

FOSS

# A LITTLE GUIDE TO ANALYZING BEER





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# A history of innovation

Founded in 1956 by the innovative engineer Nils Foss, his ambition was to offer automated and cost-efficient alternatives to time-consuming analyses in the food and agricultural industries.

We are still family-owned and today we are the leading global provider of analytical solutions for the food and agricultural industry. We cover dairy, feed and forage, grain, flour milling and oilseed processing, laboratories, meat, raw milk testing, wine and beer.

Though much has changed in more than 60 years, our approach to business and development of innovative analytical solutions has not. ■

↑  
FOSS advertisement  
from the late 1950s



**7** out of **10**  
maltsters use FOSS  
instruments to analyze  
their grains and malts



# Our team

**We are always on the lookout for sustainable solutions that will make food production better, and we're continuously developing new innovations supporting proven methods, and introducing new pioneering solutions to existing problems.**

We spend 10% of revenue on research and development each year, which is expected to add up to over 130 million EUR over the next 5 years.

We are passionate about brewing and strive towards creating solutions that can optimize production and help breweries get the most out of their daily brew. ■



↑ Rasmus is part of the beverage R&D-team and scientist in our Front-end Innovation group. He has been part of the BeerFoss™ FT Go project since the very beginning and knows everything about practical beer analysis. With a degree in Chemical Engineering and working with beer, he is an expert on fermentation and knows the function of every little piece in the BeerFoss FT Go.

← Over the past years, our colleague, Nikolaj, has been co-developing and fine tuning the BeerFoss FT Go. With a huge passion for the craft, Nikolaj has been working in the brewing industry throughout his career and obtained a Msc. in brewing science and technology before joining FOSS.

# 4 ways FOSS helps you build a more sustainable brewery

We have a holistic approach to sustainability that transcends company operations and procedures. We use our knowledge to develop solutions that support sustainable practices by providing robust data to food and beverage companies across the beer industry. This comprehensive approach enables our clients to make optimal use of increasingly limited resources and get the best quality beer to their consumers.

## 4 ways we can help you in your brewery

### 1. Reduce energy costs

By testing the beer throughout the brewing process, BeerFoss™ FT Go tells you exactly when the beer is finished fermenting. This can shave days off the time your beer spends in tank, and therefore reduces each beer's carbon footprint.

### 2. Reduce waste

BeerFoss FT Go helps you to reduce waste by ensuring quality. By analyzing your beer samples throughout the brewing process, you know if your beer will turn out as expected. Not only does this secure consistency, but this insight also helps prevent breweries from making costly adjustments to save a fermentation, or even having to dump a batch.

### 3. A better use of the world's resources

Malt is a valuable and vulnerable raw material. Globally, FOSS is the leading provider of grain testing solutions, and our grain instruments secure the best quality of malt and ensure that you pay the right price for your raw materials.

### 4. Long instrument life span

Our instruments are made to last a lifetime. Our care service packages provide on-site and off-site services and spare parts can be purchased for all our instruments. BeerFoss FT Go also requires very little maintenance, and all cleaning solutions are non-toxic. ■

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It's possible for me to get around 400 litres more out of every brew and that's 400 litres directly in my pocket

MICHAEL RAHBEK, NØRREBRO BRYGHUS



# Rapid analysis of beer and beverage

**No degassing of samples, no worries about varying quality, no need to handle different items of analysis kit – just easy beer analysis for consistency, creativity and profit in craft brewing.**

The development of rapid and easy multi-parameter beer analysis follows in the slipstream of popular solutions that FOSS has developed for other application areas, for example, in the wine industry.

The technology is based on a well proven form of infrared analysis called Fourier Transform Infrared (FTIR). FTIR is particularly suited for rapid and reliable analysis of beer and liquid samples.

Additional services available through the latest in networking software create a total solution. For instance, self-maintenance diagnostics and online support helps users to keep everything running right. Inexpensive reagents, consumables and maintenance ensure low running costs and make for easy analytical beer operations. ■



The data helps us to be a better brewery

MORTEN VALENTIN LUNDSBAK, AMAGER BRYGHUS

↑ Demonstrating the BeerFoss™ FT Go at a brewery.

# The ultimate guide to spectroscopic methods in beer

**What are the different spectroscopic methods and what are their advantages? We have been speaking with our in-house Senior Data Scientist, Kasper Winther Jørgensen, about spectroscopic analysis and the advantages of using FTIR compared to NIR when analyzing craft beer.**

The craft brewing industry is constantly evolving and many breweries that started as small micro-breweries are now reaching considerable beer production totals each year. With production growth, many craft breweries are reaching a point where it is more beneficial to use in-house quality control methods rather than outsourcing this key activity to external labs. Spectroscopy is becoming a more and more common method by which breweries track and monitor their beer production and fermentation.

So, what is spectroscopy? And what are the different spectroscopic methods and their advantages?

We have been speaking with our in-house Senior Data Scientist, Kasper Winther Jørgensen, about spectroscopic analysis and the advantages of using FTIR compared with NIR when analyzing craft beer.



**Q&A with  
Kasper Winther Jørgensen**  
Senior Data Scientist, FOSS

## **What is FTIR? What is NIR? And how does infrared spectroscopy work?**

“Broadly, infrared spectroscopy is a principle where light interacts with organic matter in different ways. By measuring light’s interaction with different materials, you get valuable insight about the material’s composition.

Near-Infrared (NIR) is one technique that is often used in spectroscopic analysis. It uses the electromagnetic spectrum between 700nm and 2500nm and is an accurate and rapid analysis reference method that is well-suited for quantitative determination of the major constituents in most types of food and agricultural products.

FTIR stands for Fourier Transform Infrared, and is a spectroscopic technique that makes use of the electromagnetic spectrum from 2500nm and 25000nm. This is the ‘mid-infrared’ region, and this is why FTIR is sometimes called Mid IR.

The mid-infrared spectrum 2500nm – 25000nm is broad in comparison to, for example,

NIR (800 – 2500nm). Because the spectra generated by an FTIR analyzer are based on many data points, it provides a highly accurate spectral representation of the sample under analysis. In fact, the accuracy and repeatability of results are often at least as good, if not better, than traditional chemical analysis, but obviously hard to prove. At the same time, measurements take less than a minute and are chemical-free.

Compared to traditional wet chemistry analysis, using infrared spectroscopy for quality control analysis is an easy-to-use, accurate, low-cost method. In a brewery, infrared spectroscopy analysis can save time and money in many ways and is a non-destructive analysis method that allows data to be collected without the need to throw away raw material. Additionally, you perform multiple analyses of one samples simultaneously with little or no sample preparation, and you can take these measurements around the clock.”

### How do different spectroscopic methods give insights into malt and beer analysis?

“FOSS has been using NIR since the 70s and NIR is an excellent way of measuring moisture percentage, starch, and protein in grain and other raw materials before the brewing starts. It is also used when analyzing cheese, cream, and unhomogenized milk as the penetration depth is important to obtain a representative measurement throughout a sample with an uneven consistency.

While this is great for grains and solid materials, for most liquids, FTIR has turned out to be a more reliable solution.

The dairy industry was the first to benefit from the convenience and speed of FTIR analysis through pioneering FOSS solutions introduced in the 1980s and FTIR is now the leading method to test milk and dairy products for fat and protein content.

FTIR analysis has also become an important tool for winemakers ever since FOSS introduced FTIR analysis to the industry in 1999. It is not that winemakers could not make high-quality wine before, but now they can do it more consistently with objective data available to cross-reference their instincts and judgement. We also use FTIR technology in our BeerFoss™ FT Go to bring these benefits to the craft beer industry.”

### Where in the brewing process can you use spectroscopic analysis?

“The short answer is that you can use spectroscopic analysis in every stage of brewing. From raw material analysis to the finished beer. FOSS has been using infrared technologies to support grain growers and maltsters for more than three decades.

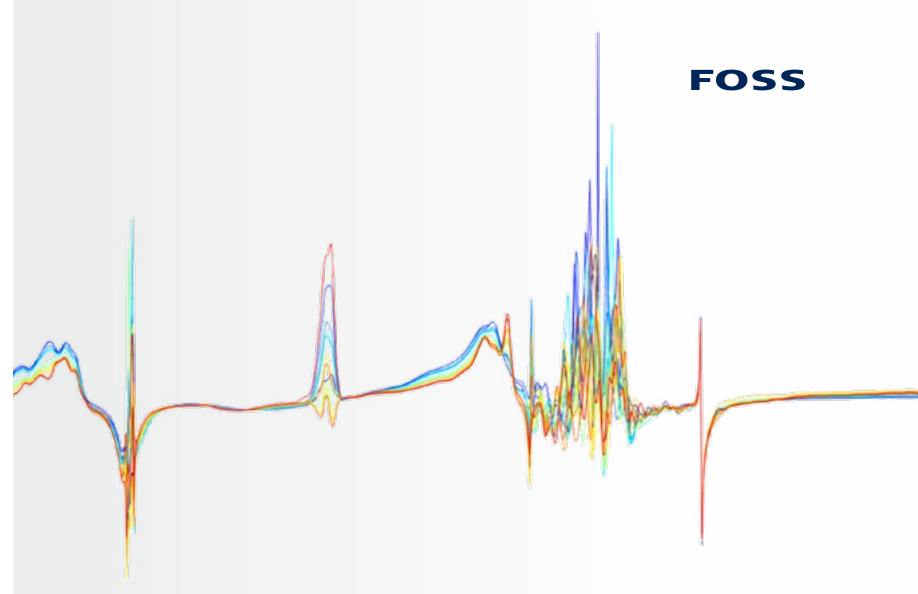
With FTIR spectroscopy, you can measure ABV, density, gravity, real extract, RDF, pH, calories (and more) to help you track production data and ensure that your quality standards are consistent.”

### Craft breweries often view themselves as brewing better tasting and better-quality beverages than macro beers, but is taste and quality something that can be measured with spectroscopy?

“Taste is a very subjective thing, but quality is certainly something that can be measured.

When speaking about beer, quality control is about ensuring that a certain style meets the specifications that have been made for the specific style of beer. This includes specific combinations of barley and hops, fermentation, temperature, and finishing of the product. You also need to be sure that you hit the ABV listed on your labels to avoid taxation issues.

With Near Infrared (NIR) and Mid Infrared (IR) spectroscopy, you can



measure all of the key parameters, from ABV to density to real extract, to get insights into the wild world of fermentations, and be sure that you are brewing the exact beer you want, every time. By tracking and recording data values throughout production and fermentation through to packaging, you can ensure that specifications are met, and consistency is achieved.”

### In summary, what are the benefits of FTIR in craft beer?

“The benefits of FTIR in beer are plenty. First of all, the mid-infrared spectrum of 2500nm – 25000nm is broad in comparison to, for example, NIR (800 – 2500nm) and because the spectrums generated by an FTIR analyzer are based on many data points, it provides a highly accurate spectral representation of the sample under analysis.

Secondly, FTIR is more sensitive and can therefore measure both low and high alcoholic beer with greater accuracy than NIR. It is also much more adaptable when measuring all kinds of sour, hoppy, or sweet beer. Samples do not need to be degassed or filtered prior to analysis since FTIR is able to measure the critical alcohol molecules and ignore the particle ‘noise’.

On top of this, FTIR is not a single-purpose measurement solution. New features can be added depending on customer needs and we are constantly working on new features to be added. This is a great advantage for craft breweries that are often much more experimental and constantly looking for new ways of producing and using different ingredients when creating new types of beer.” ■

# BeerFoss™ FT Go

BeerFoss™ FT Go is a competitive solution that provides key test data for more effective quality control of the whole brewing process. It is easy to use and delivers results within 3 minutes.



## Sample types

Wort, fermentation, finished beer and hard seltzer.

## Parameters

Alcohol, SG, density, pH, RDF, ADF, calories and extracts.

## Technology

FTIR technology.

## Applications

Components	Units	Ranges within product type				Comments
		Wort	Fermentation	Beer	Hard Seltzer	
Alcohol	% vol	N/A	0 - 20	0 - 20	0-16	
Specific gravity	None	1.03 - 1.14	1.003 - 1.14	1.003 - 1.14	0.985 - 1.086	At 20 °C calculated
Density	g/ml	1.03 - 1.14	1.003 - 1.14	1.003 - 1.14	0.983 - 1.084	At 20 °C
Real extract	°Plato	N/A	0 - 32	0 - 20	0 - 22	
Apparent extract	°Plato	8 - 32	0 - 32	0 - 12	-4 - 21	Calculated
Original extract	°Plato	N/A	0 - 32	6 - 32	5 - 32	Calculated
Real degree of fermentation	%	N/A	0 - 100	0 - 100	0 - 100	Calculated
Apparent Degree of Fermentation	%	N/A	0 - 100	0 - 100	0 - 100	Calculated
pH	None	4.5 - 5.5	3.0 - 5.0	3.0 - 5.0	2.6 - 5	
Calories	Kcal/100 g	N/A	N/A	20 - 134	20 - 128	Calculated

## Technical specification

Analysis time	Less than 3,5 min
Noise level	< 70 db (A)
<b>Sampling</b>	
Sample volume	6 - 10 ml
Sample preparation	Wort and fermentation: Filtration* Beer: None (no need for degassing) Hard Seltzer: None
Sample temperature	15 - 25° C
<b>Maintenance</b>	
Cleaning	Automatic and programmable
Test	Automatic, integrated. Self test option

\*Use BeerFoss™ FT Go filtration device. Provided with the purchase of BeerFoss™ FT Go.

## Installation requirements

Power supply	100-240 VAC, 50-60 Hz
Power consumption	60 VA (12 V, 5 A)
Ambient temperature	15-25 °C
Ambient humidity	< 80 % RH
Ambient CO <sub>2</sub> concentration	< 2000 ppm
Weight	11 kg (Including Zero/Clean liquids)
Dimensions (h x w x d)	285 x 345 x 280 mm
Environment	For best performance place the instrument on a stable surface away from excessive and continuous vibrations

A close-up photograph of a person's hands holding and pouring malted barley grains. The grains are golden-brown and are falling from the hands, creating a dynamic scene. The background is blurred, showing what appears to be a brewery or laboratory setting. Overlaid on the image are several semi-transparent circular graphics: a large white circle at the top, a smaller white circle in the middle, and a larger white circle at the bottom. A large orange quotation mark is positioned to the left of the main text block.

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Because I have constantly measured values and high measurement accuracy, I find deviations relatively quickly, which previously happened either too late or the results couldn't be determined before to the right degree of accuracy

SASCHA BRUNS, LANDGANG BRAUEREI



# When fermentation becomes an open book

Many breweries buy a BeerFoss™ FT Go as a quick and easy way to measure ABV in beer. But there are many other benefits of measuring the beer throughout the brewing process. From wort to finished beer - we have been speaking with two of our in-house specialists, Nikolaj and Rasmus, about their passion for beermaking and their excitement about data as guidance when making top-quality beer.

Nikolaj and Rasmus both have a background in the brewing industry. Nikolaj studied brewing science to become a Master Brewer at the University of Copenhagen before joining Copenhagen's famous brewpub Warpigs as a brewer. Rasmus worked at Carlsberg along with his studies at the Technical University of Denmark – and on the side he brews excellent beer in his basement.



**Q&A with  
Nikolaj and Rasmus**  
Specialists, FOSS

**Craft breweries often promote themselves as a better-tasting and better-quality alternative to macro breweries, but is taste and quality something that can be measured?**

“Taste and quality are very subjective things,” Nikolaj and Rasmus agree. “Consistency on the other hand is something that can easily be measured and producing consistent beer goes hand-in-hand with making quality beer,” Rasmus adds and explains that this is what macro breweries are really good at doing. “Craft breweries are really good at challenging existing brewing methods and analyzing their beer throughout the brewing process helps making consistent beer,” he says. “When you have created a really good beer, you need to know exactly how it has been done, so that you can replicate it and make the same beer over and over again.”

**When did you first realize the importance of data in the brewing process?**

“When you study brewing science, you quickly realize that you need good data to be able to do the same beer twice. And when data is available you just want to know more and more,” Rasmus says.

“The first time I wanted to redo a nice tasting experimental beer, we thought we did the same exact thing, adding the same ingredients etc. But the outcome was completely different, and data would have helped us localize when in the process, the beer had gone wrong,” Nikolaj adds.

**Where in the brewing process should you analyze your beer?**

“Everywhere in the brewing process! And where you want to know more or you don’t feel in control,” Nikolaj says.

“You won’t get anywhere based on your gut feeling. You always need data to find out where things went right or wrong,” Rasmus adds.

**When does it get really interesting?**

“Troubleshooting” they both agree. “The fermentation process is a living process that can be affected by so many different external factors depending on the yeast, temperature, water etc. When you start linking data to what happens in the actual brewing process, you can start replicating the exact process and then look at trends to optimize an already excellent beer. This is when it becomes really interesting,” Nikolaj and Rasmus agree.

**Do you have any good advice for breweries, that are interested in making more analysis in-house?**

“Define your way of doing things and create a system that is manageable,” Rasmus says. “Instead of measuring the beer here and there, create a system for when in the process to measure your beer and repeat it every time you make this beer. When you have created a functional system of when to measure your beer, you can start adding new measuring points into your system,” Rasmus adds.

“The more consistent data you get about your brew, the more you learn about your beer and gradually fermentation will become an open book.” ■

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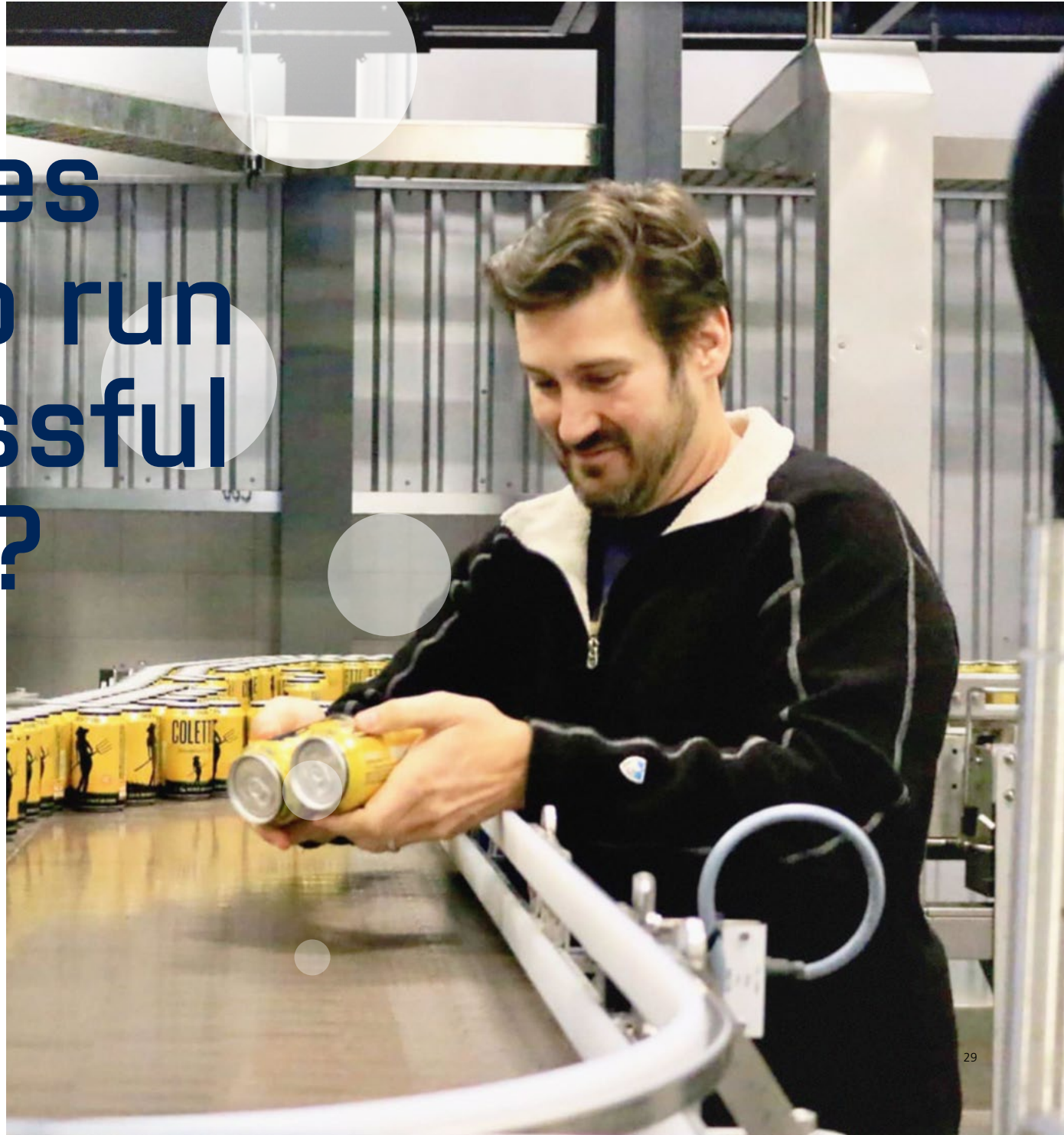
The processing is actually very complex, and this is also the reason I choose the BeerFoss to help me simplify the quality control work of all the products of both plants

NICOLA PERRA, OWNER OF BIRRIFICIO BARLEY

# What does it take to run a successful brewery?

**Great Divide Brewing Company is a pioneering American craft brewery based in Denver, Colorado. Founded in 1994, they brew all sorts of exciting beer styles and have become one of the most decorated breweries in America.**

According to Director of Operation, Jeff Martin, the secret behind running a successful brewery is all about being consistent "(..) batch to batch, year to year, so when you go and grab a Titan IPA, you know that it's going to taste like a Titan IPA every time you pick it up from the grocery store."



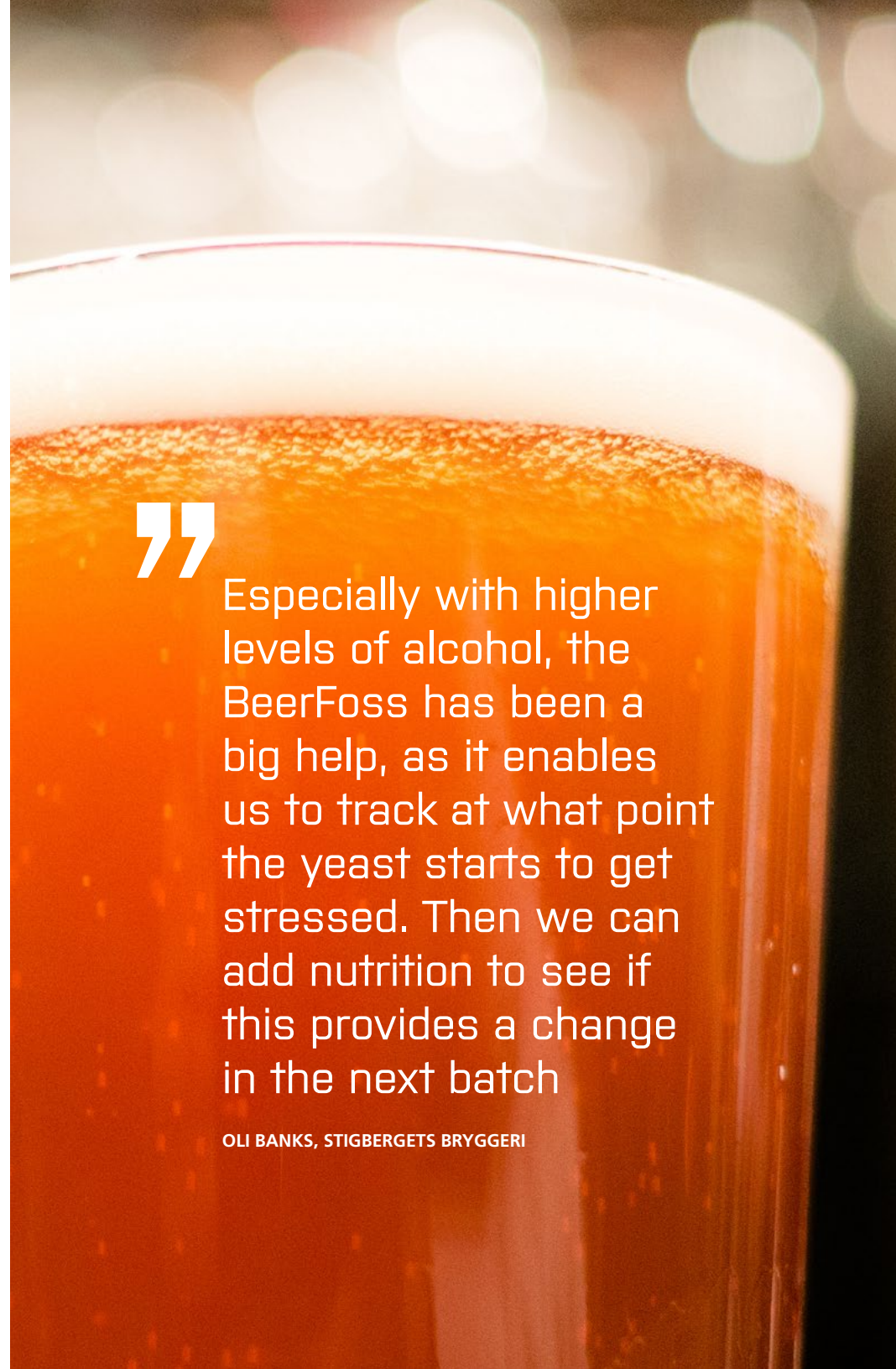


**“What really drives us is being consistent”**

This is where the BeerFoss™ FT Go has been really helpful. “It gives us the data to dive in along the entire process to make sure that we are consistent.” Jeff says: “One of the abilities we were really missing in-house, was the ability to track ABV and now we have a very robust, quick, easy system that allows us, not only to look at the whole fermentation curve but also making sure that our finished product also is finishing right where it is expected to.”

“We take samples every single day and out of that, I can tell if something is going to go wrong earlier, to correct the processes earlier. It has probably saved us three or four of the beers since receiving the BeerFoss,” Tim Batog, R&D Innovation Brewer, adds. “Creating new recipes every week is a lot of dialing-in processes. A lot of new recipes don’t behave the same way as other recipes do and tracking that part is incredibly helpful.”

“With FOSS you have an answer, a real digital answer. It takes the guesswork out of it, which has been my favorite part about it and that’s huge for the company and myself,” Tim Batog concludes. ■

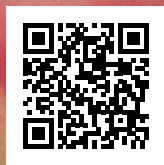


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Especially with higher levels of alcohol, the BeerFoss has been a big help, as it enables us to track at what point the yeast starts to get stressed. Then we can add nutrition to see if this provides a change in the next batch

OLI BANKS, STIGBERGETS BRYGGERI

# FOSS



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