

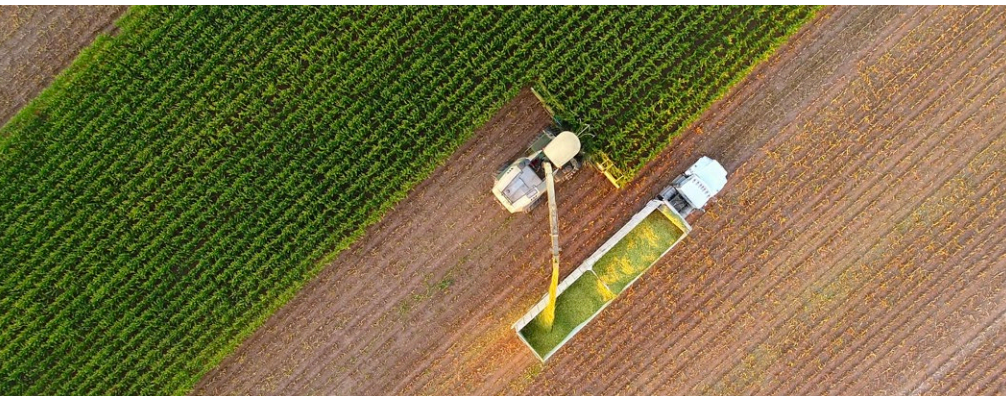
FOSS

MICRAL™

Accelerate to win



ANALYTICS BEYOND MEASURE



Accelerate to win

The agri-food industry today has a growing focus on resource efficiency driven by net zero ambitions and consumer demands for sustainable food production.

This means that producers, farmers and the agricultural industry as a whole are challenged to find new ways to reduce carbon footprint, such as optimized feeding of livestock and optimized nutrient flows in crop and feed production.

Meeting these challenges requires data driven solutions!

In this context, the need for element analysis is growing, but current methods are time consuming, expensive and require skilled labor and chemicals to perform, making it very demanding for laboratories to grow their capacity and business in element analysis.

So, how do we rise to the challenge and secure a better flow in the laboratory? Innovation offers the logical path ahead.



Introducing Micral™

Micral™ changes the game by dramatically speeding up test capacity.

Get valid results for key elements such as calcium, magnesium, phosphorus and more with a time to answer of only three minutes for dried and ground samples. Say goodbye to chemicals, reduce the need for specially trained operators and deliver many more results quickly, sustainably, and profitably.

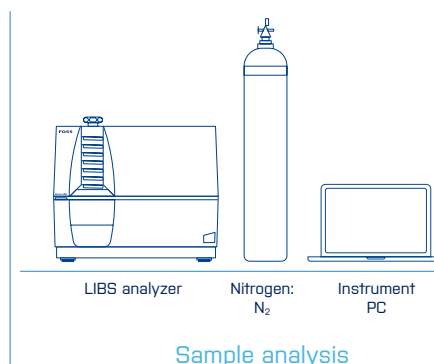
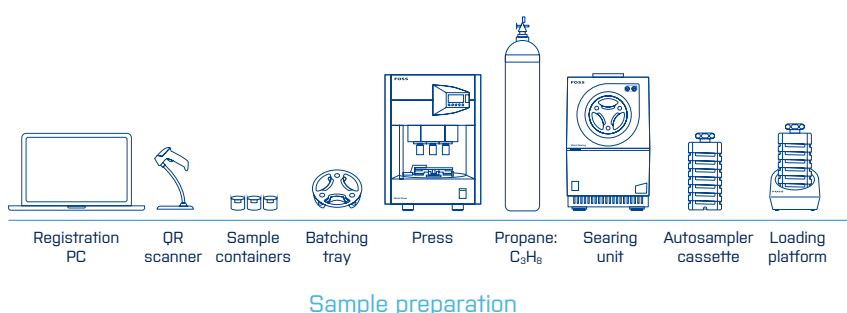
Micral is based on Laser Induced Breakdown Spectroscopy (LIBS) and is the first fully automated solution to measure elements in a broad variety of agricultural samples such as feed and forage.

The LIBS solution is easy to use and allows anyone working in the laboratory to make a valid test

without the need for special training. No chemicals and consumables are required for sample preparation or testing, making it a very accessible and scalable technology and a strong contributor to profitable growth. Adding to this, Micral comes with ready to use calibrations out of the box and includes an option to develop your own models.

Further gains in laboratory logistics result from a smaller footprint and digital functionalities, including barcode identification of samples and associated traceability of results.

Micral gives a massive boost to the throughput of key element testing while dramatically reducing the turnaround time and cost-per-sample.



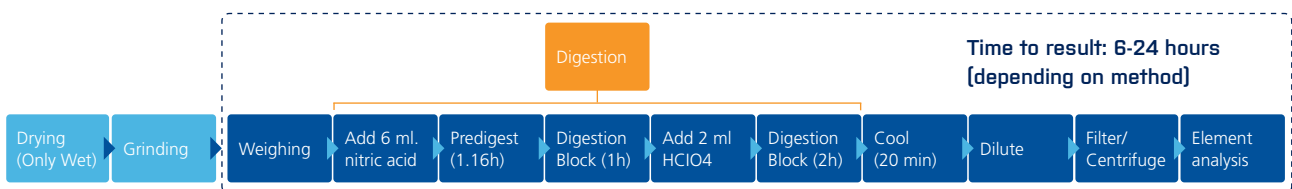
Offer your customers a better business

Does it take you hours or even days to produce the results that your customers need? Current testing methods are known for being time consuming, requiring many steps, skilled operators, modern lab facilities with fume hoods, use of hazardous chemicals and expensive gases.

All this has changed with Micral™. After the drying and grinding steps, analysis time is less than three minutes. This results in higher throughput and faster time to result, allowing laboratories to significantly increase their sample capacity without compromising on accuracy and quality.

Micral measures 12 elements simultaneously (6 macro + 6 micro elements) with an autosampler included for unattended analysis and even higher throughput.

Current element analysis process - ICP



Micral analysis process



Just load the autosampler cassette containing 60 samples directly into the Micral LIBS analyzer for accurate and unattended analysis. The complete running time is approximately 60 minutes.

What can you measure?

Micral is a complete solution that offers new possibilities for element analysis, covering six macro and six micro elements in feed and forage.

6 macro elements:

Calcium [Ca], magnesium [Mg], phosphorus [P], potassium [K], sodium [Na], sulfur [S]

6 micro elements:

Aluminum [Al], boron [B], copper [Cu], iron [Fe], manganese [Mn], zinc [Zn]

These elements cover the most important minerals for agricultural production, including phosphorus and sulfur, of which phosphorus is subject to strict government regulations, and minerals such as calcium, magnesium, potassium and more, that are essential for the health and performance of livestock.



Current sample types include:

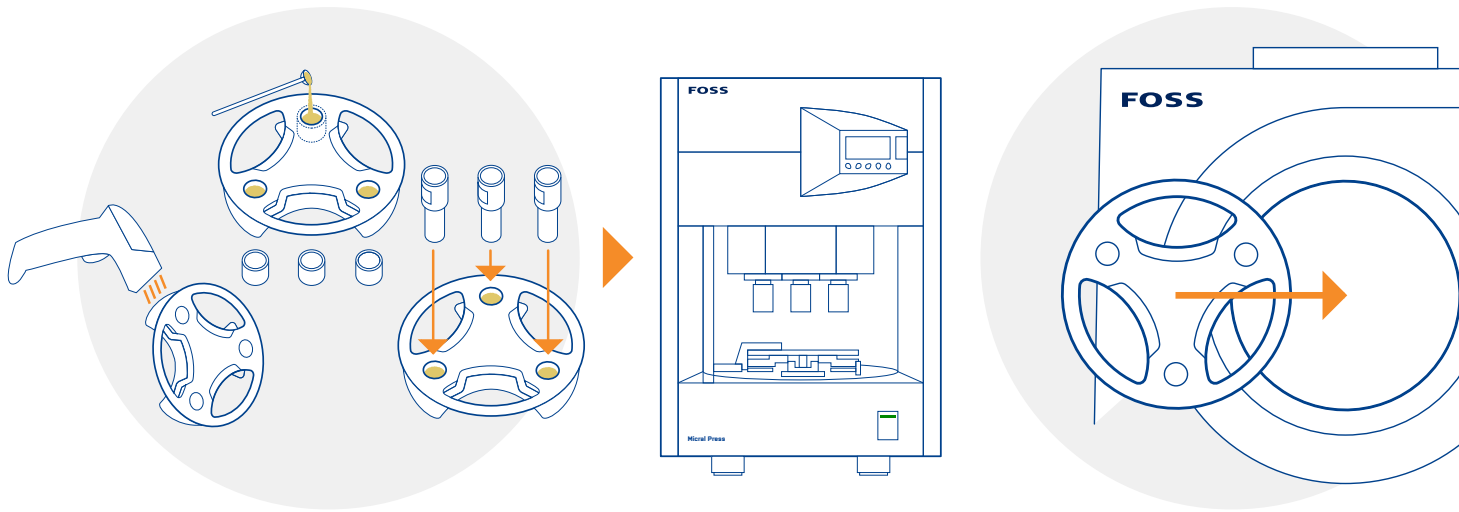
- Grass silage
- Corn silage
- Alfalfa/legume hay
- Hay
- Fresh grass
- Haylage
- Mixed hay
- Sorghum
- Straw
- Grass and clover
- Barley silage (whole crop silage)

Profitable from year one

Switching from traditional wet chemistry methods to LIBS means significant savings due to reduced operator time and no cost of chemicals.

With a Micral™ total solution the cost per sample is reduced by more than 50%. This means that a laboratory analyzing between 15-20,000 samples per year at a sales price of 50 EUR per sample, will achieve an increased profit of 550,000 EUR the first year and 750,000 EUR the following years.

Remove the friction: From registration to results



The best lab technicians deserve the best lab environment. With Micral™, we have reduced the complex process of element analysis to a few simple steps, freeing up time for other tasks.

3 sample containers are placed in the batching tray. The sample ID and the matching sample container ID is scanned and matched.

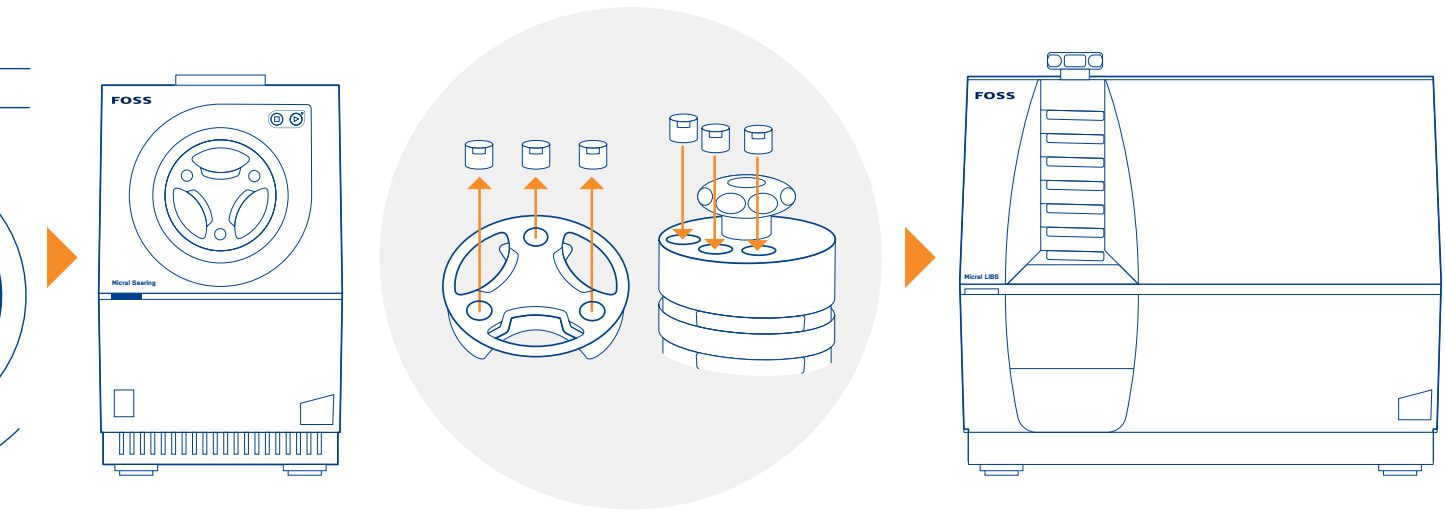
The sample material is then scooped into the container. This process is repeated with sample 2 and 3 until the batching tray is full. This process ensures full traceability of each sample container, and reduces the risk of contamination or human error.

A press shaft is inserted into each sample container and the entire batching tray is positioned in the press for pelletization.

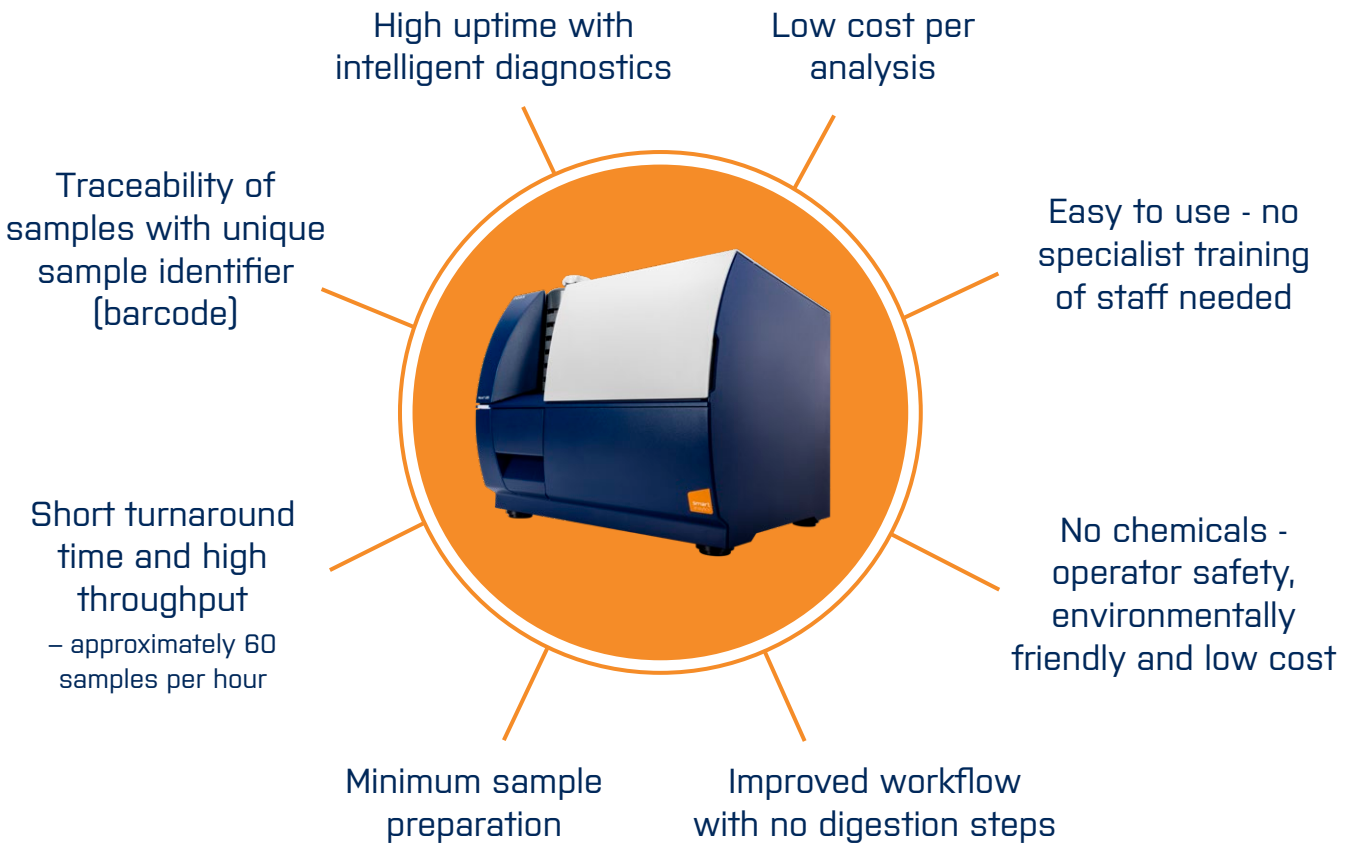
After pelletization, the batching tray is moved to the searing unit where the sample surface is seared for a few seconds.

Finally, the pellets are loaded into the sampling cassette which is placed in the Micral analyzer.





Get time on your side with fast, safe and accurate LIBS analysis



Let real-time data support your decisions

With climate change mitigation high on the political agenda, an increase of industry regulations concerning sustainable agricultural practices in the future is to be expected. In this light, getting the right data, at the right time, to make the right decisions is crucial to save time and money, improve quality and protect our planet.

Fast, accurate and cost efficient testing of the basal diet for livestock enables tailored supplementation of feed additives, ensuring an adequate supply of minerals for optimal performance. This helps to reduce overuse of costly feed additives and consequently keeps the environmental impact at a minimum.

New possibilities for efficient resource management

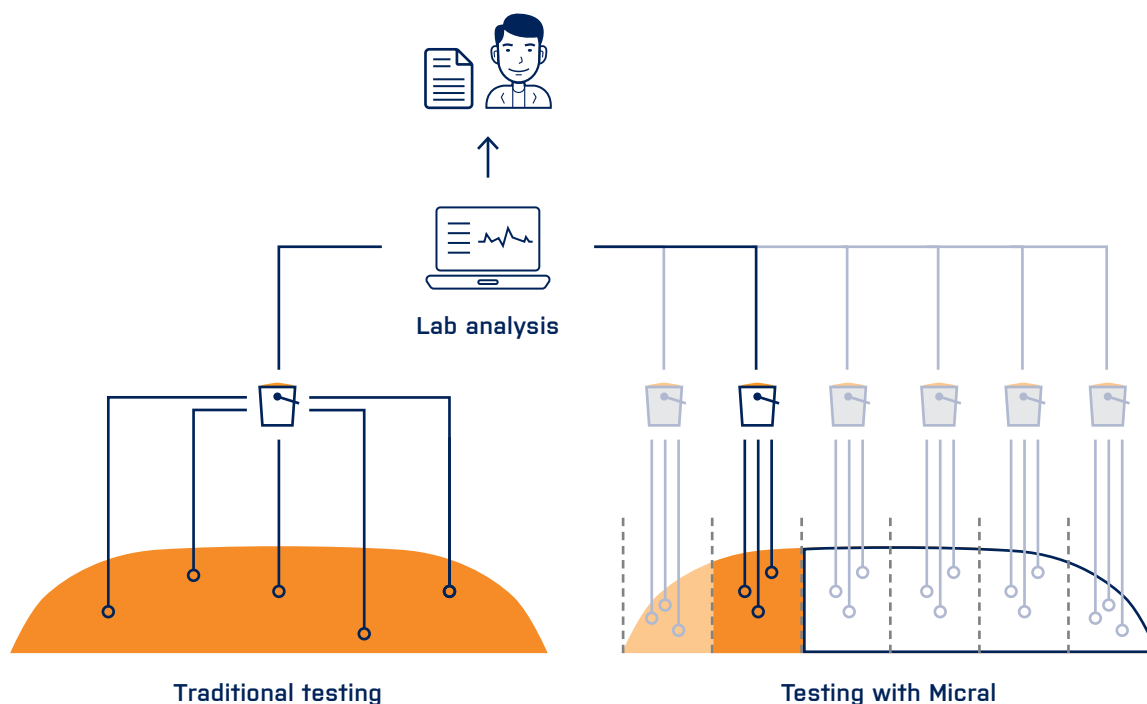
The bulk part of many minerals in livestock feed comes from the basal diet such as silage. Adding

knowledge of the mineral profile to the existing nutritional profile of your silage is essential to optimize the growth, performance and welfare of animals while keeping the environmental impact low.

Precision animal nutrition

Micral™ is a gamechanger when it comes to testing silage. Faster time to result and lower cost per sample means that you can test regularly throughout the year. Samples taken from silage clamps progressively, instead of once yearly, provide an instant snapshot of the nutritional profile of the clamp as it is used.

Micral takes the guesswork out of precision animal nutrition by adding accurate and timely data about mineral levels, reducing the cost and the environmental impact of unnecessary overuse of feed additives.

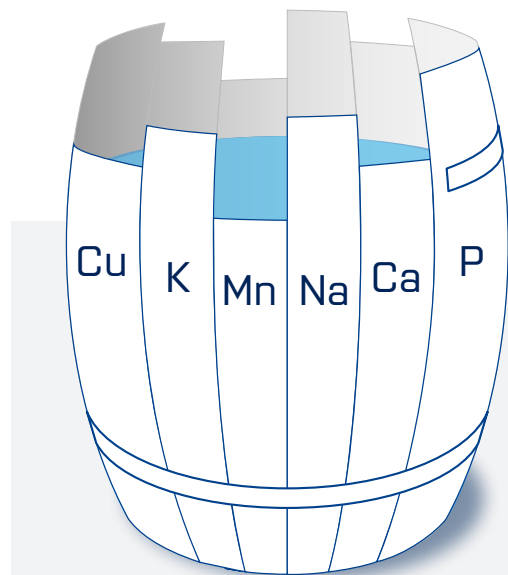


With traditional testing strategies where silage is typically tested once per year, results are not representative as the quality may change over time. Testing more often will provide more precise data about mineral levels of the silage at the time of use. This helps optimize the use of mineral supplements in the feed mix.

The limiting element determines yield and performance!

In the 1800s, German scientist, Justus von Liebig used the image of a barrel with unequal staves to explain how plant growth is limited by the nutrient in shortest supply, just as the level of water in the barrel is limited by the shortest stave. This principle is called Liebig's law of the minimum.

This principle also applies to animal performance, which means that the macro or micro minerals and nutrients in shortest supply determine the overall health and performance of each individual animal.



Speed up operations

As busy laboratories face more incoming samples and many sample types, the risk of error increases. Traditional methods for element analysis typically involve complex analysis steps, a special set-up for chemical handling and a large footprint to match. At the same time, recruiting highly skilled employees, has become increasingly difficult.

Faced with these challenges, it is important to simplify laboratory operations and minimize space. It is even more crucial to reduce the risk of error, contact with chemicals and contamination and environmental impact.

No need for specialists or highly skilled staff

The LIBS enabled Micral™ solution offers new levels of usability, enabling anyone to make a precision quantitative test of 6 macro and 6 micro elements without the need for skilled operators or special training. Micral offers a massive boost in throughput, with low onboarding requirements, and significantly reduced cost per sample.

- Significantly reduce the laboratory space and requirements for testing.

- Run more samples at a lower cost and increase your business opportunities.

Autosampler for unattended analysis

Increase sample throughput while reducing your training and staffing burden. The autosampler cassette allows you to run 60 samples in one go. Batch handling significantly increases throughput, contributes to a significantly reduced cost per test and frees up staff to do other jobs, enabling you to upscale capacity for increased lab efficiency.

Safe and sustainable laboratory operations

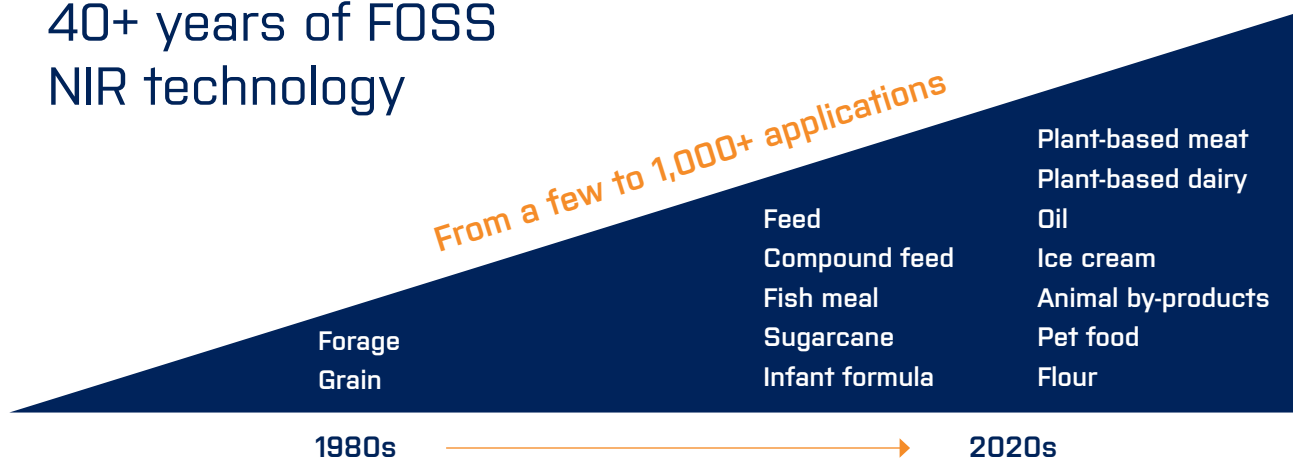
Micral offers a faster, safer and more sustainable flow with valid results in less than 3 minutes. Improve throughput and run more samples at a lower cost, with chemical-free quantitative tests that do not compromise lab safety.

- Easy and safe to use for operators
- No environmental risks from chemical disposal
- Reduced risk of swapping samples or cross contamination

Improve and expand your service offerings

Much like the introduction of near infrared (NIR) in the 1980s, LIBS technology is a major gamechanger. The Micral™ solution for element analysis currently offers analytics packages covering six macro and six micro elements in forages, but the potential of LIBS technology is only at the very beginning.

40+ years of FOSS NIR technology



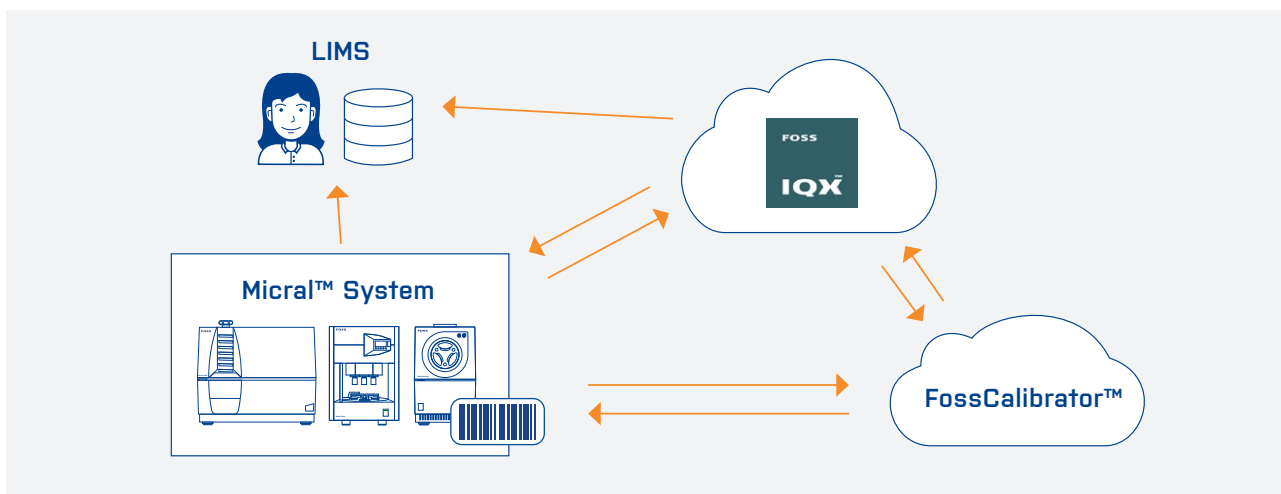
Over a span of 40 years, NIR technology has expanded from offering fast and reliable analysis of forages and grain to covering a broad variety of sample types. As the always evolving food industry introduces new types of products, so does the product portfolio covered by NIR analysis.

Similarly, LIBS technology has the potential to evolve over the coming years and decades to cover an expanding portfolio of elements and sample types. Micral is a future proof solution for any busy laboratory performing element analysis.

Future perspectives on precision crop nutrition

Getting fast results about the nutrient status of crops makes all the difference for farmers wanting to ensure that the right level of fertilizers and supplements is added to the field. Current testing methods are slow, with a typical turnaround time of up to 5-6 days for results. This means that by the time the end user gets access to results, they may not be relevant any longer. Fast turnaround time is the foundation for building valuable and practical plant analysis services.

Future uses of LIBS technology include a broader selection of sample types within plant leaf analysis. With precise knowledge about nutrients in the plant, it will be possible to fertilize crops with the relevant nutrients that are lacking, thus optimizing resources and plant yield.



FOSS IQX™ is a suite of software solutions that empowers data-driven decisions with trust, quality and insights. The software simplifies tasks that are essential to improved profitability and sustainability in food and agri production, including the management of fleets of instruments, food safety compliance and supplier collaboration. Read more at IQX.net.

Automate for better flow

In an age of uncertainty and volatile market conditions, running a profitable business can be a challenge. Added to these conditions, a higher diversity of incoming sample types, new government regulations and a common goal towards more sustainable production have increased the complexity of day-to-day business in the laboratory. Under these circumstances, delivering fast and reliable results is crucial.

Micral™ exploits advances in instrument hardware and the latest in software and networking connectivity to achieve new levels of productivity. Now you can benefit from digital tools that allow you to boost productivity and evolve your laboratory operations.

Ready-to-use analytics packages

Speed up your element analysis from day one with ready-to-use analytics packages covering 11 key sample types. With optional digital tools you can develop and expand analytics for other matrices.

Traceable results with sample ID barcode

Complete traceability of results is ensured with sample matching. The sample ID barcode and

sample container ID barcode are scanned and matched. Automatic logging throughout the analysis process ensures traceable results and avoids the risk of human error.

Link up your lab to get a full overview of your data

Automatic backup and reporting ensures that the data is safe, traceable and accessible from anywhere. Log in to your PC to check results, monitor instrument performance and get access to reports.

Always stable, high uptime with a connected service solution

Instrument downtime is a major concern for any laboratory. With a connected SmartCare™ service solution, uptime is safe-guarded and troubleshooting alleviated, setting you free to do your job in pursuit of improved laboratory efficiency. Know that your Micral solution is always delivering consistently accurate results with exceptional performance and uptime supported by:

- Automatic troubleshooting
- Intelligent diagnostics
- Remote service and support

LIBS - Laser technology in a box

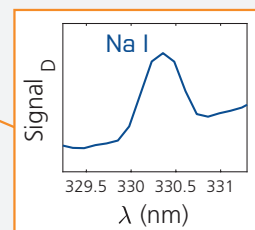
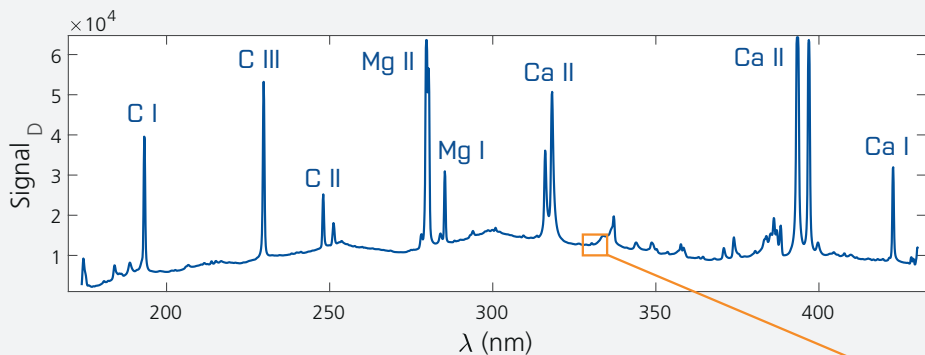
LIBS is an abbreviation of Laser Induced Breakdown Spectroscopy. It sounds great, but how does it actually work?

In short, the Micral™ analyzer has a high-energy pulse laser that focuses laser pulses onto the sample surface. Each laser pulse is powerful enough to ionize the sample, i.e., breaking it down from solid state, through liquid state, and finally to the plasma state. A UV spectrometer detects the signal strength released by each element in the plasma phase, delivering accurate data about the mineral concentration in the sample.

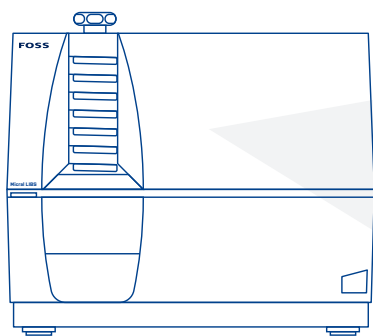
The process from laser pulse to plasma emission takes about a microsecond and for just one sample measurement, 6000 laser pulses are delivered to the sample.

From plasma to data

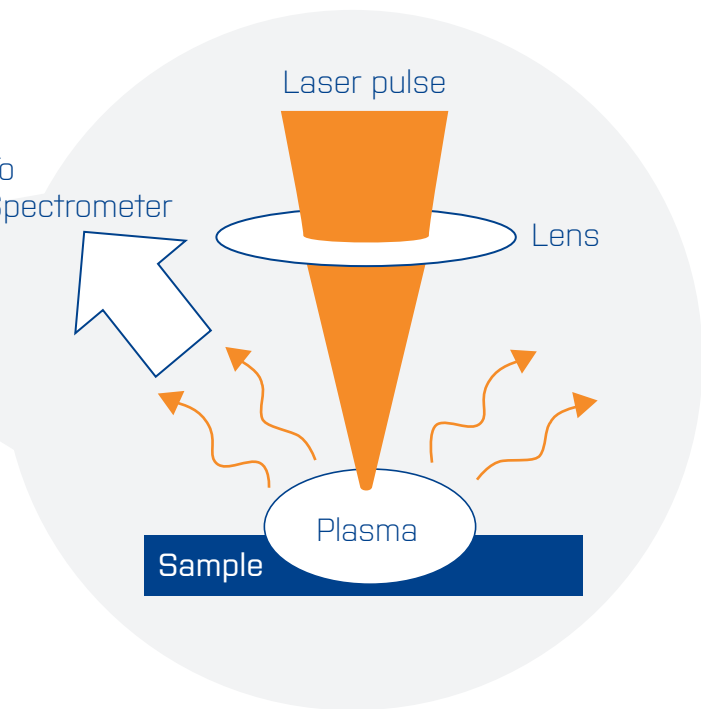
The plasma induced by the laser pulse emits radiation where each element in the periodic system has its own unique radiation signature in the shape of emission lines. To the first approximation, the strength of an element emission line is proportional to the concentration of the element in the sample. E.g., a high concentration of calcium in a sample yields strong Ca emission lines, whilst a low concentration of Ca yields weak Ca emission lines. In the Fig. below we show signal vs. wavelength for a grass silage LIBS measurement. A few known element emission lines are highlighted.



Example of signal vs. wavelength for a grass silage LIBS measurement. Some elements, such as Mg and Ca, have strong emission lines, and some elements such as Na has a weak emission line for the wavelength range covered by the instrument.



To Spectrometer



Micral translates these spectra into applicable data that defines the mineral concentration in each sample using prediction models.

High accuracy ensured by pressing and searing

Prior to analysis, each sample is pressed into a pellet. Pelletizing improves the quality of the spectra that is produced because the LIBS measurement requires a flat and hard sample surface. If the surface is not flat, it will affect the spectra quality significantly since the sample is not always in the focus of the laser beam. If the surface is not hard, the explosive force in the laser ablation will induce an uneven sample surface.

After pelletization, the samples are seared. Searing enhances the element emission line strengths, i.e., improving the level of quantification. Addi-

tionally, searing reduces the sample matrix effect which improves prediction modelling accuracy.

Precision pulse laser technology

The pulse laser builds up a high level of energy that is released onto the sample through a focusing lens that intensifies the light before hitting the sample. The irradiance at the sample surface, for each laser pulse, is high enough to ionize the sample material, thus creating a plasma. The radiation from the plasma is detected by the spectrometer.

The laser has a repetition rate of 200 pulses per second, and the spectrometer collects sub-scans for 30 seconds. The sub-scans are averaged into one final sample scan – after removal of bad scans.

Improve your lab flow every step of the way



Micral™ LIBS

With a wavelength range coverage of 178 nm - 427 nm, and a low-energy, high-power pulse laser operating at 1064 nm, Micral™ LIBS ionizes the sample and enables quantitative analysis of elements. Micral LIBS has an analysis time of about 1 minute per sample.



Micral™ Press

The Micral™ Press handles one batching tray with 3 sample containers at a time. Each sample is pressed into a pellet to ensure a hardened, uniform surface before searing and analysis.



Micral™ Searing

After pelletizing, the batching tray is moved to the Micral™ Searing unit. Searing of the sample surface improves the level of quantification and reduces the sample matrix effect. The amount of searing is automatically adapted to the individual sample. E.g., a light hay sample is seared for longer than a dark sample type until the same dark surface is achieved.



Micral™ Reg

The Micral™ Reg is a loading platform that registers the pelletized samples in the sample containers. The Micral Reg also functions as a docking station for the autosampler cassette and has an indexing mechanism that ensures correct loading of the sample containers.

Autosampler cassette

The autosampler cassette containing 60 samples is loaded into the Micral™ LIBS with a complete running time of approximately 60 minutes.



Sample containers

The sample containers are marked with a QR code to uniquely identify each pelletized sample and designed to only fit one way in the batching tray. This ensures that they are always positioned in the right direction, making it easy to scan the QR code.

Sample containers are made of aluminum and can only be used once. Used sample containers should be recycled as metal (aluminum) waste.



Batching tray

The batching tray can hold 3 sample containers and fits directly into the press and the searing unit.



FOSS

FOSS
Nils Foss Allé 1
DK-3400 Hilleroed
Denmark

Tel.: +45 7010 3370
Fax: +45 7010 3371

info@foss.dk
www.fossanalytics.com
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