

BY DEBORAH PARKER WONG

GO WITH THE FLOW

*By necessity or by choice,
cross flow filtration
is a boon for winemakers.*

To filter or not to filter? You'll find winemakers in both camps. But when filtration is called for, cross flow technology is proving to be the best case scenario for leaving wine sitting pretty.

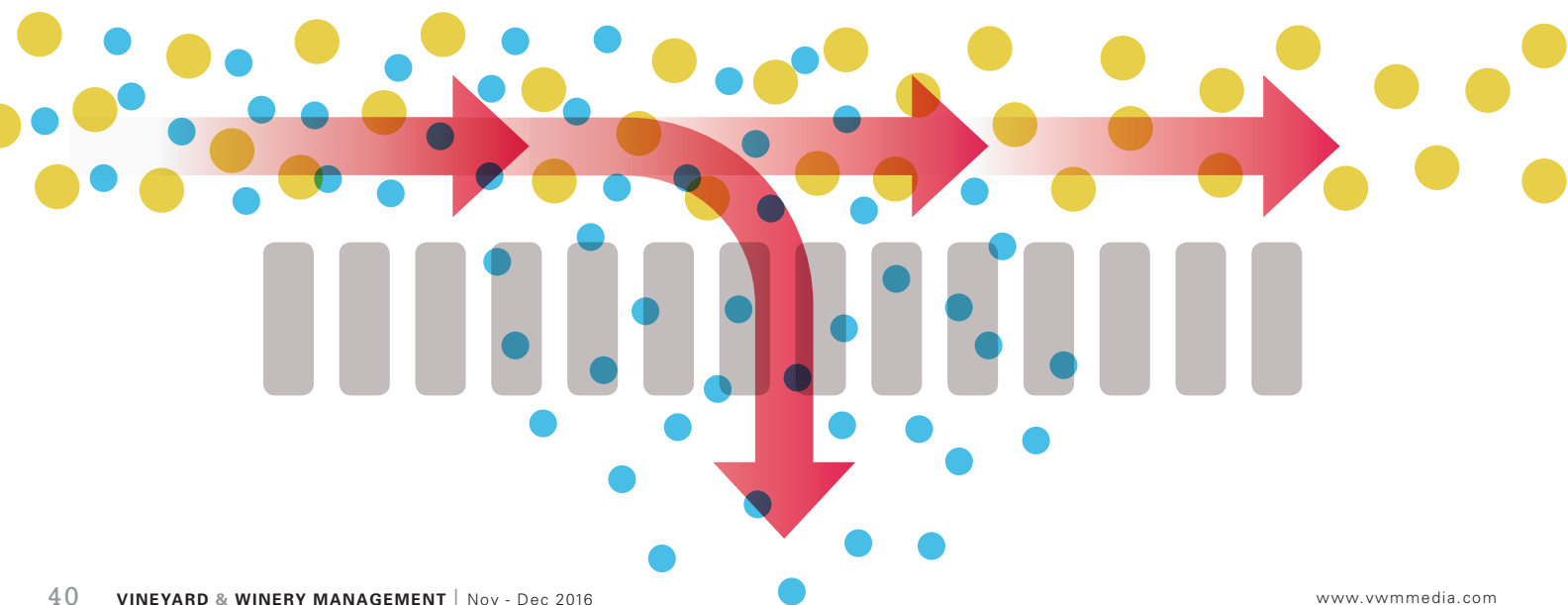
Although there are scenarios where older filtration technologies like hardwood cellulose pads or diatomaceous earth (DE) might be better suited to the task, the minimal risks and considerable rewards of state-of-the-art cross flow filtration are readily apparent in the cellar and in the glass. "There's a time and place for unfiltered wines,"

says Gary Sitton, newly appointed winemaker at Ravenswood Winery (Sonoma, Calif.), founded by winemaker Joel Peterson in 1976. "We view filtration as a tool that lets us guarantee the quality of our Vintners Blend and County Tier wines."

In an effort to work more sustainably in the cellar when filtration is necessary, winemakers like Sitton have found alternatives to crystalline silica-laden DE filtration, which requires workers to wear protective gear and to dispose of hazardous waste. "From a quality perspective, cross flow has let us

move away from the use of pads and DE, and we've seen improvements across the board."

With DE use on the decline, and ever-present concerns over oxygen pick-up and the replacement costs of filtration pads, the one- to two-year return on investment that's now being realized when using cross flow filtration for bottle polishing or lees recovery starts to pencil out. Massimo Pivetta, sales manager at Padovan Spa in Vittorio Veneto, Italy, observes, "A cross flow filter for lees recovery is a chief financial officer's favorite purchase."



Cross flow filtration — a synonym for cross flow clarification also known as tangential flow filtration — includes three families of tighter filtrations: ultrafiltration, nanofiltration and reverse osmosis; it had its beginnings in France about 20 years ago, then migrated to the Veneto region of Italy, where the latest advances in ceramic membranes have been realized. It's now being used by the largest wineries in the United States, including Gallo and Constellation. After an initial period of trial and error spanning eight to 10 years, the price of membranes has dropped, and cross flow has evolved as the gentlest and most sustainable method of filtering wine.

"There've been considerable advances over the last 10 years, particularly in the polymers used for hollow fiber cross flow membranes," says Stefano Migotto of WineTech, a filtration service provider that designs proprietary cross flow equipment and is based in Napa, Calif. "Using as little intervention as possible, concerns about scalping, stripping and heat transfer are generally a thing of the past."

ORGANIC OR INORGANIC MEMBRANES

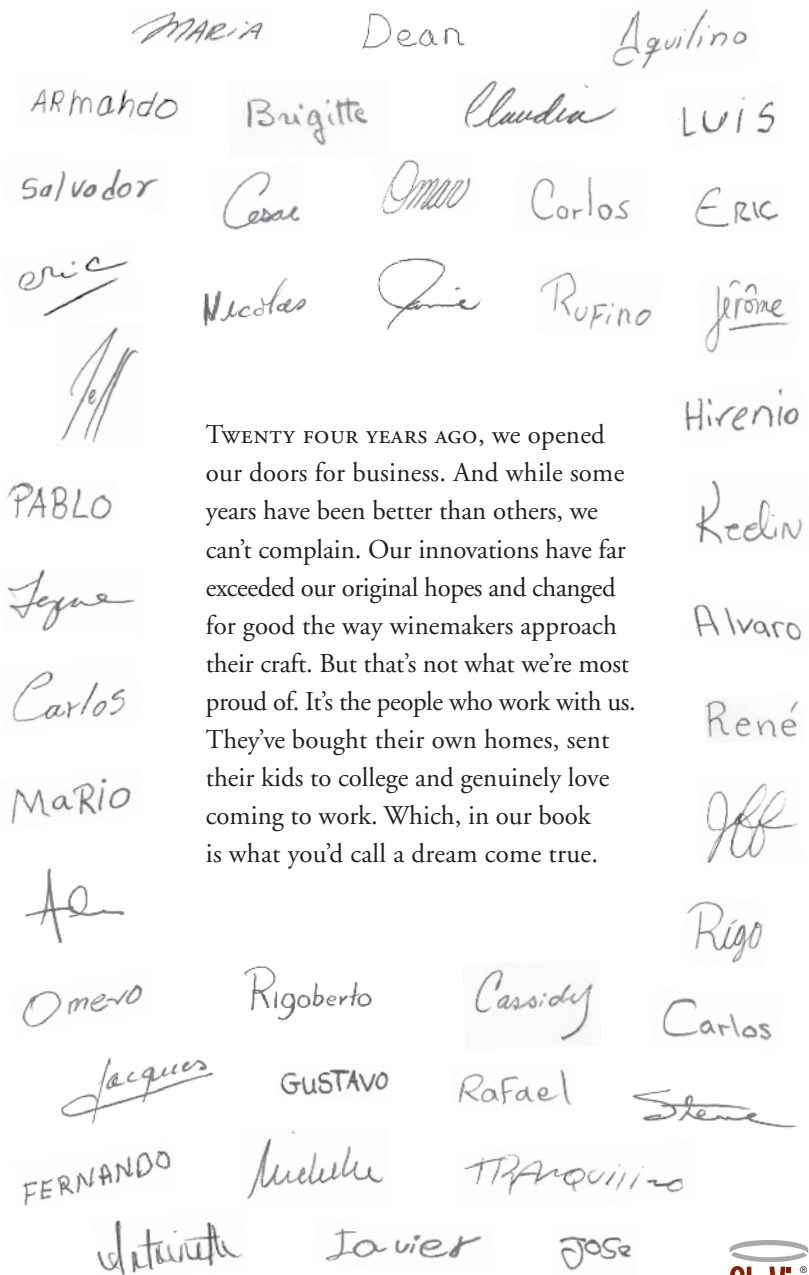
The cross flow process is named for the principle action of the wine during clarification — wine flows

through or "across" a hollow membrane that can be made of either an organic polymer or an inorganic ceramic, typically with 0.2 microns (or finer) porosity. Smaller molecules pass through the membranes as permeate, while larger molecules are filtered out as lees. Proponents of cross flow filtration cite

wine quality as its ultimate benefit over dead-end filtration techniques that push wine through a filtering medium like DE or a cellulose pad where it picks up oxygen and off flavors along the way.

According to Migotto, who prefers to use polymer membrane filters (bundles of hollow polymer

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AT A GLANCE

- + Cross flow filtration has minimal risks and considerable rewards.
- + The technology can be largely automated, but requires a skilled operator.
- + The filters are easy to clean and maintain.
- + The long-term effects of filtration are unknown at this time.

fibers encased in a stainless steel or plastic housing), today's symmetric hollow fiber membranes run at lower pressures, require less energy and generate less heat. "Polymer filters perform best on wine with low levels of solids," says Migotto, who currently uses a polypropylene membrane and also recommends modified Polyvinylidene fluoride (PVDF) membranes like those made by Pall Corporation of Port Washington, N.Y. "Other polymers, like Polyethersulfone (PES) membranes, are excellent for white wine, and cost effective, but they aren't suitable for reds with higher levels of solids."

Pall manufactures hollow fiber filtration systems, the Oenoflow XL system for wine clarification and the Oenoflow HS system for lees recovery, and sells direct to the wine industry globally. "PVDF is a very robust membrane that withstands backflushing during operation to maintain longer filtration cycles and repeated regeneration with chemicals for longer membrane life," says Nicole Madrid, global food and beverage marketing manager for Pall. "A key feature is our low concentration volume (LCV) option, which isolates one filtration module to further concentrate the wine or 'hold up' that remains in the system at the end of a run to significantly reduce losses.



Pall's Oenoflow HS is a hollow fiber filtration system for lees recovery.

"Our Oenoflow HS system has dual filtration capability," she adds. "With wide diameter hollow fiber membranes, it works well processing high solids for recovering wine and juice from lees. When not in use for lees filtration, it can be used for post-fermentation wine clarification to expand cellar capacity."

Ceramic membrane filters, like those sold by Della Toffola, a Veneto-based manufacturer, are solid rods made of an extremely strong aluminum/titanium compound — the kind used for medical bone replacement — that are perforated with tubular channels. Multiple ceramic rods called candles are

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contained inside one large filter housing. "We've used ceramic membranes from day one. Initially, the filtration caused the wine to heat. This has been solved using different pumps," says Mariangela Guarienti, CEO of Della Toffola USA.

Consultant and author Clark Smith calls the Della Toffola ceramic filter a "godsend" for the 25,000 Midwest wineries faced with filtering wine that's been corrected using the double salt method perfected by Dr. Ralph Kunkee and Jed Steele. In one scenario, winemaker Charles Brammer Jr. of Morgan Creek winery in Harpersville, Ala., who works with Muscadine, found the Della Toffola filter cut his workload in half. "You have to choose a ceramic spacer wide enough to accommodate the high solids of calcium malate, calcium tartrate, the double salt, excess calcium carbonate and juice pulp," says Smith. "This costs you surface area, but you can limp along on simple wine clarification jobs when time is less of a factor."



Della Toffola's ceramic membrane filters are solid rods made of an extremely strong aluminum/titanium compound and perforated with tubular channels.

Key benefits in favor of ceramic membranes are their durability and easy maintenance. Standard clean in place (CIP) features use a combination of water, caustic (to remove organic fouling) and citric acid (to remove minerals and neutralize). A ceramic filter can be stored dry, eliminating the need for proprietary cleaning solutions and regular flushing, as with polymer filters. It also eliminates any chance of mold developing inside the membrane during the off season.

Life expectancy for Della Toffola ceramic

membranes is 10 years. "We guarantee the membranes for that amount of time," says Guarienti.

CROSS FLOW FOR LEES FILTRATION

While traditional cross flow works by pushing wine from the inside of the membrane out, Padovan, a manufacturer of polymer and ceramic cross flow filters for several different industries, has developed a new ceramic technology for lees filtration that's flipped the process. Dubbed the "Dynamos," it uses stacked, rotating ceramic discs that filter wine from the outside of the membrane to the inside and into a hollow shaft that runs down its center.



Padovan's Dynamos uses stacked, rotating ceramic discs that filter wine from the outside of the membrane to the inside and into a hollow shaft that runs down its center.

According to Craig Garbo, capital equipment sales for Padovan's Windsor, Calif.-based distributor ATP Group, the Dynamos is, in effect, self-cleaning. "When you're filtering wine with as much as 80% solids, the lees scrape along the surface area of the ceramic discs, keeping them clean." Cleaning the unit uses minimal water along with standard caustics and acids. These parameters can be adjusted in the Dynamos automated CIP program based on the requirements of the winery's water recycling system.

While it's possible to bottle polish wine using the Dynamos high-solids lees filter, according to Garbo, it's not designed for this purpose. The flow rates are too slow for most bottling lines. As a dedicated lees recovery technology, the Dynamos cross flow is far superior to older technologies, like the lees press or rotary vacuum, for lees filtration. ATP Group offers custom filtration services and employs Padovan's technology in California.

A WORD ON AUTOMATION

With earlier generations of cross flow, the operator had to tell the filter when to adjust the pressure. Now, most manufacturers claim to be fully automated, letting a computer algorithm make adjustments based on a default program or

parameters that have been defined by the winemaker. "You don't have to do as much guesswork to optimize the process," says Della Toffola's Ken Kosmicki, who's been known to train customers on the optimal use of their new filtration system via Skype. With the ability to control filtration from a desktop or smartphone, gone are the days of babysitting — but seamless automation still relies on experienced operators.

Migotto likes to operate his filters both manually and automatically. He believes if a winery uses its hollow fiber filter several times per year, the automation will work well. But, he cautions, with annual use, automation can "get stuck" as the machine ages or if winery has an infrequent operator.

Until recently, integrating a filtration step into the bottling line was a future scenario. But according to Pivetta, Elizabeth Grant-Douglas,



Stefano Migotto of WineTech in Napa, Calif., likes to operate his filters both manually and automatically.

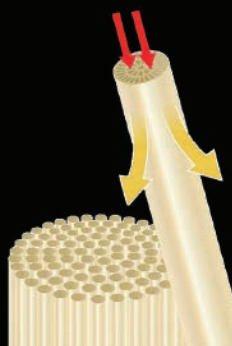
director of winemaking at La Crema winery in Sonoma County, is doing just that. Grant-Douglas filters barrel-fermented lees with Padovan Dynamos directly into the fill basin of the bottling line.

SENSORY QUALITY

In a 2014 study conducted at UC Davis, the sensory and chemical effects of 0.22 micron polyethersulfone hollow fiber membrane cross flow filtration on wine were evaluated and found to have a stabilizing effect on the sensory profiles of both white and red wines.

In white wines, the effects of filtration were found to be significant for one sensory attribute out of 16. Similar analysis for the red wines saw a statistically significant difference in six out of 16 total sensory attributes. While chemical analysis showed statistically significant changes in color and phenols

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in both wines, sensory analysis couldn't detect any changes.

The take away: When filtered and unfiltered red wines were compared after two months in bottle, filtered wines were higher in mixed berry and stone fruit aromas, while unfiltered wines had more earthy, grassy, oak and smoke aromas. If style preferences favor the rapid development of secondary aromas, the results of this study could point winemakers away from using hollow fiber cross flow membranes.

These results mirror those of a 2004 study by Rektor et al, conducted on sensory analysis of musts of Hungarian varieties that had undergone malolactic fermentation and filtration with hollow fiber cross flow, in which tasters preferred filtered samples with fruit-forward flavors (where the off-flavors were less intense).

At ATP Group, Garbo points to oxygen pick-up and pressure as factors that have the most significant impact on quality. "Cross flow exerts up to one and a half bars, while DE filters can exert four to five bars of pressure during filtration," he says.

When comparing the sensory qualities of filtered wines that have been subjected to lower pressure and temperatures, anecdotal evidence aligns winemakers' perceptions with what's being recorded in the lab. When he was working with Peterson at Ravenswood in the late 1990s, Sitton ran a number of trials with standard DE and a .65 micron yeast-sterile ceramic



Gary Sitton of Ravenswood Winery in Sonoma, Calif., uses cross flow for some of the winery's products.

membrane. The pair conducted what Sitton described as "a lot of sensory work" and determined they couldn't detect the difference between the two wines immediately after filtration — but, when tasting at six months and one year after bottling, they preferred the membrane-filtered wines.

While studies comparing filtration characteristics between organic and inorganic membranes have thus far been confined primarily to flux decline and the amount of housekeeping related to optimal performance, both membranes remove some high molecular

weight carbohydrates and protein colloids. As such, the long-term impact of different types of cross flow filtration on a healthy wine's longevity is still unclear.

ROI METRICS

In addition to quality, flow rates and recovery are key metrics for determining the size of the equipment and the return on investment in a cross flow filter. "ROI is tied to throughput and recovery," says Garbo. "Your ROI can be different for units from different manufacturers. Size, throughput, recovery and filtrate quality are all important factors to consider. We've been in the U.S. market for more than five years and, within that time, 95% of our customers for the Dynamos [which ranges in price and configuration from \$35,000 to \$1 million] have achieved a return on their investment within one to two years."

Given the options currently available from cross flow filtration vendors and the increasing performance and decreasing cost of membranes, from this vantage point, state-of-the-art filtration technology has cleaned up its act.

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