Factsheet

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Managing the microbiology of winery wastewater treatment systems

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Key messages

- Prevent problems by managing solids in the winery (i.e. don't flush out lots of yeast solids, take care when using activated carbon).
- Prepare for vintage (i.e. conditioning the wastewater system ahead of peak loading by dosing nutrient).
- Monitor the flowrate and composition of the influent wastewater (i.e. conduct analyses to help with control).
- Vary the influent carbon source and maintain the correct carbon (C) to nitrogen (N) ratio (i.e. dose with various carbon sources or dilute influent as necessary for C:N of 60:1).

Background

Waste water is generated at all stages of winery operations including crushing and pressing of grapes, wine processing and bottling. Waste streams are extremely variable in volume and quality and include non-water waste such as cleaning agents, grape marc and lees.

Microbiological treatment of winery wastewater is common but is poorly understood and can be difficult to manage effectively. A collaborative project between the University of Adelaide, CSIRO Land and Water and JJC Engineering was established to provide the sector with practical strategies based on an improved understanding of the microbiology of winery wastewater treatment processes. The project focused on aerobic wastewater treatment processes, and the key findings relate to those types of treatment plants.

What have we learned about the causes of poor performance?

Winery wastewater presents particular and unique challenges to wastewater microbiology because of the large variations in composition and flow rate of influent to the treatment system. For example, in many wineries, the flow rate and composition during and just after vintage can be much greater than that experienced throughout the rest of the year, which can 'shock' the microbial population and lead to a breakdown in performance. Better management of these parameters can help to avoid failure.

One of the most serious symptoms of poor performance is poor settling of the treated supernatant (the liquid lying above a solid residue), which is now known to be caused by particular types of bacteria. These are the so-called 'G-bacteria' (belonging to the groups *Alphaproteobacteria*, *Actinobacteria* and *Gammaproteobacteria*) that have been observed to be the cause of similar problems in other types of wastewater treatment (e.g. municipal wastewater). Maintaining diversity in the microbiological population and avoiding the proliferation of these 'G-bacteria' so that they do not dominate, can help to avoid poor performance (Figure 1).

Maintaining diversity in the carbon and nutrient substrates of influent is critical to ensuring a balanced and correctly functioning microbiological population. Managing the influent feed, by monitoring it through timely and appropriate analytical methods, therefore provides a means of avoiding treatment failure.

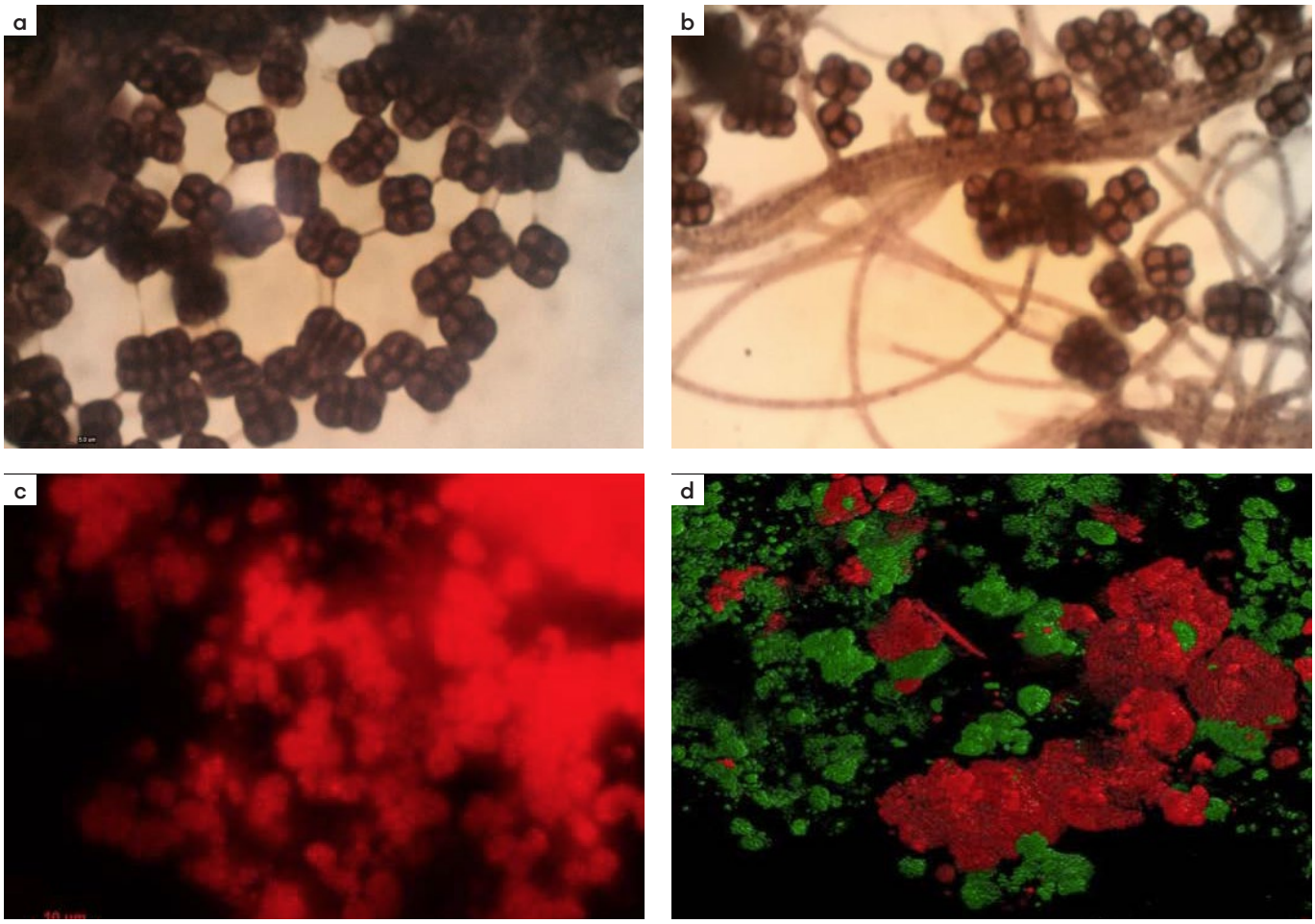

Figure 1 (a, b) Different phylotypes of G-bacteria (c) Fluorescent tag used to detect G-bacteria (d) Mixture of bacteria in wastewater treatment plant.

What can I do to avoid problems?

The project examined a wide range of winery wastewater treatment plants across the country, and it became clear that each is unique in terms of loading, capacity and the dynamics of the microbiological population (for example, Figure 2). Therefore, it is not possible to define a universal set of operating guidelines that will be applicable to every situation. Nonetheless, there are some general principles that can be used to help minimise the risk of process failure.

Solids management in the winery

Solid materials that are often present in winery wastewater can have a detrimental effect on microbial performance.

Firstly, the presence of large quantities of wine yeast in the influent was strongly associated with poor settling of treated wastewater. Therefore, wineries should try to avoid washing out large amounts of yeast in lees to their wastewater treatment plants. This can be achieved by using various standard techniques of clarification including centrifugation and filtration.

Importantly, activated carbon can also have a profound effect if used in the winery and then flushed out as winery effluent. The activated carbon absorbs a range of chemicals from the wine, which are then released once it reaches the wastewater plant. This causes a sudden surge in loading on the microbiological population leading to 'shock' and a resulting decline in performance. Care should be taken when activated carbon is used to prevent its impact on the wastewater treatment system.

Managing (and monitoring) the influent wastewater

Sudden surges in the flowrate and composition of the influent wastewater can have a profound impact on performance. Such surges are very common as the wine-making process is seasonal in nature.

The flow rate of the influent to the wastewater treatment plant should be monitored and severe volume surges managed by the use of buffer storage vessels (e.g. tanks or deep lagoons).

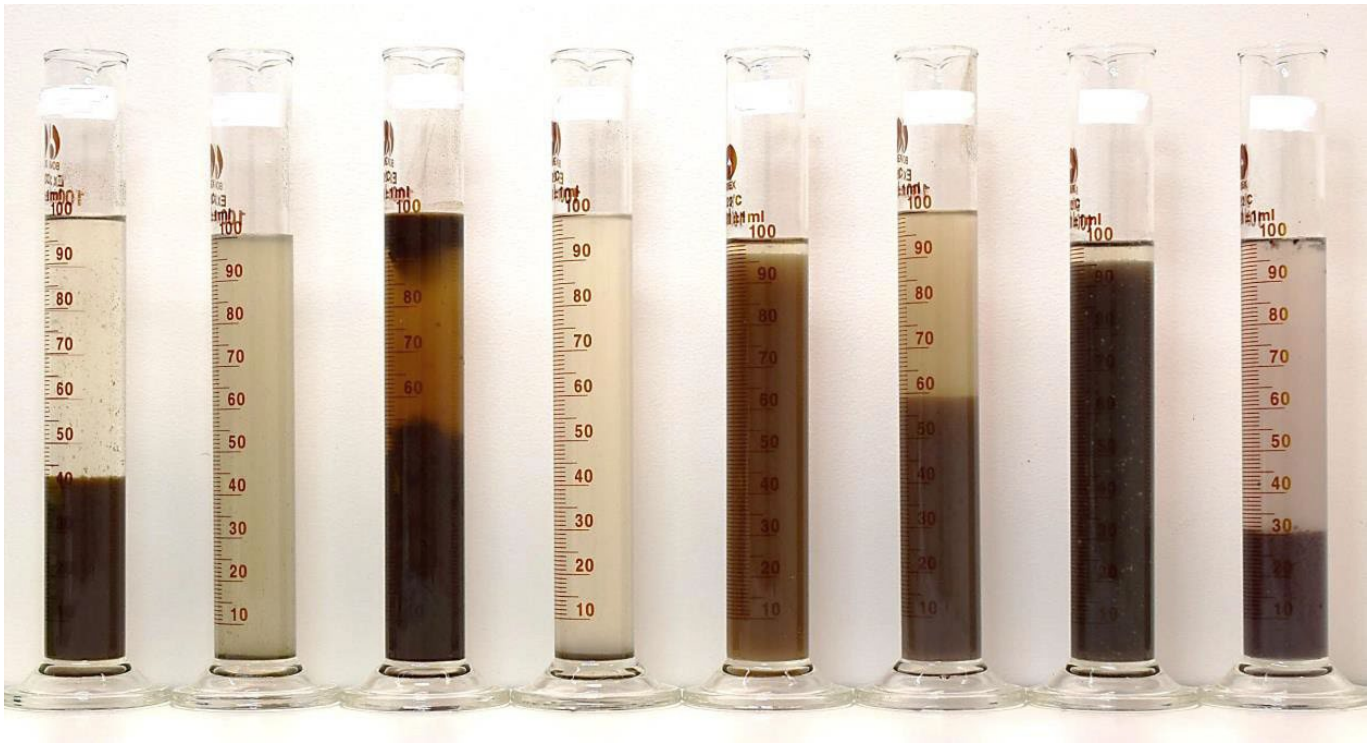

Figure 2. Sludge volume differences between wastewater treatment plants.

The same can be said for the composition of the influent wastewater, which should be monitored using a couple of key parameters. The influent can then be adjusted to prevent a sudden 'shock' in the carbon or nutrient levels. The most important parameters that should be measured are COD (chemical oxygen demand) and the turbidity. It is possible to measure these relatively easily using a spectrophotometer – with a test kit for COD, and by using absorbance at 650 nanometres as a measure of turbidity.

An important finding of the research project was that the ideal carbon-to-nitrogen ratio for winery wastewater is vastly different from that in municipal wastewater. Winery wastewater treatment plants should aim to maintain a carbon to nitrogen ratio of 60:1 to encourage healthy performance of the microbiological population.

The types of carbon substrates present in the influent wastewater can have an impact on performance. Using a range of substrate types will encourage more diversity in the microbiological population, which is necessary to maintain performance of the treatment system.

Therefore, when dosing with nutrients in response to low carbon, a range of sources (such as urea, molasses, sugar or other carbon rich material) should be used and this should be varied throughout the year. Importantly, preconditioning of the wastewater microbiological population by increasing the chemical load through dosing should be conducted ahead of the predictable surge during vintage.

Acknowledgements and further reading

This information was compiled by Mark Gishen, drawing on and highlighting the outcomes from Wine Australia project UA1301. The final report of the project can be found here.

Outcomes from the project reinforced previous material and practices. More detailed information can be found in the Operational Guidelines for winery wastewater treatment.

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