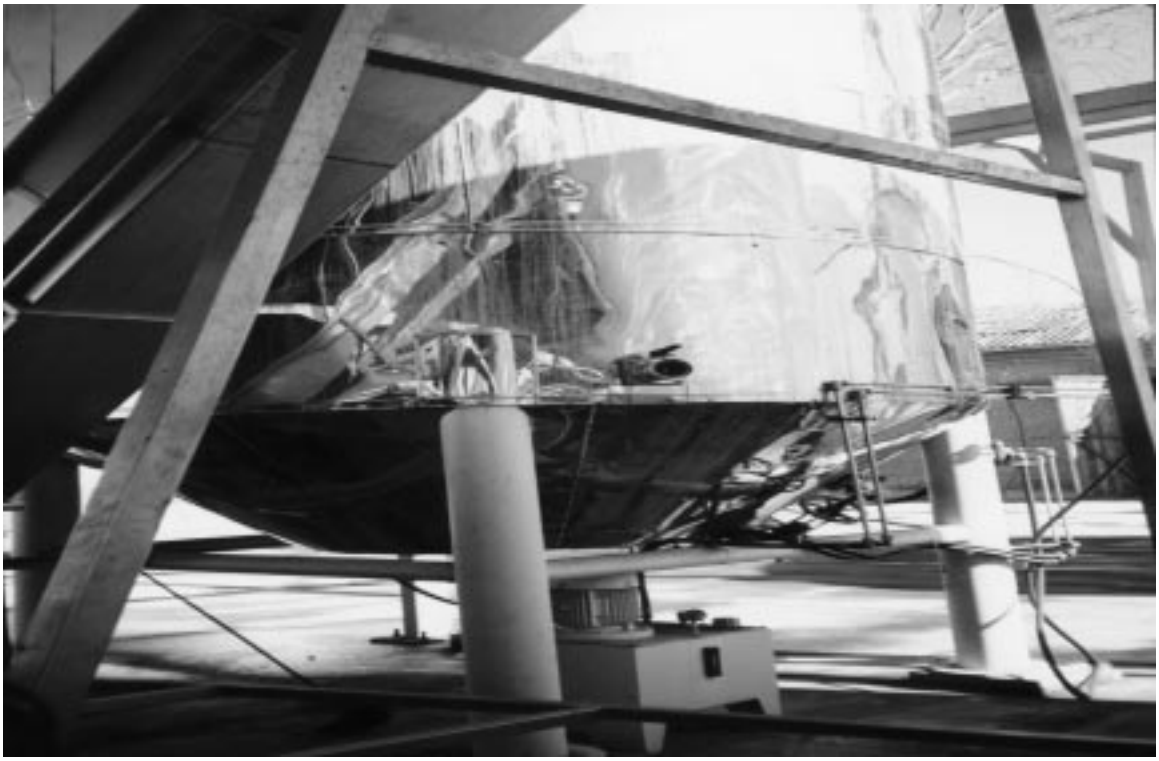
POLLUTION PREVENTION FOR THE WINE INDUSTRY



Disclaimer

This manual contains information about technology, equipment, and operating practices that are available to the wine industry, and which have environmental advantages. However, not every technology is appropriate to every facility. In addition, mention of brand names is not an endorsement of that brand, but is used to provide examples of types of technologies or approaches..

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INDUSTRY PROFILE

Overview of Current Practices And Technologies

Wine production is commonly regarded as much as an art as a science. Typical steps for winemakeing are shown in Figure 1. Steps marked with an asterisk are those for which pollution prevention options are provided in this manual or referred to in Appendix A.

Materials Used

Sumac Ridge Winery in California , reports that there are between 200 and 300 grapes in a bottle of wine. From one ton of grapes, approximately 720 bottles of wine

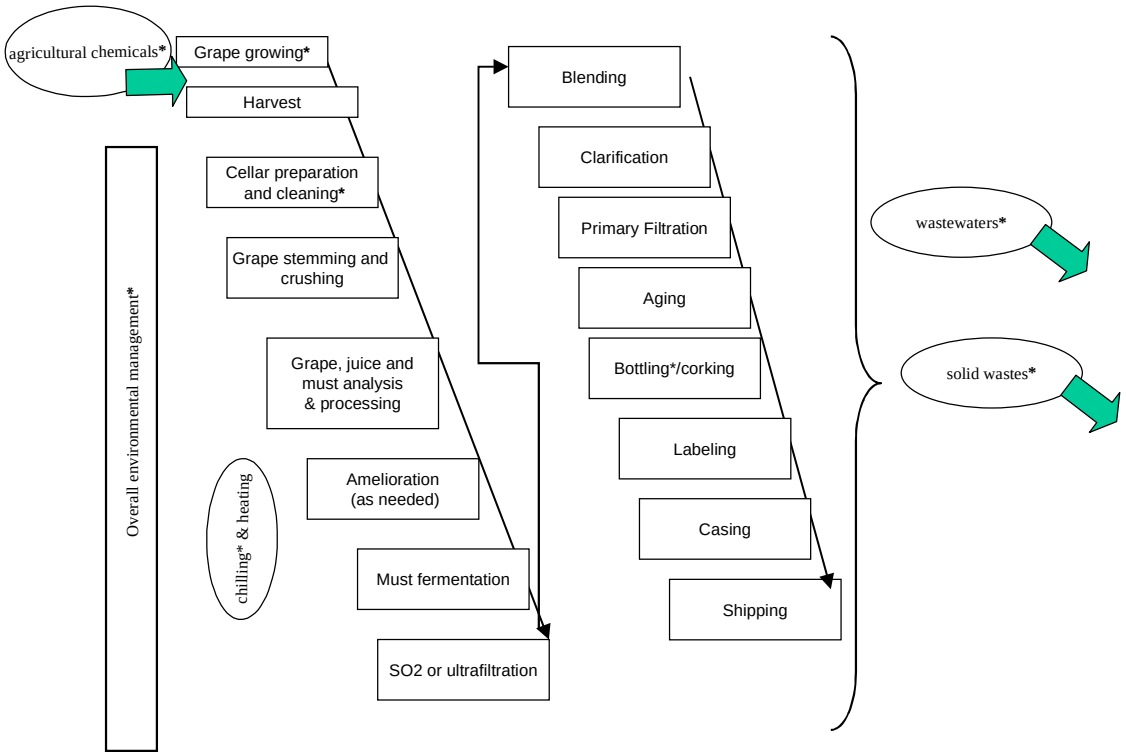

Figure 1: Typical Steps for Winemaking.

can be made. A 225 L wooden barrel will hold enough wine to fill 300 750ml bottles of wine, which is equivalent to 25 cases of wine.[1]

It takes an average of 30 to 150 L of water to vinify 100 L of must (unfermented grape juice).

Winemaking requires a variety of additional materials beyond the grapes. Sulfur dioxide is often added to grape must to inhibit wild yeast and control microorganisms such as bacteria and mold. Sumac Ridge reports, however, that they use almost no additional chemicals. They add cultured yeast to start fermentation and just before bottling and they adjust the free sulfur-to-molecular-weight to reduce oxidation.

Air Emissions

Fermentation of the grape juice produces a host of atmospheric emissions, aside from carbon dioxide, including amyl alcohol, n-propanol, iso-butanol and a variety of esters. Wine tanks can be open or closed, and in both cases, must is protected from atmospheric oxygen by a CO_2 blanket.

Water

Water is used to clean and sterilize winery equipment (washdown water) and sometimes as a coolant. A closed system is desirable when possible.[2]

Sumac Ridge Winery says that all wine tanks and barrels must be thoroughly cleaned after holding each vintage. Hot water and/or steam cleaning helps prevent future spoilage.[3]

Champagne makers have calculated that the vinification of 1 liter of white wine must generates the same amount of daily water pollution as 3 people.[4]

[1] http://www.sumacridge.com/

[2] http://www.latinsynergy.org/environmental-impact.htm

[3] http://www.sumacridge.com/

[4] http://www.burgundy-today.com/october-november/pollution.htm

POLLUTION PREVENTION

Overview

Pollution prevention (P2) refers to the systematic use of products and industrial processes designed from their inception to prevent the pollution of air, water, and land, and to reduce wastes, to minimize risks to the environment and to humans, and to make an efficient use of raw materials, such as energy and water. P2 means the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and the environment

P2 looks at the following options, with the first being the most preferred[5]:

- Identify less polluting materials that can be substituted in the process
- Use the existing materials in ways that create less waste/emissions
- Recycle or reuse the waste/emissions on-site
- Recycle or reuse the waste/emissions offsite
- Safely dispose of unavoidable wastes

P2 includes process modification, raw material substitution, product and administrative development, in order to minimize the resource use, the quantity of wastes generated, and their content of environmentally harmful substances, as well as to adapt the products and the wastes for increased re-circulation.

Examples of typical P2 activities and goals are provided by the State of California in the US. The California Bay Area Green Business Program has established a set of goals for "green businesses". Businesses are certified as "green" if they do the following:

- Monitor, record, and post rates of water and energy usage and hazardous and solid waste generation.
- Provide ongoing incentives and training for management and employees to participate in the Green Business program
- Inform customers about environmental efforts
- Introduce other businesses to the importance of the Green Business program
- Demonstrate a 25% reduction in hazardous materials usage.

[5] These follow the "waste reduction hierarchy" established by the U.S. Environmental Protection Agency. For more details see the U.S. EPA's 1997 Pollution Prevention Report at http://www.epa.gov/opptintr/p2_97/.

- Demonstrate a 15% annual reduction in water usage
- Demonstrate a 25% reduction in solid waste
- Reduce energy usage by 15% annually.

Pollution Prevention Assessments

Facilities that are investigating pollution prevention often conduct systematic pollution prevention assessments. These assessments have the principal objective of improving the environmental performance of a facility by identifying points where emissions are being generated, including solid waste, hazardous waste, liquid waste, water, air emissions, and hazardous air emissions, and finding ways to reduce those emissions. Each of these waste streams represents points of inefficiency in the process.

In addition, the pollution prevention assessment considers improvements in energy efficiency. Energy efficiency can be a strong cost driver for a facility. Where fossil fuels are used, energy is associated with emissions. Where hydroelectric power is used, energy usage can be associated with disruption of natural rivers and ecosystems.

By finding ways to decrease emissions, pollution, and waste, the P2 assessment can help a facility save money and be more efficient.

Worker protection is also of concern in a P2 assessment, since worker safety is often affected by plant emissions. Worker safety is a financial concern to companies as well as a social concern, since an injured or disabled worker is temporarily or permanently non-productive and therefore a replacement will need to be trained. In addition, there may be medical bills incurred. Finally, it is our experience that there is lower employee turnover in facilities that are safer.

The issue of accident protection is also considered in a P2 assessment, since accidents like explosions and fires are a serious, although infrequent, environmental performance problem in industrial facilities.

Barriers to and Drivers for Pollution Prevention[6]

P2 barriers that are internal to a facility include:

- A lack of information and expertise
- A low awareness of environmental issues
- Financial obstacles.

[6] Barriers and Motivators to the Adoption of Cleaner Production Practices, by Neil Cunningham, Darren Sinclair, and Patricia Burritt, Australian Centre for Environmental Law, Australian National University, 1997. http://www.erin.gov.au/portfolio/epg/environet/ncpd/pubs/ncpcsd_reports.html

- Lack of communication in firms
- Management inertia
- Labor force obstacles
- Difficulty in implementing cleaner technology.

Barriers external to a facility include:

- Difficulty in accessing external finance for pollution prevention projects
- Improper economic incentives
- An absence of markets for recycled goods
- Economic cycles.

Internal drivers (motives) for pollution prevention include:

- Environmental management systems and continuous improvement
- Voluntary initiatives
- Environmental leadership
- Corporate environmental reports
- Environmental accounting
- Improvements in productivity.

External drivers for pollution prevention include:

- Innovative regulation and pollution prevention
- Negotiated self-regulation
- Economic incentives
- Industry codes of practice (like the Chemical Manufacturers' Association Responsible Care program)
- Education and training
- Industry networking
- Buyer supplier relations
- Financial institutions
- Community perceptions and involvement
- Environmental auditors
- Green consumers
- Increased access to international markets

Comparison of Pollution Prevention to Conventional "End-of-Pipe" Environmental Solutions

End-of-pipe treatment and control solutions are curative:

- They apply changes in the industrial process just before a pollutant would have entered the environment.
- They include such activities as water treatment plants and waste facilities.
- Pollutants and wastes may thus simply be collected, stored, or disposed of elsewhere.
- They involve technological response to environmental pollution, requiring little change in management, direction, or the actual manufacturing process.
- To date, end-of-pipe methods have been the predominant industry response to environmental improvement.

Pollution prevention is a preventative approach: It is a management process that seeks out and eliminates the causes of pollution, waste generation and

resource consumption at their source. P2 uses materials input reduction or substitution, pollution prevention, internal recycling and more efficient production technology and processes. P2 requires shift in management culture, from the board room to the shop floor, away from reactive solutions towards an integrated approach where environmental considerations form a central component of the decision making process. Finally, P2 emphasizes a systems based approach to environmental management in addition to the purchase of new technologies.

Environmental benefits of P2 include:

- Avoidance or reduction of the amount of waste produced;
- A reduction in the use and production of toxic materials;
- A more efficient use of energy and resources;
- The prevention of pollution at its source; and
- The production of environmentally sound products and services.

Competitiveness benefits that may accrue to industry include:

- Improvements in productivity
- Savings on energy and raw materials;
- Decreased storage requirements for waste and toxic materials;
- Decreased liability and accident potential
- Savings on pollution control expenditure;
- A focus on continuous improvement;
- An improved public profile.

STEPS FOR POLLUTION PREVENTION IN WINE PRODUCTION

Pollution Prevention in Grape Growing

General

Grape growing issues include soil management, water use in irrigation, and use of pesticides, herbicides and fertilizers.

The two main issues of concern relating to soil care are erosion prevention measures (cultivation of cover crops, plantation of vegetation along the roadside), and soil management (mulching and composting) to conserve soil fertility.

P2 measures for grape growing can involve substituting less-harmful pesticides, herbicides and fungicides for more toxic or environmentally persistent ones. Specific alternatives for vineyard fungicides are discussed in the next section of this manual. Organic farming eliminates the use of these chemicals entirely and promotes healthy crops through healthy soils, conserving the soils for future uses. The Fetzer Vineyards in California has a public goal of using 100% organically grown grapes in its wines by 2000.

A good source of P2 for grape growing is the Northwest Berry and Grape Information Net at http://osu.orst.edu/dept/infonet/. This site has useful links, factsheets, and online information related to crop management, pest management, irrigation, soils and plant nutrition, and other related topics.

Fungal Control

Fungal diseases have been a particular problem for the wine industry, Most fungal pests can build up a resistance to chemical treatments within a few years. Resistance requires growers to alternate attack strategies regularly. Many of attack strategies are environmentally suspect and have been known to interfere with yeast activity. The following is a review of some of environmental sound products for fungal control:

- AQ10: This product, developed by Ecogen Inc., is promoted as the first-ever bio-fungicide. The active ingredient, Ampelomyces quisqualis (AQ) in heavy concentration, is itself a fungus. Live AQ spores exist naturally in vineyards and feed

on Oidium tuckerii, the fungus responsible for powdery mildew. Thorough applications of AQ10 by itself have proven effective, it may also be used in conjunction with the traditional standby of sulfur as well as chemical sterol inhibitors (products which affect fungus cell membranes) developed in the 1980s. AQ10 is the only California Certified Organic Farmer (CCOF) approved fungicide currently on the market and is regarded as a worthwhile component of a vineyard Integrated Pest Management (IPM) program. Tests have shown no adverse effects on grapes or fermentation, and the product can be applied up to and including the day of harvest.

- Abound: The active ingredient in this Zeneca Inc. fungicide is azoxystrobin, a chemical derived from naturally occurring fungicides found in certain mushrooms. The product was granted U.S. EPA approval for use against powdery mildew, downy mildew, black rot and phomopsis in grapes. The EPA registered Abound as a reduced-risk pesticide because of its favorable toxicological and environmental profiles. It proved extremely effective at controlling powdery mildew when used in conjunction with the sterol inhibitor Rubigan. Abound has been commercially available in Europe since the spring of 1996. Studies conducted in European vineyards over a two-year period showed that even a late-season application is no threat to fermentation. Abound chemically breaks down into low levels of carbon dioxide.

- Vigor-Cal: This CCOF-certified product, developed Agro-K, is not a fungicide but a nutritive calcium supplement which helps vines build up a systemic resistance to fungal infection. It is easily absorbed through the leaves of the vine helping to maintain beneficial calcium. Studies conducted using Vigor-Cal in conjunction with sterol inhibiting fungicides have shown the combination to reduce the incidence of fungal infection by as much as 50 percent over fungicide alone.

- Elexa: This product, developed by IGG International Inc. (IGGI), is not a fungicide, but works on the principle of systemic activated resistance to boost a plant's natural fungus defense system. The active ingredient in Elexa is a carbohydrate molecule which creates a seal at the receptor site of fungal infection. Carbohydrate chemistry is regarded as biologically safe, and Elexa has already been recognized by the U.S. EPA as a safe compound. IGGI expects EPA approval by late

September and plans to have Elexa on the market within a year.

- Adcon weather network disease forecasting system, which constantly monitors disease factors in the vineyard and transmits information via radio telemetry and modem to provide growers with an updated disease index. The system, now in place in over 300 vineyards, allows growers to time treatments so that fungicides are as effective as possible.

Manufacturer contact information for these fungicide systems is available through the California Environmental Protection Agency Department of Pesticide Regulation web site, located at http://www.cdpr.ca.gov/docs/label/prodnam.htm

Changes for Pollution Prevention in Wineries

Energy Conservation

There are many opportunities for energy efficiency in the winemaking process. Winemaking can require significant energy inputs from crushing the grapes, pressing the must and filtering the juice, to the cooling/heating of fermentation tanks, and the bottling of the wine. Typical energy costs for US wineries are about $0.50 per case of wine produced.[7]

The Bay Area (California) Green Business Program recommends that wineries assess their energy usage by tracking usage, and posting energy usage rates for employees to see. Resulting reductions in energy usage are expected to result from changes in employee behavior.

The Beaulieu Vineyard re-scheduled the use of its process cooling equipment so that it is used in the evenings, when ambient temperatures are cooler. In cooler ambient temperatures, the cooling equipment does not need to run as long to achieve the same cooling effect. The facility reports that this shift has resulted in a 20% reduction in energy use.

Hot water used for sterilization in bottling can be used again for other activities that require hot water, like cleaning operations. This saves energy, as the second use of water does not need to be independently heated. It also offers savings on water usage, and reduces the quantity of wastewater generated.

Cline Cellars, a US winery, is trying a geothermal heat pump, a cost-effective way to keep wine at a constant temperature. The

[7]Winery Eco-Efficiency Assessment Guide, Business for Social Responsibility Education Fund, 1998. http://www.bsr.org

heating cycle starts as the cold refrigerant passes through a heat exchanger and absorbs heat from the low-temperature source. In the cooling cycle, the cool fluid from the earth absorbs heat from the building and transfers it to the ground. The winery has stated that it would make sense for a winery to use the system because it can reduce power usage by 50 to 60 percent. What makes the system so efficient is that it moves heat, as opposed to generating it by burning fossil fuels or burning energy. Most wineries have existing ponds or a reservoir system to process waste water, so installation of the system is less costly because ponds can be modified into the "heat sink;" this subtracts the step of digging into the earth to establish the heat sink. Also, additional service and maintenance costs associated with using a traditional air conditioning system may be eliminated. This system may be an effective way to heat and cool buildings more economically and add more sustainability.

The Fetzer wine company has published its goal to reduce power usage 50% by 2005, and become 100% solar powered by 2015. They have incorporated these goals in their administrative operations; their administrative building uses passive and active solar heating and is designed to maximize natural lighting.

Office operations are an often-overlooked source of energy savings, particularly if the operations are occurring in older buildings that were not designed with energy efficiency in mind. Simple measures include adding building insulation, reducing air leaks through window and door frames, employees' awareness of energy costs and having them shut off lights and office equipment when not in use.

Substitutes for Restricted Ozone Depleting Refrigerants in Chillers

Conventional chillers for wineries often use Freon (an ozone-depleting chlorofluorocarbon or "CFC") in their refrigeration system. Since the phaseout of Freon production under the Montreal Protocol[8], prices for the coolant have risen sharply.

Alternatives for freon refrigerants are hydrochlorofluorocarbons (HCFC/HFC) and hydrocarbon (HC) refrigerants. Each of these technologies can be relatively easily installed in existing systems. Overall, it seems that hydrocarbon refrigerants may be a more favorable option than HCFCs because 1) production of HCFCs are also scheduled for production phase-out under the international ozone protection treaty. In addition, HFCs, like the DuPont product HFC-134a, has a global warming potential (GWP)

[8]Montreal Protocol. Text of agreement available electronically at http://www.unep.ch/ozone/

150 times that of HCs. For an example of the HC product, see Oz Technology http://www.dmi.net/ozone-safe/index.htm. A second HC product is Duracool, and information is available from Bob Small, General Manager, Duracool Limited duracool@compusmart.ab.ca.

Reducing Bottling Losses

Minimizing rejects from the bottling line is an important part of pollution prevention for the wine industry. For instance, a bottling plant in Australia found that it was generating a great deal of waste and losing money because of 4 problems with beverage bottling[9]:

- Faulty materials were entering the plant and being used;
- Damaged materials were passing down the line to the next operation;
- There were design problems with some conveyor systems;
- Staff did not know what levels of wastage were occurring and what levels were acceptable.

The waste problem was significantly reduced by the following steps:

- Damaged raw materials are now rejected. Problems are discussed with suppliers, leading to better relationships and less damaged material. Lines are shut down immediately to fix a problem rather than allowing faulty production to continue.
- Information about damage is passed back to the previous step in the operation so that the problem can be avoided in the future.
- Changes have been made to packaging lines including rerouting conveyors and altering platform access.
- Progress is graphed and displayed on notice boards around the plant, as shown in the following figure. This gives staff an incentive to maintain improvements and gives them "ownership" of the achievements.

The Napa Valley, California, winery, Domaine Chandon, is making efforts to re-use excess wine bottles from its bottling operations, rather than just recycling them. The company has received a Waste Reduction Award from the State of California for its efforts in this and its efforts to redesign packaging to reduce use of non-renewable resources. Domaine Chandon helped design and is now using new individual bottle shipping cartons featuring a custom-

[9] Profile of DB Breweries, available on the Enviro$ense web site http://es.epa.gov/techinfo/facts/newz-cs3.html.

formed starch based cushioning material. This material is made from corn and is reusable and biodegradable, as opposed to the petroleum-based plastic cushioning which it replaced.

Inventory Control

An investigation into eco-efficiency at the Sutter Home winery found that an investment of $43,000 in a computer-managed inventory control system could yield annual savings of $76,000.[10] The savings resulted from using the system to reduce the need for chillers during peak electrical times, improving use of storage facilities, and reducing the number of cold-storage tanks that are needed. An example of computer managed inventory control systems provided by L & J Engineering can be found at http://ljtechnologies.com/ljcomp.htm

Reduction of Wastewater

Wastewater is an important P2 opportunity for wineries. Production rates vary based on individual conditions: for instance one large US winery predicted that it would generate 5.328 liters wastewater per liter of production, while a similarly large winery claimed to produce only 1.868 liters wastewater per liter production. Regardless of current rates of wastewater, all wineries should review this area for potential reductions.

For the wine industry, maintenance to prevent water losses is of particular environmental importance. A schedule of preventative maintenance for hoses, tanks, and bottle washing apparatus is a low-cost way to prevent water waste. Even small leaks can waste large quantities of water. This is of particular concern in times when there are potential water shortages due to inadequate precipitation. The Bay Area California Green Business Wineries program recommends the following simple conservation measures:

- Regularly check for and repair all leaks.
- Monitor water usage monthly: unusual water usage can be an early indicator of maintenance needs.
- Properly maintain irrigation systems, including repairing all broken/defective lines, emitters or sprinkler heads; adjusting sprinklers for proper coverage; adjusting irrigation times and durations according to seasons.
- Save the rinse water from the final rinse of tanks for reuse; use recycled water for the first rinse of tanks.

[10] Reference to this evaluation is found in the Winery Eco Efficiency Guide. The winery ultimately chose not to implement the inventory control option..

- Use high-pressure, low volume cleaning equipment for water cleaning.

- Use mops and buckets rather than hoses for cleaning floors.

- Document all clean-up policies, including water conservation cleaning measures.

Process Efficiency

Improved process efficiency, including efficient use of materials, is part of P2 considerations for any facility. The reported grape consumption at four US wineries, shown in Table 1, can provide a general indication of ranges of grape consumption:

Preventative maintenance of tanks and other equipment is also an important P2 strategy. Equipment failure often produces excess waste and off-specification product as well as having negative effects on production and efficiency.[11]

Innovations in process equipment may also provide P2 opportunities, if they are more efficient in materials use, energy use, or if they reduce emissions to the environment. The following web sites provide information on winemaking equipment.

[11]For an excellent discussion of preventative maintenance, see Industrial Pollution Prevention Handbook, Harry M. Freeman, editor. McGraw-Hill, Inc. 1995.

http://smartwine .com/wbm/1996/1912/BM129652. html Reviews information on new products, including:

- Tank top plate assemblies produced by G&H that combine all tank top equipment, including pressure and level transmitters, anti-vacuum and pressure relief valves, gas or CIP valves and sight units into one custom fabricated unit. With the top plate, only one cut for the counterflange need be made, eliminating the increased cost, time and sanitation threats separate cutouts introduced for individual fittings.

- Lightweight Linerboard by International Paper. Lightweight linerboard offers higher brightness, uniform coverage, and consistent ink holdout.

http://smartwine.com/wbm/1997/9701/bma9714.html Sitevinitech offers descriptions and contact information for the following wine production tools:

- Software package designed to manage wine growing and winemaking operations

- Automated system for cleaning grape harvesters

- Combined high temperature and vacuum unit to increase color extraction.

http://smartwine.com/wbm/1997/9704/bmd 9745.html Lists tip from the seminar "Innovative Techniques in Red Wine Fermentation." The seminar was taught by wine makers who addressed practices like rack and return, maceration, rotary fermenters vs. static fermenters, oak vs. stainless steel tanks and effects on temperature and wine quality, and philosophy of red wine fermentation in terms of extraction.

Table 1: Grape Usage Reported by California Wineries[12]

Name	Production (liters/year)	Grapes used (kg/year)	kg grapes/liter
Beaulieu Vineyard	~5,400,000	~9,091,000	~1.68
Frog's Leap	405,000	727,000	1.80
Korbel	14,850,000	~9,091,000	~0.61
Sutter Home	63,000,000	~96,364,000	~1.53

[12] Winery Eco-Efficiency Assessment Guide, Business for Social Responsibility Education Fund, 1998. http://www.bsr.org.

STRATEGIES FOR TREATMENT AND DISPOSAL

Reduction of waste is the most environmentally preferable and efficient option, followed by reuse and then recycling. But for the wastes that are unavoidable, or that the facility has not yet addressed, good disposal is very important to protect the environment. Wineries and agricultural industries have a long-term interest in the health of the environment because they directly rely on using the environment.

Management of Wastewater

One of the major problems in the operation of wineries is disposing of large quantities of comparatively low solids wastewater containing a medium to high content of biochemical oxygen demand (BOD). Researchers at University of California, Davis, noted problems with winery wastewater including acidity (pH levels from about 3.5 to 6.5, compared to pH levels of 5-7 in municipal waste waters), high levels of organic materials and nutrients (at least 17,000 PPM BOD5 compared to 900 PPM BOD for municipal wastes), and the flows being seasonal, which create problems for conventional methods of treatment.[13]

According to the State Water Quality Board in California the general objectives for wastewater management are:

1. prevent odors
2. avoid nutrient runoff into surrounding waters
3. prevent nitrates from entering groundwater

Water discharge requirements from California provide an indication of basic targets for water quality. The California Water Quality Control Boards issue permits that dictate the manner in which wastewater must be managed by individual wineries. Direct wastewater discharge to rivers, streams or lakes is **not** allowed. Wastewater that has been treated may be used in irrigation systems when the limits prescribed in their permits are met. Typical permit limits are as follows:

- Average biological oxygen demand over 30 days ≤ 50 mg/L
- Maximum biological oxygen demand in any single day ≤ 80 mg/L

[13]The Hydrologic Sciences Graduate Group at the University of California at Davis . http://wineserver.ucdavis.edu/av/AV9504.html

- Average total suspended solids over 30 days ≤ 50 mg/L
- Maximum total suspended solids in any single day ≤ 80 mg

Wastewater treatment permits for wineries do not specify chemical oxygen demand, nitrates, nitrites, nitrogen (including ammonia) or phosphorus limits. However, the U.S. Safe Drinking Water Act specifies limits for nitrates in groundwater at ≤10 mg/L, and nitrate limits of 1 mg/L.

The majority of California wineries collect their wastewater in primary aeration ponds and then pump to a secondary settling pond to remove solids. The winery samples the wastewater, identifies its nutrient contents, and pumps the water from the settling pond to their irrigation system. The winery then matches the irrigation rate with the rate at which the vines can uptake that water: they calculate the nitrogen and water uptake of the plants, and ensure that all the organic material that is applied to the fields is taken up by plants rather than running off or seeping into groundwater. This is known as the agronomic rates, The calculations that are required for application rate come from standard civil engineering texts, like Metcalf and Eddy.[14]

Direct discharge of untreated wastewater to irrigation systems, or natural waters is strictly prohibited. In addition, irrigation with treated wastewater disposal is prohibited for 48 hours prior to predicted storms and must not resume until the soil conditions are no longer saturated. Surface runoff from fields is prohibited. Wineries are asked to monitor their irrigation/wastewater disposal systems to ensure that surface runoff is not occurring.

Solids are allowed to be tilled ("disked") into the fields, but this too must be done at an agronomic rate, so that the plants can uptake all the nutrients provided.

Use of winery wastewater for irrigation has obvious economic advantages: the Australian Grape and Wine Research and Development Corporation estimates that for every 10 megaliters of wastewater that is recycled for irrigating vines, between Australian $20,000 to Australian $50,000 of extra gross income can be generated for additional grape production.[15] Berri Estates is an Australian wine manufacturer that is already using the wastewater from its winery to grow a plantation of Murray River Redgums. The winery crushes about 50,000 tons of grapes per year to produce grape juice and wine. The wastewater contains a medium-

[14] Metcalf & Eddy. Wastewater engineering : treatment disposal reuse / Metcalf & Eddy, Inc.; revised by George Tchobanoglous. New York : McGraw-Hill, c1979.

[15] http://www.winetitles.com.au/gwrdc/index3.html

to high-content of biochemical oxygen demand (BOD). Still wash from distillation has the highest BOD level. Among their earlier problems were that the wastewater did not biodegrade easily and quickly generated offensive odors if left to stand in ponds. Berri Estates' winery produces around 200 megaliters (ML) per annum of low-level wastewater with a BOD of about 2,500 mg/L. The distillery wastewater is around 10 ML per annum at about 15,000 mg/L. A complete case study can be found at their website at http://www.erin.gov.au/portfolio/epg/environet/ncpd/auscase_studies/berri.html.

Where wastewater irrigation of crops is not feasible, constructed wetlands offer an efficient, low-cost, low-maintenance and low-energy alternative for wineries that have sufficient land area available for wetland creation.[16] A wetlands ecosystem acts as a water "filter". Water quality improves as surface water moves through soils, plant stems and plant roots, and is acted on by the microrganisms living in the system. Constructed wetlands include wetland plant species and stay wet through application of water. In this case, the objective of a constructed wetland is to mimic the filtering activity of natural wetlands to manage wastewaters.

Kenwood Vineyards, in California , gives their equipment washdown water to a private composting company at no charge.[17] While they do not make any money from that, they undertake the activity as part of their goal of being an environmentally conscious manufacturer since the water now ceases being a waste stream and becomes a useful byproduct. They also avoid the cost of treating and managing the wastewater.

Management of Skins and Lees

A common practice of dealing with waste grape skins and lees is plowing skins back into fields and with discharging lees to its irrigation system. The primary concern is the high biological oxygen demand related to the skins and lees, which could lead to a depletion of dissolved oxygen in surrounding streams, rivers and other waters.

As with wastewater discharges, California wineries and other agricultural processors who apply solids and discharge water to irrigation are required to do so at agronomic rates.

[16] The Hydrologic Sciences Graduate Group at the University of California at Davis . http://wineserver.ucdavis.edu/av/AV9504.html

[17] http://smartwine.com/wbm/1996/9603/bm039606.htm

Many California wineries are currently composting their pomace, sometimes with the addition of other organic matter. The resulting compost can be used on growing fields, or can be sold to other users as an agricultural additive.

The seeds contained in pomace can be separated, and then used for producing grapeseed oil.[18] Grapeseed oil is sold as a gourmet food item in specialty shops, used for mild food flavoring, and also may have health benefits.[19]

Some breweries use the filtered solids from fermentation as animal feed[20]. Although the literature does not specifically mention this technique for wineries, it may be feasible for wineries to sell skins and lees as animal feed, or as an amendment to animal feed.

The E&J Gallo Winery mixes wine filtering byproducts with cow manure and used as a soil enhancement. Four thousand tons of filter cake is produced annually. This is now diverted from the waste stream and used for beneficial purposes. The company received a State Waste Reduction Award for their efforts, and also reports that the diversion has generated "substantial" savings.

Other Solid Waste Management

Packaging materials can be an expensive disposal problem for wineries. Recycling these materials can help reduce that cost, as well as conserving raw materials and energy. For instance, waste plastic wrap from pallet wrapping can be packed with LDPE string that allows for easy recycling.[21] Other examples from the California , State Waste Reduction Awards Program include the following:

- Buena Vista Winery, Inc. (years awarded: 1996, 1995, 1994, 1993) produces and bottles premium wines. In order to reduce the amount of cardboard sent to be recycled, Buena Vista has worked closely with their suppliers to produce boxes that can be shipped back to the supplier for reuse. Buena Vista also has an ongoing employee education program that highlights current as well as new recycling policies, keeping the idea of recycling

[18]http://smartwine.com/wbm/1996/9603/bm039606.htm

[19]For an example of a vendor selling grapeseed oil, see http://www.salutesante.com/. The site provides a copy of an article citing studies of health benefits of grapeseed oil.

[20]World Bank Pollution Prevention and Abatement Handbook, Part III. http://www-esd.worldbank.org/pph/home.htm

[21]Winery Eco-Efficiency Assessment Guide, Business for Social Responsibility Education Fund, 1998. http://www.bsr.org

fresh in employees minds. Buena Vista's waste reduction and recycling program has decreased the use of additional general waste containers from two to one. This factor alone is a significant source of company savings, given that their waste hauler charges by the ton. (PO Box 182 Sonoma, CA 95476)

- Chateau St. Jean Winery (years awarded: 1995) has been crafting fine wines in Sonoma Valley since its founding in 1974. The company reuses or recycles virtually all waste products from the vineyard, winemaking and bottling .

  In addition to savings from the reduced number of dumpsters required for waste, St. Jean is now able to realize rebates for scrap tin, cardboard, glass and some plastic packaging. (PO Box 293 Kenwood, CA 95452)

- Fetzer Vineyards (years awarded: 1995, 1994, 1993). From 1991 through 1997 the company reduced its waste by 94% and saved over $150,000 in disposal fees.

  Their business has grown by 20 to 30 percent in those years. The company recycles or reuses 13.5 tons of plastic shrink wrap, 70 tons of corrugated cardboard, 75 cubic yards of paper board, 10,000 cases of glass, 740 gallons of oil and 392 cubic yards of wooden pallets. They also compost 12 cubic yards of corks and 10,000 tons of grape seeds.

- Korbel Champagne Cellars (years awarded: 1998) recycles waste oils, solvents, paints, laboratory processing chemicals, and metals (including aerosol cans) More than 500 tons per year of cardboard is baled and sold. All glass, stretch film and shipping plastics are also recycled. Over a six year period, Korbel has been able to reduce refuse to landfill costs by 50 percent. (13250 River Rd Guerneville, CA 95446).

ENVIRONMENTAL MANAGEMENT SYSTEMS (EMS)

An EMS involves a structured, systematic way of identifying, addressing, and correcting environmental problems. The EMS would normally involve elements like assessing environmental concerns, establishing targets for environmental improvement, training managers and workers in environmental issues, and reviewing the facility's progress. Typically, all of these activities will be guided by an environmental policy statement from the company's management, which provides "top down" direction for environmental protection at the facility.

ISO 14001 provides widely recognized specifications for an EMS. Many companies are adopting ISO 14001 EMSs as a way of demonstrating to their customers or stakeholders that they have an acceptable level of dealing with environmental issues. A company that has implemented an ISO 14001 EMS can hire an outside auditor to come in and certify compliance to the ISO standard, or they can do their own internal audits and self-certify. Self-certification can be a good interim option for companies that want the benefits of an EMS, but do not yet have customer requirements for a full, externally certified EMS.

EMS For Improved Data Collection, Evaluation, Process Operations

Implementing a systematic structured EMS can provide benefits to the company that go beyond market drivers. A good EMS, like a good quality system, can be a structure to ensure efficiency and can ensure consistency of outcomes/ products. Table 2 shows how components of an ISO 14001 EMS overlap with better process operations.

Additional information about how developing an EMS is available from the following sources:

- http://www.iso14000.com/DNV_Article.htm—Provides overview of benefits of ISO 14001 in business terms, including avoided liability, improved materials usage and better supply management.
- http://www.epa.gov/OWM/wm046200.htm--Environmental Management Systems: An Implementation Guide for

- Small and Medium-Sized Organizations

- http://www.epa.gov/opptintr/dfe/pwb/case_studies/case7/ --shows example of how one company (a printed wiring board manufacturer) developed its aspects, objectives, and targets.

Table 3 provides a sample of software available to assist with ISO 14001 implementation.

Table 2. How ISO 14001 Components Relate to Process Operations.

ISO 14001 Component	Connection to Better Process Operations
Identify Environmental Aspects	Emissions points that are identified often are points of inefficient usage or potential accidents. Facilities should use their list of environmental aspects to assess opportunities for improved operations and better materials use (e.g., find ways to recirculate water, reduce energy usage, reduce bottling losses). They should also look at environmental aspects to see if there is a need for better hazardous-materials accident prevention.
Identify Environmental Targets	When a facility chooses the targets that they want to achieve, often they go back and re-analyze their production processes to figure out how to achieve the targets. Periodic process analysis is beneficial to ensure that all systems are optimized.
Evaluate Progress towards Environmental Goals	When evaluating whether goals have been met, facilities often keep closer track of their emissions than they normally would. For instance, they may carefully monitor energy usage. This information can also be used to identify optimal process conditions. The practices that lead to most efficient energy usage can then be implemented on a regular basis.

Table 3: ISO 14001 and EMS Software

Software Title	Software Function	Cost (if available)	Available From
GreenScore	Deals with environmental self- assessment, ISO 14000 readiness and evaluates environmental policies and practices	Program, $300. additional services: customized profile, $50; expert analysis, $150.	National Center for Manufacturing Sciences, 3025 Boardwalk Drive, Ann Arbor, MI 48108-3266. Phone: (800) 222-6267. paul.chalmer@ncms.org http://www.ncms.org
EHS/Life Cycle	Facility Management, Environmental Health and Safety; Regulatory Compliance for US Laws; Environmental planning and management; Incorporates environmental cost information with environmental data	Cost dependent upon system and options selected	Essential Technologies formerly EIS International Corporation, 1401 Rockville Pike, Suite 500, Rockville, MD 20852. Phone: (3 01) 738-6900, (800) 999-5009; Fax: (301) 738-1026. http://www.eisintl.com ; Email: info@eisint.com
Environmental Management Systems	Components include Materials (including surplus management), Material Safety Data Sheets, Facility, Human Resources, Air Management, Waste Management (including wastewater), Reporting, Bar Coding, and Navigate (Searching).	Cost will depend on options—modular/ integrated and single user/network. e.g., site license (1-4 workstations) for an integrated system is $18,000 (+15% annual system support); single user option for a Waste Measurement and Reporting Package is $3,800.	Chemical Safety Corporation; Sybil Kelly(sybilk@chemicalsafety.com), 5901 Christie Avenue, Suite 208, Emeryville, CA 94608-1932. Phone: (510) 594-1000, (888) 594-1100; Fax: (510) 594-1100. http://www.chemicalsafety.com, ems@chemicalsafety.com
EMS-Plus	EMS-Plus helps users evaluate an EMS based on whether it incorporates components known to promote environmental improvement. The tool leads the users through a series of questions about his or her EMS, and then provides a report based on the key EMS components	Free tool, accessed via world wide web (used on—line, not downloaded to users computer).	Research Triangle Institute; Melissa Malkin (mjmalkin@rti.org), P.O.B. 12194, Research Triangle Park, NC 27709. Phone (919) 541 6154. Fax: (919) 541 7155. http://ems.rti.org/

(continued)

Table 3: ISO 14001 and EMS Software (continued)

Software Title	Software Function	Cost (if available)	Available From
ICF 14000 Workstation	Information management tool to enable companies to meet the ISO 14001 specification. Lotus-based application. Main modules include assessment, conformance and supporting documents	1 copy $1,295; 5 copies $4,500, Additional installation and user support $800, training $1,000.	ICF Kaiser International, Inc., 9300 Lee Highway, Fairfax, VA 22031 Phil Marcus pmarcus@icfkaiser.com
ISO 14000 EMS Conformance Series	Software is designed to help the user develop and EMS, prepare for 14000 implementation and learn to do internal audits for 14000.	Each CD costs $1000 for a total of 5 CD's. Each can be purchased separately or can be purchased together with a 10% discount.	Reality Interactive, 7500 Flying Cloud Drive, fourth floor, Eden Prairie, MN USA 55344, (800) 675-7789
ISOsoft 14001	Contains four sections. Reference contains information on ISO 14001 and developing an EMS; Assessment analyzes gaps between existing and ISO 14001 requirement; Management organizes and tracks EMS tasks and document control. Manages information about EMS activities and procedures (documentation, training, and inspections). Records whether ISO14001 nonconformance occurred, which staff managed the nonconformance, what solutions were employed.	$1,495 for single site/single user; more for multiple and network licenses.	Intelex Technologies, Inc., 93 Skyway Ave., Suite 101, Etobicoke, Ontario M9W 6C7 Canada, (800) 387-4019, http://www.intelex.com/14000.html
ISO 14001 Implementation Software	Implementing ISO 14001, tracking documents and compliance with ISO 14001 administrative requirements. The implementation tool provides worksheets and guidance from ISO 14004. Assessment and auditing software are also available.	$1,199 Single user, $2,099 for up to 5 users.	Greenware Environmental Systems, Inc. 145 King Street East, Suite 200, Toronto, Ontario, M5C 2Y8 Canada, (416) 363 5577, greeninfo@greenware.ca

EMS Elements Not Required by ISO 14001

In addition to the required identification of ISO aspects, impacts, and targets, there are elements of a good EMS to promote environmental improvement that are not specifically required for ISO 14001. We refer to these as non-ISO EMS elements. Several of these concepts are described below.

Environmental Accounting Concepts

Environmental accounting concepts suggest that a facility should integrate the cost of wastes into decision- making. For instance, if a specific product line generates a hazardous waste that causes fire insurance costs to increase, then the facility should include that added cost into the price they charge for the product line.

For an overview of environmental accounting as a business management tool see: http://www.epa.gov/opptintr/acctg/earesources.htm/ For case studies and further information see: http://www.epa.gov/opptintr/acctg/ The Tellus Institute describes the related concept of total cost accounting: http://www.tellus.org/r-tca.html

Systematic Process Optimization Methods

Systematic process control helps a facility optimize use of raw materials and energy, and reduce emissions and waste. Process optimization can be achieved with a variety of methods from simple spreadsheets to computerized sensing devices and statistical process control methods.

Measure Pollution Prevention

Measurement is important to achieve good environmental management. In order to track progress towards environmental goals and objectives facilities should track changes in waste and raw materials over time. When this data is combined with information about production the facility will have a better understanding of how well their environmental improvements are working. See http://www.rti.org/units/ese/p2/documents.html for more information.

Life-Cycle Concepts

Life-cycle assessments (LCA) can be used to provide a very detailed comparison of the environmental impacts of a product, including all impacts associated with its raw materials, usage, and disposal.

Traditional LCA can be quite expensive and data-intensive. However, the concepts of LCA can be used in a less rigorous way to help facilities understand the true environmental impacts of their activities.

For more links and information visit the following web site: http://www.tiac.net/users/tgloria/LCA/lca.html#Environmental and LCA

APPENDIX A: RESOURCES, INCLUDING USEFUL INTERNET SITES

EPA and Other Documents

Wine Industry: Environmental Compliance and Pollution Prevention/Resource Conservation. Self-Assessment Checklists. Napa and Sonoma Counties. Published by the Bay Area Green Business Program, North Bay Permit Assistance Center, Santa Rosa California . Fax (707) 527 2661, email nbaypac@ix.netcom.com. Gives general information about requirements for hazardous waste, wastewater systems, and water supply systems.

Integrated Pest Management and Soil Pest Control Technologies In California Vineyards. U.S.EPA Part of EPA 430-R-96-021, 10 Case Studies, Volume 2 December 1996. Large-scale California grape producers, including Fetzer Vineyards, Savage Island Farms, Soghomonian Farms, Steven Pavich, and many other vineyards in the Lodi-Woodbridge region are successfully using Integrated Pest Management (IPM) practices to grow grapes profitably without methyl bromide. Also available at http://www.epa.gov/docs/ozone/mbr/cavine2.html.

Industrial Heat Pumps Improve Plant Efficiency and Recover Wasted Energy Resources: Advances in Industrial Energy-Efficiency Technologies, U.S. Department of Energy, February 1993. From steel making to milk production, virtually all industrial processes require both heating and cooling of the various process streams. One key to good energy efficiency is exchanging heat in the most effective way between components within the system, thereby cutting the need for additional heating or cooling. Full abstract available at http://es.epa.gov/techinfo/facts/pumps.html.

Technical Journal Articles Abstracts

These are most easily found through The American Journal of Enology and Viticulture web site, http://www.ajev.com/

Identification and Contacts for U.S. Trade Organizations

Family Winemakers of California
1400 K Street, Suite 304
Sacramento, California 95814.
Phone (916) 498-7500

Fax (916) 498-7505.
http://familywinemakers.org/index.html

Napa Valley Vinters Association (California)
(707).942-9783
http://www.napavintners.com/index.html

Sonoma County Wineries Association (California)
(707) 586-3795
info@sonomawine.com
http://www.sonomawine.com/index.html

Club Bonterra, is an organization of Fetzer grape growers who are dedicated to sharing information about sustainable farming practices. Information available by email from Fetzer@fetzer.com

Organic Trade Association
50 Miles Street
PO Box 1078
Greenfield, MA. USA 01302
Phone: 413- 774 7511
Fax: 413 774 6432
Email: ota@igc.apc.org

Useful Internet Sites

The following list of world wide web resources provides information about new wine making technologies and practices.

Web Sites Dealing With Wine Industry Air Pollution

1. http://www.smartwine.com/wbi/tbi6n15.htm AIR POLLUTION OFFICIALS CONSIDER TANK PERMIT . Wine Institute Fears Fermentation Restrictions Monterey County's air pollution control district is considering requiring permits on fermentation tanks that emit more than 100 tons of ethanol a year.

2. http://smartwine.com/wbm/1996/bm019609.htm GRAIN RESEARCHERS TEST VOLCANIC GAS AS METHYL BROMIDE SUBSTITUTE. But Questions Remain On How CO2 Can Be Effectively Applied To Ground Pests. With all the talk about the impending global ban on methyl bromide, you'd think someone, somewhere, would be trying to come up with a replacement to fumigate crops and commodity food supplies--and someone is--stretching things about as far as they can go to find a substitute.

3. http://204.242.24.14/wbm/gc89503.htm VINTNERS, GRAPE GROWERS DO MORE GOOD THAN BAD TO ENVIRONMENT. Vines Suck Up Ethanol Emissions; Contribute Oxygen To The Earth. With expensive new winery anti-pollution regulations looming on the horizon, a University of California, Davis, plant physiologist has begun constructing a statistical defense showing that the wine industry cleans up the

atmosphere as much as, or even more, than it pollutes it. 1995 article.

4. http://www.atinet.org/cati/upda/96/spring/story11.html Report focuses on hydrogen sulfide in wine

Web Sites Dealing With Beverage Industry Solid Waste Reduction

5. http://www.epa.gov/wastewise/id-bev.htm Information from WasteWise, including some beverage industry goals, Recycling, Buying or Manufacturing Recycled Products, Buy-recycled activities of WasteWise partners in the beverage industry, WasteWise Partners in the Beverage Industry (As of July 21, 1997), and Sample Partner Achievements.

6. http://smartwine.com/wbm/1997/9708/bmh9740.htm WINE BARREL RE-USE TECHNOLOGY BEING COOKED TO PERFECTION. A Guide to Understanding the Different Approaches.

7. http://smartwine.com/wbm/1997/9701/bma9766.html Chardonnay In Recycled Wine Bottles to Debut At NHL All-Star Game.

8. http://es.epa.gov/techinfo/facts/newz-cs3.html DB Breweries LTD. This brewery has employed "good housekeeping" methods, thus reducing packaging wastage from 2.5% in July 1991 to 0.5% in March 1995. These actions have saved more than $250,000 per year.

Web Sites Dealing With New Wine Industry Technologies

9. http://smartwine.com/wbm/1997/9708/bmh9744.htm NEW YORK WINE, BEER EXPERIMENTAL LAB OPENING. Facility a Proving Ground For new Technology and Equipment. The Vinification & Brewing Technology Laboratory is being heralded as the first East Coast facility for winemakers looking to make improvements on winemaking techniques.

10. http://smartwine.com/wbm/1997/9707/bmg9746.htm What if a machine could smell out Brettanomyces or volatile acids before a wine was bottled, or alert a winemaker to the existence of mold or bacteria in a barrel, sniff out TCA in cork with more accuracy and consistency than even the best noses in the sensory science business? Scientists at the California Institute of Technology in Pasadena predict that it won't be long before artificial olfaction technology can do all this and more for the wine industry.

11. http://smartwine.com/wbm/1997/9704/bmd9745.htm FORTY-ONE TIPS ON RED WINE FERMENTING. Unified

Symposium Seminar Draws a Crowd. This article offers highlights of the most valuable tips from the seminar, Innovative Techniques in Red Wine Fermentation. The select group of winemakers gave their perspectives on such practices as rack and return, maceration, rotary fermenters vs. static fermenters, oak vs. stainless steel tanks and effects on temperature and wine quality, and philosophy of red wine fermentation in terms of extraction. The techniques varied with respect to growing areas and size of production.

12. http://smartwine.com/wbm/1997/9703/bmc9746.htm SON OF PRESSURE SENSITIVE? On a Clear Label, You Can See the Backside of the Back Label. The explosion in pressure sensitive labeling and its adaptation to wine bottling technology has spawned a second wine packaging trend—clear labeling. Perhaps the strongest change is in the direction of clear labels. Self-adhering, pressure-sensitive technology has eliminated visible strips of glue on label backs, making way for see-through labels.

13. http://smartwine.com/wbm/1997/9701/bma9714.html SITEVINITECH OFFERS FIRST-LINE GADGETRY TO VINTNER French Flavor Dominates at Products and Technology Show. Brief descriptions and contact information provided for technologies such as software package designed to manage winegrowing and winemaking operations, automated system for cleaning grape harvesters, combined high temperature and vacuum unit to increase color extraction, and others.

14. http://smartwine.com/wbm/1997/9701/bma9742.html SHEDDING NEW LIGHT ON BARREL PROBLEMS French Researchers Premier Work at Sitevinitech that Targets Odors. Concerned about such familiar problems as reduction in white wines, barrel odors and tartaric precipitation? Then, it seems, French barrel maker Seguin Moreau's latest research may have some answers for you.

15. http://smartwine.com/wbm/1997/9701/bma9748.html 'GUT FEELINGS' AND MATH BLEND TO MAKE FINE WINE Unified Symposium Session to Tout Efficiency Tools. Efficiency experts are gearing up to teach the wine industry how to maximize profit and quality while minimizing the headache and expense of premium wine production. "Maximizing Winery Efficiency" was be the topic of this one-hour panel discussion that discussed how technologies such as braced barrel tracking and computerized production information management can work with mathematical process flow models to

produce the best wine in the most effective way possible.

16. http://smartwine.com/wbm/1996/9612/BM129652.html Some information on New Products for winemaking: New Tank Equipment Launched G&H Products released a new line of tank top plate assemblies. The new top plates are the latest addition to G&H's line of tank and tank cleaning equipment, including manway covers, fixed and rotary cleaning heads, tank legs and sight glasses. The new top plate assemblies combine all necessary tank top equipment, such as pressure and level transmitters, anti-vacuum and pressure relief valves, gas or CIP valves and sight units into one custom fabricated unit. With the top plate, only one cut for the counterflange need be made, eliminating the increased cost, time and sanitation threats separate cutouts introduce for individual fittings. New Lightweight Linerboard Produced. International Paper has produced a new lightweight linerboard at its Mansfield mill. The company said the new product, called WhiteTop, offers higher brightness plus uniform coverage and consistent ink holdout. New Strapping Machines Introduced Dynaric has introduced the new DF-207S stainless steel semi-automatic strapping machine for use in harsh packaging environments. The company said the machine is ideal for meat, seafood and agricultural packaging applications. It is ideal for saltwater and wet environments because it is equipped with corrosion retardant component parts.

17. http://smartwine.com/wbm/1996/9612/BM129652.html December 1996 news. Magnotta Acquires Chilean Vineyards

18. http://204.242.24.14/wbm/bm79501.htm Marking Chile's Export Success.

19. http://smartwine.com/ Wine Reviews, questions, live chat, on-line magazines.

20. http://smartwine.com/wbm/1998/9802/bmb9847.htm Small Viticulture and Enology Programs Flourishing. US Universities—various research and extension programs.

Web Sites Dealing With Ecolabeling And Efficiency

21. http://smartwine.com/wbm/1998/9803/bmc9801.htm Article on Wine Ecolabels. The California Association of Winegrape Growers together with the Lodi-Woodbridge Winegrape Commission sponsored a conference entitled Exploring Eco-Labeling for California Winegrapes in Sacramento.

22. http://smartwine.com/wbm/1996/bm019604.htm WINE INDUSTRY ECONOMICS EXAMINED Vintner and Grower "Wheels Of Fortune" Demystify Wine Business Cycles. The boom and bust cycles of the wine industry can be distilled into two "Wheels of Fortune" that distinguish four marketing phases in the growing of grapes and making of wine.

Web Sites Dealing With Energy

23. http://smartwine.com/wbm/1998/9802/bmb9832.htm Solar Energy Applications Explored For The Wine Industry. The importance of hot water for winery sanitation cannot be underestimated. Unfortunately, creating adequate supplies can rapidly turn into a costly and energy-intensive proposition.

24. http://smartwine.com/wbm/1997/9703/bmc9733.htm GROUNDBREAKING GEOTHERMAL HEAT PUMP WILL BE INSTALLED AT WINERY System Saves Energy, Reduces Costs. It would be quite an understatement to say that it takes a lot of water to make wine. So why not use that water to save energy and cut operating costs? Winery managers may want to take another look at their holding ponds or irrigation systems and consider using that existing pond or irrigation system as an alternative energy source.

25. http://smartwine.com/wbm/1997/9701/bma9766.html ETC Releases RiteTemp Wine Cooler. Exothermal Technology Corporation has developed wine cooling wrap that is the first to keep wine at its recommended temperature of between 48 and 54 degrees Fahrenheit for up to 1.5 to 2 hours. Re-energizing takes approximately 15 to 20 minutes in a refrigerator or freezer unit. RiteTemp weighs 5.5 ounces and wraps around all wine bottles up to 1.5 liters. The product is available in black, teal and burgundy with art deco geometric trim.

26. http://204.242.24.14/wbm/bm79510.htm NEW PRODUCTS MONITOR AND CONTROL HEAT AND COLD DURING SHIPPING. Wineries Testing Protective Shipping Blankets. Vintners worried about premium vintages getting cooked in transit to destinations around the globe are starting to track heat variations with temperature monitors and cover case shipments with heat-and-cold resistant blankets. Small, lightweight temperature monitors stashed inside wine cases or glued to outside packaging keep track of ambient temperatures in transit.

Web Sites Dealing With Grape Growing and Good Agricultural Practices

27. http://smartwine.com/wbm/1997/9710/bmj9701.htm#cont Wine growers—environmental practices.

28. http://smartwine.com/wbm/1997/9711/bmk9736.htm Expert plant pathologists and mycologists the world over have been working for years to expose this fungal fiend, but its identity remains a puzzle.

29. http://smartwine.com/wbm/1997/9708/bmh9746.htm FUNGICIDE RESEARCH STAYING FRESH. Environment Wins Out in Sacramento Field Trials. Wine grape growers were among the first to embrace the green revolution in agriculture, but fungal disease haunts vineyards regardless of control strategies. Now, a boom in environmentally sensitive fungicide technology is helping growers get a handle on menaces like powdery mildew, eutypa, botrytis and bunch rot.

30. http://smartwine.com/wbm/1997/9708/bmh9736.htm INNOVATIVE EROSION CONTROL PROVIDES MODEL FOR INDUSTRY. Environmental Vineyard Practices Gain Recognition and Funding for Sonoma Valley Growers

31. http://smartwine.com/wbm/1997/9706/bmf9750.htm SOIL DR. TENDS TO NORTH COAST DIRT. Calcium is King, Agronomist Tells Growers. Increased bloom, berry set and cluster size could be in store for growers who follow the right soil nutrition routine.

32. http://smartwine.com/wbm/1997/9702/bmb9739.htm YOUR SOIL NEEDS FRIENDLY NEMATODES. Oregon State University scientist Dr. Elaine Ingham talks to grape growers in Santa Rosa on sustainable growth methods.

33. http://smartwine.com/wbm/1997/9702/bmb9746.htm LOW-KEY SCIENCE LAB KEEPS PEST WATCH. Dennis Mayhew speaks to Sonoma county grape growers about what he calls “the best-kept secret in California agriculture”—the Plant Pest Diagnostics Center he runs for the state Department of Food and Agriculture in Sacramento. The lab offers pest diagnostics to any Californian—business, government or private gardener—at no extra charge. Mayhew, himself a plant virologist, recited the lab telephone number twice to the growers at the Luther Burbank Center—(916) 262-1100.

34. http://smartwine.com/wbm/1997/9702/bmb9749.htm GENETIC ENGINEERING COMBATS ROOT DISEASE. Fan Leaf, Phylloxera are Targets of Modesto Firm. Modesto, home

of the world's largest winery, is also the site of some fascinating research into genetic engineering to combat the scourges of grapevine rootstock.