Brewery Wastewater BMPs

What Are Best Management Practices

Best Management Practices (BMPs) for fermentation involve not just meeting sewer discharge rules, but designing for and practicing efficiency in brewing, cleaning, and product management. Useful metrics are water use, energy use, and waste produced per unit of production. This focus sheet describes some common BMPs as a starting point for developing BMPs for your particular brewery.

Your Local Sewer Agency

Always contact your local sewer service provider to let them know what you are doing and get their rules for discharging to the sewer. Commonly rules for fermenting address the need to:

- Obtain a permit for certain sizes or types of activities.
- Install a sampling point, flow meter, & allow inspections.
- Keep effluent pH in the target range (at least 5.0-11.0).
- Meet prohibitions such as keeping solids, flammables, stormwater, and excessive heat out of the sanitary sewer.
- Equalize flow to the sewer to avoid causing overflows.
- Promptly react to spills and alert the sewer utility.
- Pay applicable sewer capacity and extra strength charges.
- Employ necessary BMPs (which can be situational).
- Keep records of BMPs, flows, and waste disposal.

Well operated breweries have good procedures and training programs to minimize staff errors that could impact the sewer.

General Overall Concepts:

Examine each process against the waste management hierarchy.
Employ the best layout and design features for your equipment.
Segregate high strength wastes for beneficial reuse.
Clean in multiple steps using efficient cleaning systems.
Choose sewer friendly chemicals.
Reuse chemicals when possible, and neutralize when spent.
Treat wastewater where needed to meet sewer rules.
Conserve water wherever possible, meter use, refine the plan.

WHY BMPs MATTER

Brewing operations involve frequent transfer of large volumes of “high strength” liquids, high temperatures, and powerful cleaners and disinfectants. If not properly done, discharges from brewing can harm sewer pipes and the biological processes used at the sewage treatment plant. In such case, blocked sewer lines or treatment upsets can send sewage to the environment.

HOW TO APPLY THE WASTE MANAGEMENT HEIRARCHY

Developing good management practices involves carefully reviewing each step of your brewing operation. Try this:

1. Draw a diagram of each step of your brewing process showing raw material inputs, outputs, losses, intermediate products and wastes.
2. Identify all the wastes created in each of step.
3. For each ask (in order) if by an alternate process or procedure: Can you:
   a) Avoid creating it?
   b) Reduce its amount?
   c) Return it, recycle it, or beneficially reuse it (or could someone else)?
   e) Blend it with other wastes to reduce treatment costs?
   f) Lower the cost of properly treating it?
4. Compare valid alternatives.
5. Make the most cost effective changes (biggest bang for the buck).
6. Refine the plan periodically.

Desirable Facility Design Features:

NOTE: This is intended to be a starting point. Not every facility will find it cost effective to employ all these features, and alternatives may be a better fit for your brewery.

WATER CONDITIONING / TREATMENT:
- If regenerating a water treatment system, plan to neutralize pH of that wastewater.

BREWING:
- Dry mill the malt if using malted grains.
- Have an extra tank for high strength wastes.
- Have a bin for capturing spent filter solids.

TANKS:
- High quality stainless steel compatible with harsh cleaners, adequate bottom slopes, access and clearance for cleaning, secondary containment, and CO2 and steam recovery systems where warranted.
- Pressure rating for fermentation tanks if pressure relief valve > 15 PSIG.
- Transfer pipes sloped to drain liquids and insulated to preserve temperature.

TANK CLEANING:
- Automated Clean In Place (CIP) systems, steam, high pressure water and cleaner provided for both tank and keg cleaning.
- Catwalks and hose bibs in handy places.
- Ozone generation system for cleaning.
- Metering pumps for chemicals used.
- Holding tank for reusing cleaning solutions (caustic or acid) for subsequent passes.
- Holding tank for neutralizing pH of acid or caustic cleaners prior to discharge.

HOUSEKEPING:
- Slop sink to allow mopping and squeegee floors rather than hosing them down.
- Collection troughs are cupped, sloped, and smooth to prevent standing water.
- Removable grates allow daily cleaning.
- Drainage systems lead to holding tanks.
- Holding tank alarm when full & valves allow containing & isolating spills.
- Secondary containment for storage areas.

Overhead cover and berms avoid storm water contamination in transload areas

KEGGING/BOTTLING:
- Waste beer recovery systems.
- Recycling system for keg cleaners.
- Inline final filters that can be isolated and serviced with minimal loss of product.

ENERGY CONSERVATION:
- Choose a countercurrent heat exchanger with automatic temperature controls to get optimal wort temperature for brewing.
- Employ a heat pump or glycol system for closed loop cooling during fermentation.
- Insulate the chilled water tank and lines.
- Motion activated, zoned, LED light system.
- Combined Heat and Power (CHP) energy system if using a distributed energy system.
- Compressed air (if used) checked for leaks.
- High efficiency motors (do efficiency audit).

WATER CONSERVATION:
- Meter all water uses, track use & trend.
- Set target water use per unit of production.
- Use low flow, high pressure pistol grip type wands for all manual cleaning.

REGULATORY COMPLIANCE:
- Sampling point with continuous pH meter.
- Sewer flow meter (also reduces sewer bill).

Segregating High Strength Wastes:

High strength wastes at breweries include:
*Sweet water, spent grain, hops, yeast, trub.
*Tank heels and initial rinse of brew tanks.
*Beer & yeast lost in racking and transfer.
*Beer lost in filtering, bottling, & kegging.
*Beer contained in returned kegs or bottles.
*Used filter media (e.g. diatomaceous earth)

These wastes streams are several orders of magnitude higher in strength than normal sewage and should be beneficially used as soil amendments (used filter media) or animal feed (everything else). Segregate unfermented wastes from waste yeast and beer to maximize the feed value. Discharging excessive amounts of high strength wastes can disrupt the sewer system and/or incur surcharges and fines.

Cleaning

Proper and frequent cleaning and sanitization of brewery equipment (tanks, hoses, transfer lines and pumps) is essential to quality brewing operations. As such it is a major part of the labor and expense of brewing. Below are some general ways to reduce waste in cleaning. But you must decide which apply to your specific operation.

EXAMPLE TANK CLEANING STEPS:
The most efficient cleaning protocol is site specific but here is one method to consider for stainless steel (304 or 312) tanks:
* Drain the tank and purge CO2 as needed for cleaning. (note: CO2 can be deadly)
* Use warm high pressure water for initial rinse down (segregating this high strength waste for beneficial use).
* Use a clean in place high pressure system with a commercial nitric/phosphoric acid blend. Segregate and recycle this wash water.
* For beerstone, follow with a warm high pressure non-caustic alkaline cleaner before and after a physical scrub step (manual or automated) to remove the softened beerstone.
* Do final sanitization (ozone, peracetic acid, or other) as needed.

Blend wastewater from last two cleaning steps to maximize self-neutralization.
Adjust pH to meet local sewer limits.
Meter wastewater slowly into the sewer.

Consider Sewer Friendly Chemicals:

Acids: Avoid hydrochloric or sulfuric acids. Prefer formulations of nitric and phosphoric acids designed for cleaning food equipment.
Caustics: Sodium hydroxide, and potassium based alkali cleaner are easiest on sewers. Chlorinated compounds are less friendly.
Sanitizers: Ozone, UV, or Peracetic acid (PAA) sanitizer are easiest on sewers.

Water Conservation Measures

Brewery managers are often surprised to find out how much water they use. The typical brewery uses four to eight gallons of water for each gallon of beer produced. Most of it in cleaning or inefficient single pass water cooling systems. Here are some general tips which go along with the design features and tank cleaning processes described earlier.

Metering: There is a saying "what gets measured improves" so mapping water use and using multiple meters to track water use in each area allows managers to evaluate costs and progress. Also, it's good to check wastewater strength (BOD and TSS) from each area and ensure water is off when production stops. **Lost water increases your costs in:** 1) Water bills 2) Sewer bills 3) Larger treatment systems 4) Treatment system chemicals 5) Sewer surcharges 6) Water conditioning costs and 7) Utilities to transport, heat, and cool the lost water.

Cleaning: Steam and high temperature and pressure water (typically 500psi to 3000psi) can significantly reduce water demand. But since increasing temperatures lower mineral solubility, keep the temperature of rinse water in neutral or alkaline environments low enough to avoid mineral scaling on tank walls. There are many good new commercial tank washing systems and products, so choose one best suited for your size operation.

Brewing: Use counter-current heat exchangers to heat up the next batch of mash water while cooling down the wort to brewing temperature. Use an automatic temperature control system to ensure optimal brew temperature. Heat pumps and glycol based systems are common supplemental systems for heating and cooling. Use level sensors to avoid overfilling tanks (and the associated spillage).

Packaging: Water use in bottling and kegging lines can also be significant. Review of where water is used (and lost) in this step can lead to significant savings. Often cleaning of spillage is not done efficiently. Select and plumb filters used in-line with the bottling/kegging operation so that they can be isolated, taken offline, and serviced with minimal loss of product and cleanup costs.

Energy Efficiency

Most breweries use motors and compressed air systems for various purposes. Air leaks and inefficient motors can waste a lot of energy. Ecology's TREE team provides free energy audits: www.ecy.wa.gov/tree/index.html

Take advantage of significant advancements in high efficiency LED lighting, ultra-efficient heat pump technology, heat recovery systems, and on-site combined heat and power (CHP) systems if you can. The applicability of such technologies to your situation requires an expert analysis which is generally well worth the expense (but beyond the scope here).

Handling Mistakes & Emergencies

Ecology recommends breweries develop plans to prevent and respond to spills to the sewer (a.k.a. slug discharges) regardless of whether their sewer provider requires it. Such plan should:
a) Identify the quantity of each ingredient, chemical, intermediate, and final product on site.
b) Describe where chemicals are stored and how liquids are secured and handled to prevent and isolate spills. This includes transfer protocols.
c) Describe how you will respond to a spill, including immediate notifications to emergency responders and the sewer department
d) Describe staff training to carry out the plan.
e) Update the plan as your processes change.

As brewing is an art as well as a science, not every batch will meet the strict quality control standards of the brewmaster. In such cases, please don't dump it down the drain. Develop a plan for what you will do in such case before it happens. Usually beer can be beneficially used for animal feed, even if you can't find a processor to extract the alcohol. Dumping an entire tank of beer is likely to upset the sewage treatment plant causing environmental damage, negative publicity, and scrutiny (fines, or worse).

Design of Treatment Systems

Ecology recommends breweries employ a licensed professional engineer to design a treatment system if one should be necessary or desired and have them provide an O&M manual for operating the system.

Generally when high strength wastes are managed as described in this focus sheet further reduction in strength by biological treatment is not required for discharge to sewer.

However, control of pH is often necessary, and batch treatment to meet pH limits is still the best option for many small breweries. Necessary features typically include a tank, mixer, continuous pH meter, and a delivery system for the acids and bases used for neutralization.

Treating for pH on a batch basis involves circulating the batch, taking a sample, figuring out how much of the acid or base it takes to bring it to the target pH range (jar test). Scale the results to the tank, add that amount of chemical, mix, resample pH, and discharge if within limits (otherwise repeat the process).

For example: If a bench test of a quart sample from a 500 gallon neutralization tank takes 0.1 ounce of 3% nitric acid to bring the pH down from 11.5 to 8.5. To neutralize all 500 gallons to this level requires metering in: [500gal * 0.1 oz/qt *4qt/gal] = 200oz (~1½ gal) of the acid.

For more information see: Brewers Association, *Water and Wastewater Treatment/Volume Reduction Manual*