REDUCING WASTE AND MAKING MONEY

A Concise & Practical Guide to Pollution Prevention in Wineries
1.0 INTRODUCTION

"Pollution prevention means the use of processes, practices, materials, products or energy that avoid or minimize the creation of pollutants and wastes at the source."
Canadian Council of Ministers of the Environment (CCME)

A pollution prevention (P2) assessment is a detailed and systematic assessment of a company's processes and wastes. The objective of this investigation is to improve process efficiency and to evaluate opportunities to increase product yields, reduce water, energy and chemical use, and waste generation at source.

As illustrated below, actions taken to prevent waste at source tend to be relatively inexpensive and more effective than end-of-pipe treatment processes.

This concise manual is designed to help you and your staff to efficiently identify and economically justify practical pollution prevention measures for your winery. It follows the standard journalistic lines of questioning:

- Who are your Champions (Assembling your Team)
- What are your Wastes (Quantifying and Prioritizing)
- Why are your wastes Generated (Root Cause Analysis)
- Where can they be Improved (Designing Alternatives)
- When should they be Implemented (Preparing an Action Plan)

Case studies from several Canadian wineries are included at the end of the manual.
Who are Your Champions: Assembling Your Team

"The time and attention of competent managers are among the most valuable and scarce resources in any organization." Forest Reinhart

P2 assessments provide teambuilding opportunities as inter-departmental staff collaborate to improve the environmental and economic health of their winery. It is essential to assemble and train a competent and motivated team to efficiently identify and evaluate resource conservation opportunities.

2.1 Conservation Team Leader

Select an individual with:

- a passion for conservation work;
- commitment and skills to follow through from assessment to commissioning;
- interpersonal skills to motivate a diverse team; and
- the support and public endorsement of senior management.

2.2 Internal Resources

A multidisciplinary team is necessary to assemble data, develop and refine ideas and to facilitate implementation. Team members will find that an assessment is an excellent opportunity to refine and justify their conservation ideas (by quantifying the cost and payback potential of the ideas). Key team members include:

- Plant Managers
- Environmental Health & Safety Managers
- Operators and Maintenance staff
- Cellar & Bottling Supervisors
- Engineers and Purchasing Staff
- Vintners

Team members should be selected based on their willingness to consider new ideas, creativity, interpersonal skills, and competence in their respective disciplines. In smaller wineries, several of these roles are often served by the same individual.
2.3 EXTERNAL RESOURCES

It can be helpful to include an external consultant on the project team to provide project management, training, and/or technical expertise. A fresh set of eyes can also provide perspective and objectivity. If winery staff time is limited, outside resources can be used to rapidly collect and evaluate process and economic data. This frees up internal team members to focus on higher value tasks.

When retaining an outside resource, be sure to contact references for their work in other wineries. Ensure that the specific individuals assigned to your project are those with the skills, creativity and experience necessary to develop and implement technically, environmentally and economically sound alternatives.

3.0 WHAT ARE YOUR WASTES: QUANTIFYING & PRIORITIZING

3.1 QUANTIFYING RESOURCE CONSUMPTION

In order to reduce resource consumption, it is necessary to develop an understanding of the consumers of each resource and the generators of various wastes. The relative quantity of resources consumed and waste generated is then used to prioritize and economically justify conservation measures.

Quantifying Water Consumption/Wastewater Generation:

A typical winery consumes 7 US gallons of water per case of wine bottled. Therefore, water conservation can significantly reduce both operating costs and a winery's impact on the environment. Water consumption is frequently quantified using:

- In-Plant flowmeters
- Effluent flowmeters
• Bucket and Stopwatch Technique

• Engineering Calculations (such as nozzle capacities, cooling tower heat loads and the water incorporated into product)

Bucket & Stopwatch Technique. The flowrate of a devise can often be measured by recording the time that it takes to fill a bucket, tank or sump of known volume.

By multiplying the flowrate by the operating pattern (hours/day), the daily flow can be estimated.

Quantifying Energy Consumption:

Energy is an expensive resource with a large impact on the environment. Energy quantification tools include:

• Metering of electrical loads and bus bars;
• Product documentation (such as lights)
• Observation of patterns of usage;
• Compressed air consumers and leaks;
• Thermal calculations on heated and chilled tanks and transfer lines; and
• Boiler condensate balances.

Quantifying Product Losses:

Wine and juice losses to sewer are expensive ($1 to 2/L) and contribute to low pH and high Biochemical Oxygen Demand (BOD₅) compliance problems. Product losses can be estimated by measuring the flow and BOD₅ concentration of various waste streams.

For example, pure wine typically exhibits a BOD₅ of about 225,000 mg/L. If a 1,000 litre flush of a bottling vessel contains 9,000 mg/L of BOD₅, then approximately 40 litres of wine is lost to the sewer in this step as calculated below:

(1,000 Liters of rinse water) times (9,000 mg/L of BOD₅ in rinse water) divided by (225,000 mg/L of BOD₅ in wine) equals 40 Litres of wine in the rinse water.
3.2 SUMMARIZING RESOURCE CONSUMPTION: PROCESS FLOW DIAGRAM

Resource consuming and waste generating processes and operations can be summarized with a process flow diagram (PFD). A PFD is constructed by arranging a facility’s production steps from receiving to shipping and identifying each process and operation that consumes a resource or discharges a waste.

This information can be helpful in identifying byproduct streams that can be recycled or reused as inputs to other processes and operations. It also provides a tool for tracking wine yields and resource consumption based on grapes harvested and product bottled.
3.3 PRIORITIZING RESOURCE CONSUMPTION: PARETO CHART

Resource consuming and waste generating processes can be prioritized in the format of a Pareto Chart. Essentially, most of any given resource is typically consumed by a relatively few processes and operations. Therefore, even a relatively minor change to a major source can have a greater impact than substantial reductions to trivial sources.

![Pareto Chart: Present and Potential Water Balance](image)

**Figure 1**

**Pareto Principal**
In 1906, Italian Nobleman Vilfredo Pareto realized that 80% of the wealth in his country was owned by only 20% of its people. He then reasoned that the greatest returns would be achieved by taxing this portion of the population.

4.0 WHY ARE YOUR WASTES GENERATED: ROOT CAUSE ANALYSIS

Quantifying and prioritizing wastes (Section 3) identifies a facility’s significant resource consuming/waste generating processes and operations. The next step is to determine the factors limiting conservation of the targeted resource.

If the root cause (limiting factors) of resource consumption/waste generation for a given process or operation are not readily evident, a root cause analysis diagram can be used.
This diagram is a brainstorming technique in which the resource conservation team suggests possible causes under various categories.

Depending on the nature of the problem being investigated, the categories can include combinations of:

- The Four Ms (method, machines, materials, manpower);
- The Four Ps (place, procedure, people, policies);
- The Four Ss (surroundings, suppliers, systems, skills).

Sensing of ideas is not allowed during the brainstorming process as ideas that may seem impractical often inspire other team members to conceive of practical solutions.

For example, the quantity of water consumed by vacuum pumps is typically limited based on the quantity of heat gained (temperature rise) in the pump's seal water.

In the photograph to the right, a small heat exchanger is used to remove excess heat from the seal water (allowing water reuse).

**Good Questions Lead to Good Answers**

A sugar mill was supplying 20 percent of its Reverse Osmosis treated water to an abandoned labor camp. By asking why, the conservation team identified a water main leak that had been undetected for over 10 years (130,000 gal/day water savings).
WHERE CAN THEY BE IMPROVED:

DESIGNING ALTERNATIVES

Following the in-plant assessment work, the conservation team meets to identify and evaluate potential resource conservation measures. The team then narrows the viable options for any given resource consumer or waste generator to the one or two most attractive alternatives.

Selected members from the team prepare conceptual designs for these alternatives and complete an economic analysis.

5.1 CONCEPTUAL PROCESS DESIGN

At the conceptual level of design, the primary process components required to implement the conservation measure are listed. Based on discussions with vendors and contractors, budget estimates for procuring and installing these components and associated equipment can be determined.

Contingencies are added for other minor components that will be identified during subsequent stages of engineering design. Operating costs for manpower, materials, energy, waste disposal etc. are estimated relative to the present conditions at the facility (i.e. relative to the status quo).

5.2 ECONOMIC ANALYSIS

The potential economic benefits are quantified for selected conservation measures. Direct benefits frequently include:

- The internal value of recovered product and process de-bottlenecking;
- Labour savings;
- Health and Safety benefits of less toxic materials;
- Utility savings (natural gas, electricity, water, and chemicals); and
- Sewer surcharge and concentrated waste disposal savings;

Payback period is calculated by dividing the estimated total installed capital cost by the net savings. Many facilities desire a payback period of less than two years for capital projects (i.e. 50% return on investment per year). However, as resource conservation measures permanently reduce operating costs and increase revenues, longer payback periods are also advisable in order to stay competitive.
Net Present Value (NPV) is calculated based on the installed capital cost, the projected savings over the next 20 years and an assumed average interest rate (often 5% is used). NPV predicts the value of a given alternative in present dollars.

Table: Sample Capital & Operating Cost Estimate and Payback Potential

<table>
<thead>
<tr>
<th>I. CAPITAL COSTS</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Installed Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cooling Tower</td>
<td>1</td>
<td>$31,333</td>
<td>$47,000</td>
</tr>
<tr>
<td>2. Chemical Dosing Systems</td>
<td>2</td>
<td>$1,000</td>
<td>$3,000</td>
</tr>
</tbody>
</table>

**ESTIMATED CAPITAL COSTS**

| Engineering | $6,000 |
| Subtotal    | $56,000 |
| Contingency (25%) | $14,000 |

**TOTAL ESTIMATED CAPITAL COSTS**

$70,000

<table>
<thead>
<tr>
<th>II. ANNUAL OPERATION, MAINTENANCE AND MONITORING COSTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Electrical Power</td>
<td>$1,987</td>
</tr>
<tr>
<td>2. Operations Labor (status quo plus 1 hr/wk @ $28/hr)</td>
<td>$1,456</td>
</tr>
<tr>
<td>3. Maintenance (@ 3% of Total Estimated Capital Costs)</td>
<td>$2,100</td>
</tr>
<tr>
<td>4. Credit for Lower Water Consumption</td>
<td>($60,000)</td>
</tr>
</tbody>
</table>

**TOTAL ESTIMATED ANNUAL O&M COSTS (RELATIVE TO STATUS QUO)**

($54,457)

| STRAIGHTLINE PAYBACK PERIOD (yrs) | 1.3 |
| NET PRESENT VALUE BEFORE TAXES (assuming 20yr project life, 5% interest) | $748,656 |

6.0 WHEN SHOULD THEY BE IMPLEMENTED:

PREPARING AN ACTION PLAN

Conservation measures selected by the team can be tabulated in the form of an action plan spreadsheet. The conservation measures can then be prioritized into short, medium and long term projects.

The technical and economic benefits of certain conservation measures are self evident based on the results of the resource quantification and root cause analysis work. For example, process leaks identified during the assessment are “Low Hanging Fruit” that can be rapidly implemented to generate immediate savings and finance other conservation measures.
In general, projects with short payback periods and large NPVs can be the most attractive. However, certain measures can coincidentally solve other problems at a facility (such as effluent quality concerns) and hence be ranked higher. As illustrated below, the implementation plan should include provisions for monitoring and reporting as well as continuous improvement.

(1) Commitment and Policy

(2) Baseline Review

(3) Planning

(4) Implementation

(5) Monitoring and Reporting

(6) Review, Evaluation and Improvement

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### OTHER RESOURCES

Case studies for large, medium and estate wineries are included in the following pages. These case studies illustrate how Pollution Prevention work can be incorporated into other initiatives in progress at wineries.

Other resources that can assist in your assessments include trade associations, information clearinghouses, and cleaner production/pollution prevention roundtables:

- Wine Council of Ontario's Sustainable Winemaking Ontario
- Canadian P2 Information Clearinghouse (http://www.ec.gc.ca/cppic/)
- Environment Canada National Office of Pollution Prevention (http://www.ec.gc.ca/nopp)
- Canadian Center for Pollution Prevention winery industry tools and resources (http://www.c2p2online.com/main.php3?section=40&heading=183&session=)

A blended team of Vincor and Enviro-Stewards staff completed water, product, and energy conservation assessments at Vincor's Niagara Falls winery. Matching funds for the energy efficiency and resource efficiency assessments were provided by NRCan's Energy Innovators Program and the Agricultural Adaptation Council, respectively.

The Niagara Falls winery's water consumption has decreased by more than one third since the initial assessment and its product yield is set to increase by up to 6%.

Insulation of the cold stabilization tanks had a straight line payback period greater than two years based on energy conservation alone. However, the insulation would allow the tank contents to reach cold stabilization temperature 9 days sooner. The resulting increase in cold stabilization capacity lowered the payback period to 1.5 years.
Andrés Proactively Commissions Environmental Compliance and Stewardship Assessments

Andrés retained Enviro-Stewards to conduct Environmental Compliance and Stewardship Assessments (ECSAs) at its wineries in Grimsby, Ontario and Port Moody, British Columbia.

The ECSA assessments consist of two primary components:

- Assess Compliance with Present & Pending Environmental Laws, and
- Prepare a Resource Consumption and Non Product Output Baseline to Facilitate Conservation Work.

Environmental protection measures implemented at the facility include a tank farm storm water detention chamber designed to safely guard a salmon stream & fish ladder located adjacent to the facility. Stewardship baseline information collected included water, chemical & energy consumption per case of wine and greenhouse gas emissions.
RJ Spagnols operates a wine kit blending and packaging facility in Kitchener, Ontario. As the Region of Waterloo (RMOW) receives most of it’s water from groundwater, they have proactively commissioned the Business Water Quality Program (BWQP) to assist industries to protect the groundwater aquifers.

Based on a pollution prevention (P2) assessment by RJ Spagnol and Enviro-Stewards staff, measures have been implemented to recover product rinses and incorporate them into formulations for compatible products.

Acid & caustic dosing and control facilities would have been required to meet RMOW sewer bylaw limits. However, decreases in water consumption and product losses, combined with in-plant equalization measures, have eliminated the need for end-of-pipe wastewater treatment.