

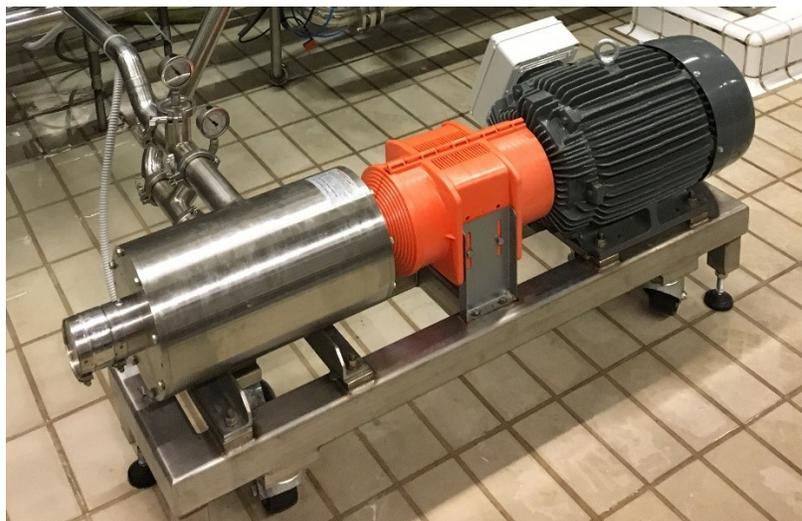
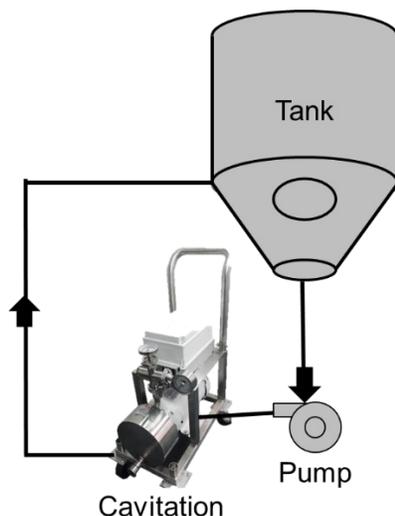
XTRACTMOR

A Hydro Dynamics Company

Accelerated Aging of Wine Using Cavitation

Using the force of cavitation, the ShockWave Xtractor™ (Xtractor) can significantly accelerate and catalyze wine aging, allowing flavor transitions that often take years to develop to happen in minutes. This allows companies to sell wines with aged or barrel flavors immediately barrel with less loss due to evaporation.

The Xtractor contributes to aging in several ways. In addition to extracting flavors and colors from wood, it also helps catalyze the natural esterification and oxidation reactions required for a complete aged flavor. The aging process is as simple as pumping the product through the device either alone or with wood chips. More cavitation time and/or intensity results in increased aged flavor.



Other flavors such as spices, fruits or other botanicals can also be processed through the Xtractor allowing wineries to use less of these ingredients to achieve the same flavors. The technology has also been used commercially on wines with undesired flavors, allowing producers to remediate and conceal wine faults. The Xtractor can also assist in many other processes including extraction of grape skins or the mixing of additives like bentonite or flocculants.

Test Data

Tests were conducted on a red cabernet wine with cavitation only and with wood chips. Approximately 10 gallons of wine was processed through the Xtractor in a recirculation loop at approximately 10 gallons/min and 1500 rpm on a 14x2 SR Xtractor. For the wood experiments 0.4 pounds (2.5 pounds/barrel) of small oak chips were added. Samples were filtered immediately to remove wood chips.

Analysis of the wine samples was conducted by Marsili Consulting Group using GC-TOFMS. The data below shows the chemical transformation that occurred in a wine in just 3-6 minutes processing.

Legend:	W	Chemicals extracted from wood/oak barrel during aging
	E	Ester
	A	Alcohol
	C	Control
	1	Cavitation only for 3 minutes
	2	Cavitation plus 2.5 lbs/barrel wood chips for 3 minutes
	3	Cavitation plus 2.5 lbs/barrel wood chips for 6 minutes

Chemical Class	Name	C (ppb)	1 (ppb)	2 (ppb)	3 (ppb)
W	o-Cresol	0.00	0.00	0.00	0.40
W	Anisole	0.28	0.00	0.12	0.36
W	p-methyl anisole	0.00	0.00	0.17	0.13
W	Salicylaldehyde	0.00	0.00	0.90	0.00
W	o-Guaiacol	0.00	0.00	0.00	11.34
W	p-Cresol	0.10	0.00	0.00	0.80
W	Creosol	0.63	0.48	1.26	3.10
W	4-Ethyl guaiacol	0.00	0.00	0.00	0.84
W	Homovanillyl alcohol	0.04	0.00	0.00	0.00
W	cis-Oak lactone	3.11	2.25	11.59	33.77
W	Eugenol	0.00	0.43	1.05	0.65
W	Syringol	1.14	0.60	1.03	5.06
W	trans-Oak lactone	4.19	5.79	11.88	30.78
W	Vanillin	0.00	0.00	3.59	4.14
W	Ethyl vanillate	0.00	0.00	8.31	13.22
W	Butyrovaniellone	0.00	0.00	2.42	7.04
W	Syringaldehyde	0.00	0.00	1.61	2.11
W	4-Allylsyringol	0.00	0.00	0.00	0.44
W	Acetyl syringic acid, ethyl ester	2.70	2.77	1.91	4.15
W	Butylsyringone	0.00	0.00	0.73	2.76
E	Butanedioic acid, diethyl ester	0.00	528.10	728.91	216.38
E	Propanoic acid, ethyl ester	263.38	155.97	22.43	13.14
E	Isobutyl acetate	315.83	237.39	143.26	0.00
A	1-Propanol, 2-methyl-	0.00	25.68	203.27	500.93

Flavors associated with chemicals that were extracted from wood/oak.

Chemical	CAS	Flavor Descriptor*
o-Cresol	95-48-7	leather, spicy
Anisole	100-66-3	phenolic, anise
p-methyl anisole	104-93-8	narcissus, ylang, nutty
Salicylaldehyde	90-02-8	medicinal, spicy, cinnamon, wintergreen
o-Guaiacol	90-05-1	smoky, spicy, vanilla, woody
p-Cresol	106-44-5	narcissus, animal, mimosa
Creosol	93-51-6	spicy, clove, vanilla, phenolic, medicinal
4-Ethyl guaiacol	2785-89-9	phenolic, leather, smoky
Homovanillyl alcohol	2380-78-1	vanilla
cis-Oak lactone	55013-32-6	sweet, spicy, coconut, vanilla
Eugenol	97-53-0	clove, honey, spicy, cinnamon
Syringol	91-10-1	smoke, burned wood
trans-Oak lactone	55013-32-6	spicy, coconut, clove, incense
Vanillin	121-33-5	sweet, vanilla, creamy
Ethyl vanillate	617-05-0	phenolic, burnt, guaiacol, smoky
Butyrovaniellone	64142-23-0	caramel, sweet, buttery
Syringaldehyde	134-96-3	vanilla
4-Allylsyringol	6627-88-9	spicy, smoky
Acetyl syringic acid, ethyl ester	NA	unknown
Butylsyringone	69271-91-6	unknown

*From the Good Scents Company and chapter Gas Chromatography in the Analysis of Compounds

Of special note in the data are cis-oak lactone and trans-oak lactone that are characteristic of oak aroma. Using the Xtractor 30+ ppb was achieved in only 6 minutes while 20+ ppb of each is typical of a barrel matured product.

Esters provide the characteristic of fruit flavors in wine. Esters are often both created and destroyed in aging through a complex series of chemical and biological reactions. These reactions are further complicated with significant differences between aging in wood barrels as compared to aging in just a glass bottle[^]. Our data shows both creation and destruction of esters expected in natural aging as well as differences when comparing cavitation alone to samples processed with wood chips. This chemistry shows cavitation is doing more than just extracting flavor from wood.

Alcohols can also be created or destroyed during aging Creation of alcohols such as 1-propanol, 2-methyl alcohol is also characteristic of aging*. We see the emergence of this compound in our data and it is greatly accelerated with wood chips, aging demonstrating the “complete” aging effect.

[^]Ancín-Azpilicueta C., González-Marco A., Jiménez-Moreno N. Evolution of Esters in Aged Chardonnay Wines Obtained with Different Vinification Methods. J. Sci. Food Agric. 2009;89:2446–2451. doi: 10.1002/jsfa.3744.

*From the Yeast Metabolome Database (YMDB)

Commercial Example

The ShockWave Xtractor™ has already been installed for wine processing commercially. An example of the accelerated aging application is the installation at [Mount Hope Estate](#) in Manheim, PA. One of Mount Hope's first experiments was with a young red wine they felt would benefit from flavor enhancement. Within minutes of processing with a small amount of oak chips the Xtractor added complexity and increased flavor to the wine.



Wood chips in one recommended size for Xtractor

Scott Bowser, Owner of Mount Hope remarked, "For our production, the ShockWave Xtractor is a great triple threat. Our wine maker can add natural flavors to our wines and ciders, our brewer can accurately dry hop beer products and, as we introduce our distillery, the technology will allow us to add deep flavor profiles to our spirits. It is revolutionary equipment, and within 15 minutes of the demonstration, we knew we were sold on it."



ShockWave Xtractor™ at Mount Hope Estate (Image courtesy of Mount Hope Estate)