

THE ULTIMATE BARREL CLEANING AND SANITIZATION TECHNOLOGY

**Paper presented by Andrew Yap, Oenologist and
R & D Director, Wine Industry Ultrasonics at the
WEA National Conference 2012 held in the
Barossa Valley, South Australia on 20th and 21st
June 2012
(Abridged version)**

Short Bio. – Andrew Yap

Current activities

- ❑ Oenologist and R & D Director, Wine Industry Ultrasonics
- ❑ Hon. Visiting Lecturer in Wine Science, The Uni. of Auckland, 2003-present

Previous employment

- ❑ Director of Oenology and Industry Marketing, and Co-Founder of Cavitus Pty Ltd, 2003-2010
- ❑ Senior Lecturer in Oenology, The University of Adelaide, 1991-2002
- ❑ Senior Lecturer in Wine Microbiology, Former Roseworthy Agricultural College (RAC), 1976-1990
- ❑ Head, Department of Viticulture and Oenology (RAC), 1985-1986

Recent conference presentations

- ❑ 60th ASEV Annual Meeting, June 2009, Napa Valley, CA
- ❑ WEA National Conference, June 2008, Barossa Valley, SA
- ❑ 13th Aust Wine Industry Technical Conference, July 2007, Adelaide, SA
- ❑ 3rd Innovative Food Centre Conference, Oct 2006, Melbourne, VIC

Awards

- ❑ Winner of Best oenology research paper Award published in Volume 62 (2011) of American Journal of Enology and Viticulture.

Ultimate Barrel Cleaning and Sanitization Technology

- ❑ **High Power Ultrasonics scientifically proven to be the most powerful and efficient technology for the cleaning and sanitizing of barrels (both actions occur simultaneously).**
- ❑ **>5 years (2006- 2011) intensive research and field trials by Cavitus P/L.**

Technological Development, Innovation and Advancement – Sanitary Status of Barrels

- ❑ Extensive surveys in Australia and California to establish sanitary status of barrels, post-cleaning by popular traditional methods, in particular, high pressure hot water (HPHW) and newer methods such as dry-ice blasting. >1000 barrels examined.

- ❑ Widely adopted cleaning and sanitization technologies and/or methods over the ages
 - ✓ Found to be wanting
 - ✓ Inadequate and inefficient for removing tartrates, microfilms and yeast lees from barrels, and killing spoilage microorganisms
 - ✓ Resulting in considerable loss of revenue for wineries due to shortened barrel life, loss in wine quality, complete loss of wine, longer maturation times, etc.

Ineffective and Inconsistent Tartrate Removal by HPHW (2000 psi, 65-80C)



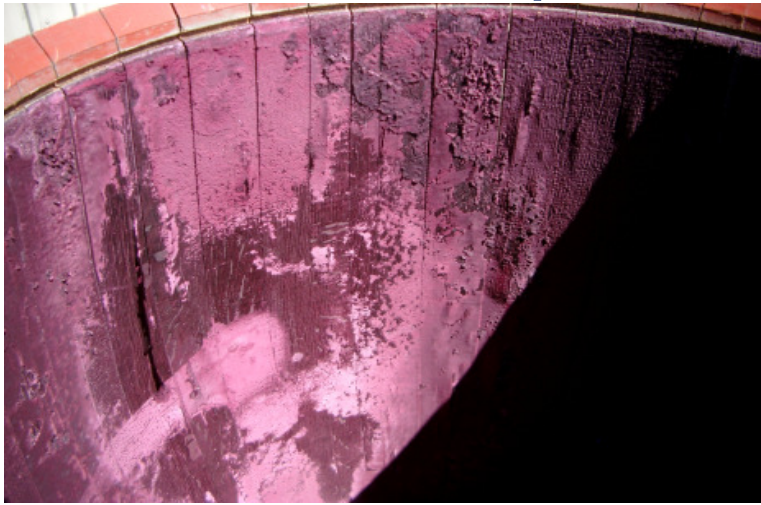
1-yr old barrigue



4-yr old barrigue



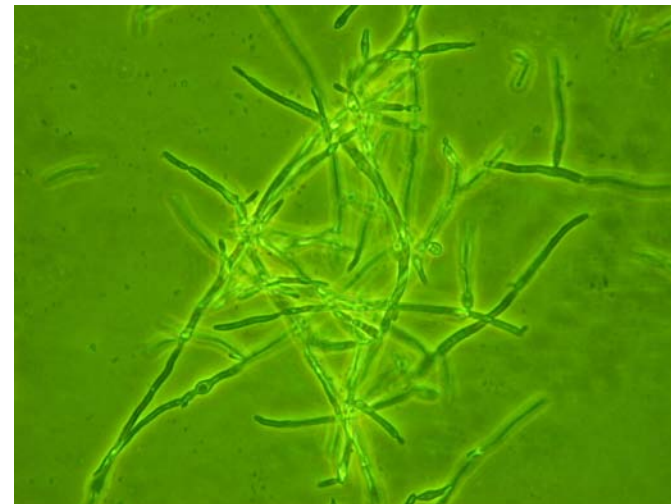
3-yr old barrigue



5-yr old barrigue

Technological Development, Innovation and Advancement – Research

- Extensive research by AWRI, Uni. of Adelaide and UNISA to validate the efficacy of HPU in removing tartrates and solid deposits and killing *Brettanomyces* (*Brett*) (2006-2007) on surfaces and subsurfaces; and study effects of HPU on oak wood.





Technological Development, Innovation and Advancement – Lab and Field Trials

- Extensive laboratory trials by AWRI and universities to compare the efficacies of HPU and HPHW (2006-2008).
- Extensive comparative field / winery trials in CA, Aust, Spain and NZ (2008-2011) with Beta-prototype and mobile units.

Technological Development, Innovation and Advancement – Research Data and Publications

- ❑ Ten papers published in scientific (refereed) and wine industry technical journals in Australia, California, Spain and Greece from 2007-2011.**
- ❑ Best Enology Research Paper in AJEV 2011 – Awarded by ASEV. Award being presented at ASEV Conference in Oregon today.**
- ❑ Data from research and trials presented in four scientific conferences in Aust and CA.**
- ❑ Research cited in Scientific American, International Food Technology, Biotechnology Letters, and others.**

High Power Ultrasonics Technology

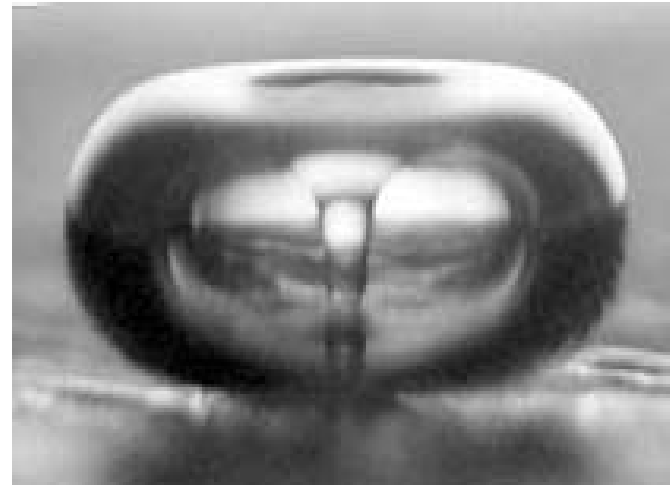
- ❑ Energy for cleaning and microbial destruction from high power ultrasound (20 kHz – 100 kHz) – clean, green, safe technology; no OHS issues

- ❑ Numerous industrial and medical applications of high power ultrasonics (HPU) since 1950s, including:
 - ✓ cleaning, microbial destruction, pasteurization
 - ✓ colour and flavour extraction, fermentation enhancement, enzyme activation / deactivation, de-foaming
 - ✓ ultrasonography, phacoemulsification, lithotripsy

- ❑ Energy for ultrasound activity derived from “cavitation”

High Power Ultrasound – How does it work?

- ❑ Sound waves causes micron-size bubbles to expand and contract to the point where the bubbles implode (=cavitation)
- ❑ Happens thousands of times per second.
- ❑ Very high pressure (up to 2000+ atmospheres) & temperature (up to 5000+ Kelvin) generated at time of implosion – localized; and creation of a fast moving high-shear energy wave (speeds up to 570 kph).



High Power Ultrasound – How does it work?

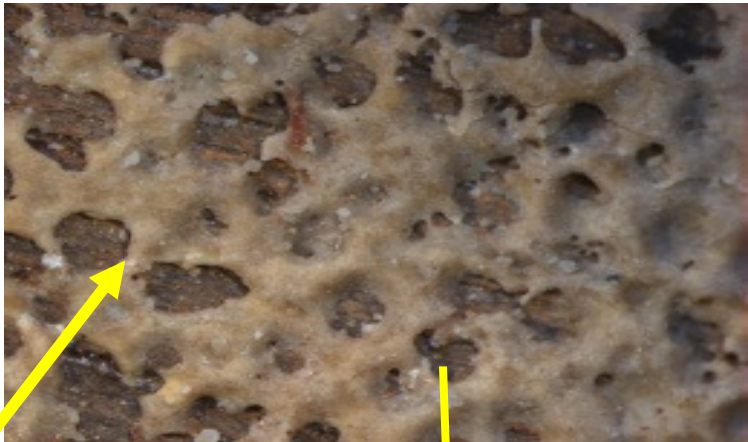
- ❑ Cavitation generates shock waves, micro-jetting, micro-streaming and enormous fast-moving shear forces.
- ❑ Cavitation occurs within the body of the fluid, at surfaces of particles and within the structure of solid components, tissues, microbial cells and wherever liquid is present (8-14 mm staves).



Cavitation (Cleaning) Action of HPU on Tartrate-coated Surface of a 6-year old White Wine Barrel



Uncleaned staves – hard tartrate deposit



5 mins HPU at 40C - 5% KHT removed (magnified 400X)



Section of KHT-covered stave (magnified 400X)



8 mins HPU – 100% KHT removed (magnified 400X)

Efficacy of HPU in Removing Tartrates from a 5-year old Red Wine Barrel

Before HPU treatment



After HPU treatment for 10 mins



Efficacy of HPU in Removing Tartrates from a 3- year old White Wine Barrel

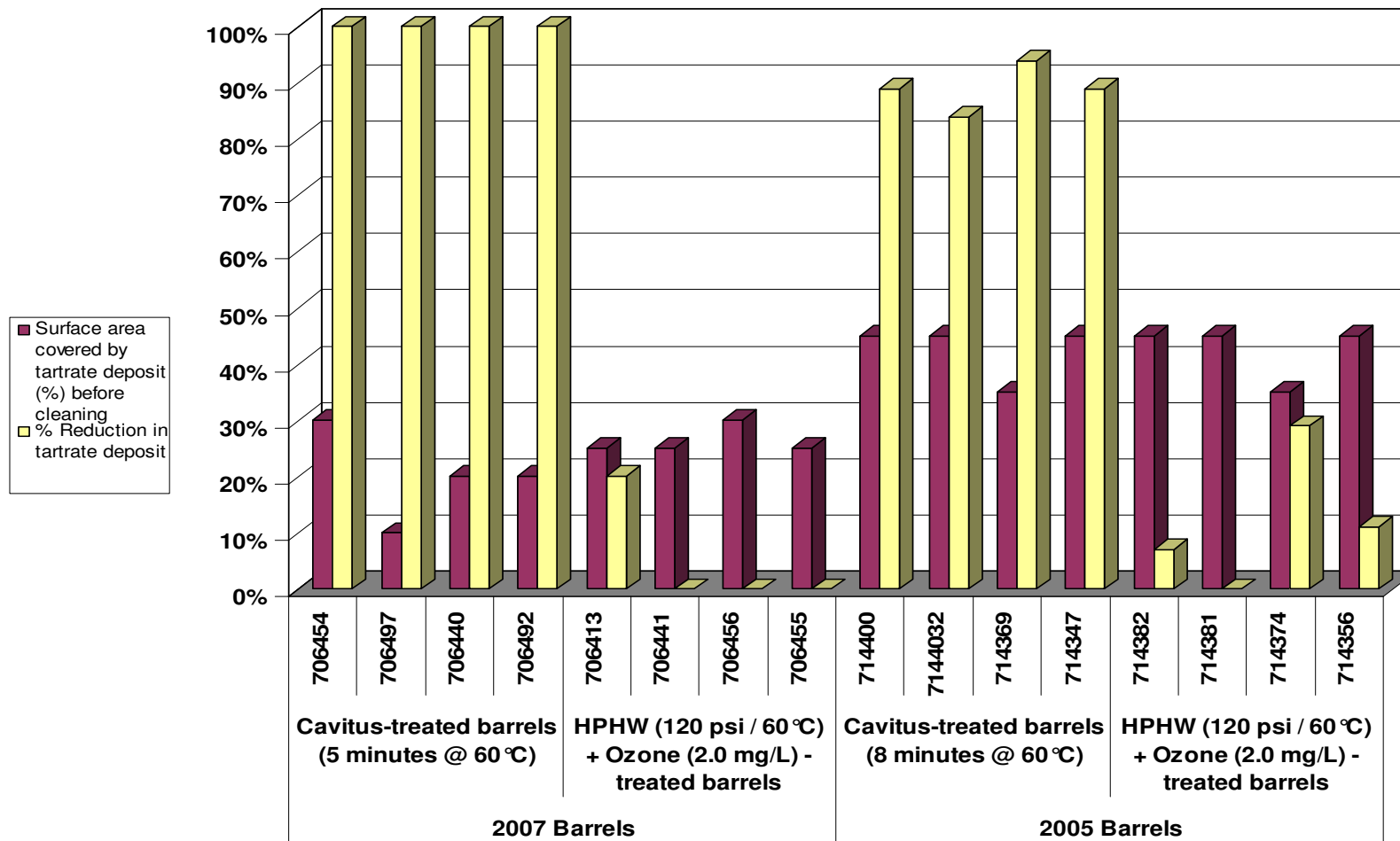
Before HPU treatment



After HPU treatment for 10 mins



Comparative Removal of Tartrate Deposits by HPU and HPHW from Surface of 1-yr old (2007) and 3-yr old (2005) Red Wine Barrels – CA Winery (Monterey). Q4 2008.



**Comparative Study on *Brett*-Infected 2-, 3- and 4-year old Red Wine Barrels at a Napa Winery – Ozone treatment (following HHPW cleaning) vs HPU.
(Viable *Brett* cells determined by plating method)**

HPU-treatment @ 60C			High Pressure Hot Water + Ozone Treatment		
Sample ID	Viable cells/mL pre-cleaning	% reduction post-cleaning	Sample ID	Viable cells/mL pre-cleaning	% reduction post-HPHW cleaning (82 °C) + Ozone (3.5 mg/L for 4 mins)
CAV101	135,750	99.997	OZ101	253,530	TNTC
CAV102	154,150	97.3	OZ102	218,640	TNTC
CAV103	4,698,260	99.999	OZ103	359,880	TNTC
CAV104	1,166,160	96.7	OZ104	245,410	TNTC
CAV105	591,440	99.96	OZ105	80,640	TNTC
CAV106	314,970	99.97	OZ106	243,130	TNTC
CAV107	67,950	97.8	OZ107	347,810	TNTC
CAV108	141,000	99.3	OZ108	108,840	TNTC
CAV109	144,880	99.997	OZ109	118,070	TNTC
CAV110	311,810	97.2	OZ110	189,440	TNTC
CAV111	383,790	100.0	OZ111	130,790	99.94
CAV112	167,739	99.998	OZ112	411,520	TNTC

All trials conducted in 2009; subsequent ozone trial at 7.6 mg/L provided 1-log kill in 75% of barrels treated (data not shown in this table)

Why is HPU superior to all other cleaning and sanitization technologies and methods?

- ❑ **Cleaning efficacy**
- ❑ **Sanitization / disinfection efficacy**
- ❑ **Wine quality**
- ❑ **Preservation efficacy**
- ❑ **Environmental benefits**
- ❑ **Economic benefits**

Why is HPU superior to all other cleaning and sanitization technologies and methods?

□ Cleaning efficacy

- ✓ Cleans and disinfects simultaneously, i.e. one-step operation. Efficacy 5X better than HPHW.
- ✓ Uniform cleaning – no ‘hit-or-miss’ action.
- ✓ Cleans surfaces, porous interior structures, joints, cracks (by breaking down hard tartrate deposits and microfilms formed by *Brett* and other spoilage microorganisms)
- ✓ Removes and dislodges particulate matter (tartrates, dead and live microbial cells) from pores, blisters, joints and cracks. Unclogs pores
- ✓ Removes taint compounds (e.g. VA, TCA and *Brett* taints, etc.) to refresh and revitalize barrel.
- ✓ Does not damage wood surface and pores.
- ✓ Cycle time/barrel (225 L, 1-year old) is 5 minutes.

Why is HPU superior to all other cleaning and sanitization technologies and methods?

- ❑ **Sanitization / disinfection efficacy**
 - ✓ **Destroys *Brettanomyces*, other spoilage yeasts, acetic acid bacteria and lactic acid bacteria on the surface, and in cracks, pores and joints.**
(*Note: There is no scientific data supporting the efficacy of ozone, microwaves, electromagnetic radiation, ultra-violet light and dry ice in killing *Brett* or other spoilage microorganisms in barrels. OHS issues with ozone.*)
 - ✓ ***Brett*-infected barrels cleaned by HPU do not show *Brett* growth in sterilized wines matured in them compared to barrels cleaned by HPHW, HPHW followed by steam and HPHW followed by ozone treatment.**

Why is HPU superior to all other cleaning and sanitization technologies and methods?

- ❑ **Wine quality – assessments (blind tastings) by sensory panels in California, Australia and Spain**
 - ✓ Better quality wines from HPU-cleaned barrels.
 - ✓ Wines have cleaner and fresher nose and palate, more intense fruit flavours and more appealing complexity.

- ❑ **Preservation efficacy**
 - ✓ Retains significant levels of toasted flavour compounds. (*Note: HPHW and other technologies erodes and wastes valuable toasted compounds during cleaning and causes premature barrel disposal.*)
 - ✓ Faster oak flavour transfer
 - ✓ Extends barrel life
 - ✓ Better oxygen transfer

Why is HPU superior to all other cleaning and sanitization technologies and methods?

□ Environmental benefits

- ✓ No additives or chemicals, thus eliminating need for their special disposal, as well as reduced costs
- ✓ Adds to the sustainability efforts of the businesses which embrace it.

□ Economic benefits

- ✓ Low energy consumption (<3.5 kWh / barrel).
- ✓ Low water consumption (c. 4L / barrel).
- ✓ Decreased product and barrel spoilage
- ✓ Reduced annual barrel replacement expenditure
- ✓ Short cleaning cycle.
- ✓ Low labor cost.

Testimonials

- ❑ ***“High power ultrasound has become a credible and effective technology alternative for removing tartrates and destroying Brettanomyces in wine barrels”*** - Professor Ken Fugelsang, California State University, Fresno, CA, September 2008.
- ❑ ***“In summary, the potential of the technology to maintain a major winery asset, i.e. oak barrels, in sound clean condition and to minimize spoilage is substantial”*** – Dr Terry Lee, 2007. Formerly VP of Research and Technology, E & J Gallo, CA., Director, AWRI and Professor of Oenology, The University of Adelaide, 2007.

Testimonials

- ***“Having seen Cavitus cleaning system in operation during trials in Californian wineries and after having reviewed the trial data, I believe that Cavitus’ innovative technology could help industry overcome Brett problems arising from barrel maturation of red wines and also extend barrel life.”*** – David Hayman, Snr VP, Wines Operations, Diageo, Chateau and Estate Wines, June 2009.
- ***“I definitely think this technology has a great deal of potential in the industry..”*** Robert Tracy, Managing Partner, BevTrac Mobile Quality Systems, California, 2009

Testimonials

- ❑ ***“To be honest, I think the results that we have obtained so far indicate that the HPU system is working... Brett is growing in the non-treated barrels...”*** - Andrew Miller, Wineries Technical Manager, Pernod Ricard Premium Wine Brands, May 2012.
- ❑ ***“..the lab results indicate that Brett cells have been eliminated from the ultrasonics with no detrimental effects to the sensory aspects of the wine.”*** - Andrew Miller, Wineries Technical Manager, Pernod Ricard Premium Wine Brands, Mar 2012.
- ❑ ***“...After cleaning, the smell of fresh oak is obvious, even from wood that is several years old and that has not been cleaned for some time.”*** - Dr. Terry Lee, Formerly VP of Research and Technology, E & J Gallo, CA., Director, AWRI and Professor of Oenology, The University of Adelaide, 2007.

Quote

- ***“Current wine barrel cleaning technology on the market has been known to be ineffective for 20 years, but winemakers do not have an alternative”*** – Large US wine equipment distributor, April 2008.

Publications

- ❑ Yap, A.; Jiranek, V.; Lee, T.; Grbin, P.; Barnes, M. and Bates, D. (2007a) Cleaning / disinfection of oak barrels / oak adjuncts with high-power ultrasonics. Practical Winery and Vineyard. November/December: 1-9.
- ❑ Yap, A.; Jiranek, V.; Grbin, P.; Barnes, M. and Bates, D (2007b) Studies on the application of high power ultrasonics for barrel and plank cleaning and disinfection. Aust. NZ Wine Ind. J. 22(3): 95-104.
- ❑ Yap, A., Schmid, F., Jiranek, V., Grbin, P. and Bates, D. (2008) Inactivation of Brettanomyces/Dekkera in wine barrels by high power ultrasound. The Australian and New Zealand Wine Industry Journal 23(5): 32-40.
- ❑ Jiranek, V., P. Grbin, A. Yap, M. Barnes, and D. Bates. 2008. High power ultrasonics as a novel tool offering new opportunities for managing wine microbiology. Biotechnol. Lett. 30:1-6.

Publications

- ❑ Yap, A. and Bagnall, W. (2009) High power ultrasonics: a new and powerful tool for removing tartrate deposits and killing viable *Brettanomyces* cells in barrels. *The Australian and New Zealand Wine Industry Journal* 24(5): 29-39.
- ❑ Yap, A. (2009) Cleaning and disinfecting barrels with high power ultrasonics: a new industry benchmark. *The Australian & New Zealand Grapegrower & Winemaker Issue 551*: 89-93.
- ❑ Yap, A., Wright, W. and Kilmartin, P. (2010) Protecting and maximizing the potential value of your wine and barrel assets by high power ultrasonics. *The Australian & New Zealand Grapegrower & Winemaker, Issue 557*: 73-80.
- ❑ Schmid, F., Grbin, P., Yap, A. and Jiranek, V. (2011) “Relative Efficacy of High-Pressure Hot Water and High-Power Ultrasonics for Wine Oak Barrel Sanitization”. *Am. J. Enol. Vitic.* 62:4. (Awarded best oenology research paper by American Society of Enology and Viticulture for 2011).

THANK YOU

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