Winery wastewater workshops translate research into practice

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Increased wine production has increased the need for robust tools, technologies and practical guidelines for the management of winery wastewater. Development of a sustainable wastewater management strategy is important for the Australian industry, as it has not only the potential to reduce the cost of wine production, but also demonstrates environmental responsibility crucial for international markets. CSIRO staff, in collaboration with industry leaders, developed a workshop program funded by the Grape and Wine Research Development Corporation (GWRDC) to bring the latest research and best practices in winery wastewater management to industry practitioners.

The key objective of these workshops was to increase the industry's awareness and knowledge of sustainable winery wastewater management by addressing the needs and interests of the local wine industry on issues such as:

- how to reduce the amount of wastewater
- the key winery wastewater quality characteristics
- limitations and advantages of the treatment processes that are currently used in Australia
- regulatory frameworks and guidelines for winery wastewater re-use
- options for winery wastewater re-use
- salt management options associated with winery wastewater irrigation
- risk assessment approach to manage wastewater management related issues.

At the time of writing, workshops had been presented in the Barossa Valley, McLaren Vale, Clare Valley, and south-east wine regions of South Australia; Swan Valley, Margaret River, and Great Southern regions in Western Australia; and Rutherglen and Wangaratta wine regions in Victoria. In total, 220 people have been trained through these workshops, with good feedback on both the topics covered and the way the material was presented. In addition, we targeted 350 more delegates through invited presentations at four other workshops and seminars including the Australian Water Association's Worry Waters conference in Sydney; Murray-Darling Basin catchment workshop in Berri; the Environment Institute of Australia and New Zealand meeting in Adelaide; and the 2008 Winery Engineering Association conference in the Barossa Valley. These workshops have provided extensive interaction between the researchers and the wine industry.

LEARNING FROM INDUSTRY COLLEAGUES

The key speakers at the workshop included engineers, regulators and researchers from the wine industry.

Rosemount Wines in McLaren Vale, South Australia.
Photographs in this article courtesy of Shutterbug Studios.

It is important that winery staff know about the potential pollutants in winery waste to enable them to manage the waste stream effectively, so that the environmental impact can be minimised. Loss prevention, wastewater treatment and disposal systems are critical components of winery facilities that pursue environmental best practice. A systematic approach was used to discuss all aspects of winery wastewater management from source to re-use. Figure 1 represents some of the key issues that need to be addressed as well as opportunities for the winery wastewater management.

TACKLE THE SOURCE NOT THE SYMPTOMS

Waste minimisation is slowly being adopted in the wine industry, owing to a combination of powerful drivers, which are either internally or externally motivated. Best practices used for minimisation of winery wastewater load are based on reduce, re-use and recycle principles. Capture and re-use of caustic-based cleaning solutions when cleaning tanks is the most efficient way of reducing caustic re-use. Cleaner production initiatives that

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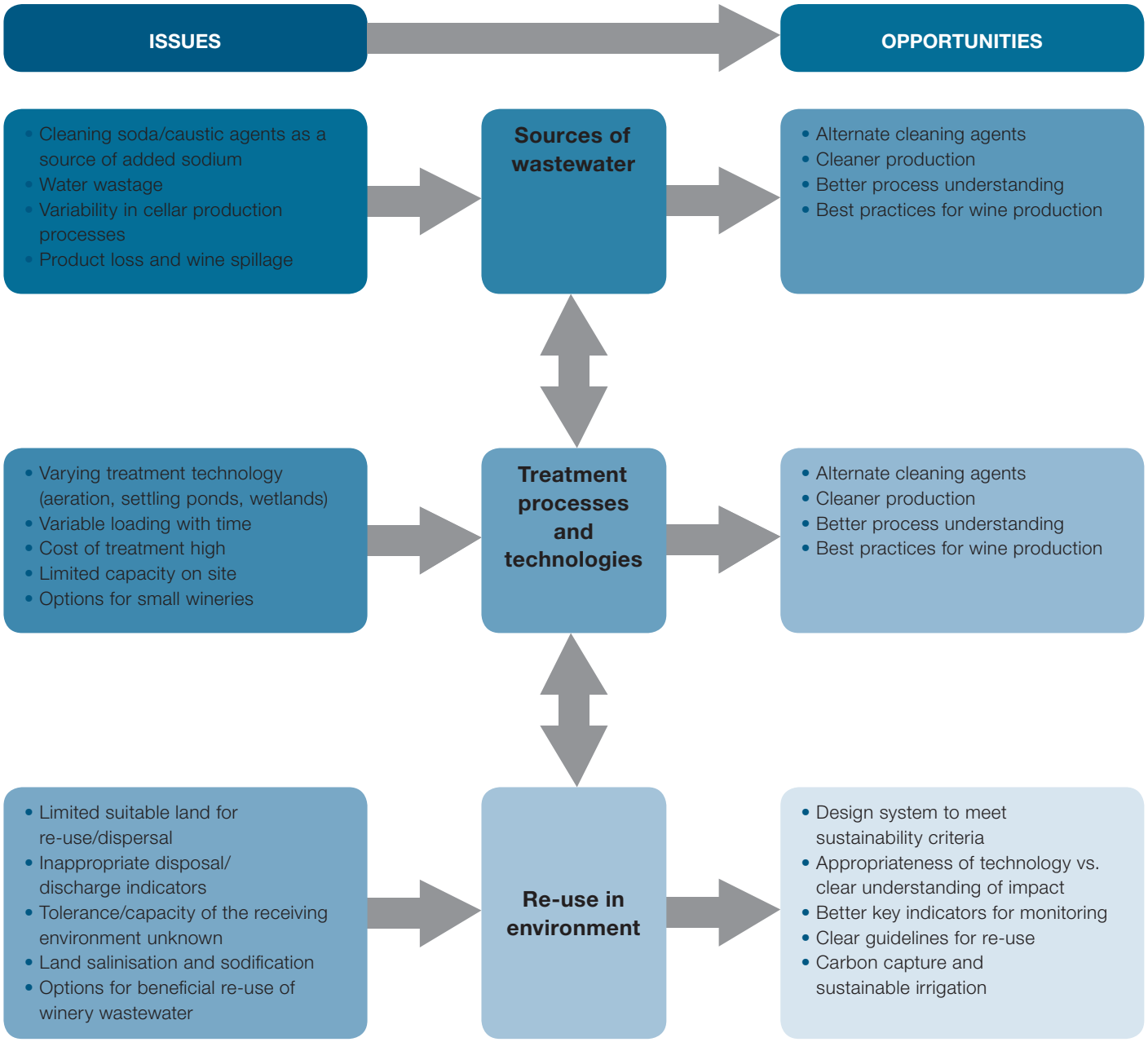


Figure 1. Current issues and opportunities for improving winery wastewater management.

reduce salt and organic load in the winery wastewater can make it fit for immediate irrigation with shandying, saving treatment costs. Technologies that are fairly simple, easy to adopt and can help in improving environmental performance are identified as 'low hanging fruits ready to be picked'.

There are several options to reduce water use within wineries and in turn, also reduce the volume of wastewater requiring treatment. For example, using brooms, squeegees and shovels rather than a hose to clean work areas are very effective in reducing water use. High pressure hoses use less water than low pressure hoses. Covering all drains with a suitable mesh to stop solid waste material going into the wastewater system is effective in reducing the wastewater load.

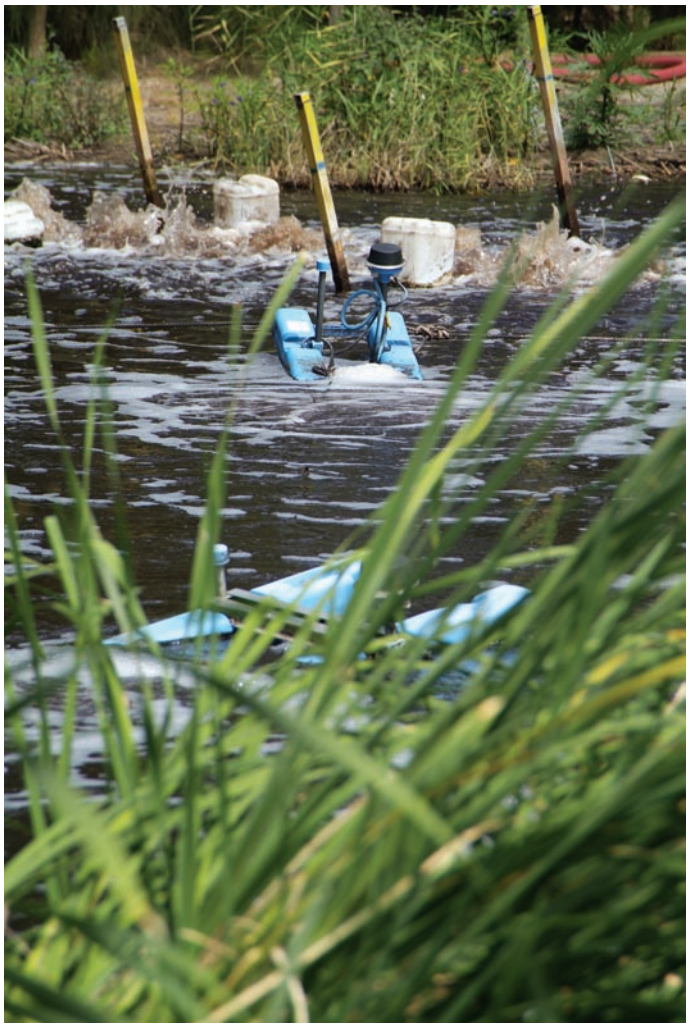
A significant amount of wine (up to 10%) can be lost within the winery due to spillage and transfers. Reduction of loss of product by using techniques such as pigging not only increase production but also reduce wastewater load.

Minimising waste produced is always a cheaper option than spending money on treatment capacity and operating costs. With a bit more effort, segregating strong wastes for separate offsite disposal can also reduce the size and cost of the treatment plant. The best practices that have been found to be effective by industry are discussed during the workshops.

TREATMENT NEEDS TO BE 'FIT FOR PURPOSE'

Each winery generates wastewater with a unique quality, quantity and seasonal variation pattern. The end use winery wastewater is the most important factor to consider when deciding on treatment options. Various treatment options and their limitations were discussed by an engineer during these workshops. A visit to local winery was also included in the workshop program.

For winery wastewater, there is no single best answer for the best method for treatment and disposal. Many engineered solutions have been developed that allow the physical, chemical and biological processes to occur in treatment facilities, which has the benefits of faster treatment, reduced



Hardys Tintara, wastewater treatment dam.

space requirement, high load capacities and minimising pollution risks. The best choice will include consideration of the critical issues, such as: chemical oxygen demand (COD) of the wastewater, flow rates, pH, seasonal variations, Federal/State regulations, and location constraints (including climate, topography, depth to groundwater, adjoining land, nature and properties of soils), scale of the winery operation/expansion plans, quantity of flow from the treatment plant, uses and existing quality of receiving waters, degree of mixing between plant effluents and stormwater, final uses of treated effluent (evaporation, sewer disposal or irrigation) and lifetime cost and benefits of the treatment options. The key drivers in choosing a wastewater treatment system are minimising capital costs, minimise operating costs and making the system as automated and 'robust' as possible, thereby minimising management requirements.

The treatment must be 'fit for purpose'. If the wastewater can be rapidly used for irrigation, only minimal treatment is required – removal of COD would be just using energy to make CO_2. On the other hand, if it is necessary to store the wastewater near an urban area, it may be necessary to remove the COD to control odour.

WETLANDS MAY HAVE A PLACE

There is balance that needs to be sought between the right level of treatment and storage of wastewater, such that it does not cause odour nuisance versus rapid disposal on the land through irrigation and the suitability of wastewater for irrigation. Guideline values for key indicators of winery wastewater quality for onsite and off-site disposal of winery wastewater were discussed during the workshops. Constructed wetlands have proven to be effective at removing solids, chemical oxygen demand (COD), neutralising pH and rendering wastewater of sufficient quality for irrigation re-use. For a successful wetland treatment, the design and capacity of a wetland system should be precisely matched to the characteristics and volumes of the wastewaters that are to be processed. A case study on wetlands was presented during the workshops.

RE-USE FOR IRRIGATION

Winery wastewater improvement for irrigation re-use is a keystone to the industry's environmental sustainability. The practices of irrigation of pastures, woodlots and grapevines with treated winery wastewater and land treatment of winery wastewater are becoming more common as a means to treat, dispose or recycle wastewater. It is important to use the current wastewater end use (i.e. irrigation) as the starting point when developing the winery wastewater plan, and to determine whether the current irrigation practice is beneficial or detrimental to the particular soil and crop. Some of these issues were discussed during the workshops.

SOIL LOVES BOD IN THE WINERY WASTEWATER

Biochemical oxygen demand (BOD) was selected in 1908 as the definitive test for organic pollution of rivers. Aquatic disposal of winery wastewater is no longer allowed, so most winery waste is destined for land-based disposal (whether this is for irrigation of vines, woodlots, grazing pastures, dates or other crops). Salinity, sodicity and pH are more important than BOD for land disposal. In fact, organic matter input coming to soil (BOD) is good for soil health and can counter some of the adverse impacts of salts. This means that producers may need not treat the winery wastewater to remove BOD all year round, especially during periods where there is sufficient capacity in the environment to receive partially treated wastewater.

Wastewater contains nutrients and, with the right treatment, can be a safe, affordable and sustainable source of irrigation water. Many wineries are considering the use of treated wastewater or wastewater that has only undergone primary treatment to produce a commercial benefit that does not lead to deterioration of soil or crop health. Grasses, root crops and cereals have been trialled by some wineries. Shane Philips from Thachi Wines in the Riverland has experimented with a variety of irrigated crops using treated wastewater. Examples include millet, sorghum, oats and turnips that produce a crop for stock feed in eight weeks. Such options were discussed as a case study during the workshops.

There are challenges in using irrigation water that is high in BOD – these include odour and clogging of the irrigation system.

WHAT TO MEASURE AND WHEN?

The variability of the influent quantity and quality of winery wastewater coupled with the intrinsic complexity of biological systems may prove challenging for operators that want to achieve cost-effective compliance. Operators need rapid and reliable quantitative indicators to tell them if their effluent falls within the allowable thresholds and if not, to diagnose, optimise and troubleshoot the plant processes. The suggested suite of key indicators includes pH, conductivity, dissolved oxygen (DO), turbidity and COD. BOD, while a useful indicator, is both expensive and has too large a lag time to assist with day-to-day management, so COD is suggested as a surrogate. During the workshops, the project team discussed the winery wastewater quality based on these key indicators and the need for different treatment processes. Such information is highly valuable in assessing the efficiency of different methods for removing organic loads and using wastewater as a resource for land irrigation.

When winery wastewater is used for irrigation, some soil monitoring is required. The workshop outlined cost-effective sampling schemes that are geared to detect both chemical and structural changes in the soil. Monitoring of the soil water status is an essential part of sustainable irrigation practice.

The presenters were conscious of the costs associated with monitoring. Low cost methods of monitoring were discussed and some cost-effective methods were suggested. These included use of a water quality meter for pH, EC and DO, simple field techniques for monitoring soil structure and ways of reducing laboratory costs.

KEEPING TABS ON SOIL CHEMISTRY THROUGH SAR

Sodium ion present in winery wastewater can accumulate in soil and with time, the sodicity can cause dispersion of clay particles leading to seriously impaired soil water intake and poor soil fertility. Sodium and consequently, high sodicity in treated winery wastewater for land irrigation, is mainly caused by chemical use within the winery and salinity of the processing water. The sodium adsorption ratio (SAR) of irrigation water is a good indicator of sodicity, or the sodium status that will occur in the soil. 'Tackle the source not the symptom' is a clear message for wineries using this wastewater as a resource.

Replacement of sodium with potassium is not a real solution as both being monovalent cations have similar effects. A literature review has been compiled to assess the fate of potassium in plant-soil systems after application of wastewaters. Disposal of high potassium wastewater in soil with low content of selective adsorbing minerals will create high concentrations of potassium in solution with potential effects on soil structure and potassium mobility. However, the effect of disposing high potassium effluents versus high sodium effluents on soil structure is still not fully understood.

The current recommendation is to minimise the use of both sodium and potassium, and if necessary adjust the wastewater by adding calcium or magnesium. This is an area of ongoing research.

REFERENCE MATERIALS AVAILABLE AT WORKSHOPS

During the workshops, participants received presentation hand-outs and additional information on the course modules. The courses were delivered using indoor instructions and group discussions. Hands-on exercises regarding calculations of key winery wastewater characteristics, environmental ranking and risk assessments relevant to winery wastewater management were also included in the workshop program. The highlights of all the workshops have been the presentations given by experienced researchers and passionate practitioners. These have provided an excellent grounding for participants to not only to gain knowledge on the current piece of research, but to continue to develop an environmental culture and contribute towards sustainability of the wine industry and its 'clean and green' image.

Much of the information concerning the environmental impact has been incorporated into an index that rates the environmental performance of a winery. The index has been formulated in a self-documented, easy-to-use worksheet that is currently available for Beta testing.

FUTURE WORKSHOPS

Further workshops are planned for the first half of 2009 to cover Sunraysia, Great Western region of Victoria, Tasmania, Hunter Valley, Adelaide Hills and southern Queensland. The feedback from participants has been very good, and they have also been a fruitful source of ideas for the research team. Depending on the availability of funding, it is hoped that these workshops can continue so that the researchers can continue to partner with wine producers, both in setting research priorities and sharing information on the best practice in winery wastewater management.

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Information regarding forthcoming workshops can also be checked on the website www.clw.csiro.au/conferences/winery/

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