EVALUATION OF TARTRATE STABILISATION TECHNOLOGIES FOR WINE INDUSTRY

by

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SUMMARY

In the Australian wine industry, cold stabilisation is a widely used industrial process to prevent tartrate instability in bottled wines. This process involves cooling the wine close to its freezing point for extended periods, thereby inducing tartrate precipitation. However, it has several important disadvantages. Consequently, alternative methods to cold stabilisation have been developed. This includes electrodialysis, nanofiltration and contact processes.

In this study, current knowledge regarding performance and cost of cold stabilisation and alternative technologies for tartrate stabilisation is reviewed. Whilst there have been occasional cost comparisons between cold stabilisation and alternative technologies, existing data is not suitable for properly evaluating the relative economics of the different process options. Therefore, alternative technologies to cold stabilisation, including the Westfalia process, nanofiltration and electrodialysis were compared for both technical and economic performance. Berri Estates Winery was used as the basis for engineering calculations and conceptual cost estimates. This is the first time that such a comprehensive evaluation has been undertaken of a broad range of alternative technologies for tartrate stabilisation during wine production. Product loss was a key cost driver in differentiating tartrate stabilisation processes. Cold stabilisation was found to be the most economic treatment process irrespective of scale or winery size. The Westfalia process and nanofiltration were the next most cost effective options.

Data for economic evaluation and environmental assessment were summarised in a survey form that was circulated to technical experts from Hardy Wine Company, the Australian Wine Research Institute (AWRI) and the University of Adelaide. The purpose of the survey was to obtain the experts' opinions on the merits of the alternative technologies. The results of this survey were used for comparison between current cold stabilisation and alternative technologies, by performing multi-criteria decision analysis (MCDA). This represents an original application of MCDA techniques to decision making in the wine industry. The MCDA analysis identified a strong preference by experts for nanofiltration combined with centrifugation as an alternative to cold stabilisation.

As a consequence, laboratory investigations and field testing of nanofiltration were conducted to obtain new and practical information which was not presently available and relevant to understanding and implementing this process for tartrate stabilisation of wine.

The laboratory experiments were performed with a range of membranes and tartrate unstable wines (i.e. *Semillon*, *Colombard* and *Shiraz*) using a purpose-designed laboratory-scale continuously-stirred batch-test membrane cell. The results showed that a range of commercial nanofiltration membranes with a nominal molecular weight cut-off (MWCO) between 200 and 500 Daltons (Da) were able to achieve tartrate stabilisation of all wines tested. This was achieved at moderate pressures less than 20 bar with a recovery of at least 50 %. It was also observed that seeding of wine following nanofiltration might reduce the holding time required to achieve stability and also enable reductions in the recovery rate to values of less than 50 %.

The field testing was performed at Berri Estates Winery in the Riverland region of South Australia. The testing was performed using an existing commercial membrane system. This membrane system was already used for juice/wine concentration. The nanofiltration membranes had a nominal MWCO of 300 Da. The testing was conducted on *Colombard* and *Shiraz* wines. The field tests confirmed that nanofiltration could successfully tartrate stabilise *Colombard* and *Shiraz* wines at recoveries of 50 %; without seeding; within relatively short holding periods of less than four hours; and at flux rates between 5 and 10 $L/m^2/h$. Crystallisation kinetics were also studied. At low recovery, the crystallisation was initially controlled by diffusion step, then surface integration. However, at high recovery, the crystallisation was controlled solely by surface integration.

Sensory testing (by duo-trio difference tests) produced adverse sensory outcomes when compared with treatment of the same wines by cold stabilisation. Unfortunately, it could not be established whether this problem was inherent to the process or arose from unrelated factors. Setting aside the adverse sensory result, this is the first time that technical feasibility of nanofiltration for tartrate stabilisation has been successfully demonstrated.

Further field testing and sensory evaluation of nano-filtered wines should be carried out to verify the effect of nanofiltration on wines. If the process is successful and favourable, the process design for implementation of a production scale nanofiltration for tartrate stabilisation should then be optimised.

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LIST OF PUBLICATIONS

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