Guideline 4: Wastewater Treatment

This section provides guidelines for evaluating winery wastewater treatment system alternatives and selecting energy-efficient equipment that will best meet the winery's needs for subsequent discharge to land or a publicly owned treatment works (POTW). Conceptual treatment alternatives for salt, organic and nitrogen reduction are outlined in the overview section below, followed by more detailed discussion of specific treatment methods. Refer to Figures 4-1a through 4-1g for initial screening of potentially applicable treatment process options.

4.1 Overview of Treatment Process Selection

Identification of an appropriate wastewater treatment technology or multiple technologies is strongly influenced by the characteristics of the wastewater stream and the degree of treatment needed to meet site-specific discharge requirements. Wineries may need to consider using some combination of the following types of wastewater treatment processes to address discharge requirements:

- Physical and chemical processes for removal of solids (total suspended solids (TSS) and coarse solids such as lees, stems, and seeds). The technologies range from screening and sedimentation to pre-aeration, chemical precipitation, dissolved air flotation (DAF), and filtration.

- Biological processes for removal of organic matter (BOD) and nitrogen control. Treatment options include aerobic, anaerobic, and facultative (both aerobic and anaerobic) biological degradation systems.

- Membrane (reverse osmosis and nanofiltration) and thermal processes (mechanical or solar evaporation) for removal of salt.

The amount and type of treatment required will depend on the treatment objectives. Pretreatment for discharge to a publicly owned treatment works (POTW) may require only partial reduction of BOD, TSS, and perhaps total Kjeldahl nitrogen (TKN) to levels similar to those found in domestic wastewater. Higher levels of treatment may be necessary for discharges to receiving waters under NPDES permits.

On the other hand, only minimal treatment (e.g., coarse screening) may be required prior to land application treatment. However, requirements for more extensive pretreatment for discharge to land application are beginning to emerge in California for wineries regulated under Waste Discharge Requirements to address site-specific issues including organics, nitrogen, and salts. These treatment requirements are usually established by regulatory agencies with input from the discharger.

Small wineries generally produce small wastewater streams that can be assimilated by on-site disposal systems. Septic systems consisting of a settling tank and drainfield are the most common treatment and disposal option (refer to Guideline 3). In these systems, solids are allowed to settle in the septic tank, and then the effluent is discharged to an adjacent drainfield. The septic tanks must be cleaned out periodically to maintain the treatment system. Where more extensive treatment is required, pond systems, and in some cases small package treatment plants are typically used.

4.1.1 Removal of Organics

The reduction of organic compounds in wastewater is generally addressed through a combination of physical/chemical treatment for solids and biological treatment (refer to Guideline Figures 4-1a through 4-1b). Biological treatment of organics generally falls into two broad categories: aerobic and anaerobic treatment. Aerobic processes involve the use of bacteria that require oxygen and metabolize the dissolved organics into carbon dioxide and water. These types of systems can be fairly expensive and complex, and require significant amounts of energy to supply the required oxygen for the bacteria due to the high BOD concentrations in winery wastewater. These types of systems are generally effective in reducing BOD to levels below 100 mg/l. However, achievable treatment levels are highly dependent on the influent wastewater characteristics.

Anaerobic systems utilize bacteria that metabolize dissolved organics in the absence of oxygen. The resulting end products of the metabolic process are methane and carbon dioxide. These types of systems can be more robust than their aerobic counterparts and are often more expensive. They can generally treat more highly concentrated wastewaters (3,000 mg/l or higher of influent BOD), but cannot reach treatment levels as low as aerobic systems.

4.1.2 Nitrogen Reduction

The reduction of nitrogen compounds in wastewater is commonly addressed through biological treatment (refer to Figure 4-1f). Other treatment technologies exist to reduce or remove nitrogen compounds, and include ion exchange, chemical oxidation, and air stripping. However, these types of technologies are often not suited for winery wastewater applications. Ion exchange and chemical oxidation generally increase salt loading in the facility discharge. Air stripping requires operation at pH levels of 11 or higher and also results in increased salt loading.

Biological treatment for nitrogen removal is fairly complex and expensive, and generally achieved through the use of nitrifying bacteria that metabolize ammonia into nitrite and nitrate. Further operation of the biological system under anoxic conditions converts the nitrate into nitrogen gas. These type of processes are already used in the municipal wastewater treatment industry and can readily be applied to winery wastewater treatment applications.

4.1.3 Salt Reduction

Winery wastewater is not typically treated to remove salts (TDS); however, salt may limit reuse options such as irrigation. As a result, many wineries are starting to implement best practices to minimize the salt in their wastewater effluent. In California and other regions where salts may pose a threat to groundwater quality, regulatory agencies are asking for even greater salt reductions, which is driving consideration of salt removal treatment technologies.

Currently available salt reduction strategies that may be applicable to winery operations are summarized on Figure 4-1g. They are all costly, so careful evaluation of the economic feasibility of these end-of-pipe approaches is paramount. Technologies include membrane treatment, either through reverse osmosis (RO) or nanofiltration (NF). These systems are used to separate the water from its dissolved components by forcing the water through a semi-permeable membrane. The dissolved components are left to concentrate on the feed side of the membrane. The result of this process is a clean water stream, generally suitable for discharge or reuse applications, and a concentrated brine stream, which must be disposed of. Both RO and NF must be coupled with pretreatment to avoid fouling the membranes and frequent, expensive cleaning and operating measures.

Salts can be separated from winery wastewater by evaporation in shallow ponds, if sufficient land is available, or with mechanical evaporators. This process can also be used to concentrate membrane treatment reject streams. The salt brine or cake will then need to be disposed of properly, which is again difficult and expensive to accomplish.

4.1.4 Energy Efficiency Considerations

Energy efficiency should be a major consideration in the design of a winery process wastewater treatment system. An energy audit of an existing or planned treatment facility will assist a winery in determining the life cycle cost of treatment equipment and deciding where to invest resources in treatment processes. The local power utility can provide wineries with assistance conducting energy audits of their treatment facilities.

Treatment system components that have significant energy demands include aerators, pumps, motors and motor drives. Optimal selection, operation and maintenance of aerators and pumps are discussed in Appendices F and J, respectively. Key features of energy efficient treatment systems can include premium efficiency motors, variable frequency drives, and design and process improvements, as discussed below.

4.1.4.1 Premium Efficiency Motors

Properly sized premium efficiency motors (PEM) can save energy compared with standard efficiency motors and oversized motors. For assistance selecting PEM and estimating payback times, refer to a software package called MotorMaster+, which can be obtained at no cost from the U.S. Department of Energy website: http://www.eere.energy.gov/industry/bestprsctices/software.html.

4.1.4.2 Variable Frequency Drives

Variable frequency drives (VFD) are used to control the speed of pumps, mixers, surface aerators, blowers, compressors, and other rotating components used in wastewater treatment systems. Pumps and aeration equipment are the largest users of electricity in wastewater treatment systems. For pumps that operate at varying flow rates, two-speed or VDFs can be used to improve electrical efficiency. Energy savings from using such equipment will offset any higher capital cost incurred.

4.1.4.3 Design and Process Improvement

Process control systems can be used to improve the energy efficiency of many wastewater treatment processes. A primary example of design and process improvements (DPI) is the use of dissolved oxygen probes to control aerators in aerobic ponds instead of continually operating the aerators at capacity.

4.2 Physical and Chemical Processes

Many wineries employ physical and/or chemical processes for the removal of solids from process wastewater. The treatment technologies employed are usually energy efficient. Typically, they are not standalone processes, but are used in conjunction with other processes in a treatment train. Table 4-1 below provides a list of the most common physical-chemical processes.

Table 4-1: Energy Use in Physical and Chemical Treatement Processes

Process	Equipment	Energy Efficiency Measures
Coarse screening	Motors	Premium efficiency motors
Chemical addition	Pumps	Premium efficiency motors Dosing control
Mixing	High intensity mixers	High efficiency motors Variable speed drives
Flocculation	Low intensity mixers	Premium efficiency motors Variable speed drives
Sedimentation	Sludge collection devices	Premium efficiency motors
Dissolved air flotation	Pumps Air compressors	Premium efficiency motors Variable speed drives
Centrifugation	Motors	Premium efficiency motors Variable speed drives
Fine Screening	Motors	Premium efficiency motors
Filtration	Pumps	Premium efficiency motors Variable speed drives

4.2.1 Coarse and Fine Screening

Wineries frequently employ coarse screening to remove coarse solids by interception using technologies such as bar racks, fixed and rotary screens, and rotary disks. Many wineries have used fixed and rotary screens to remove organics such as seeds, stems, and skins prior to downstream treatment. When removal of finer suspended solids is required, fine screens have been employed to improve effluent water quality.

Motors are used to rotate moving screens. Thus, wineries should consider the use of high efficiency motors when available.

4.2.2 Clarification

Clarification processes are used to separate suspended solids from wastewaters. Sedimentation is the most common process, although DAF is also being used where space is a consideration or where solids are easier to float (e.g., anaerobic biosolids). Some wineries have used centrifuges for removing organic solids such as seeds, stems, and skins from wastewater and suspended solids from stillage. Where effluent polishing is required, granular media or fabric filters may be used to remove finer residual suspended solids. Chemicals may be added to aid separation of colloidal material. In these cases, rapid mixing to disperse chemicals and flocculation (slow mixing) to agglomerate solids is usually provided. The removed solids require disposal.

As noted in Table 4-1, many of the processes use motors and drives for rotating equipment associated with the process equipment. Examples include mixers, chemical feed pumps, sludge collector drives, and air compressors and recirculation pumps for DAF units. Wineries should consider the use of premium efficiency motors and variable frequency drives when feasible.

4.3 Biological Treatment: Facultative Pond Systems

Faculative ponds are often used by smaller wineries to accomplish biological stabilization. The ponds provide an environment for aerobic degradation of wastewater constituents near the surface, coupled with anaerobic degradation by microbes at depth. Aerobic degradation can be accelerated by installing aerators to increase available oxygen and preclude stagnation (refer to Section 4.6.3 below).

Pond systems are sized based on the expected wastewater quality and flows coming into the pond, as well as the quality of effluent needed to match potential reuses or meet discharge requirements. Design should provide for recirculation of water to buffer intermittent loading conditions, naturally supplement oxygen to reduce needs for aeration and nutrients, accomplish efficient treatment for removal of BOD and TSS, and increase alkalinity for pH control. Ponds should also be designed with contingencies for emergencies, potential overflows, 100-year precipitation events and any applicable local regulations. One of the primary drawbacks of pond systems for larger wineries is that significant land areas must be dedicated to ponds to meet treatment objectives with reasonable detention times.

Detention times for pond treatment during various times of the year can be estimated based on the daily volume of wastewater discharged into the pond, the average BOD concentration of that water, pond size, aerator characteristics and the target BOD concentration of the pond effluent. In general, greater pond surface area results in higher surface oxygen transfer, allowing lower detention time.

4.4 Biological Treatment: Anaerobic Systems

Anaerobic biotechnology, in the form of either low-flow rate or high-flow rate systems, can reduce BOD by about 90% and TSS by about 90%. Anaerobic systems also convert about a quarter of the Total Nitrogen in wastewater to Ammonia, while reducing some of the organic nitrogen. However, if alkalinity is added during in the anaerobic treatment process, TDS may be increased. Low-rate and high-rate anaerobic system options are described below. System features are summarized for comparison on Table 4-2.

Energy is required for operating pumps, mixers, and heating anaerobic reactors. Note that more energy can be generated with anaerobic processes than required to offset process energy requirements. Wineries can use premium efficiency motors, variable speed drives, high efficiency boilers, and process controls to improve energy efficiency.

4.4.1 Low-Rate Anaerobic Option

A conceptual low-rate anaerobic process for a large winery may consist of a lined, covered reactor lagoon constructed of native or imported earth fill. The reactor would have an influent and effluent distribution system and mixers; supernatant recycling and sludge systems; process instrumentation and controls; a compressed air system; biogas handling system, including an enclosed biogas flare with flame arrestor; an HDPE liner with leak monitoring and collection capabilities to protect groundwater (any leakage that accrues is pumped back into the reactor); and a flexible, insulated geomembrane cover. Typically, the low-rate anaerobic treatment process does not require nutrient supplementation to provide alkalinity and pH neutralization; however, if needed, this can be accomplished at the influent pump station. The winery must provide a control building or portion of an existing building space to be used for this purpose.

A boiler system can be used to heat the water to improve the treatment efficiency of the anaerobic reactor. But wineries should evaluate whether there are other, more efficient ways to heat the wastewater, such as using spare hot water heater capacity or waste heat from the winery. If the influent flow to the reactor is near 80° Fahrenheit (F), the water heater and heat exchanger may not be needed at all.

A low-rate system can have a number of advantages:

- Well suited for treating winery and food and beverage wastewater.
- Simple to operate. Typically controlled and monitored with a PLC/PC system that provides a graphical, user-friendly interface, allowing optimization of the anaerobic process.
- Efficient, reliable and robust. Designed to cope with peak organic and hydraulic loading conditions, given the long hydraulic and solids retention times.
- Provides consistently high performance and efficient removal of chemical oxygen demand (COD), BOD and TSS.
- Can accept high TSS concentrations and spikes without the need for extensive pretreatment, with the exception of course screening.
- Operation and maintenance costs are comparatively lower than for other anaerobic and aerobic systems.
- Can achieve high performance at less-than-optimum anaerobic operating temperatures because it is a low loaded system with a large inventory of biomass.
- The geomembrane cover and biogas handling system minimize the potential for release of objectionable odors.
- Sludge production is minimal due to the high solids retention time. Depending on reactor size, sludge wasting may not need to begin until several years after installation, continuing once or twice per year thereafter. Sludge is typically taken directly from the reactor to tanker trucks for land disposal, composting, or other disposal. With sufficient sludge storage capacity, sludge wasting need only take place when it is most desirable to do so.
- Sludge is relatively thick and very stable. It makes an excellent soil conditioner and amendment if used for land application.

- Provides an opportunity to capture and utilize biogas for hot water heaters or boilers in the winery or to heat process influent to provide improved reactor stability and performance or to generate electricity.

4.4.2 High-Rate Anaerobic Option

A conceptual high-rate anaerobic system for a large winery may consist of covered concrete reactors or tanks that treat winery wastewater biologically at a relatively high rate using a type of fluidized biofilm bed or sludge blanket. The reactors are placed on a structural foundation.

High-rate systems typically require a mechanical pre-treatment screening process. They generally come complete with an influent and effluent distribution system; supernatant recycle and sludge systems; a chemical addition system; process instrumentation and controls; compressed air system; an influent wastewater heating system; and a biogas handling system including an enclosed biogas flare with flame arrestor. A control building or portion of an existing building space is needed for system control.

The high rate anaerobic treatment process may require some nutrient supplementation and alkalinity addition for pH control. If spent alkaline cleaning compounds can be recovered from the winery, they can be reused for this purpose. Alkalinity or pH control is typically accomplished in a preconditioning tank upstream of the reactors. It may be necessary to include a heating system to bring the influent process water up to near 90° F. To maximize efficiency, wineries should assess their existing process water heating options, such as using spare boiler capacity or available waste heat.

A high-rate system has a number of advantages, including:

- Well suited for treating winery, and food and beverage wastewaters.
- Relatively simple to operate. Typically controlled and monitored with a PLC/PC system that provides a graphical, user-friendly interface, allowing optimization of the anaerobic process.
- Efficient, reliable, and can accept peak organic and hydraulic loading conditions if upstream equalization is integrated.
- Provides consistently high performance and efficient removal of COD, BOD and TSS.
- Can treat wastewater at high applied organic loading rates.
- Can accept moderate TSS concentrations and spikes without the need for extensive pretreatment, with the exception of course screening.
- The cover on the reactors seals biogas from the atmosphere, and coupled with the biogas handling system, will minimize potentially objectionable odors.
- Anaerobic solids in the effluent cab be collected and further stabilized in a downstream aerobic treatment system.
- Provides an opportunity to capture and utilize biogas for hot water heaters or boilers in the winery or to heat process influent to provide improved reactor stability and performance.
- Occupies a relatively small footprint compared with a low-rate system.
- A two-compartment or tank high-rate system provides flexibility for optimal management during crush, and offers redundancy during the non-crush season.
- High-rate reactors are modular and conducive to expansion with additional reactors if wastewater volume rises in the future.

4.4.3 Comparison of Anaerobic Options

In selecting an anaerobic system, wineries should examine the various trade-offs between high- and low-rate systems. The low-rate system offers greater treatment volume and is considered less complex than a high-rate system. A high-rate system requires only a small fraction of the site area required by the low-rate system, potentially reserving space for integration of additional reactors in the future, if necessary to treat increased flows. Estimated costs of the two systems can be comparable, but high-rate systems are usually more costly. Regardless of the selection, bench testing is recommended to optimize the anaerobic system and overall biological treatment process. Low-rate and high-rate system characteristics for anaerobic treatment of winery wastewater are compared in Table 4-2.

Table 4-2: Comparison of Low- and High-rate Anaerobic System Characteristics

Criteria	Low-Rate Process	High-Rate Process
Construction Area	Larger than high-rate	~10% of low-rate
Reactor Volume	Larger than high-rate	~3% of low-rate
Method of Containment	▪ Liner system ▪ Earth berms	▪ Concrete or tank reactors ▪ Leak containment wall
Equalization and Preconditioning Tanks	Not required	Required
Alkalinity and pH Adjustment	Unlikely to be needed	May be required
Estimated Renewable Energy Generated	Equal to high-rate	Equal to low-rate
Operation Requirements	▪ Simple to operate ▪ O&M costs lower than high-rate system	▪ Relatively simple to operate ▪ More complex than low-rate ▪ One full-time operator required (single shift)
Estimated O&M Annual Cost	~75% of high-rate	Higher than low-rate
Estimated Annual Biogas Capture Credit	Equal to high-rate	Equal to low-rate
Influent Heating System	▪ May not be required if temp is near 80° F ▪ Could be added in the future, if warranted	▪ Requires heating influent to near 90° F
Operational Flexibility	▪ Minimal, one compartment	▪ More than low-rate, dual compartments
Potential For Future Expansion	▪ May be limited by large footprint	▪ Additional reactors could be installed

4.4.4 BioGas Handling and Energy Recovery

A by-product of anaerobic digestion of wastewater is biogas containing methane. Biogas can be captured and recovered for potential reuse as a supplemental fuel source for the winery, or if necessary, used to power hot water heaters/exchangers that raise the temperature of wastewater entering the anaerobic reactor(s) to optimize the treatment process.

Excess biogas that is not used by the winery can be managed by a biogas handling system equipped with an enclosed flare with a flame arrestor. The flare will need to be permitted and operated in compliance with local air quality requirements. Of the biogas components (which will primarily include methane and carbon dioxide, and minor amounts of hydrogen sulfide and ammonia), hydrogen sulfide is the main compliance concern. Concentrations could exceed health-based concentrations and produce objectionable odors. As a result, the biogas handling system and flare will need to be managed appropriately to preclude odors.

To recover and reuse the biogas as a supplemental fuel source that is of sufficient quality for a specific end use, it may be necessary to include a gas treatment and polishing system, such as a scrubber. The actual amount and quality of biogas generated from the anaerobic process may vary depending on the type of system (high-rate or low-rate) installed. But it should be possible to develop an estimate of biogas generation and energy value (from offsetting electricity or natural gas purchases) for a specific proposed treatment option in order to assess the cost/benefit potential. Either flaring or reusing biogas is an important step to mitigate the greenhouse gas effects of the methane component, which is 23 times more powerful as a greenhouse gas than CO2. When biogas methane is combusted, it releases carbon monoxide as a by-product, which quickly and readily combines with oxygen to create CO2.

In some states, capture and reuse of biogas from anaerobic processes will qualify for renewable energy incentives or rebates that help to offset the cost of the treatment system. For example, in California, PG&E representatives indicated that rebates for a large project of this type could be as much as $150,000 to $300,000, and the California Public Utilities Commission offers incentives to customers who produce electricity with microturbines, gas turbines, wind turbines, photovoltaics, fuel cells and internal combustion engines; payments can range from $1 per watt to $4.50 per watt for renewables, depending on the type of system. In addition, many states, including California, offer net metering incentives that pay the customer the retail rate for generated electricity.

4.5 Biological Treatment: Aerobic Systems

Aerobic treatment systems are widely used to provide pretreatment for reuse, land application or discharge to a POTW. They are also used in sequence with an anaerobic system to oxidize or polish effluent to meet water quality goals for reuse. Aerated treatment processes include aerobic and facultative ponds; activated sludge, suspended growth aeration tanks; fixed film contactors of sessil fabrics; random or sheet packing, suspended growth contactors; hybrid fixed film, suspended growth contactors; and combinations of these options (Ryder, 2006). Multi-stage pond systems can often achieve BOD removal greater than 99 percent with little or no need for addition of chemicals for pH control, nutrients (aqua ammonia addition or salts) or supplemental bacteria. When pond systems are well designed and managed, they are much less likely to be a source of objectionable odors.

A multi-compartment pond approach provides a staged treatment process that is economical, flexible, effective, low maintenance and easy to operate. The basic reaction that occurs in aeration ponds is removal and biological stabilization of residual organic matter by aerobic bacteria that grow in the ponds and remain in suspension. The ponds can also facilitate nitrification if sufficient aeration is provided. The oxygen source for metabolizing carbonaceous material and for nitrification is generated by pond aerators.

If an upstream anaerobic process is used to pre-treat and remove organics, aerobic biotechnology can reduce the remaining BOD and TSS by more than 90 percent. The remaining Total Nitrogen can be reduced by up to approximately 50 percent via incorporation in cell biomass and settling out. Nitrogen that remains can be converted to nitrate, although less nitrogen will be incorporated into cell mass. Some alkalinity will be consumed during nitrification. Removal of organics prior to aerobic treatment also translates to a decrease in the aeration required for the ponds, which reduces both capital and operating costs. As with the anaerobic process, aerobic treatment can be accomplished utilizing different approaches such as aeration ponds, sequence batch reactors (SBRs), extended aeration, or activated sludge. Package plants are also available.

A well designed aeration system for aerobic pond treatment of winery wastewater will prevent formation of nuisance sulfurous odors that would otherwise occur in a relatively short period of time, on the order of a few hours to a day. This can be attributable to the relatively high concentration of sulfate in the water supply of many wineries, sulfites used for disinfectants, and the high concentrations of organic materials in the wastewater or sludge deposits.

Wastewater regulations in some states specify a minimum dissolved oxygen concentration in ponds. In California, for example, where air quality and odor emissions are strictly regulated, a pond operator must maintain a minimum dissolved oxygen concentration of 2 mg/l within the top two feet of a winery pond surface and a sulfide concentration of less than 1 mg/l. Typically, activated sludge processes in aeration tanks have optimal dissolved oxygen concentrations of about 2 mg/l (Tekippe 1998). It is generally considered unnecessary to maintain dissolved oxygen concentrations much above 2 mg/l to obtain efficient aerobic biological treatment.

Typically, aeration is accomplished with mechanical or diffused aeration devices that have varying oxygen transfer efficiencies and mixing abilities. Dissolved oxygen transfer efficiency is affected by temperature, elevation, salinity, aerator dispersion characteristics, flux between dissolved oxygen saturation and actual concentration. Typical actual oxygen transfer rates (AOR) are in the range of 50 to 75% of the standard oxygen transfer rate (SOR) or theoretical transfer rates.

Considering that the wastewater flows and the organic loading that result in biological oxygen demand can be highly irregular diurnally, weekly and seasonally, it can be challenging to design a cost-effective, energy efficient aeration system. This is particularly true in view of the fact that the costs of electric energy have increased by a factor of two to three times in the past ten years, and further energy cost increases are reasonably certain. To meet stringent regulations for nuisance odor control and management of wastewater applied to land disposal sites, real-time monitoring and control of dissolved oxygen is often required. A detailed discussion of aerator system design is provided in Appendix F.

4.6 Membrane Treatment Processes

Reverse osmosis (RO) and nanofiltration (NF) are two membrane processes most likely to be used to remove salt from winery wastewaters. These processes require significant pretreatment and would be added after biological treatment and effluent polishing. In addition, the RO and NF membranes are subject to fouling and frequent cleaning of the membranes is required. Relatively high operating pressures (typically 200 to 600 psig) are required to overcome the osmotic pressure and force clean water through a semi-permeable membrane, leaving the salt in a concentrated brine stream that may be 15 to 50 percent of the feed stream that will require disposal.

Pumping is the primary energy use for RO and NF systems. If these systems are used, wineries should consider the use of premium efficiency motors, variable speed drives, and energy recovery devices.

4.7 Evaporative Processes

Mechanical or solar evaporation (in shallow ponds) may be used for desalting winery wastewaters or reducing the volume of brines generated by ion exchange or membrane processes. Solar evaporation is contingent on the availability of sufficient land and favorable weather conditions. Mechanical evaporators usually have high energy costs. The pond systems themselves tend to be expensive because they must be double-lined and monitored to guard against leaks. The residual brine or cake that accrues in the ponds must be periodically removed, which can pose a disposal issue.

4.8 Solids Handling

Many of the wastewater treatment processes produce residuals that require disposal. Requirements for residuals disposal should be included in selection of site-specific treatment facilities. Some materials such as coarse odors and screenings may be disposed on site unless regulations require off-site disposal on these wastes.

4.8.1 Biosolids Handling

Anaerobic and aerobic biological processes both produce biosolids. In low-rate anaerobic systems, sludge is minimal due to the high solids retention time of the reactor. Sludge wasting will not need to begin until several years after installation. After this time, sludge wasting will occur once or twice per year directly from the reactor to tanker trucks for land disposal, composting, or other disposal method. There is sufficient sludge storage capacity such that sludge wasting need only take place when it is most desirable to do so. The waste sludge will be relatively thick and very stable, and will make an excellent soil conditioner and amendment if used for land application. If a high-rate anaerobic system is used, the anaerobic biosolids will be collected and further stabilized in the downstream aerobic treatment system.

Aerobic biosolids (including anaerobic solids from a high-rate anaerobic digester, if applicable) can accumulate at the bottom of aerobic pond treatment systems, and will need to be removed approximately every 5 to 10 years. Again, these biosolids can be utilized as a soil amendment or disposed of offsite at an additional cost. If high-rate or package aerobic systems are used, the aerobic solids and residuals will require careful management to control odors. Because the aerobic biosolids are still active and unstable, they have the potential to produce highly offensive odors in a short period of time. Solids or sludge stabilization processes such as the addition of iron salts to precipitate sulfides or lime to elevate pH are often needed to control odors prior to disposal.

4.9 Off-Site Disposal

For smaller wineries and/or those where there is no access to a city sewer or site conditions are not conducive to land application, storing and hauling wastewater to an offsite treatment facility may be a last-resort option. For example, in Northern California, the East Bay Municipal Utilities District (EBMUD) treatment facility in Oakland accepts high-strength wastewater from wineries and food processors.

Larger wineries may find that offsite disposal is an economically viable option for certain concentrated waste streams that have been segregated from the bulk flow, such water softener regenerant. The cost of hauling this waste may be significantly less than installing equipment necessary to treat it onsite.