

FOSS

FOSS IN RAW MILK TESTING



ANALYTICS BEYOND MEASURE



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Today even the most accomplished milk producers face the challenge of getting more and more out of their raw materials while still improving their product quality. That is a tall order in an industry built on highly variable raw materials and quickly changing markets. But where nature can wreak havoc on your production, data harvests never fail.

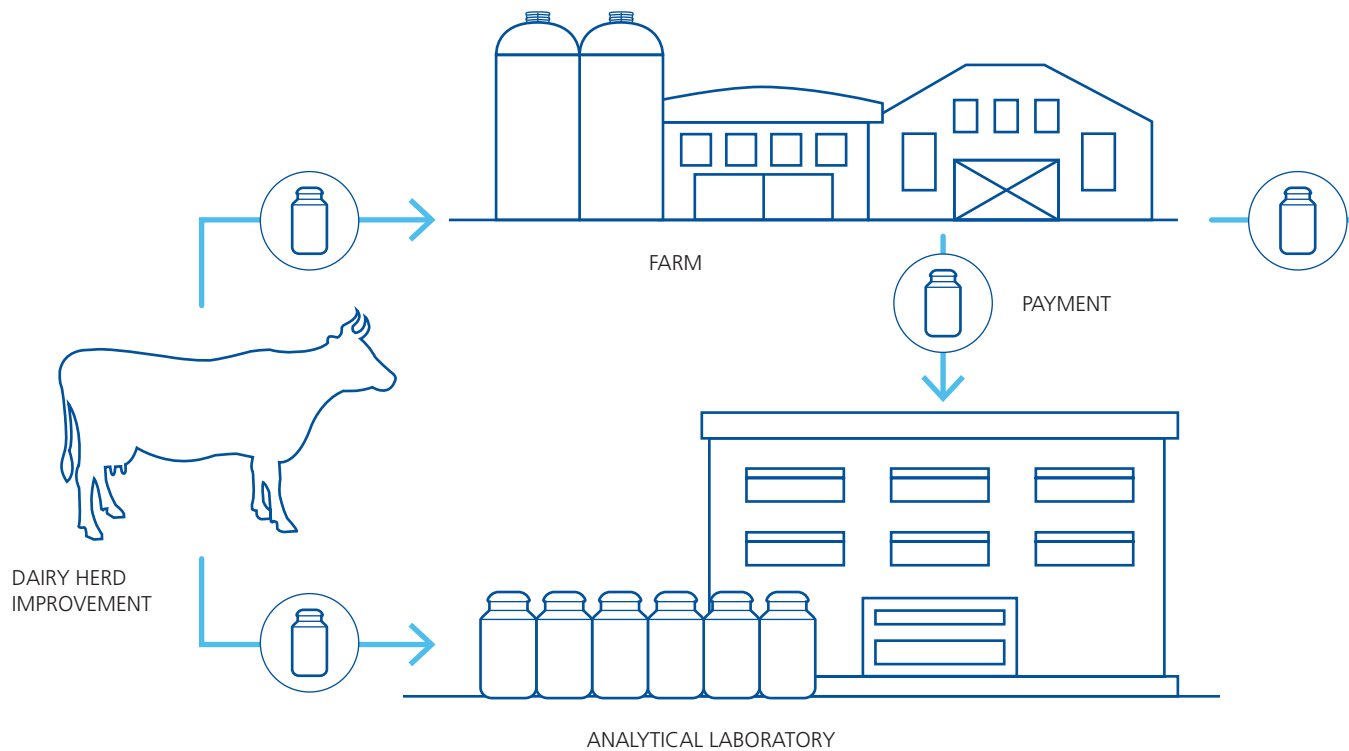
By driving digitalisation forward, you can add a new level of automation to your business and secure quality and consistency. You will be able to limit the number of human errors that slow you down. Scale your business faster. And reduce manual labour and labour costs.

A lot can be lost and a lot can be won on the journey from raw

material to finished product. That is why we have spent the last 60 years developing and refining instruments that measure every little step of the way. We translate measurements into mathematical algorithms that power automated systems, optimise your manufacturing process and make you grow. Securing and improving food quality is what we do.

Neither natural resources nor knowledge go to waste. Intelligent information management can turn existing production into efficient processes that generate less waste, bigger yields and higher quality.

We call it:
Analytics Beyond Measure



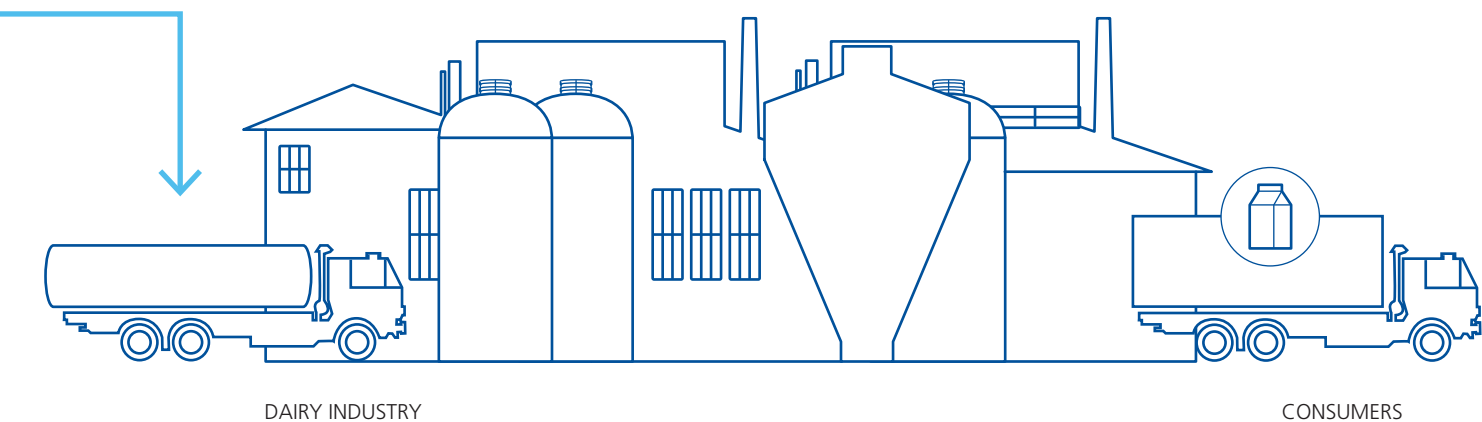
WHERE FOSS ADDS VALUE

FOSS works side by side with dairies and milk testing laboratories around the world. Often being the first with groundbreaking innovations, our goal is to keep you a few steps ahead of the game with new analysis options for improved business opportunities. Here's a selection of some of our innovations over the years. FOSS was first to:

- Develop a rapid method for individual bacteria count as used in BactoScan™
- Introduce automatic somatic cell counting as used in Fossomatic™
- Use Fourier Transform InfraRed (FTIR) for milk analysis
- Introduce a high-throughput analyser for simultaneous differential somatic cell count and total somatic cell count
- Implement routine analysis of urea with MilkoScan™ for optimised feeding
- Offer fast screening of fatty acids with MilkoScan for improved milk quality
- Offer routine analysis of Casein
- Offer up to 600 samples an hour
- Offer screening for adulteration
- Offer screening for ketosis by FTIR
- Provide automatic measurement of freezing point depression with MilkoScan
- Link instruments in networks for online support

For over 50 years FOSS has led the way in improving raw milk quality around the globe





Raw milk holds a wealth of valuable data that can help us to make significant improvements in the dairy milk supply. For over 50 years, FOSS has worked to

unlock this value by developing dedicated analytical solutions for central milk testing laboratories, allowing you to offer an unrivalled range of services within dairy

herd improvement and payment analysis.

Within dairy herd improvement, accurate and timely analysis results provided by FOSS solutions helps dairy farmers to:

- Optimise feeding
- Combat diseases such as mastitis
- Improve breeding programmes
- Manage culling
- Increase milk yield

Similarly, in payment analysis of raw milk, FOSS solutions help to:

- Ensure compositional quality
- Improve hygienic quality
- Screen for food safety



ROUTINE TESTS AVOID THE COSTS OF DISEASE

Milk analysis with FOSS can reveal important information about the health of the dairy herd

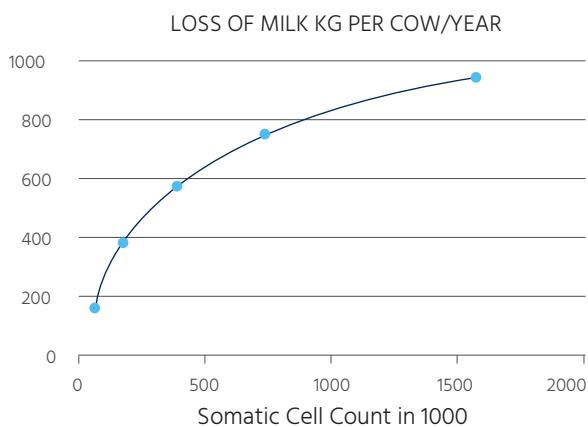
How to avoid clinical and sub-clinical mastitis

Mastitis is a costly disease both for individual farmers and the dairy industry as a whole, leading to unwanted veterinary costs, antibiotics, milk retention, decreased yield, poor quality and reduced payment and culling.

Somatic cells are white blood cells (leukocytes) and cells from the udder secretory tissue (epithelial cells) which eliminate infections and repair tissue damage done by bacteria.

The somatic cell count is very low in uninfected glands. However, when infection or damage occurs in the udder, the body sends high numbers of somatic cells to the injured site. The somatic cell count is therefore a common measure of mammary gland health and milk quality. Mastitis can be clinical (SCC usually > 1 mill.) or sub-clinical (usually 200,000 < SCC < 1 mill.).

Of critical importance for the dairy farmer is to not only catch the obvious clinical cases, but the sub-clinical as well. For every cow with clinical mastitis there are 15-40 others with sub-clinical mastitis and



Regular testing of somatic cell count helps to avoid unnecessary loss of milk and valuable constituents due to mastitis.



a substantial loss of yield occurs already at this sub-clinical stage.

Regular tests for somatic cell count allow results for individual cows to be monitored over time and any changes in somatic cell count can be used to give farmers a timely warning.

Differential somatic cell count

In addition to total somatic cell count, the development of a differential somatic cell count test adds a new dimension to modern milk testing.

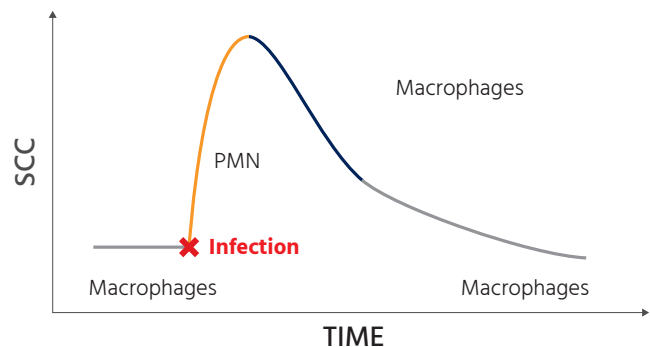
Differential somatic cell count gives a more detailed picture of the actual inflammatory status of the

For every cow with clinical mastitis there are 15-40 others with sub clinical mastitis



mammary gland. Milk testing laboratories can use it to help dairy farmers manage mastitis more effectively and head off the worst effects of the disease.

At the same time, the new differential somatic cell count can be performed at up to 600 samples per hour as an integrated part of normal DHI testing procedures.



Cell differentiation refers to the differentiation of immune cells occurring in milk into lymphocytes, macrophages, and polymorphonuclear neutrophils. These three cell populations play a vital role in inflammatory responses within the mammary gland. Macrophages are active phagocytic cells and are also involved in the regulation of the immune response. The main task of polymorphonuclear neutrophils (PMN) is to defend against invading bacteria at the beginning of mastitis.

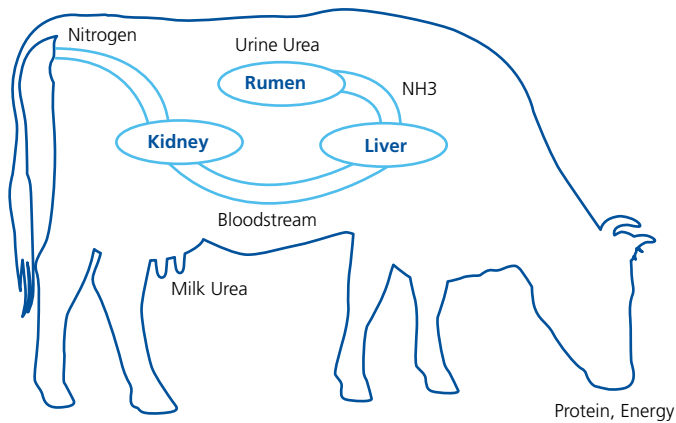
Ketosis risk assessment

Ketosis is a metabolic disease that can cost the dairy farmer a lot of money. It can reduce milk yield by over 500 kilograms of milk per cow per year, while also having an adverse effect on reproduction and welfare for the individual cows. A screening system from FOSS can provide an early warning of ketosis in dairy herds.

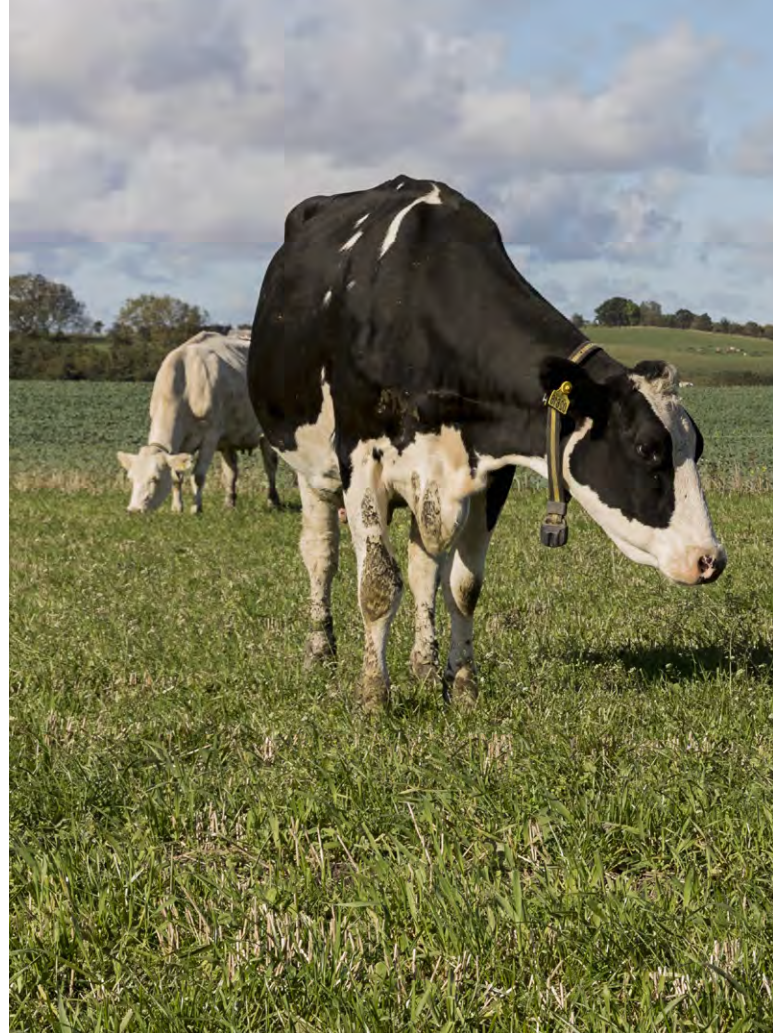
Ketosis occurs in dairy cattle when energy output for milk production is too high relative to energy input from feed and uptake from fat deposits. Primary ketosis occurs when too little feed (or too low energy concentration) is offered to the cow. Secondary ketosis occurs if the cow stops eating due to illness while still producing (too much) milk.

Parameters

Fat, Protein (true & crude), Casein, Lactose, Solids (SnF & TS), Urea, Citric Acid, Free Fatty Acids, Fatty Acids Profile, Freezing Point Depression, pH, Ketosis Screening, Adulteration screening (untargeted model), Somatic Cells, Individual Bacteria Count, Differential Somatic Cell Counting



Information about urea content in milk helps dairy farmers to get the balance between energy and protein in feed just right



FEED INDICATORS ALLOW FINE-TUNING FOR PROFIT

Feed is a major production cost for dairy farmers. It also impacts fertility and optimal feeding reduces the environmental impact of dairy herds by avoiding unnecessary high levels of nitrogen in urine.

With FOSS milk testing equipment you can empower dairy farmers to get feed mix just right by giving them timely information derived from key parameters of milk such as Fat, Protein and Urea.

As well as a normal payment parameter, fat content can be used as a feed indicator. For instance, a low fat content indicates a low pH in the rumen. Likewise, protein is another payment parameter that also helps to define feed strategies. A decrease in the protein content indicates that adjustments to the feed mix are required.

Urea helps to get the feed balance just right

Information about Urea content in milk is especially valuable to the farmer in identifying nutritional issues and getting the balance between energy and protein in feed just right.

Cows need to be fed adequate levels of protein to maximise milk production, but feeding protein in excess of the cow's needs does not increase milk production further and will only be an extra cost for the farmer.

Urea, together with Fat/Protein ratio, indicates whether the right balance between energy and protein has been achieved.

Less available energy may put early lactation cows at increased risk of ketosis and high levels of urea



An additional kilogram of casein in the milk supply means three to four kilograms more cheese

are toxic to sperm and embryos and can result in infertility and repeat breeding.

Urea levels also help to track the environmental impact of the dairy herd through excretion of nitrogen in urine.

Breeding and feeding for more casein

Casein is a valuable milk constituent, especially for cheese and yoghurt producers who often estimate casein content in milk from their protein measurement. However, research shows that casein as a percentage of protein in milk is subject to change due to factors such as the dairy herd feed, geography and seasonal variations.

Advanced milk analysis pioneered by FOSS allows casein to be analysed more accurately as part of normal routine milk testing. This allows you to give farmers information on individual cows allowing breeding and feeding for optimal casein content.

Farmers can gain improved payment levels and the dairy can adjust the Casein to Fat ratio of the cheese milk to get the most out of the milk supply. As a general rule, one additional kilogram of casein in the milk supply means three to four kilograms more cheese. Milk from cows bred for more casein, shows better cheese precipitation time, better curd firmness and up to 5% higher cheese yield.

Parameters

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QUALITY STARTS ON THE FARM

Your milk testing services have a vital role to play in helping farmers deliver quality milk with a long shelf life and with the qualities demanded by dairy producers and consumers.

Raising the hygiene level with bacteria counting

Milk with a high bacterial load is an undesirable raw material for dairy production. Although pasteurisation kills the majority of bacteria, their metabolites may cause off-flavours, and enzymes continue their activities resulting in product defects and reduction of shelf life. Most milk payment schemes therefore grade milk according to the level of bacteria.

Traditional plate count methods require at least two days of incubation before a result can be reported back to the farmer. Hygienic problems may go undetected for days, making corrective action more difficult and production losses larger than necessary.

By implementing the approved and rapid BactoScan™ FC+ method, offering results in less than nine minutes, farmers can be advised about possible hygiene breaches the same day as the sample is drawn. Such rapid feedback enables the farmer to correct for leaks, insufficient cleaning or

cooling in the milking system, or health problems in the herd. The method includes control samples and other instrument-performance checks.

Keeping free fatty acids in check

A too high content of Free Fatty Acids (FFA) can cause a bitter taste in milk and rancidity in butter.

Free Fatty Acids occur when the milk fat is broken down into glycerol and free fatty acids through a chemical reaction called lipolysis, which is caused by lipase enzymes in the milk. There are two sources of lipase. One is a natural presence secreted into the milk while still in the cow and the other is bacteria entering the milk after milking and producing lipase either by excessive aeration or by agitation of the milk. The fat is exposed to attack by the lipase resulting in an increase in FFA during subsequent storage.

Thermal and mechanical treatment of the milk, such as milking, pumping, sloshing, temperature changes and transport, can result in an increase of FFA. The level of FFA is also influenced by physiological conditions such as stage of lactation, seasonal changes, age of cow, milk yield, hormonal changes, diseases and composition of fodder. FFA is easily measured by MilkoScan™ 7.



Milk with a healthier balance of saturated and unsaturated fats

Another FOSS innovation is the ability to monitor saturated and unsaturated fat content in milk to improve the quality of raw milk entering the supply chain and improving the characteristics of milk for healthier dairy products. FOSS MilkoScan™ 7 can reveal the main groups of fatty acids in a milk sample. Dairy farmers whose milk does not match the ideal profile of fats can be alerted so that they can take action by adjusting the feed for their cows, for example feeding based on more traditional grass grazing and less corn has been found to reduce levels of saturated fats. Breeding programmes have helped to breed cows giving a more favourable balance of fatty acids in milk.

In some regions, farmers have been involved in incentive schemes to provide milk with a specific fatty acid profile for several years. The milk is subsequently used in a special range of products which the manufacturer can then promote as containing higher levels of healthier fatty acids.



Parameters

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PROTECTING THE SUPPLY CHAIN

As a key junction between the dairy farm and the milk used by dairy producers, your testing services can have an important impact on the integrity of the milk supply.

In addition to performing standard tests such as bacteria count, fat and protein, somatic cell count and freezing point depression, FOSS milk analysis technology allows you to offer dairies screening for accidental or intentional adulteration of milk. Such tests can be performed simultaneously with routine tests, involving no extra sample handling and at little extra cost to your operations.

Screening for added water

Extraneous water should be avoided for many reasons and is therefore a penalty factor in most payment schemes. Earlier, added water was solely detected by cryoscopy measurement of freezing point depression in a number of randomly selected samples.

FOSS innovation helps to enforce legal requirements and incentive programmes

Bacteria

BactoScan™ FC+ measures Individual Bacteria Count for immediate action.

Somatic Cells

Fossomatic™ 7 offers Dynamic Precision (patented) for high grading accuracy.

Freezing Point Depression

MilkoScan™ 7 screen samples based on combined FTIR and conductivity in the samples.



Screening for abnormalities

Raw milk containing abnormalities is a growing problem. The abnormalities can be caused by deliberate adulteration, for example with lard or melamine, or by accident, for example, if milk from cows and buffalo are mixed unintentionally.

FOSS instruments are already used around the world to check raw milk for payment and quality assurance purposes and can also screen incoming raw milk samples for abnormalities using the Untargeted Raw Milk Screening model.

This feature helps to identify a suspect raw milk sample quickly and

as a normal part of everyday testing. The suspect sample can then be further analysed to determine the contaminant.

A sample of milk is tested against a profile for normal milk. A warning is given if there is a mismatch. This alerts you to the need for further investigations to determine the nature of the abnormality. In practice, the Untargeted model allows you to screen for an unlimited number of unknown and known potential adulterants, for example some of the known adulterants could include lard, cleaning agents and melamine. Warning levels can be set for these known adulterants.

Adulterants - examples

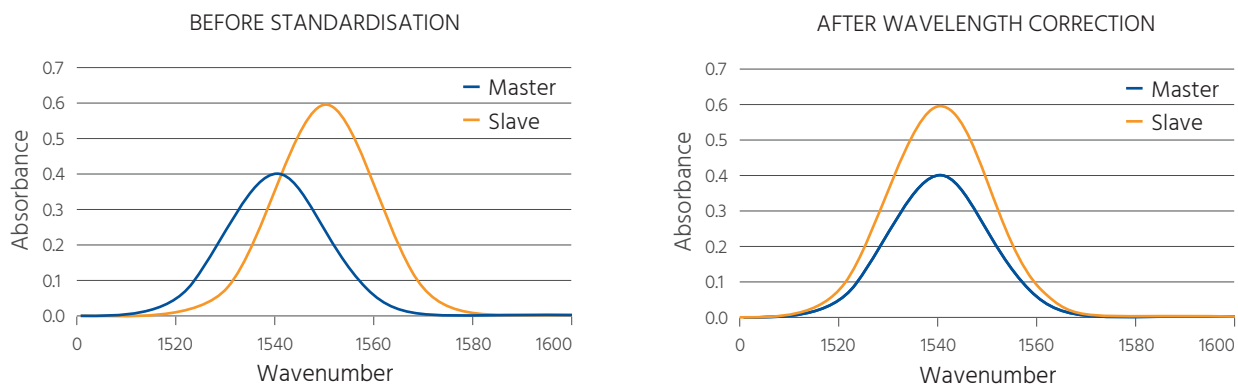
- Cleaning agents
- Different types of milk (cow, sheep, goat, buffalo ...)
- Protein adulterants
- Fat adulterants
- Hydrolysed protein
- Plant oil
- NaOH/NaHCO₃
- Ammonium sulphate
- Melamine
- Urea
- Lard
- NaNO₂
- Formaldehyde
- H₂O₂
- Sucrose
- And many more...

Parameters

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HIGHER STANDARDS IN THE LABORATORY



All measuring the same: Equaliser samples keep your instrument standardised.

At FOSS, excellence in analysis starts with highly stable and accurate analysers and extends to all aspects of instrument maintenance and calibration.

Benefits for your laboratory include:

- Reliable measurements over time protect your reputation
- High uptime for efficiency and prompt response to customers
- Plug and play calibrations based on the unique FOSS global database
- Considerable time and money saved on calibration procedures with standardisation concept (patented)
- Operational and networking software

Uniform measurements

FOSS instruments are standardised to measure the same from instrument to instrument and over time. Regular checks can be made using a number of tools such as zero-setting and pilot samples, and adjustment samples for Fossomatic and BactoScan instruments. Monthly verification and adjustment can be made on just one equaliser sample with the MilkoScan™ 7.

Self-cleaning pipettes make it easy to measure even the most difficult samples quickly and efficiently, and automatic sample tracing with Foss Integrator software avoids handling errors. Preventive maintenance of the instruments according to our recommendations keeps instruments performing optimally.



FOSS in central milk testing

- FOSS has CMT solutions in operation in more than 80 countries
- More than 3,000 MilkoScan™ instruments sold world-wide (many generations)
- More than 3,000 Fossomatic™ instruments sold world-wide (seven generations)
- More than 1,200 BactoScan™ instruments sold world-wide (three generations)
- FOSS CMT solutions have obtained many approvals and are in compliance with a number of standards/guidelines/directives (IDF/ISO, EU)

- National approvals to mention: FDA/NCIMS and MicroVal (EURL)

Powerful and comprehensive calibrations

FOSS analysers are delivered with calibrations based on the unique and comprehensive FOSS database built up over decades of activity in the central milk testing area.

A very robust calibration can be developed to cover many dimensions in the measurement such as race, feeding, season and region, where you traditionally need to develop and maintain several calibrations. This means reduced calibration development and maintenance costs, as less reference analyses are required.

The fact that FTIR instruments are standardised offers a great advantage. A calibration developed on one instrument may be transferred to other instruments,



which due to the standardisation will provide identical readings.

Standardisation is achieved by comparing spectra of a specially developed FTIR equalizer sample, collected on a newly installed instrument (slave) to the spectra of a similar sample using a master instrument at FOSS.



Parameters

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Some of the major challenges under our spotlight

- Consolidation
- Efficient lab operation
- Healthier dairy products
- Food safety
- Traceability
- Animal health
- Sustainability
- Hygienic quality



THE FUTURE OF RAW MILK TESTING

Consolidation, competition, traceability, food safety – just a few of the themes you may recognise from your working day. The unique FOSS approach to central milk testing puts issues like these under the spotlight and results in not just advanced instruments, but the sophisticated solutions you need to secure your future business.

New testing possibilities reflect a close working partnership with industry players about emerging demands. A raft of support options available globally keep your laboratory operating perfectly wherever you are located. Approvals give peace of mind for you and your customers.

In-built quality assurance checks take the load off staff, freeing up resources for other things. Performance options, for example up to 600 samples an hour, keep the samples flowing and allow you to scale up in line with consolidation in your business. Proven technology ensures high uptime.

Exploiting FTIR

Fourier Transform Infrared (FT-IR) spectroscopy coupled with advanced chemometrics methods has

proven a valuable tool for not only conventional milk parameters but also providing new information on fatty acids profiling and screening for ketosis and abnormal milk.

These findings are promising for uncovering new herd management information for optimising herd as well as individual cow performance, and for improving practical farm procedures and breeding programmes.

Networking – expertise always online

A relatively new colour on the FOSS palette of options is the FossManager™ networking software now available for CMT solutions. This allows support through the convenience of the internet for:

- Setup and support
- Instrument surveillance
- Calibration maintenance
- Performance monitoring
- Reporting



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