THE ART OF INNOVATION

CELEBRATING 25 YEARS OF MODERN WINEMAKING

FOSS

Celebrating 25 years of wine analysis innovation with winemakers around the world

It is nearly 25 years since we expanded our horizons in food and agri analysis into the wine industry landscape. Now, with the launch of a new advanced wine solution, we can safely claim to have taken the concept of all-in-one, fast and easy-to-use wine analysis to a whole new level. And, in an era that has seen significant change for everyone in the business, it appears to be right on time as we face up to the challenges of creating great wine consistently around the globe.

So what better way to mark this milestone than with a celebration of winemaking today. We have collaborated with leading winemakers to write interview-based articles that sum up the resilience, adaptability and creativity of winemaking over the past quarter of a century. Complementing these industry insights are a series of articles that show how advances in technology fit hand-in-glove with the ambitions of the industry. Above all, we hope this collection serves to highlight how innovation in both approach and technology lays the ground for continued success in such a dynamic business and even greater quality wine in the years to come.

FOSS

The art of innovation: Celebrating 25 years of modern winemaking

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Sustainably produced by FOSS.

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Tradition and the transformative impact of modern technology

Quality wine has become something we take for granted. Not only do we expect something delicious from every bottle, we also want a broad choice of quality wines within an affordable price range, and, as many dinner table discussions testify, we love a good story behind the product too.

A look back through the long history of wine shows that this is by no means a new phenomenon.

In Roman times, Falernian wine from the region of Campania, produced on the slopes of Mont Falernus (now Monte Massico), became a highly prized luxury transported in amphorae along an extensive road network to the furthest outposts of the empire.

Archaeology certainly suggests this was the case. Research and excavations by the Museum of London highlights the common presence of wine amphorae, used for storage and transport, at traffic hubs along the highways of ancient Britain. While the native Celts may have brewed something that could pass for wine, the Romans would have likely turned their noses up at it in favour of Falernian wine, no matter how long it took to reach them.

The legendary character of the wine continues to this day in accounts of the production methods behind each vintage. The wine was produced from grapes grown in three vineyards, with the area half way up the mountain reputed to produce the best grapes. Pliny the Elder described three types of Falernian wine as the 'rough, the sweet and the thin.'

The story of Falerian wine is just one example however, of how the pursuit of wine appreciation and the desire to craft exceptional vintages have been ingrained in human culture for centuries. And today, it remains a cornerstone of successful wine production, reminding us that traditional craftsmanship in pursuit of wines with both character and consistency, is more important than ever.

Amphorae and wooden cart obtained in Pompeii, Italy

What sets our current era apart, however, is the remarkable development of the tools and techniques available to today's wine professionals to support their goals. In recent decades, the journey of transforming grapes into the wine we enjoy has taken a significant leap forward, and this progression shows no signs of slowing. All this allows a new implementation of traditional values where winemakers can explore and create with confidence.

In this book, we will explore how innovation is transforming winemaking through the eyes of industry professionals, delving into wine's rich traditions, the artistry behind winemaking, and the transformative impact of modern technology. In the following pages, we will reveal the convergence of tradition and innovation, celebrating time-honoured practices while embracing the opportunities provided by technological advancements and, not least, the ever-growing wealth of data waiting to be harvested in the pursuit of quality wine.

Originally borrowed from the dairy industry in 1960s, the use of stainless steel tanks is probably one of the greatest innovations in modern winemaking. The neutral character of tanks and the ability to seal contents from air can help to preserve pristine fruit flavours

These barrels originating from Bordeaux hold a standard of 225 liters – a measurement that was set to allow one barrel to be rolled by one man alone. Today, quality aspects of barrels, such as micro-oxidation and oak flavour are likely to ensure their continued use

The secret to quality

As the Cellar Master of Krug, Julie Cavil has one of the most revered and respected jobs in Champagne. She explains the creative process behind the house's flagship, Grande Cuvée, and how the quality of Krug evolves over time

How did it feel to become Krug's first female cellar master?

Rather than saying I'm the first female cellar master, I'd simply say I'm the eighth cellar master in the history of the house. It's my job to perpetuate the dream of the house's founder, Joseph Krug, each year with a new Édition of Krug Grande Cuvée. I've been with Krug since 2006 and prior to becoming cellar master, I was winemaking director and a member of the tasting committee alongside former chef de cave Eric Lebel. The transition was seamless for us. I work with an immensely talented team on many projects, which keeps my job interesting.

Krug Grande Cuvée is made from a blend of up to 120 wines from more than 10 vintages. How do you approach making a wine as complex as that?

We inherited a unique approach to Champagne creation from Joseph Krug. His dream was to craft the very best Champagne he could offer, every year, regardless of annual variations in climate. Paying close attention to a vineyard's character, respecting the individuality of each plot and its wine, as well as building an extensive library of reserve wines from many different years allowed him to fulfil his dream. Today, this library is home to around 150 wines, and each year I 'audition' some 250 wines of the year. Taking a plot-by-plot approach, I'm able to blend a new Édition of Krug Grande Cuvée and Krug Rosé every year. We achieve this complexity by cultivating the differences wherever possible, from vineyard to blending, to amplify each wine's uniqueness and contrasts, so we can craft the most generous expression of Champagne in one bottle.

Have you made any stylistic tweaks to Krug Grande Cuvée since becoming cellar master?

It would be easy to change something – anyone could do that – whereas the true challenge is keeping Joseph Krug's dream alive, cellar master after cellar master, and the same level of excellence blend after blend. This living legacy inspires me deeply. At Krug, there is no recipe. Each Édition of Grande Cuvée is completely new and original. Every year our inspiration is the same, but each Édition is a unique composition. Tweaking would imply a static profile, whereas every Krug Champagne is different. That being said, we base all our decisions on tastings – from the choice of the harvest date to the blend, as well as time in the cellars. Any adjustments would be a direct response to observations during tastings.

Launching the Krug iD has made Grande Cuvée more exciting for collectors. What ageing potential does the wine have and does it get better with age?

Julie Cavil, Cellar Master at Krug.
Picture by Krug

The Édition concept, which applies to Grande Cuvée and Krug Rosé, is a great way to highlight the uniqueness of each wine. Today, Krug Lovers can taste and play with different Éditions. Thanks to the Krug iD, they can also take a deep dive into the savoir-faire of their own bottles of Krug. This gives us the opportunity to share anecdotes, tips about food and music pairings, and expert ratings.

All Krug Champagnes will gain with the passage of time. As the years go by, new facets will be accentuated under time's influence. Then it becomes a matter of personal taste – whether you prefer older Champagnes, but with the backbone of freshness that characterises all Krug Champagnes. With any bottle of Krug, you will always have the long, vibrant finish, which makes it age so beautifully over the decades. Time is not a constraint but an integral component of the Krug creation equation.

You have been gradually holding more bottles back of Krug Grande Cuvée each year, is this with the view to releasing the aged stocks at a later date?

We do so to offer Krug lovers a chance to explore the influence of time on our Champagnes in different ways. You can see this, for example, with A Tribute to Time, where we present two Éditions of Krug Grande Cuvée crafted ten years apart alongside one another. It is a way to shine a light on the precious influence of time on Krug and to follow the evolution of a specific Édition.

With your vintage wines, do you like them to display the signature Krug taste, or is it more important to reflect the characteristics of the year?

Krug Vintage is the story of a distinctive year, interpreted by the house. The Krug style is the sum of all the choices we make during the creative process. A Krug Vintage is more of a free interpretation. Each time I decide to craft a new vintage, it's with the idea of telling the story of what happened in the tasting room after the harvest: what amazed us, surprised us and enchanted us.

How would you describe Krug's signature style?

Krug Grande Cuvée is generous expression of Champagne with a fullness of

"Crafted with unrivaled dedication and precision, our Champagne embodies the epitome of excellence, delighting discerning palates with its timeless elegance and remarkable quality"

JULIE CAVIL, CELLAR MASTER AT KRUG

Joseph Krug established the Champagne house bearing his name in 1843. His dream was to offer the very best Champagne every year, regardless of annual climate conditions

A typical Champagne landscape. The climate of the region is subject to both continental and oceanic influences. The continental influence ensures ideal levels of sunlight in summer, while the oceanic influence brings steady rainfall which is essential for the quality of the grapes (annual average 700 mm)

flavours and aromas in which everyone can find something to stir their emotions. The delicious ripeness of the fruit enchants the nose and the lightness of the lemony notes on the palate delights the mouth, while the precise, contoured finish prepares the tastebuds for the next sip. It takes over 20 years to craft a new Édition of Grande Cuvée – a blend of over 120 wines from more than 10 different years – combining fresh fruit from the harvest with dried and candied fruit with the patina of time from our reserve wine library.

You're a fan of precision viticulture. What are your latest developments on that front?

Everything we do, dream, imagine or develop is to strengthen our knowledge of the plots we work with, defining the characteristics of each through observations, decisions and tastings, as we see how it can contribute to our different compositions and how we may leverage its potential of expression. From the work done in the vineyard to the composition of the final blend, we discuss everything among the Tasting Committee so that we may all grow together and pass down our knowledge to the next generation. If you're interested in delving deeper, the Krug Black Book is our made-to-measure tasting app that consolidates our notes, observations and knowledge.

What makes Clos du Mesnil and Clos d'Ambonnay so special?

Our clos are situated in renowned locations for Chardonnay and Pinot Noir, respectively, and, protected by walls for centuries, they benefit from unique microclimates to which their style can be partially attributed. These tiny village vineyards are the purest expression of a single grape, from a single plot, and a specific harvest year. Clos du Mesnil and Clos d'Ambonnay epitomise Joseph Krug's plot-by-plot approach to Champagne creation.

What is the most challenging part of your job as cellar master?

Unsurprisingly, but without a doubt, it's to re-create the dream of Joseph Krug every single year, regardless of variations in climate. It's my biggest challenge but also my greatest joy and pride because each time my team and I give birth to a new Édition of Krug Grande Cuvée, it's with the idea of paying tribute to Champagne, to the vastness of its terroirs and the diversity of its winegrowers.

Have the increasingly extreme weather events, from heat spikes to spring frosts, meant you've had to tweak your winemaking approach in order to retain Krug's character and consistency?

While everyone must adapt to the realities of climate change as we continue our efforts to minimize our carbon footprint, extreme weather events are a reality. Sometimes they affect the aromatic profile of the fruit, sometimes they destroy grapes before they can be harvested. This is why we have 150 wines in our reserve wine library, so even if a year has a low yield, we can still create Krug Grande Cuvée. If the wines of the year are lacking in freshness, I'll look to wines from previous fresh years to balance the blend.

Sensitive to changes in temperature and season, wine grapes serve as an important indicator of climate change across modern agriculture

According to a recent study[1], a rise in global temperature of two degrees celsius can reduce wine growing regions by more than 50%. However, the study also found that such losses can be mitigated by choice of grape varieties

The duration of flooding and the drainage characteristics of the soil are important considerations for growers

Balancing act

From hail to heat - winemakers across France are staying light on their feet in the face of increasingly erratic weather conditions

Having always been at the mercy of Mother Nature, winemakers are acutely aware of the impact climate change is having on their livelihoods. Temperatures aren't only rising, weather patterns are becoming increasingly erratic and extreme, and incidents of devastating wildfires, floods, droughts and late spring frosts are becoming more commonplace in the world's leading wine-growing regions. In 2021, France was besieged by a cocktail of climate catastrophes, from destructive spring frosts and raging wildfires to violent hail storms. The April frosts across swathes of French vineyard land were particularly brutal, resulting in losses of up to € 2 billion.

Yields across France hit historic lows in 2021, down 30% on average, though losses were far worse in many areas. The Champagne region was heavily hit, bringing in its smallest harvest in 40 years – down by 60% – due to a combination of frost and mildew. Burgundy fared little better, with losses between 30-50%. 2022 brought new challenges, including a wild fire that swept through a pine forest in the Gironde, threatening historic vineyards in Bordeaux's Graves and Sauternes districts. Soaring summer temperatures and the resulting droughts have reduced yields across Europe, pushing harvest dates forward by a few weeks. In Jerez in southern Spain, the 2022 harvest began on 28 July; the earliest harvest in the region's history.

Adapting to change

Across the Atlantic, the UK recorded its hottest temperature on record on 19 July, when the mercury topped 40 degrees. Such statistics are alarming for winemakers, who rely on slow, even grape ripening to produce well balanced wines. A survival of the fittest scenario is starting to play out, and the winemakers that are the quickest to adapt to the changing climate, and have the means to invest in preventative measures, will be the most likely to weather the storm. Hotter temperatures are impacting on grape physiology, causing berries to ripen at a quicker rate and increasing their sugar content, leading to higher alcohol levels and cooked flavours. At the same time, acidity levels are decreasing, which is impacting on the freshness of the wines, while anthocyanins – which give red grapes their colour and protect vines from UV rays – break down under heat, which is negatively impacting on the tannic structure of the wines, especially if they're harvested early to combat rising sugar levels.

If only sugar and acid were in play then growers could simply decide picking dates for grapes earlier to retain their freshness and keep alcohol levels in check, but if you pick too early then you risk under-developed tannins and anthocyanins, leaving vintners facing the dilemma of the optimum moment to pick in order to keep everything in balance. Many growers are picking earlier in order to retain the acidity within their grapes, though not at the expense of phenolic ripeness. It's a

In a vineyard in Bordeaux, during sub-zero temperatures in the springtime, a series of small oil-burning smudge pots are placed under grape vines for frost protection on cool nights. These pots help safeguard the vines from potential damage caused by the cold weather

delicate dance that's becoming ever more challenging as temperatures continue their ascent.

French revolution

In a bid to future-proof Bordeaux against the effects of climate change, last year the INAO allowed for the use of six new grape varieties in the region that are equipped to cope with high temperatures, including Marselan and Touriga Nacional. At Château Cheval Blanc, the use of year-round cover crops and the planting of over 3,000 trees is helping to protect the vines from scorching summer sun, while encouraging them to develop deeper root systems, helping them to retain water more efficiently in periods of drought. According to technical director Pierre-Olivier Clouet, Cheval Blanc's shift to agroecology and earlier picking dates for grapes is helping to preserve the freshness, vibrancy and length of the estate's grand vin, while maintaining the delicacy of its tannins. If the château hadn't taken immediate action, Clouet believes the wines would be displaying higher alcohol levels, drier tannins and riper fruit – all of which he's keen to avoid, as fine wines like Cheval Blanc hang their hat on tasting of their terroir.

While the effects of climate change have been devastating for many wine regions, for some of the world's more marginal vine-growing areas, rising temperatures have been beneficial. "Forty years ago, we used to have to pick late into October and struggled to ripen our grapes, and now we can produce a vintage wine every year," says Jean-Baptiste Lécaillon, cellar master at Louis Roederer. The picture isn't entirely rosy, however, as Lécaillon admits that 2021 was the most challenging vintage of his 32-year career due to a hard-won battle against downy mildew. A champion of biodynamic viticulture, Lécaillon is exploring how Champagne's lesser-known grape varieties, like Pinot Blanc and Petit Meslier, can be used in the fight against climate change via an experimental plot in the Marne Valley.

Sizzling summer

Like Champagne and the UK, the cooler-climate region of Burgundy has yet to be severely impacted by climate change, but growers are aware of the need to tweak their vineyard practices in order to preserve the taste of their terroir. The start of the harvest at Drouhin, which owns vineyards in Chablis, the Côtes de Nuits and Côte de Beaune, has moved forward by a month in the last 40 years, but winemaker Véronique Drouhin has so far found this shift to be a good thing.

"To get the picking dates right, nothing beats the combination of walking through the vines, tasting the berries and looking at the pips and behaviour of the plants, combined with berry samples to get an idea of the sugar and acids content"

VÉRONIQUE DROUHIN,
HEAD WINEMAKER AT DOMAINE DROUHIN

Unstable weather is making it increasingly hard to decide picking dates for grapes

"Up until now, global warming in Burgundy has been a benefit to the quality of the wines, and by extension to the pleasure of consumers. If you think back to the 60's and 70's, there were more challenging vintages than good ones. Since 1985 we've been favoured with an extraordinary line-up of great years. Now we want the thermostat to stop going up, but sadly we know that won't happen," she says.

The last summer was a case in point – sizzling temperatures and drought conditions in Burgundy took their toll on vines that aren't allowed to be irrigated under AOC rules. "We're amazed at how resilient the vines have been after the heat and drought they went through. The older vines did a lot better than the younger ones. There were some dried berries, but the sorting tables are doing a good job removing them," Drouhin says. Like Angove, taking an organic approach to viticulture is helping amid rising temperatures. "The vines are encouraged to fight against natural problems on their own and that includes the effects of climate change. We are, of course, concerned about rising alcohol levels, and canopy management is one way to tackle this issue, along with trellising and pruning," reveals Drohuin, who hasn't found that early picking has negatively impacted on the phenolic and physiological maturity of her grapes. "To get the picking dates right nothing beats the combination of walking through the vines tasting the berries and looking at the pips and behaviour of the plants, combined with berry samples to get an idea of the sugar and acids content," she says.

While there is little winemakers can do about rising temperatures and increasingly erratic weather patterns, there are steps that can be taken in the vineyard to protect vulnerable vines against global warming, from picking earlier and clever canopy management to planting heat-resistant varieties and drought-tolerant rootstocks. A willingness to adapt is paramount if vintners want to preserve the taste of their terroir and retain the inherent character of their wines as the mercury continues to rise. It's a fine balance that winemakers seem to be getting right at the moment, but only time will tell whether it's a battle they will continue to win.

Viticulture is the fastest-growing agricultural sector in the UK

There are now 943 vineyards spread across Great Britain, accounting for 3,928 hectares under vine, according to a new report from trade group WineGB Industry report 2022-23. The industry produced 12.2 million bottles in 2022, which represents a 130% increase on the 5.3 million bottles produced in 2017

A green and pleasant land

Several days with temperatures around 35 degrees celsius are now common during the English growing season

Temperatures of up to 35 degrees are now common during the English growing season. Following a scorching summer in 2022, leading winemaker Charlie Holland explains how English wine can now compete with the world's best

Charlie Holland is one of the most respected names in the English wine industry. Having studied oenology at Plumpton College, for the last decade Holland has been blazing a trail at Gusbourne in Kent, where he's both the chief winemaker and CEO. We caught up with him to find out how the sizzling summer affected the 2022 vintage, whether English Chardonnay can compete with the best from Burgundy, and the inspiration behind his ambitious new prestige cuvée, 51 Degrees North.

How did it go with the 2022 harvest?

It's looking really good – we finished picking our sparkling grapes on 6 October, and brought in the final blocks of still Pinot Noir and Chardonnay the following week. The quality has been great – we've achieved lovely high sugars in our Chardonnay and Pinot, which have natural alcohol levels of 12.5% and 13%, and a lovely breadth of flavours. It's fun to blend in years like this and our yields have been good too.

How did the sizzling summer affect the vintage?

It definitely moved the picking date forward. With climate change most years now, we experience 35-degree heat for a few days during the growing season. Our vines are established now, with good root systems, so they can grow in these conditions. We had slightly smaller berries this year due to the heat, and our harvest started early, on the 18 September, but not as early as 2018.

What attracted you to work at Gusbourne?

I was keen to work at an estate with excellent raw materials, vineyards and fruit, and I knew Gusbourne had all three. It was exciting to join the estate at a time of growth, going from making wine in a few tanks at a neighbouring estate to building its own winery. I was attracted to the fact that Gusbourne doesn't buy in any fruit and works entirely with its own grapes. Provenance is really important and what we're trying to investigate is all the nuances of our parcels and what they give us each year, by picking and pressing everything separately. It's my 10th harvest now and I've got a much better understanding of our blocks and what they deliver, which allows me to make small improvements each year.

Do Gusbourne's sparkling wines have a signature style?

I don't want to put my fingerprints all over the wines, but the style has changed

"Climate change has helped with ripeness levels in England and has shaped our ability to grow grapes. Increased experience, knowledge, R&D and investment into the industry is helping us to make better wines year on year, and consumers are really getting behind the wines now and are becoming brand loyal"

CHARLIE HOLLAND, CHIEF WINEMAKER AND CEO AT GUSBOURNE

and evolved over time. We're viewed as a riper, more full-bodied style of English fizz, but the wines are also quite focused and precise with good balance. A lot of that comes from the soil, as two thirds of our vineyards are on clay, which leads to fuller, rounder, richer wines, and our winemaking aims to accentuate that with lees work and oak ageing. We have 15 vineyards and some have 40 different clones within them. We vinify specific blocks in 100 different tanks and use 200 different barrels, so we have up to 300 components to play with, which is a lot of work when you come to blending, but it gives us a big palette to play with.

Why do you age your sparklers in oak?

In the early days we didn't use much oak, but we've gradually increased it over time. We don't want to make oaky wines, so around 10% of the blend sees oak, of which only 2-3% is new as it's quite high impact. We treat oak like seasoning to give subtle complexity to the wines, adding weight, body and mouthfeel. English wine has a great attack from the acidity, but it can be quite hollow in the middle like a donut, so we use oak to bridge the gap and add texture to the palate.

Why do you take a vintage approach to sparkling wine at Gusbourne?

We hand sell our wines in restaurants and at the cellar door, and having different vintages gives us a story to tell each year. When the wine is made it is really important, and we want to reflect the vintage where possible. Non-vintage is a bit of a compromise, and we'd rather make the best of each year. It's a challenge though, and the equivalent of producing a vintage Champagne every year, but having hundreds of different components at our disposal helps us to bridge the gap, as does oak and lees ageing, allowing us achieve a consistency of style. A lot of winemakers wrote off 2012, but we made a great blanc de blancs that year.

Do you get more excited by making still or sparkling wines?

I love making both and am always trying to push myself. We launched a sparkling single vineyard project where we pick four of the most expressive parcels each year and bottle them separately as limited edition releases. This year we've bottled a 2017 Blanc de Blancs from Sussex grown on chalk and another from Kent grown on clay. It's fascinating to see the differences between them as they're made in the same way with the same clones, so it all comes down to the terroir.

How do English wines grown on chalk and clay differ?

Wines grown on chalk are elegant, lifted, direct and precise, while those grown on clay are fuller, rounder, richer and more fruit-driven. Perhaps conversely to what you'd expect, I prefer our clay-grown Chardonnay, as it's round and rich with tension and drive, and our chalk-grown Pinot, which is more high-toned and

Gusbourne winemaker Charlie Holland. Picture by Gusbourne

red-fruited. I think in time England will find its Grand Cru sites; Boot Hill is ours.

What innovations are you currently working on?

We made a single varietal Pinot Meunier in 2020 and are going to be making another from this year's crop. It has a fascinating flavour profile, with lighter, brighter fruit than Pinot and an appealing earthiness to it. It's a great barbecue red. We're also looking into ways to elevate our rosé into a fine wine, and are hoping to bottle our first sweet wine this year from Chardonnay, which is the missing piece of the puzzle. The Chardonnay we're using has a lovely acid line and is very floral on the nose with notes of orange blossom. It smells a bit like a Muscat.

Creating world-class Pinot Noir is the Holy Grail in England, are we there yet?

We're at the tip of the iceberg right now. We've achieved so much already, but the potential to grow the category is huge. We're still honing and developing what we're trying to do, and not every year is suitable for making Pinot in England. I didn't make any still red in 2021, as the conditions weren't good enough. The consistency of vintages and yields isn't there yet, and UK producers don't have a huge amount of experience with Pinot, but they're making amazing wines, and our Pinots are holding their own against the great Pinots of the world in blind tastings. It's exciting to see where we'll be in another 10-20 years.

We've made still pinot since 2010 and are very committed to it. The 2018 vintage was a watershed moment when we were blown away by the quality of the fruit and the level of ripeness we got. I think it inspired lots of estates to have a go. Wineries like Lyme Bay, Balfour and Simpsons all make still Pinot and a real category is being formed in England. I think a lot of Pinot will be made this year due to the warmer conditions.

Is England now capable of making Chardonnays to rival the best of Burgundy?

Yes, but it's a different style; ours are lighter and fresher styles in general. I've done a few comparative tastings and Burgundy is the natural benchmark when it comes to Chardonnay. We're only just getting going but I believe top English Chardonnay can compete with the best from Burgundy, Australia and New Zealand. Burgundy is increasingly expensive and less available, so England has a chance to move into the space and offer a more affordable alternative.

How has the English wine industry evolved since you first got in the game?

When I first studied at Plumpton there were a few pioneers like Nyetimber and Ridgeview, but there weren't a lot of opportunities to be a winemaker in England. When it comes to the world wine map, it's not very often that you get a new wine region coming onto the scene – it last happened in New Zealand in the '90s, so it was exciting to be part of England's growth and development. Climate change has helped with ripeness levels in England and has shaped our ability to grow grapes. Increased experience, knowledge, R&D and investment into the industry is helping us to make better wines year on year, and consumers are really getting behind the wines now and are becoming brand loyal. You can find English wines on pour at most good restaurants in the UK now – it's not mainstream yet, but we're getting there.

"The 2018 vintage was a watershed moment when we were blown away by the quality of the fruit and the level of ripeness we got"

CHARLIE HOLLAND,
CHIEF WINEMAKER AND CEO AT GUSBOURNE

Sales of sparkling wine have grown to 2.5 billion liters of the approximately 25 billion liters of wine consumed worldwide every year – that's a staggering 3.33 billion 75 cl bottles of fizz

Sparkling wines are easier to enjoy than to make. It can be challenging to create a consistent style of wine each year from hundreds of elements amid increasingly erratic weather conditions

Fizzing with promise – the rise and rise of sparkling wine

Sparkling wine is a complex wine of many moving parts that requires serious skill to make, so we caught up with some of the leading lights in the fizz industry, from Champagne to Spain, to find out the secrets of their craft and the challenges surrounding creating a consistent sparkling wine style in an ever-changing climate

Synonymous with celebration, sparkling wines are easy to enjoy but challenging to create. Crafting quality fizz requires a skilled hand, well-trained nose, razor-sharp intuition and nerves of steel come harvest time, when deciding on the perfect moment to pick feels like a game of Russian roulette. Cellar masters are the wizards of the wine world, able to create a consistent style of wine each year from hundreds of elements amid increasingly erratic weather conditions. They have to be time travellers too, projecting themselves into the future when tasting aggressively acidic base wines, working out how they will harmonise with one another and evolve over time in order to replicate a house style upon which reputations are hung.

The cornerstone of quality sparkling wine is its backbone of acidity, which, as temperatures rise and sustained heatwaves become more commonplace in Europe, is no longer something sparkling winemakers can take for granted. While fizz hubs like Champagne and the south of England remain marginal climates, this year's sizzling summer is a stark warning of the kind of conditions we can expect to see going forward. On the one hand it's a blessing, as English sparkling wines are becoming easier to craft by the year, and their signature racy acids are being balanced out by beautifully ripe fruit. While this is something to be celebrated, Gusbourne's chief winemaker, Charlie Holland, is keen for English fizz not to lose its racy edge. "A lot of fine wines exist on a knife-edge of something, be it reduction or oxidation, and acid is our knife-edge; it's our calling card when it's done well," he says. "Bright, vibrant sparkling wines are what we should be proud of in England. They can be austere in the wrong hands, so we need to harness the acidity rather than let it dominate the conversation. Winemakers are acid freaks in general; vibrancy is what makes wine exciting."

Sam Lindo, chief winemaker for Camel Valley in Cornwall, says acidity levels in English fizz are where Champagne levels were 30 years ago. "This gives us an opportunity to have the dosage levels that were common in Champagne back then of around 12 g/L, and this sweet-acid balance is one of the most appealing aspects of drinking sparkling wine," he says. For now, climate change has been a boon for English sparkling winemakers, helping them to achieve greater ripeness and better balance in their bubbles. "I did my first English vintage 17 years ago and got really high acid, which was hard work. Now, the wines are much more balanced. We're pretty into the sweet spot and have come away from the bleeding edge. Years like 2022 prove that, and they're a joy to pick as the parameters are easy to reach," says Holland.

Blending power

In Champagne, hotter summers are bringing picking dates forward, forcing winemakers to make difficult decisions about their grapes. The CIVC described 2022 as a "solar" vintage, which is abundant in size and healthy in character, as the prolonged heat and lack of rain kept diseases at bay. While the growing season was a breeze compared to the frost-ravaged 2021 harvest, the lack of rain shrunk berries and hardened the skins, which slowed down the ripening process. Winemakers keen to lock in freshness harvested at around 10 degrees potential alcohol to prevent malic acid levels from falling off a cliff. But those that did, risked finding green notes in their pressings due to a lack of juice in the smaller-than-average berries. Winemakers that were willing to risk sacrificing acid by waiting to obtain full ripeness, were rewarded, when early September rains helped to fatten up their grapes, concentrating the flavours and upping the yields in the process. Charles Philipponnat, managing director of Philipponnat Champagne, sits in the latter camp. "Picking, in my opinion, should take place at the height of physiological ripeness, i.e. just before the sugars start rising from evaporation rather than vegetation," says Philipponnat, who pursues freshness and purity in his wines through slightly higher yields and preserves acidity through protective canopy management.

For Julie Cavil, cellar master at Krug, the greatest challenge of her job is recreating the house's signature blend, Grande Cuvée, each year, which is made from up to 200 wines from as many as 15 different vintages. To help her in her quest, she works from a well-stocked reserve wine library, in addition to "auditioning" 250 wines from the current vintage. "Taking a plot-by-plot approach, I'm able to blend a new Édition of Krug Grande Cuvée every year, achieving complexity by cultivating the differences wherever possible, from vineyard to blending, to amplify each wine's uniqueness and contrasts, so we can craft the most generous expression of Champagne possible," says Cavil, who reveals that the 2022 harvest was the longest of her 16-year career at Krug. Despite the intense heat, Cavil is optimistic about the quality achievable this year. "All the grapes across the region revealed themselves beautifully, regardless the cru or variety. It was like the planets were aligned. That being said, we can't forget that it has been a year of extremes, including heat and drought, which left their mark on the fruit. We now need time to observe, listen and taste. Time will reveal the profiles of the wines that will be born from the 2022 harvest," she says.

Acid test

In the UK, the mercury hit a record high of 40 degrees during the July heatwave, but despite the challenging growing conditions, Nyetimber in Sussex is headed for a record harvest, and is set to produce over a million bottles of fizz from the 2022 vintage. Chief winemaker, Cherie Spriggs, is excited by the quality of the fruit, which "looks fantastic". Holland of Gusbourne

is equally gung-ho about the 2022 crop, and the high sugars and breadth of flavours the prolonged sunshine provided. Lindo of Camel Valley admits that growing grapes destined for sparkling wine is "a lot easier" than it is for still wine, as the goalposts are wider. "The picking window is much bigger and more forgiving and the range of acidity and sugar levels is broader to achieve the same outcome," he says.

For Cava king Bruno Colomer, chief winemaker at Codorníu, everything starts in the vineyard. "Each stage in the elaboration of a Cava is different, depending on the type of Cava we want to create. From the characteristics of the grape and the type of harvest to pressing, vinification and ageing. In order to achieve excellence we have to control each of these stages," he says. When it comes to picking, the longer he wants his Cavas to age, the higher the acidity he seeks in the vineyard. One of Spain's finest sparkling producers, Xavier Gramona, has made it his mission to push the limits of Cava and explore how the fizz develops with long lees ageing. Key to the longevity of his Cavas is his use of native Spanish grape, Xarel-lo, in the blends. "Xarel-lo has the highest levels of resveratrol of any white grape, which makes it the perfect grape for sparkling wines designed to age. Xarel-lo makes it possible to extend the ageing period and assimilates the autolytic notes of evolution in an excellent way," says Gramona, who believes the key to quality sparkling wine production is extended lees ageing, as the wines get much of their flavour and character from being in contact with the yeast.

For Gramona, who farms his vines biodynamically, the most crucial moment in sparkling wine production is the pressing. "Whole cluster pressing gives us the chance to classify the musts from the same plot into different qualities," he says. "We're focused on creating wines with high acidity and low pH, which means working our vineyards with medium-high yields; otherwise it increases the alcoholic concentration. We never want our wines to lose their personality and freshness, even after a long period of ageing. Gramona's signature is its acidity, and we work hard to preserve it."

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XAVIER GRAMONA, OWNER OF GRAMONA

The freshness paradox

With temperatures on the rise, the common practice of malolatic fermentation in Champagne and the UK, to convert tart malic acid into softer, creamier lactic acid, is being shunned or only partially used in sizzling years like 2018 and 2022 to keep the wines fresh. "We have always been in the habit of using only the first pressing of the juice, which is more acidic and less vegetal, and fine-tuning the malolactic fermentation to adjust the sensation of freshness in the finished wine. Over time, we've been avoiding it more often, but we never acidify artificially with tartaric acid as a matter of principle,"

reveals Philipponnat, who believes sparkling winemakers are caught in a Catch 22 situation in hot years like 2022, when dry conditions shrink grapes, bringing out a bitterness that requires full ripeness to overcome, which, in turn, decreases the acidity levels.

Holland of Gusbourne partially blocked malolactic fermentation in 2018 to keep his wines' acidity levels in check. Cyril Brun, chef de cave at Charles Heidsieck in Champagne, uses the same trick when he wants to "capture extra freshness" in his wines. In order to have greater control over the house's flagship fizz – Brut Réserve – Brun recently upped the percentage of reserve wines in the blend from 40% to 50%, made up of equal parts Chardonnay and Pinot Noir from up to 12 vintages. This unusually high percentage of reserve wine, coupled with five years' lees ageing, gives the fizz a level of richness and complexity you normally only find in much older Champagnes.

"It's a paradox in Champagne that you can bring extra freshness to a young wine with reserve wines that are 15 years old. These wines were selected based on their high acidity and great ageing potential, so even after a long ageing period they are still more acidic that the most recent wines impacted by the global warming," reveals Brun, who says a flexible approach is imperative now weather patterns have become so erratic. "I need to be open-minded to any new approach that will reinforce the identity of our wines: innovation is the fuel of consistency in a changing world," he says.

A question of balance

While achieving the correct sugar concentration in grapes used to be the biggest preoccupation in Champagne, the focus has shifted towards nailing the acidity levels and phenolic ripeness. "It's all about finding the sweet spot of balance. For a sparkling winemaker, priority will always be given to freshness, which is the identity of any sparkling wine, and a lack of bitterness – the worst enemy of bubbles, since sugar can be corrected through chaptalisation and alcohol levels can be corrected at the beginning of the fermentation process," says Brun.

Achieving this desired balance at bottling is rarely possible. Instead, Brun has to be able to project into the future to assess how the wine will level out during the ageing process. "Most of the time I bottle unblanaced wines that achieve their balance through ageing," he says. In addition to his tasting panel of trained noses, Brun uses chemical analysis data during the blending process to help save time. Building up his database of samples each year is a useful tool in the decision-making process, but he ultimately relies on his nose, palate and intuition. For Holland, before the blending process begins, he and his team conduct a vertical tasting of the fizz in question. "It means I'm fully calibrated and dialled into the style before I sit down to blend. It's a moving target but it's fun," he says.

Working with over 250 elements, it takes Brun around six months of daily tastings to come up with his Brut Réserve blend each year. "I need to take the necessary time to understand the current harvest style and how close or far it is from my target. Then I need to consider which reserve wines to involve to reach the Holy Grail," he says, admitting that the final blend requires a few "beta versions" before it's ready to bottle. "I become the conductor of an immense orchestra of tanks that will need to play, in complete harmony, an impeccable yet complex symphony for a discerning audience." Such alchemy deserves applause.

Knowledge that supports the traditional art of winemaking is increasingly important for protecting wine quality in an era of challenging growing conditions and evolving consumer tastes

Innovation in all aspects of winemaking can help to mitigate the growing threat of climate change

The small clues that define quality wine

FOSS Principal Scientist, Henrik Juhl, explains how experience in testing liquids for dairy industry applications led to an innovation that marked a new era in wine analysis

When scientists working at FOSS on analytical solutions for the dairy industry developed a breakthrough in analysis of liquid samples, they were quick to see the potential for other applications. "The original solution was for milk, but we called it a liquid product analyzer, because we could see, how it could be used beyond the dairy industry," explains Henrik Juhl, who has followed the development of liquid analysis from the original concept in the late nineteen nineties to the current day.

Instant insights with infrared

The innovation came through the use of infrared light to look deep into the composition of a liquid sample, right down to the molecular activity in fact because this is where a treasure trove of knowledge is waiting to be found.

All organic molecules vibrate and this vibration can be seen by shining infrared light through a sample and detecting what comes out the other side. This creates a signal in the form of an infrared spectrum that reveals all sorts of interesting things about the sample. "The analysis is based on infrared transmission," says Henrik. "You send light in and then you collect light on the other side to obtain the spectra. The spectra can then be converted into useable data."

Having cracked the code for applications for testing dairy products, the developers were quick to see the potential for wine. Instead of looking for molecular vibrations indicating fat and protein in milk, why not get the technology to look for ethanol, pH, malic acid and others in a sample of wine? This could open up a new world of insight for winemakers. Test results for several parameters could be delivered in seconds, much faster than the traditional test methods.

Collaboration from concept to practical solution

Having established the concept, work began on making an analyzer that would be easy and practical to use for wine laboratories and winemakers as part of their daily work. This led to the first FOSS WineScan™ analyzer launched in 1999 and a raft of further evolutionary

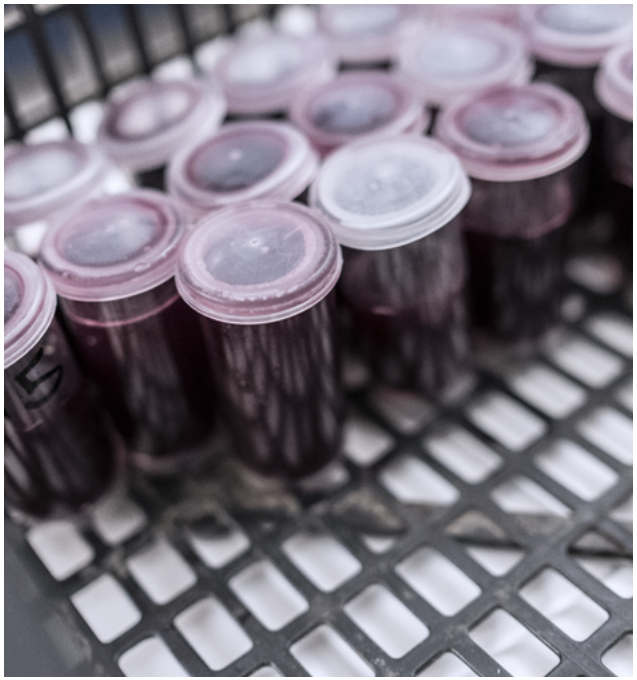
Technological development is working hand-in-hand with winemaking traditions

FROM MILK TO WINE

The innovation came through the use of infrared light to look deep into the composition of a liquid sample, right down to the molecular activity. It is here that a treasure-trove of information is waiting to be found

SENSITIVE TECHNOLOGY

Mid-infrared light is highly sensitive and can detect a lot of parameters in grape must and wine in concentrations down to around 0.5 grams per liter



VOYAGE OF DISCOVERY

An ongoing collaboration with the industry played an important part in finding out what exactly could be measured – a journey that continues to this day

Instead of fat and protein in milk, why not get it to look for ethanol, pH, malic acid and others in a sample of wine?

steps up to the present day, each providing incremental gains in terms of capability, ease of use and cost of ownership.

While the development of the instrumentation went quite quickly, the biggest step was to create the mathematical models that could convert the infrared signals into meaningful data. "It was a trial period," explains Henrik. "It was really a case of finding out what we could measure and what we could not." This is where a key aspect of the WineScan™ technology came into play.

What's your wavelength?

Compared to earlier analytical technology that only used certain parts of the mid-infrared wavelength, it exploits the full range. This can be likened to standing on a hilltop with a nice view across a broad horizon. You can see a whole lot more than if you are down in a valley full of trees.
Nonetheless, the definition of what can be seen with mid-infrared analysis, has limitations. "All molecules contribute to the mid-IR spectra, but their contribution is proportional to their concentration," says Henrik. "If their concentration is too low, it goes below the threshold of the instrument. For instance, when you go below 0.5 grams per litre, it becomes very difficult to measure."

An ongoing collaboration with the industry played an important part in the voyage of discovery. "There was a lot of interest from wine labs and a very good collaboration," says Henrik. "When they tested a sample with the standard reference methods, they also tested on the WineScan instrument to capture spectra."

The recording from both reference tests and from the infrared analysis created a rapidly growing pool of data that was used to find out just what parameters could be measured and to program the solution accordingly.

The first tests provided were for ethanol, pH, volatile acid, total acidity, malic acid, lactic acid, glucose and fructose.

As valuable and groundbreaking this was, the wine industry was quick to point out that the number one parameter of interest in finished wine was still missing from the list, namely the need to test sulfite in the form of free and total sulphur dioxide. "The most important one, and measured again and again, is SO_2," Henrik explains and continues: "As it is consumed by the wine, it is important to measure frequently to check that you still have some left to retain its preservative action, but no one wants to add more than needed."

The problem with SO_2 for the original solution was that the concentration is very low. Henrik and his team had to accept that it could not be included in the first solution offering. "But we did not give up," he says.

Ideal for liquids

Positive feedback on the first solutions in France and Spain spurred on the developers to meet an ever-grow-

ing wish list of important test parameters. The development of tests for grape must was a particular priority, as it could make a big difference to the assessment of grape quality during the busy harvest period. More insight into parameters such as glycerol, gluconic acid and acetic acid, would allow better decision making about handling grapes for best results downstream in the winemaking process.

The development required work on sample handling. With mid-infrared analysis, the light can only penetrate a very thin liquid sample of about half the thickness of a piece of paper, or 50 micron, to be precise. This places certain restrictions on the sample type and how it is presented.

In the meantime, the calls for SO_2 only grew louder until a game changer was found. "We discovered that the SO_2 can be measured with the mid-IR technology, if you can transfer the sample from a liquid into a gas phase, so we did that," Henrik describes. "It was a challenge, but we did it."

He explains, how a big part of the challenge is that a liquid sample of wine contains around 85% percent water. "It absorbs a lot of infrared light, which becomes a problem, when you want to measure low concentration parameters such as SO_2. But if you are able to create a gas, you can reduce the amount of water in the gas phase and adding acid into a sample, you can evaporate the SO_2, so you are seeing much more SO_2 and much less water."

Perfecting a proven concept

Further milestones along the wine analysis highway have included instruments working on the same technology, but with a smaller physical and economical footprint for smaller wine producers. Just one of the neat things that had come out of this, is a way to handle sparkling wine without sample preparation. Normally, the sample must be degassed to remove bubbles, as these would simply allow the light to pass straight through without registering a signal.

Bringing things right up to date, the latest WineScan™ platform returned to the SO_2 challenge to take it to the next level with ease of ownership, improvements with UV light, rather than Infrared for detecting the SO_2. "We have pretty much figured out, what we can and can't measure," says Henrik. But he also points out that the work to raise rapid wine analysis to ever higher standards around the globe, will never stop. "We are not selling instruments, but results that empower winemakers and wine laboratories to do a better job. That requires translation to local area variations in the form of a calibration that works wherever wine is made. We have been successful in re-using the calibration work for the earlier solutions and transferring them to the new, and in that way the new solutions are getting stronger and stronger," Henrik concludes.

The advent of rapid analysis has proved valuable in creating quality products out of raw material that may not always be perfect due to challenging growing seasons and harvest conditions

Data insights support creative winemaking

The brothers Tofterup reveal how rapid insights into the characteristics of must and wine have become an essential aspect of their winemaking approach

Born in Denmark, but spending most of their lives in Spain, David and Jonas Tofterup always shared a dream to make wine together. This is something that they live-out today through the creation of many fine wines produced at the Bodegas Trenza winery in Alicante. In an interview for FOSS, they explain how, in 2019 they took the winery to a whole new level, increasing production and incorporating wine from many regions of Spain. "We are exploring different great gems that we find Spain has to offer," says Jonas. "Wine for us is everything, it is our hobby, it's our work, it's our family because it is a family business. And we just continue to explore Spain because we find it has some of the best price quality and of many fantastic grapes to explore that have not been fully exploited yet."

The need for data

David explains how they are producing more than 20 different wines from different appellations. "We love experimenting with different grape varieties," he says. "We are incorporating new regions and new vinification methods because the wine industry is so dynamic, it's changing and evolving constantly."

Quality control of the many different lots proved a challenge, however, due to the time and work involved with traditional

Teamwork: innovative and easy to use technology is becoming increasingly important in supporting the traditional art of winemaking

analytical options. A faster, on the spot solution was required, setting the scene for an innovative new solution based on mid-infrared analysis technology.

Instant insights with Infrared

The simple-to-use analyzer delivers results for multiple quality parameters within two minutes – a capability that fits hand-in-glove with the brother's no-limits approach to winemaking.
"It's so quick and we get a long list of parameters, for example, we get the pH, the sugar level, the potential alcohol, the volatile acidity," Jonas explains.
A further bonus is that, compared to traditional analysis methods, it uses very little in the way of chemicals which is important for both economic and environmental considerations.

Creative freedom

The quick, clean and easy-to-use equipment is handy throughout the winemaking process, but for the Tofterup brothers, it is especially valuable during the blending trials. Because all results are stored automatically, the chemical parameters for previous blends can be called-up and compared to the new blend. This ensures high consistency between the different bottlings.

Above all, the innovative new solution provides a solid foundation of reliable analytical data that empowers users to be more creative. "With this new equipment, we can work more precisely and take a key decision and really dedicate more time to be creative, which is what we love about winemaking," says Jonas Tofterup.

"It's so quick and we get a long list of parameters, for example, we get the pH, the sugar level, the potential alcohol, and volatile acidity"

JONAS TOFTERUP

The almost instant availability of reliable analytical data can empower winemakers to work more precisely while finding more time for creativity

Data collection is a critical part of developing analytical solutions. Origin, vintage, cultivar, viticulture, winemaking procedures and wine style are all important aspects when representing samples from different regions around the world

The world vineyard surface is estimated at around 7.3 million hectares


4.31
3.71
2.79
2.80
3.31
4.30
4.39
2.78

Modelling global wine quality

FOSS Sr. Data Scientist, Kasper Winther Jørgensen, takes us on a tour of the data-modelling machine room where analytical instruments are programmed to recognise wine quality around the world

Let's start with the basics – what is data modelling and how does it work?

Our wine analyzers produce a spectrum of variables of dimensional data that we can play with. To make a measurement prediction, we have to convert this spectrum into a usable value for the end-user, who, in this case, is the winemaker. This is done by converting the spectrum into a so-called absorbance spectrum. This provides a raw data source for our modelling work.

You have to collect a lot of data in order to accurately describe all the kinds of variations that we can expect to find in a single wine sample. These analyzers can't be used for milk, for example, they're 100% specific to wine and we need to put the mathematics into the system in order for them to do their job.

One of the unique things about our innovative wine solutions is that they are built upon our entire legacy of data that we've collected over the years from our WineScan™ development program. We've been working in this sector of the market since 1999, continually collecting data, so we have around 25 years of experience to draw from. It's got to the stage where we have data reference points for all wines in the world now.


12.25%

It's important to know that a data model is never a fixed thing; you can always update it and change it. The value lies in the data that goes into the model, not the model itself. The more data that you put into these models, the better and more reliable the result is that you get out of them

How do you create a new data model?

To make a model, we work with all the data that we have to hand. As a liquid, the wine sample is very homogeneous and therefore the components we want to measure will be evenly distributed throughout.

Working with thousands of samples, we have a full spectrum of data to go on, and each spectrum has a reference value that we use in the lab. Measuring a spectrum is easy – it's just a case of pushing a button. The samples are tested on a reference instrument in the lab, which uses the data to create the model.

The beauty of working at FOSS is that we already have all the wine sample data that we need, so we don't have to go out and collect it – we can make use of the data at our fingertips. We input the data into the algorithms to predict new wine samples coming into the analyzer. Our data is so well structured and linear that we don't need fancy methods to build our models – it's very easy for us to do.

How much data do you need for it to be reliable model and how can you have a model that works for different wine regions around the world?

We spend a lot of time ensuring that we have covered what we consider to be the main components within a wine sample. We have winemakers on our team who we work closely with to ensure that we cover all bases, from high sugar and high alcohol wines to low sugar, low alcohol expressions, giving us all the necessary combinations for validation. After nearly 25 years of data gathering, we have what we need to cover the whole world and every possible type of wine sample that may go into one of our machines.

Can you explain the role of infrared light in the analysis process?

When analysing a wine sample, we look at the vibrational patterns in the organic compounds through infrared technology. We can measure for over 20 key components in a wine sample, from its alcohol and sugar level to tartaric acid – it all comes down to what the infrared can see within the sample. Generally, our instruments can detect any variable above 50 ppm. They have a source that emits infrared light that goes through a component in the heart of the instrument called a cuvette. This is a third of the thickness of a sheet of paper – it needs to be incredibly thin in order for the light to pass through it. When it does so, it's modulated and we get a signal.

Different characteristics of the sample stop some of the light going through it so less light comes out on the other side. The sensor creates an infrared spectrum based on the amount of light that has come out. The instrument is programmed to recognize certain spectra, like tartaric acid, to give just one example. This will show up as a particular

pattern, and it can work out the level of concentration from that. The more data the instrument can use to create the models, the more reliable the results and the more variables the instrument can cope with.

How is this infrared light used in the modelling process?

All the organic molecules in the liquid have bonds. When the light passes through the sample and if the light has the right frequency, then the bond will absorb the energy and won't be detected on the other side.

Our measurements are a transmission, as we send light through the samples. We're looking for what's not coming through on the other side and how the light is absorbed by the wine sample. This gives us the fingerprint of the wine that contains all the molecules present within it, many of which overlap with each other. If we're testing for malic acid, for example, we can build a model that predicts malic acid, apply this model to the spectrum to return a malic acid value. It's a fairly easy process.

How unique is this data modelling tvconcept?

We are no longer unique in using the modelling idea – our value lies in the fact that we were first-movers and we now have data that we've collected over the last 25 years. The data covers all the dif-

Mathematical models are used to program instruments to recognize components such as ethanol, malic acid, tartatic acid and many more. The more data used to create the models, the more reliable the results and the more variables the instrument can cope with

ferent wines in the world from a variety of growing seasons and vintages, which hasn't been done before on such a scale, so this makes us unique.

Are the analyzers updated from a data cloud, or would customers need to buy a new instrument if they want the latest updates?

The instruments are being updated remotely all the time by FOSS through a data cloud, like a software update while your phone is on charge, so users don't need to worry about it. Our FOSS analyzers are quite alike in nature, so if you have two different analyzers, then you can have them in a network and can apply the adjustments to your whole fleet, through the cloud.

What are the main things to consider about data modelling?

It's important to know that a data model is never a fixed thing; you can always update it and change it. The value lies in the data that goes into the model, not the model itself.

The more data that you put into these models, the better and more reliable the result is that you get out of them. People often forget that and just look at the reference and predictions graph. Some less sophisticated wine analyzers may seem good to begin with, but as they don't operate with the same level of core data, if there is a change in season or conditions that the machine doesn't recognise, then the model won't be able to handle the sample and you'll be thrown off course.

Analytical technology can measure over 20 key components in a wine sample – it all comes down to what the infrared can see within the sample

Intuitive, predictive and easy to use – innovative technology ensures that users can get on with their work with reliable data always at hand when making important decisions

Soil has always been of great interest due to its influence on the vine's growth, grape variety characteristics and ultimately wine quality. However, soil is highly variable, for instance, due to geographical variations, composition, texture, pH levels and concentration of nutrients. Analysis with rapid and convenient near-infrared spectroscopy (NIRS) can help to handle the analysis burden as a low-cost alternative to chemical reference tests

Blockchain technology promises to help establish trust and transparency by allowing every stage of the process to be recorded in secure, tamper-proof blockchain ledgers. Unique identifiers can be assigned to a bottle, making it difficult for criminals to tamper with the wine

Pervading virtually all aspects of our lives, artificial intelligence (AI) promises to help winemakers to match evolving consumer tastes. With its ability to process huge volumes of data at lightning speeds, AI can help to crunch the data on recorded preferences and target wines more efficiently

Keeping a cool head in a warming climate

Agile decision-making has become an essential part of handling the consequences of global warming

The Australian 'Black Summer' of 2019/20, which saw bushfires destroy swathes of vineyard land across the country served as a dramatic reminder of the growing challenges facing winemakers around the world. Speaking to leading Australian winemakers and lab technicians, we learned how agile decision-making has become an essential part of handling the consequences of global warming

Offering alarming proof of the escalating effects of climate change, in November 2019 bushfires blazed through New South Wales, scorching more than five million hectares of land following Australia's hottest and driest year on record. In December 2019, the fires swept through the Adelaide Hills, destroying 650 ha of vines in the region, and wiping out entire vineyards. Making matters worse, the smoke from the fires was far-reaching, rendering vineyard plots from Canberra to the Hunter Valley, useless. Ravaging an estimated 24.3 million hectares of land in total and destroying over 3,000 buildings, the September 2019 to March 2020 bushfire season – Australia's costliest natural disaster in history – became known as the 'Black Summer' due to the size, intensity and duration of the wildfires, which were caused by exceptionally dry conditions in the country.

Over 1,500 hectares of vineyards were destroyed by the wildfires, with the majority of the damage concentrated in the Adelaide Hills, Kangaroo Island, Tumbarumba and parts of northeastern Victoria. Among the producers worst hit was Vinteloper in the Adelaide Hills, which lost 95% of the vines planted at its 30 ha property. Owner, David Bowley's home, was also destroyed in the blaze.

One of Australia's most revered wine estates, Henschke, also suffered damage from the fires, losing 95% of the crop at its 25 ha Lenswood vineyard in the Adelaide Hills, along with two sheds and vineyard equipment. Among the losses at Lenswood were some of the oldest

DROUGHT

It appears that the 2019/20 Australian bushfires were a warning of more challenges to come for the global wine industry. In 2022, many wine making regions across Europe saw heatwaves and extremely low rainfall

SMOKE

A helicopter battles a bushfire. It can take three years or more for smoke taint to show up on the nose or the palate of a wine

FIRE

While the havoc wreaked on the Adelaide Hills was brutal, it didn't have a huge impact on the 2020 output of the Australian wine industry at large, as the region only accounts for 1% of the country's total wine production and 1% of its exports in terms of value

FLOODS

More than heat in vineyards around the world, climate change has meant increased flooding and high rainfall, as well as hailstorms and high winds during flowering and fruit set

Pinot Noir vines in the Adelaide Hills region, which were planted by Tim Knappstein in 1983. At the time the fires hit Chardonnay and Pinot grapes were still hanging on the vines, but the levels of smoke taint were so high that owners Stephen and Prue Henschke abandoned hope of picking a single grape, leading to yield losses of 70% across the board.

While the havoc wreaked on the Adelaide Hills was brutal, it didn't have a huge impact on the 2020 output of the Australian wine industry at large, as the region only accounts for 1% of the country's total wine production and 1% of its exports in terms of value. The engine room of Australian wine production – the Riverland – emerged relatively unharmed, so in volume terms, the damage from the fires was minimal. The bigger problem facing producers was smoke taint, which was far wider-reaching than the fires, leading a number of top producers to scrap their 2020 vintages altogether, or produce a fraction of their usual output. The first vintage affected by smoke taint on a major scale since 1969, Wine Australia estimated that the combination of fire and smoke damage amounted to losses of around 4% of the country's average tonnage – around 60,000 tonnes of grapes – in 2020. High levels of smoke taint forced Tim Kirk, chief winemaker and CEO of Canberra estate Clonakilla, to abandon the 2020 vintage entirely for the first time in the winery's 49-year history. "Once the grapes were ripe enough, we began sending samples off for testing. The results confirmed our worst fears: highly elevated levels of smoke taint. At that point we had no other choice than to write off the vintage," Kirk says – a decision that cost the estate "multiple millions of dollars".

Helping Kirk in his hour of need was Yalumba's chief winemaker, Louisa Rose, who offered him some of her Eden Valley Viognier and Shiraz. To protect her own vines in the fight against global warming, Rose has grasses growing between the vines and mulch to cool down the soils and preserve moisture, while canopies help protect the grapes from direct sun and trellising provides shading and keeps the grapes cooler, helping them to ripen more slowly. When things get really hot, Rose applies a fine layer of white clay called kaolin on her grapes, which acts like sunscreen, mixing it with water and spraying it on the vines to stop tissue damage from excessive heat, which is proving an effective way of maintaining acidity in the grapes and slowing down the ripening process.

Rose admits that when it comes to bushfires, there is very little that wineries can do to protect themselves in the event of one breaking out. "If there's a bushfire next door to you there's not much you can do about it, but a lot of research has been done in Australia around early detection of smoke taint, which impacts on picking and bottling decisions. You could turn your Pinot into a sparkling wine, for example, as there's no need for skin contact that way," she says. From a quality assurance point of view, using a FOSS WineScan™ analyzer enables Rose and her team to make quick and informed picking decisions. "It's great to have that ease and breadth of analysis at a minute's notice, which helps us with decisions around analytics. Winemakers make decisions on how a grape tastes, but it's all about balance, and the numbers are really important to back up the decisions we make with our palates," she says.

Chester Osborn, the charismatic chief winemaker at d'Arenberg in McLaren Vale, has various tricks up his sleeve when it comes to mitigating the effects of rising temperatures, from water management and canopy protection to composting and keeping nitrogen levels in the soil low in order to produce thicker and more resilient grape skins and a firmer pulp. He's also rethinking his plantings to incorporate more heat-resistant varieties. "We've been working with hotter climate varieties for some time now, from Spain, Italy, Portugal

Despite the climate onslaught, agile winemakers have developed various strategies for mitigating the effects of rising temperatures, from water management and canopy protection to composting and keeping nitrogen levels in the soil low in order to produce thicker and more resilient grape skins and a firmer pulp. Some are also rethinking plantings to incorporate more heat-resistant varieties

and the South of France. I'm very happy with how well these grapes grow in McLaren Vale," he says. Among them are French varieties Carignan and Cinsault, Italian grapes Sangiovese and Sagrantino, and Spanish natives Graciano and Mencía, which are "producing solid, strong berries with good colour," and, according to Osborn, "could be a replacement for Shiraz down the track". When it comes to heat-resistant whites, Osborn is seeing success with Rhône trio Marsanne, Roussanne and Viognier, while he believes Italian white Fiano is "extremely well suited to McLaren Vale – perhaps even better suited than its homeland of Campania."

Prioritising quality over profit during the Black Summer of 2020 was Hunter Valley-based Tyrrell's, which slashed its 2020 crop by 80% due to high levels of smoke taint, amounting to AU$ 3.5m in sales losses. "From mid-October we had bushfire smoke across various parts of the valley. We went through a series of tests for smoke taint with the Australian Wine Research Institute, and, based on the results, we made the decision to not pick anything that was over the recommended limits – around 80% of our crop," says owner Bruce Tyrrell, who believes producers that allowed smoke-tainted wines from the 2020 vintage to enter the market risked damaging their neighbours' reputations.

Frustratingly, Tyrrell reveals, there is no way to protect against smoke taint. "Grape selection is impossible because there is no way of determining it on a berry-by-berry basis. We have learnt to reduce smoke taint by about 50% with some fairly brutal processes in the winery, which means we can make decent commercial wine but no top-end wine," he says. And while smoke taint analysis has improved dramatically in recent years, by the time you receive the results, the damage has already been done. "Smoke taint analysis is very good at the moment, however, it only tells you what you've got when it's too late," says Tyrrell. "Sometimes it can take three years or more for smoke taint to show up on the nose or the palate of a wine. Luckily, we have the ability to test for the relevant compound and that can stop you spending money on a vineyard that's never going to be any good."

While making quality reds from smoke taint-affected grapes is almost impossible, whites and rosés are less impacted due to their different production methods. "You will never make fine reds from smoke-affected fruit, but some of the carbon products available did a good job with commercial whites and rosés in 2020 – we saw no bitterness in these wines and they sold very quickly," reveals Steve Webber, chief winemaker at De Bortoli, who said careful pressings were paramount on whites and rosés in 2020. "There are certain enzymes that you can add to smoke tainted juice that can 'cleave' some of the smoky characters such as guaiacol, which are tied to grape sugars and subsequently can be removed more easily with activated carbon," Webber adds.

One of the problems facing wineries blighted by bushfires is the cost of smoke taint analysis, which usually has to be outsourced. "Sensory analysis plays an important role in detecting smoke taint, but smoke taint precursor compounds are glycosylated and don't have aroma or taste, so you don't get a full idea of the potential scale of a problem," says Jill Huckel-Hicks, a laboratory supervisor at Angove Family Winemakers in McLaren Vale. "Chemical analysis can now detect these compounds, but this requires expensive equipment and for most wineries this testing needs to be outsourced, which can become a costly exercise with a lengthy timeframe for results." While there are currently no ways to protect against smoke taint in the vineyard, Huckel-Hicks points out that scrupulous harvesting, juice preparation and lab analysis can all help with managing smoke taint in wine.

While the recent wildfires have had devastating consequences, Angove's chief winemaker, Tony Ingle, stresses that the effects of climate change aren't limited to heat spikes. "It's important to consider climate change as more than just an increase in average temperatures. It's easy to look at the recent bushfires and record high temperatures and consider that's the whole story then gear our reaction to these consequences, when we need to look at many other issues," he says. "Climate change has meant increased flooding and high rainfall, as well as hailstorms and high winds during flowering and fruit set, so solely looking at heat can't help us ride out changes in climate." For Angove, taking a holistic approach and adopting organic viticulture and regenerative farming has helped to produce more resilient vines that cope better with the various climate challenges thrown at them.

Dr Eric Wilkes, general manager of Affinity Labs, which offers a comprehensive range of advanced analytical services for the drinks industry, reveals that smoke taint analysis has got to such a level now that it can effectively detect smoke taint in finished wines. "Smoke taint analysis is an area of ongoing research, however we're quite confident that our current testing gives a good indication of the risks of smoke impacts being evident in the final product," he says. "Much of the advances in recent times have been around understanding the levels of the compounds that are tested that lead to discernible impacts in the final product. It has to be remembered that the compounds we're testing, are naturally occurring within the grapes at some level, and so an understanding of what the base natural levels are, is incredibly important to the assessment of risk."

With bushfires proving increasingly problematic in Australia, Wilkes and his team have seen a rise in interest for their smoke taint testing services in recent years, "and a much greater awareness of the potential for smoke events to have an impact on final wine quality," he says. Wilkes calls upon the FOSS WineScan™ on a daily basis when analysing various parameters in wines for his clients. "It's an integral tool in our support of the wine industry and its producers. While it's not directly involved in the analysis of smoke markers, the data it produces is incredibly important towards wine analysis, and contributes to the overall production of high quality wines in the face of climate change," he says.

Looking ahead, Wilkes believes investment in R&D will be paramount for the Australian wine industry in order to safeguard its future. "Wineries need to continue to invest in research and development to better understand the impacts of fire events and how to mitigate those when they happen, as it's very unlikely that we'll see a decrease in such events invent the future," he says. Steve Webber of De Bortoli, meanwhile, believes wineries should be factoring the effects of wildfires and smoke taint into their business strategies. "We need to factor in a vintage write-off every so often into our planning and pricing," he says. "We have to do the same with poor flowering conditions in our cooler climates."

Chester Osborn of d'Arenberg would like to see the Australian government ploughing more funds and resources into early bushfire detection. "People in helicopters and planes that can detect and put out fires before they become out of control, could massively assist in reducing losses in hard to reach areas," he says. Whatever the future holds, rising temperatures and increasing incidents of bushfires across Australia are a sad inevitability of global warming, meaning a nimble approach to both grape growing and winemaking is key if producers want to stay one step ahead in the ongoing fight against climate change.

More insight, less work and more time for winemaking

Coinciding with the launch of a new generation of analytical solutions, we caught up with Søren Thiis Heide, Technical Product Management Director for wine and beer at FOSS, to learn how innovative technology is becoming more accessible than ever

How would you describe the latest analytical solutions for wine?

Powerful yet simple is what comes to mind first. The solutions today are so fast and easy-to-use where the winemaker or laboratory operator can take a sample of wine, place it under the pipette and press play. The next thing you see is the values on the screen for various parameters, including sugar, alcohol, acid; whatever the winemaker needs to know about, providing them with the insight to make informed decisions on when to pick, controlling fermentation and when to bottle. The whole process can take less than a minute.

So not only do the latest solutions offer a wealth of test data, they also makes it simple to get that data with minimal stress on operations. This is a neat development when it is a challenge to secure and retain skilled labour in the winery or in the laboratory.

What excites you about the latest generation technology?

Building on the past and making everything more accessible than ever. We've taken a big leap with both the OenoFoss™ 2 and WineScan™ 3 instruments. On the outside they might look very similar to others on the market, but the mathematics built into them stands on the shoulders of all of the knowledge, experience and expertise that FOSS has built up since 1999. Every single sample we've measured over the last 25 years has been input into the latest solutions, which makes them a compelling proposition.

All models are based on mathematical algorithms from hundreds of thousands of wine and must sample references from around the world. In addition, the instruments are more user-independent because of a flow system that allows the user to simply present the sample to the machine. For instance, the first OenoFoss solution was also a fantastic instrument, but it uses a method that's more dependent on the skills of the user. With the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“The easier something is to use, the harder it was to make”

SØREN THIIS HEIDE,
FOSS PROGRAM DIRECTOR FOR WINE AND BEER

new model, the winemaker can focus on making wine and the machine will provide the data. It’s much easier to get started with it.

In a similar way, with the WineScan™ 3, the automatic instrument standardization eliminates instrument drift and ensures stable results over time. In contrast to earlier generation solutions, there is no need to perform time-consuming instrument-standardization checks with associated use of chemical reagents and significantly reducing the need for costly reference analysis.

There are also features that are making it easier to do analysis on auto-pilot while just getting on with winemaking. For example, there’s an autosampler for the WineScan supporting over 130 tests per hour, fully unattended. Advances in software and connectivity are making a difference too, for instance with automatic backup and reporting keeping data safe and connectivity that ensures accessibility and traceability.

What parameters can be measured with these machines?

They can measure over 30 different parameters, from ethanol, glucose and fructose to volatile acidity with new ones being explored all the time. We’ve recently added a sucrose measurement for the OenoFoss™ 2 that can be used when making a dosage in traditional method sparkling wine. The new WineScan 3 includes unique new test options such as tannins in wine and yeast assimilable nitrogen during fermentation, not to mention the option to get free and total SO_2 results, faster than with earlier instrument generations (now two minutes instead of two-and-a-half).

Do you need special training to use and run these solutions?

Anyone can use these instruments – it doesn’t require special training or expertise as the software is intuitive. The smaller OenoFoss 2 comes with an instruction manual and there’s a welcome letter with a QR code in the box, which takes you to a dedicated website that guides you through the installation, so it’s really easy to set up. From a closed box to a fully working instrument takes around 12 minutes.

Other aspects of the solutions we can mention are the touch screen operation and a highly intuitive software interface that makes it simple for anyone in the laboratory or winery to operate. Another thing is what we call a ‘smart-enabled’ platform. It is smart in that it provides a close level of support via connectivity and intelligent diagnostics that help users to run and look after their solutions, also if they want to run several units at once across sites and locations. We have also developed ‘SmartCare™’ support packages, where the machines are monitored regularly to make sure everything is running properly and customers can back up their data and readings on our cloud, so the instrument can be restored if it needs to be rebooted, keeping data

WineScan™ 3 with autosampler

safe and traceable. Things are moving in a digital direction and we're ready for it. All this makes perfect sense, I think, for Winemakers today. They often need to push the envelope on wine style and quality in step with consumer tastes and the demands of an ever-changing climate. It is here that the time and performance gains offered by the latest solutions are really relevant in reducing the worry about running instruments. As I see it, users now have more time to spend on what they are best at – creating quality wine.

Who is the equipment aimed at and who will benefit most from it?

What we've learned with launching these new instruments is that they're attractive to a broader range of customers than we first thought. We initially thought that the OenoFoss™ 2 was only for smaller wineries with less measuring needs, or for smaller co-ops and wineries looking to join together and buy a machine to share. But we've seen interest from bottlers for example – instead of having one WineScan™, they buy three of these, so it's able to offer value on a broad scale. Similarly, a big winery might have a WineScan at the main site and an OenoFoss 2 at its smaller site.

How do these solutions help the winemaker in their pursuit of precision?

We can get very close to the true answer of a wine's chemical composition with our analytical solutions. We have data analysts, physicists, electronic engineers and mechanical engineers all coming together and collaborating very closely to make these solutions work. It's a team effort, which gives us our strength and helps us to add value for winemakers and wine laboratories.

As is often the case, the easier something is to use, the harder it was to make. We've put the effort in at the design stage so our users have less to do to get the results they're looking for.

Winemakers today often need to push the envelope on wine style and quality in step with consumer tastes and the demands of an ever-changing climate. It is here that the time and performance gains offered by the latest analytical solutions are relevant in reducing the worry about running instruments. Users now have more time to spend on what they are best at – creating quality wine

Who we are

FOSS was founded in 1956 by the innovative engineer Nils Foss. His ambition was to offer automated and cost-efficient alternatives to time-consuming analyses. And though much has changed in more than 60 years, our approach to business and development of innovative analytical solutions has not.

FOSS is the leading global provider of analytics for the food and agricultural industries. We help producers maximize the value of their production while making the best possible use of valuable natural resources. Value for the customer and value for the environment go hand in hand.

Always at the forefront of analytical technology development, FOSS provides a range of analytical solutions from laboratory to at-line and in-line solutions. Across a number of industries, FOSS helps optimize the use of food and agricultural resources around the world. We do so by enabling customers to run intelligent data-driven productions, based on fast, easy-to-use and dedicated analytics.

We cover these food and agricultural industries: Dairy, Feed and Forage, Grain, Flour Milling & Oilseed Processing, Laboratories, Meat, Raw Milk Testing, Wine and Sugar.

If you want to know more about winemaking and wine-analytics, visit our knowledge area at: www.fossanalytics.com

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