ASK FIVE WINEMAKERS the color of the sky, and you will get six answers. Ask them how or why they filter wine, and you will get similar results. It is soon obvious the “book of filtration” will never be written; and some brave souls do not filter at all.

That said, filtration is for arresting fermentation, clarification, fining agent removal, bio-reduction, polishing and bottling preparation. For small- to mid-sized wineries that filter, the best way to prepare wine for the bottle is still dependable depth filtration.

There are four most common types of depth filtration. Only two really make sense for the majority of wineries and they will be the topic of this article. They both come with several names attached: The traditional pad—sometimes called a sheet filter and often referred to as the plate and frame—and the newer lenticular, modular or stacked disc filters that are rapidly growing in popularity.

For the small- to mid-sized winery, these two offer the best economy of scale primarily because of cost and effectiveness. Looking at this month’s survey article on filtration, more than 80 percent of wineries use one of these methods for filtration. They both come with several names attached: The traditional pad—sometimes called a sheet filter and often referred to as the plate and frame—and the newer lenticular, modular or stacked disc filters that are rapidly growing in popularity.

In focusing this review on pad and lenticular filtration, there are several issues a winery might consider before deciding which to buy. They both accomplish the same thing but differently. The big questions are: (1) equipment design (2) ease of handling and (3) cost to purchase and operate.

There are two other forms of depth filtration: The “pressure-leaf” filter, where a cake of loose DE is layered onto a metal screen inside a large bell-housing, and cartridge depth filtration. Pressure leaf equipment technology is relatively expensive and requires laborious handling of free-floating DE. While having large throughput, when used by well-trained technicians (typically in large wineries), it is hard to justify the cost of the equipment and risk for the small operation. Finally, cartridge depth filtration, while inexpensive, is simply too limited in its capacity to handle “dirty” wines.

In focusing this review on pad and lenticular filtration, there are several issues a winery might consider before deciding which to buy. They both accomplish the same thing but differently. The big questions are: (1) equipment design (2) ease of handling and (3) cost to purchase and operate.

In focusing this review on pad and lenticular filtration, there are several issues a winery might consider before deciding which to buy. They both accomplish the same thing but differently. The big questions are: (1) equipment design (2) ease of handling and (3) cost to purchase and operate.

WHY DEPTH FILTRATION WORKS

Many people confuse the terms “surface” and “depth” filtration. Surface filtration is when a fluid passes through a pleated or smooth sheet of paper containing pores smaller than the particulate they intend to filter. A good example is a coffee filter. Unfortunately, the capacity of surface filters is limited.
as they plug quickly. In wineries, where production is the focus, this is unacceptable. Particulate retention must be an ongoing process as we might filter thousands of gallons of wine at a time, not a 10-cup coffee maker. To accomplish the task we must increase filter medium “depth.”

The Egyptians possibly started depth filtration when they needed to clean up their beer. Back then silk and other fabric mediums were employed. Today depth filtration is based on a simple technology where a pad or disc is simply a combination of cellulose fibers containing DE and an inert resin to provide strength. Filtration capacity is a result of the depth of this matrix. They may be between 1/8 to 3/8 of an inch thick, and as wine flows through the three-dimensional maze of cellulous and DE, the micron and sub-micron particulate (retentate) is captured. The combination of materials results in a “fabric” with high retention capability while maintaining excellent throughput capacity.

The resins also impart a “zeta potential,” a positive charge that increases the collection of small, negatively charged particles and microorganisms. Zeta potential refers to the overall charge a particle acquires in a specific medium, like wine. Research is currently developing resin-DE binders that will have a neutral charge, as tannins and proteins are negatively charged and may be unintentionally stripped from the wines. This is an ongoing debate among winemakers, particularly those who make Pinot Noir, but the ideal filtration will remove solids, haze, colloids, bacteria and yeasts while preserving color, flavor and aromas.

**ATTRIBUTES TO CONSIDER**

**Hardware design is based on medium design – Pads or Discs**

Whether you use pads in a plate and frame filter or discs in a lenticular housing, they accomplish the same thing. Regardless of the type of hardware used, depth filtration is all about stacking multiple filter pads or discs. The idea is to contain a total surface area of filtration media into a small footprint.

Certainly there is a life span to any filter media as it will all eventually plug and no longer filter. The point is to hopefully maintain a continuous flow and process all the wine to be filtered. More pads or discs translate into more flow and less time filtering, but also more cost. A winemaker must make the call, based on the typical size of lots to be filtered and, most importantly, the level of filtration desired.

All suppliers of pads or discs will offer a wide range of nominal porosity ratings between .20 microns to 10 microns and beyond. Again, the level of filtration desired will determine the porosity of the media and will therefore affect the flow of the wine. A sterilizing filtration with pads may afford 20 gallons of wine flow per hour per pad, while a polishing filtration may increase it to 35 gallons per hour.

Plate and frame filters are generally sold as holding 20, 40, 60, 80 or 100 plates. Between each plate are the individual filter pads; the most common size are 40 cm x 40 cm, though 20 cm x 20 cm and 60 cm x 60 cm are also available. These are usually too small or large for the average winery.

A 40 plate and frame filter holds 39 pads when alternating plate and pad. If laid out on a floor, the total pad area would cover roughly six square meters of surface. Obviously this would be impossible to contain as a single component so you again stack smaller, individual pads.

A lenticular filter is simply a circular housing or canister that is secured to a base plate with a clamp closure. Built to **American Society of Mechanical Engineers (ASME) specifications**, these
Product Review: Depth Filtration for the Small Winery

Housings hold circular stacks of filter discs, sometimes called frisbees, either 12 inches or 16 inches in diameter. Several will be contained as a single package, hence the term “stack.” It is the same concept as a large surface capacity confined into a small space.

Discs are inserted, depending on the amount of wine to be filtered. Normally a 12-inch diameter stack contains approximately 18 square feet (1.67 sq. meters) of surface area or roughly the equivalent of 12 pads in a 40 cm x 40 cm plate and frame. (A single 40 by 40 cm pad is 1.54 square feet). Basically, three stacks of 12-inch discs will be close to the same surface area of a 40-plate filter.

The obvious difference between the two types of filters is how they contain the medium, and herein lies the key. Their design differences result in different set-up, breakdown, cleaning and training procedures, which ultimately affect time and cost.

**OPERATION**

**Set-up**

As the name implies, a pad filter, again called the plate and frame, is a stainless framework that suspends varying numbers of backing or support plates. Sandwiched between the plates are the filter pads, and again the most common size for small wineries is 40 cm by 40 cm. The pads are arranged in a manner that allows for a specific flow of wine through alternating plates and the pads. The biggest issue when setting up this equipment is the necessity for the operator to properly face and position each pad within the stack. There is an inlet and exit side to each pad, and they must be positioned correctly in relation to the plates.

Thereafter, the entire length of dry pad medium must be slowly hydrated and gradually compressed with a large screw assembly. Eventually all the sheets are totally saturated and tightly squeezed between the plates for the entire length of the framework. This can easily take 30 to 60 minutes or more.

In contrast it takes almost no time to load a lenticular filter. The operator simply opens the housing, stacks the proper number of the packaged discs over an internal spindle, closes the housing and secures everything with a clamp. Little training is required and, because the discs can only fit in one direction, there is no room for error.

Jon Priest, winemaker at Etude Wines in Napa, has been using lenticular for five years. “Plate and frame filters just required too much set-up time, labor, are more expensive in the long run, and also result in too much loss of wine,” he said.

By design, the edges of the pads in the plate and frame filter are exposed to the air and are without any outer container. The “seal” of the entire stack of pads is nothing more than their compression between the plates. This is the primary reason they are often associated with oxygen pickup.

In addition, because there is no external housing and regardless of the amount of compression, there will always be leakage, hence the added “feature” of a drip pan beneath these filters. Virtually all pad filters leak and this should be considered if bottling a “high-end” wine. Drip-pan wine is usually a loss due to oxidation and contamination, and is often the basis for your next sangria punch. Poorly maintained equipment can easily result in loss of up to 1 to 2 percent.

Lenticular or modular housings by design are enclosed, eliminating all leakage and loss. In addition, because the filter discs are enclosed inside a single, sealed housing, clean-up is considerably easier.

**Clean-up**

Eventually, the filter medium (pads or discs) will “plug” with retentate and will need to be changed. Pressure is the determining factor. Separate gauges on inlet and outlet plumbing will exhibit a differential pressure and, as the pads or discs plug up, the inlet pressure will climb. At 1.5 bar (22 PSI) the filtration is usually over.

Clean-up is significantly easier with lenticular. Because plate and frame filters are open to the environment, the last of the wine is usually pushed with water. Sealed lenticular housings can be evacuated with inert gas, which eliminates any loss of wine.

Once the filtration is over, the all-stainless lenticular housing is easily opened and rinsed. For an added bonus, the winemaker can clean with steam since the housing is entirely stainless steel.

Steam is not a good idea on a plate and frame filter for two reasons. First, the plates are made of a Norel plastic and can easily become distorted, resulting in more drips. Second, there are four rubber gaskets on each plate and, in time, with elevated heat they can easily become overly compressed when building the stack, resulting in more leakage. Unfortunately, clean-up results in excessive water usage.

Ozone should never be used around any type of filter as it will destroy gaskets, or for that matter any rubber in the winery. As mentioned, pad filters have four rubber gaskets for each plate. They cost around $10 each, and replacement for a 40-plate filter is pricey.

If the filter medium is not plugged and the winemaker should choose to hold the equipment for a later filtration within a few days, lenticular stacks inside the housing can be simply flushed with hot water and suspended in a citric-meta (bisulphate) solution.

“For long-term storage we place the partially used discs into a sealed container, again with citric-mete for up to three months,” said Ryan Acker, cellar master at DeLoach Vineyards in Santa Rosa, California. Acker added that with proper regeneration they can “experience an additional 25 to 30 percent additional life.”

A plate and frame filter by design has multiple hollow plates that need to be thoroughly cleaned inside and out, along with related plumbing, sight gauges, nooks, crannies and drip pans, resulting in more water usage and labor. While some claim pads can also be maintained, you will soon notice mold growth along the edges because of external exposure. As a result, change-out of pads is usually more frequent, and to break down, clean and reconfigure a pad filter can easily take several hours. It is usually best to break down to remove possible contamination.

In either scenario, because both discs and pads are designed with the DE secured within the cellulous material, they are biodegradable and disposal is not an issue.

**THE MEDIUM**

Filtration flow rates and quality are the same whether using pads or discs. But equipment hardware is what might influence a winemaker’s choice: such as dripping, extended set-up labor, training, energy use, possible oxidation and contamination. There is also another big difference in the cost of the media itself.

A single 40 cm x 40 cm pad will be around $1.50. At 39 pads in a 40-plate filter we are looking at about $60.
Comparable throughput with discs in a lenticular filter will require three stacks at $130 each and up. The winemaker must balance the cost against the convenience.

As mentioned, the difference in cost begins to diminish if you extend the life of the discs. But how much you can regenerate your filters also has to do with how the winemaker makes wine.

If making Chardonnay, for example, and having gone through all fermentations, bentonites, rackings and cold stabilization, and not in a hurry to get to market, not much filtration is required. Reds, if left in barrels for 1½ years, may not require much other than to prepare the wine for bottling. It is also interesting that as winemakers refine their techniques the amount of coarse or rough filtration is beginning to diminish, a particular advantage once claimed by pad filters. The argument was that the coarse filtration would plug the expensive disc filters, but that is no longer the issue it once was.

“Winemakers are well advised to monitor their wines and check turbidity levels prior to and during the entire filtration,” said Molly Hill, winemaker at Sequoia Grove Vineyards in Napa. Hill uses their own equipment but beginning winemakers should make use of laboratory services offered by many media vendors to test wine samples and determine the amount of filtration required to stabilize. Often called validation labs, such services are either free or available at a minimal charge.

Disc technology is constantly improving and one new development is to replicate “cross-over” or double filtration. Traditionally limited to plate and frame, it is where two different levels of media can be used in a single pass of the wine, such as a majority of rough filtration sheets followed by pads for a finer level of filtration. This requires the purchase of a crossover plate to separate the two media, also requiring additional plumbing, a gauge, two endplates and easily an additional $1,500.

Lenticular discs are now being configured whereby the finer media is simply sandwiched inside the rougher more open media, much like an Oreo cookie. Again contact your supplier to get the best results.

Remember that not all equipment vendors/distributors sell pads and discs. In the same light, not all media suppliers sell equipment. It might be worthwhile for a winery to balance its filtration media options against the appropriate hardware. The good news is that almost all discs and pads are interchangeable with competing equipment.

BUYING THE EQUIPMENT
Filtration is not cheap and wineries should get the most equipment now while planning for the future. As we have asked in other product reviews, “What is the winery’s current production and where will it be in five years?”

Features
Plate and frame filters usually come as a complete package, meaning they have all related gauges (glycol filled is more accurate), plumbing and valves to control flow. Be sure to get tri-clover fittings. Just about all of P&F filters are
made in Italy and might come with unacceptable garolla fittings.

With plate and frame filters, the winery is buying a heavy duty, welded frame or chassis on wheels, and quality of fabrication will vary considerably. Hygiene and ease of cleaning is paramount and a major issue is to avoid any unnecessary plumbing dead-ends or turns. Make sure the entire plumbing labyrinth can be completely disassembled for sanitation.

The frames are of different lengths so plates and pads can be added or subtracted depending on gallons of wine to be filtered. Most small- to mid-sized wineries will do well with a 40-plate frame, though the cost of a 60-plate upgrade is usually not prohibitive. Buying a 60 plate now, while only using 40 plates, allows for future growth. You can also drop to as few as 15 to 20 plates.

If using fewer plates, you will need to add a prolunga (Italian) or extension to add length to the screw bar that compresses the plates against the pads. These are about $150. Additional plates are either Norel plastic for about $60 or stainless steel for almost $600 each. Stainless plates are usually relegated to breweries and not necessary in wineries. Simply multiply 40 by $600 to understand why. Unfortunately going from a 40-plate to a 60-plate frame goes from 60 inches to 80 inches in length. At roughly two feet wide, floor space may become an issue.

Lenticular filters are usually complete but this may depend on the vendor. Sometimes the winery might have to supply its own valves. The big difference again is the simplicity of the design. As a single, vertical housing, with a small footprint of about a square foot, some are available in sections. Referred to as “split domes,” a small winery may begin with a three-foot tall housing to accommodate up to three stacks. As the winery grows, simply mount this first housing on top an extension for around $1,500. The internal spindle that positions the discs will need to be replaced, but that is it. With lenticular, the winemaker can add on later rather than having to initially commit to a large frame. Similar to a 60 plate frame, vendors will generally advise the winery to buy up to a four stack lenticular to accommodate potential growth. The offset in dollars from a three to a four stack is around 10 percent, and this is minimal when looking at the initial capital cost.

**Equipment Cost**

Relative costs of the two forms of hardware are surprisingly close. Traditionally, lenticular was considered more expensive, but not any more. WBM found that a 40-plate filter and a three or four stack lenticular housing, with similar throughput, cost about the same. For either the range was roughly $6,500 to $8,500.

Since the spiraling price of stainless is the same all over the world, material costs are fairly similar. At issue, however, is the Euro exchange rate. Most lenticular equipment is manufactured domestically, while almost all plate and frame filters come from Europe. This also adds shipping cost and paper trails.

As always, research all options and, if possible, buy from a vendor’s inventory. Inventoried equipment rapidly grows dust and cost can usually be negotiable. There are even times when a vendor will offer a trial prior to purchase, so test drive and get a feel for set-up, cleaning and labor.

**Rutherford Equipment Rentals**

In Rutherford, California will allow a winery the opportunity to experiment with either plate and frame or lenticular for under $300 per week. A small operation with limited filtering needs might rent for a few years before committing. Owner Brad Warner said “that for startup wineries it is important to establish a market for their wine (first) before purchasing a lot of equipment.” Even so, a small winery that filters but a few days per year may forgo a purchase entirely.

For Elaine Johns, assistant winemaker at White Cottage Ranch in Angwin, California (1,500 cases) said, “We used to filter with pads; we now can use lenticular because we save set-up time and do not worry about leaks and contamination. Due to the size of our winery we only rent now because owning is just not cost effective.”

**CONCLUSION**

As the two most viable means of filtration for the smaller winery, pad and lenticular are relatively simple pieces of equipment, whose sole purpose is to house depth filtration media. Whether the winemaker chooses pad filtration or disc is more about labor, ease of set-up, breakdown, cleaning, and overall hygiene. While some winemakers like Jon Priest will argue that pad filtration may strip wines, the wide variety of media available for both types suggests winemakers will find exactly what they need. The gentleness of the filtration might possibly have more to do with the delivery system (the force of the pump) rather than the media.

The cost of discs versus pads is easily offset by all the advantages of the lenticular over plate and frame. The winemaker should also look beyond the capital expenditure and factor the total cents per gallon that a filtration may cost. At the end of the day it is almost a moot point.

The determining factor for the winemaker may possibly be the level of service available from the vendors. Maintenance for either form of equipment is generally a non-issue, but the level of expertise and services afforded by the media companies is paramount. Most vendors that specialize in filtration will have support laboratories to help a beginning or growing winery. Testing wine samples will help direct the filtration, so the more information the winery can offer about their wine, the better the filtration. And a final note: it is always a good idea to maintain exact records of the wine, filtration requirements and media selection to get the best results for future wines.

*WBM*

Bill Pregler has worked in the winery equipment industry for many years and is a staff writer for *Wine Business Monthly*. As an alternative to depth filtration, cross flow filtration is another form of filtration that is also gaining in popularity. For additional information on the technology, see WBM “Cross Flow Filtration Systems,” July 2006.
Highly asymmetric microporous membrane. Applied to keeping fine wine fine.

Solutions for All Aspects of Wine Filtration

For decades, 3M Purification (formerly CUNO Incorporated) has provided high performance yet economical solutions to demanding wine filtration challenges. Our efforts have resulted in numerous innovative products, such as the Zeta Plus™ multi-zone depth filter, the LifeASSURE™ BA series final membrane filter and the LifeASSURE™ BLA series prefILTER. Our spirit of innovation, now combined with the advanced materials science of 3M Company, has resulted in the offering of LifeASSURE™ BNA series PES membrane based final filter for maximized final membrane throughput and the 3M™ Clean-Trace™ hygiene monitoring system.

3M Purification is in the forefront by offering complete, integrated filtration solutions to the wine industry including bottling membranes, prefilters, particle control filters, and clarification filters, as well as filter housings and automated integrity test devices. All are designed from the ground up to ensure seamless and economical operation.

To learn more, visit us at www.3Mpurification.com/wine