

# **Improved Wastewater Treatment at Hess Collection Winery**

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Winery wastewater treatment at Hess Collection Winery (Napa, CA) features floating horizontal brush aerators, data logging, and computer monitoring and control to simplify required water quality reporting. Since installation in 2001, Hess Collection Winery has never been out of compliance with state discharge limits.

Wineries generate a strong organic wastewater that is highly depending on production activities. Dissolved constituents in the wastewater include sugars, ethanol, organic acids, aldehydes, other microbial fermentation products, and soaps and detergents from cleanup operations.

Large suspended matter consists of grape skins, leaves, stems, and seeds, while smaller suspended particles are primarily dead yeast cells and cell fragments (lees), grit, dirt, diatomaceous earth, and bentonite.

Winery wastewater typically is low in pH because of organic acids produced in the fermentation process. Winery wastewater generally has sufficient phosphorus but is deficient in nitrogen and other trace minerals, which are necessary for efficient biological treatment.

Variability in wastewater composition depends mainly on the season and the particular operations being conducted at any given time. Maximum organic loading usually occurs from early September through early November (harvest season). Certain winemaking operations – such as cleaning of the crusher, pomace conveyors, presses, and fermentation tanks – can also generate high strength wastewaters.

Other process wastewater includes washing of storage tanks, bottling and other equipment, and wine racking. Total Hess Collection Winery wastewater includes the process wastewater, cooling water, and sanitary wastewater from about 50 employees, more than 100 daily visitors, and 100 residents of an onsite monastery.

Total average daily wastewater flow rates are approximately 10,000 gallons per day (gpd) during the wine bottling period (January through early September). During harvest, total wastewater flow rates generally average about 26,000 gpd. The highest BOD<sub>5</sub> (biochemical oxygen demand) loadings are approximately 1,000 to 10,000 mg/L (200 to 2,200 lb/day). In December, facility cleaning contributes to about 30,000 gpd of total wastewater.

Average annual wastewater total flow is about 14,000 gpd. Because of the significant sanitary wastewater component, the combined wastewater likely contains adequate nitrogen, phosphorus, and micronutrients for effective biological wastewater treatment.

#### Traditional treatment processes for winery wastewater

Because it is a strong organic waste, winery wastewater is suitable for biological wastewater systems. The most common type of biological treatment system is an aerated lagoon or ponds. Activated sludge, sequencing batch reactors (SBRs), and artificial wetlands are used by some wineries. Each of these processes is capable of producing an effluent that is suitable for spray irrigation of vineyards, woodland, or other suitable land.

Some wineries have leachfields, which are biological systems in that they rely on microbial treatment within a soil column. Leach fields placed below the upper aerobic soil layer tend to have little to no treatment, resulting in discharge of high-strength winery wastewater to the groundwater table.

Biological treatment systems are economical and provide BOD and suspended solids (TSS) removal. Aerated ponds generally perform well and are usually reliable. They are low maintenance, mechanically simple systems that minimize the amount of operator attention required.

Aerated ponds are capable of handling surges in hydraulic and/or organic loadings that are common to wineries. When properly designed and operated, the potential for environmental problems (odors, ground and surface water contamination) is minimal.

#### Wastewater management at The Hess Collection Winery

The wastewater management system at The Hess Collection involves pollution prevention measures and end-of-pipe wastewater treatment. Pollution prevention involves careful management of wine production and ancillary activities to reduce wastewater volumes and loadings.

During cleanup operations the winery uses pressure washers, which emit a high-pressure, low volume spray. Sump screens are cleaned daily to help reduce suspended solids loading to the ponds. For hand-held washing operations, winery staff use pistol-grip nozzles.

Screens are placed over floor drains to prevent skins and seeds from entering the process drain. In addition, lees and bentonite are allowed to settle in tanks and are separated from the process water prior to wastewater treatment. Lees and bentonite solids are taken to a sanitary landfill for final disposal. Typical of many wineries, these pollution prevention measures reduce process wastewater volumes and pollutant loadings.

The Hess wastewater treatment system consists of two aerated ponds (in series), located more than 1,500 feet downhill from the winery. Most wineries benefit by introducing aqua ammonia for nitrogen addition and pH adjustment. However, this is not necessary

at Hess Collection because of the impact of sanitary wastes on raw wastewater quality. The pH of the raw wastewater is typically in the range of 5.5 to 8.5.

Process monitoring and the control of the wastewater treatment process is accomplished by recording influent wastewater flow, recording and data logging of pond, pH, dissolved oxygen (D.O.), and freeboard accomplished by an automatic aeration control system.

The original treatment ponds were constructed in the 190s. Until 2001, aeration in the ponds was provided by conventional vertical, splash aerators and/or aspirating aerators. Pond #1 has a volume of approximately 1.7 million gallons, providing an average detention time of 65 days during harvest and 94 days during the wine bottling season. Land-application return-flows, which are minor compared to influent flows, were excluded from detention-time calculations.

#### Aeration

In 2001, the winery renovated the pond electrical system and installed floating horizontal brush (FHB) aerators in Pond #1. Primary reasons for improvement of the treatment system were inadequate oxygen transfer capacity of the former aerators and the winery's commitment to using more efficient were manufactured by S&N Airoflo, Inc. (Greenwood, MS).

Two 10-horsepower (hp) FHB aerators in Pond #1 provide more than 1 mg/L oxygen level and mixing and directional water movement to prevent short-circuiting. One 7.5-hp aspirating aerator (original unit) provides additional oxygen transfer and minimal mixing capability. Two 10-hp FHB aerators, which are about twice as efficient as aspirating aerators, are located on opposite sides of Pond #1 to provide a serpentine mixing pattern.

These FHB aerators can transfer up to 1,100 lb/day of oxygen to the pond to satisfy the oxygen requirements of pond microorganisms under most BOD-loading conditions. For 80% BOD removal in Pond #1, all three aerators can meet oxygen requirements at peak BOD loading on 1,100 lb/day.

The aerators create distinct flow patterns inside two lobes. In each lobe, water is pushed away from the aerator and then pulled back to the aerator, providing numerous passes through the flow patterns, which helps to minimize short-circuiting (wastewater exiting the ponds in a time less than the calculated detention time). The shape of the active mixing zone is determined by the sides of the unit to the edge of the pond.

Pond #2 (about 1.6 million gallons) has two 5-hp vertical splash aerators (original units) for mixing and oxygen transfer prior to land application of the treated wastewater. The water level in Pond #2 fluctuates depending on raw wastewater flow rates and the effluent land application rate as well as precipitation and evaporation. In anticipation of higher wastewater volumes during harvest and during heavy rain periods, the winery tries to have both ponds at a depth of five feet prior to harvest.

Wastewater flows from Pond #1 to Pond #2 by gravity or it can be pumped as necessary. Because gravity flow from Pond #1 is rather slow occasionally, the winery can activate pumps to increase the transfer rate. BOD removal in each of the two aerated ponds is approximately 85% to 90%. Effluent from Pond #2, which is land-applied, is less than 50 mg/L of BOD<sub>5</sub>.

#### Dissolved oxygen control

A unique feature of the aerated ponds system is the real time monitoring/data logging and D.O. control system manufactured, installed, and maintained by Heritage Systems, Inc., (Napa, CA). The PondSentry™ monitoring/control system consists of a control panel that contains pH and D.O. analyzers, a microprocessor, data logger, cellular modem, and associated sensors.

The PondSentry™ system is currently used to measure freeboard, D.O. levels, pH, influent flow rate, and aerator run times. The unit starts and stops aerators automatically at user-defined set points. The system software allows the microprocessor to make smart decisions about operating the aerators, to ensue optimum performance and energy conservation.

D.O. and pH sensors are mounted in a float to allow monitoring of water approximately one foot below the surface. The float, located in the center of the pond, is suspended from a pulley system. An ultrasonic freeboard sensor is suspended by a retractable boom over the water surface. Heritage systems technicians visit the ponds to clean and calibrate the probes and sensors every two weeks.

The patent-pending PondSentry™ system determines when the aerators are activated and deactivated, alternated operation of the three units, and records total operating time of each aerator. This system saves the winery about \$1,000 per month in electrical costs due to reduced aerator run times.

At current settings, the PondSentry™ control system enters all measured parameters into a data logger. Heritage Systems retrieves the data and generates monthly and quarterly California Regional Water Quality Control Board (CRWQCB) compliance reports for Hess Collection Winery.

Heritage Systems provides all of the above mentioned products and services for a fixed monthly fee. The PondSentry™ system is owned, installed, and operated by Heritage Systems, requiring no capital budget or maintenance costs that would impact the winery. With the improved aeration efficiency and control, Hess Collection is consistently in compliance with CRWQCB discharge limits.

#### Beneficial reuse of winery effluent

Although low in BOD and TSS, the treated wastewater has some residual macronutrients and many micronutrients (primarily iron, manganese, zinc, boron, copper, and molybdenum) that can enhance plant growth. During biological treatment, some of the nutrients are converted to other forms.

For example, some ammonia-N will be converted to microbial cell mass and may exit the system as organic nitrogen. Because of the long detention time, some ammonia-N will be oxidized to nitrite-N and nitrate-N via nitrification.

The final effluent is applied to a 0.9 acre woodland adjacent to the aerated ponds. At 14,000 gpd over 0.9 acres, with an adjustment for pond evaporation, the average daily wastewater application rate is 0.36 inches per day.

Wastewater is pumped from Pond #2 through an effluent distribution system consisting of 3-inch, 2-inch, and 1-inch plastic pipes, and four sprinkler heads. Regulatory restrictions require that wastewater cannot be land applied 48 hours prior to a rainfall event, during the event, or within 48 hours after rainfall.

Depending on local weather conditions, and under the parameters of their discharge permit, pond effluent is land-applied. Runoff from the land application area is collected in earthen trenches and routed back to Pond #1. This ensures that no wastewater effluent is discharged to receiving water body.

In slow rate land application, applied wastewater is treated as it flows through the soil matrix, and a portion of the flow may percolate to shallow ground water. The wooded land application site has a moderately steep (approximately 10%) slope. Therefore, percolation to ground water is reduced and runoff is collected. Because runoff is occasionally produced, this system could be referred to as an overland flow system. However, all runoff is collected and rerouted to the aerated ponds.

Advantages of slow rate systems are:

- Treatment of applied wastewater;
- Water conservation, by replacing potable water with treated effluent, for irrigating landscaped areas;
- Preservation and enlargement of forested areas.

The requirements for spray land application are a BOD<sub>5</sub> concentration less than 80 mg/L, TSS less than 80 mg/L, D.O. greater than 1.0 mg/L, and settleable solids less than 1 ml/L. Land application of the treated effluent provides water and nutrients which are consumed by forest vegetation if applied at agro-economic rates.

In addition, through percolation and evapotranspiration, the pond effluent is disposed on in the land application system. This approach eliminates the need for a direct discharge of treated wastewater into surface waters. Therefore, this system enhances environmental quality in Napa Valley.