Cleaner Production: It’s easier than you think

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Any process which transforms raw materials into a higher value product has the potential to generate by-products. A winery is no different, and winery wastewater is the most important by-product from a winery. However, winery wastewater is simply water and lost product that should be in a bottle and sold to a customer. Instead, the product is lost down a drain and now costs the winery in lost revenue, higher wastewater processing costs and higher disposal costs.

By maximising product yield through process efficiency, a winery is able to maximise its return by minimising its losses. Measurements taken at a number of wineries suggest that the average Australian winery loses 7% of product post-press, with some losing as much as a cavalier 15%. That is, for every 100 litres of juice or wine that drains from the press, only 93 litres ends up on the customer’s table: the rest is lost down the drain. A minor improvement of only 1% in yield across the Australian wine industry would see an additional 14 ML/yr of wine available for customers and would earn the industry an estimated extra $56 M/yr in sales. As a reference, dairy plants boast a 99% product yield and those plants with a 97% yield are considered inefficient.

The dilemma is that the average Australian winery does not accurately measure product yield and so losses are easily hidden in inventories of finished goods, wine carried over from last vintage, and stock on hand from this vintage.

Cleaner Production is a process-orientated and preventative approach to environmental management and can assist the winery to increase its output as it focuses on reducing loss in the first place. Cleaner Production is not just about reducing water volumes at the winery; it is also about reducing nutrient (wine) and salt loads in the wastewater. A focus on water minimisation only has the potential to concentrate the nutrients in the wastewater if the loss of product is not reduced in conjunction. When a Cleaner Production approach is adopted, the winery will have more product to sell and have a smaller load on its wastewater plant, which then makes it easier and cheaper to operate.

Biological oxygen demand (BOD) and chemical oxygen demand (COD) are measures of the strength of the wastewater. Fresh water has zero BOD. BOD enters the water stream as product loss. The higher the BOD level, the more product has been potentially lost in the process. The stronger the wastewater, the more difficult treatment becomes and the harder the wastewater treatment system has to work to reduce the nutrient levels. The harder the treatment plant works, the more it costs the winery in treatment plant operating costs, while requiring larger capital input, a larger disposal area, and causing increased risk to the environment through salt and nutrient loadings.

One barrier to the adoption of Cleaner Production is that it is perceived to be difficult to implement, however, it’s easier than you think. For example, one winery processing around 30,000 tonnes per annum was able to dramatically reduce the wastewater generation at its site as shown in Figure 1. The primary focus was on water reduction, but improvements in the overall winemaking practices resulted in much greater improvement.

Wastewater volumes were reduced significantly over the period from 2001 to 2005, but the raw nutrient levels (mg/L) in the wastewater increased and so it appeared that the winery was just concentrating up its losses. However, the winery also embarked upon a series of initiatives to reduce the amount of product loss and as a consequence, the amount of BOD per tonne processed has decreased as shown in Figure 2.

Apart from saving 51 ML in water use at the site, 144 tonnes of BOD was kept out of the wastewater stream. The equivalent of 2,888 kL of wine was kept out of the wastewater stream and even if half that BOD came from finished wine, the winery now has an extra 1,444 kL/yr in the bottle to go to its customers (160,444 cases) and at $1.50 per litre, the winery has an extra $216,600 of product to sell.

The reduction in BOD load meant that the winery also saved in treatment plant processing costs. Every kg of BOD needs around 2 kWhr of energy to treat it effectively. In broad terms, one bucket of

**Figure 1.** Non-stormwater wastewater generation per tonne processed.

**Figure 2.** Amount of BOD in raw wastewater per tonne processed.
lost wine means that a one kW aerator needs to operate for around one hour to treat that wine loss. A reduction of 144 tonnes of BOD resulted in a saving of $51,840/yr in energy costs. In addition to having extra wine in tank, the winery was not spending as much on the treatment and disposal process. The savings in water use pocketed another $51,000/yr. The added benefit was that the treatment system for that 30,000 tonne winery can potentially take them to a production capacity of 45,000 tonnes or beyond.

Potassium and nitrogen levels in wastewater reveal the source of the product loss. In broad terms, potassium is found in wine product, and nitrogen in marc. The higher the potassium in wastewater, the more wine product and lees is lost down the drain. The higher the nitrogen levels, the more marc or grapes is lost.

Installing grates in vintage areas to prevent ingress of wet marc and skins makes a huge difference at this winery (Figure 3).

The reduction in loss of product resulted in lower potassium levels in the wastewater stream. The lower salinity reduced the salt loading in the disposal area making irrigation of the wastewater more sustainable (Figure 4).

When embarking on a journey the first steps are often the most difficult. The first step in Cleaner Production is to consider where you are at the moment with a process audit. Consider all the processes undertaken at the winery and investigate the wastewater volume from each process and its strength.

Next, consider those tasks which generate the highest amounts of waste and consider what improvements can be made so that output loss is minimised, or eliminated. Each winery is different and the gains achieved at each winery depend on their unique practices. By involving cellar hands in determining ways to be cleaner, the gains achieved at each winery is different and the gains achieved at each winery depend on their unique practices.

Tank farm operations (31% of BOD load and average BOD of 3,500 mg/L)

In order to reduce loss in this area, the focus is on recovery of product and reducing spillages and dumps of wine, particularly during transfers. On average one litre of wine is moved 10 times. Pigging of major wine lines in and out of tank farm areas will result in reduced losses. Reuse of tank cleaning chemicals reduces both salinity in the final wastewater and cost.

Fermentation and pressing (23% of BOD load and average BOD of 4,950 mg/L)

Transporting wet marc for pressing is an area of potential high loss. Marc which slops onto the floor and enters the drainage system carries product which should be in the bottle. The more marc entering the press, the more product is potentially extracted. The wastewater plant rotary screen at one 5,000 tonne winery in Vintage 2006 was removing 1 tonne/day in skins and lost marc. Over the period of the vintage 56 tonnes of skins went down the drain.

Barrels (15% of BOD load and average BOD of 11,500 mg/L)

Barrel washing is one area where product is easily lost. If wine is not extracted fully from a barrel, there will be residual wine which just enters the wastewater collection system when the barrel is washed. Next time the winery washes barrels, count how many barrels of wine you lose in the process. A small percentage will be the ‘angel’s share’, but most will be lost wine poured down the drain.

Clarification (15% of BOD load and average BOD of 7,950 mg/L)

Lost product through scheduled backwashes and dumps is throwing product down the drain if they are not required. Any area where DE is used must be isolated so that all DE (what is DE)? can be collected. DE is a sponge: it soaks up wine. When DE is lost down the drain, it becomes a medium to transfer wine into the wastewater stream. The DE settles in the bottom of a sump allowing the wine to then leach out over time.

Marc bays (3% of BOD load, but average BOD of 50,000 mg/L)

While only a small load on the system, the wastewater from marc bays is a difficult wastewater to treat. Wet, under-extracted marc lying in a marc bay can seep wine into drains. The wastewater from the marc bay at one 5,000 tonne winery in Vintage 2006 was diverted to a separate tank. A total of 44 kL of wine was collected in the first month. In effect, this winery was under-extracting marc by at least 30 litres/tonne of grape. If the winery staff had paid more attention to detail, they would have had 150 kL/yr more wine ex-press and a lot less heartache at the treatment plant. At $1.50/litre, they would have had $225,000 more wine in tank, rather than spending more money in treating the wastewater and compromising their irrigation field through increased salt loading.

Cleaner Production has many benefits and saves the winery money. Reducing the amount of product lost during processing and reducing the amount of water used to process wine not only means more product for sale, it means a smaller and weaker wastewater stream with less salt that will cost you less in treatment and disposal.

Every winery needs a treatment system, but with a minor investment in taking time to understand the processes at the site through Cleaner Production, a substantial improvement can be achieved. Engaging your people in Cleaner Production is the smart solution to managing wastewater and the money invested in preventing wine product entering the wastewater system has a short payback.