brewhouse and cellaring operations, Back East separately recorded a log, documenting the volumes of beer purged from draft lines at the bar and volumes of waste beer dumped at the end of the night. A total volume of 7.25 gallons of raw product wasted from taproom operations was recorded during this week-long study. Though this is not considered a significant volume, the organic strength of beer resulted in an additional 4.25 pounds of BOD per week, or 0.84 pounds of BOD per day for each day that the tap room was in operation. At 5 days of taproom operation per week, this has a potential sewer surcharge value of nearly $50 over the course of the year.

Conclusions. Implementing BMPs in brewing and cellaring operations at Back East Brewing resulted in a significant load reduction. If additional BMPs were to be implemented throughout the brewery and taproom, we expect much greater reductions in waste load, and potential wastewater disposal expense could be achieved.

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