



Animal Feed & Pet Food Analysis

- FT-NIR Spectroscopy for QC in the Lab and Production



Bruker Optics Solutions for the Animal Feed & Pet Food Industry

In order to maintain an optimum balance between costs and productivity, ingredients and finished products should be verified for nutrient concentration. Raw materials differ widely in composition, due to frequently changed suppliers, and origins, and naturally occurring ingredient variation, thus it is recommended to regularly reformulate rations and required supplements. Fourier Transform Near Infrared (FT-NIR) spectroscopy provides a fast and effective solution for all required tasks to ensure an optimal, cost-effective quality product.

Quality Control for Cost-Efficiency

FT-NIR advantage

In contrast to most wet-chemistry and other reference methods the FT-NIR technology is quick, cost-effective, non-destructive and safe, since it does not use chemicals, solvents or gases. It simply measures the absorption of near-infrared light by organic molecules in the sample at different wavelengths. Therefore NIR spectroscopy is the first choice for the analysis of all kind of materials on fat, protein, fiber, moisture, ash and more components, making it ideal for a wide variety of, ingredients, forages, and finished feeds and pet foods.

The key benefits of FT-NIR spectroscopy are:

- no sample preparation, no waste
- no special skills required, easy sample presentation
- no typical errors of classical lab methods
- analysis of multiple components in less than one minute
- suitable for any solid, semi-solid or liquid sample

To produce the optimum feed or pet food at lowest cost FT-NIR spectroscopy provides the information you need for formulation in a matter of seconds rather than hours or days when using conventional technologies. Moreover, due to the speed and extreme low cost of each single analysis, you can have a much tighter control to optimize the quality and reduce out-of-spec production.

Gold standard for feed and pet food analysis

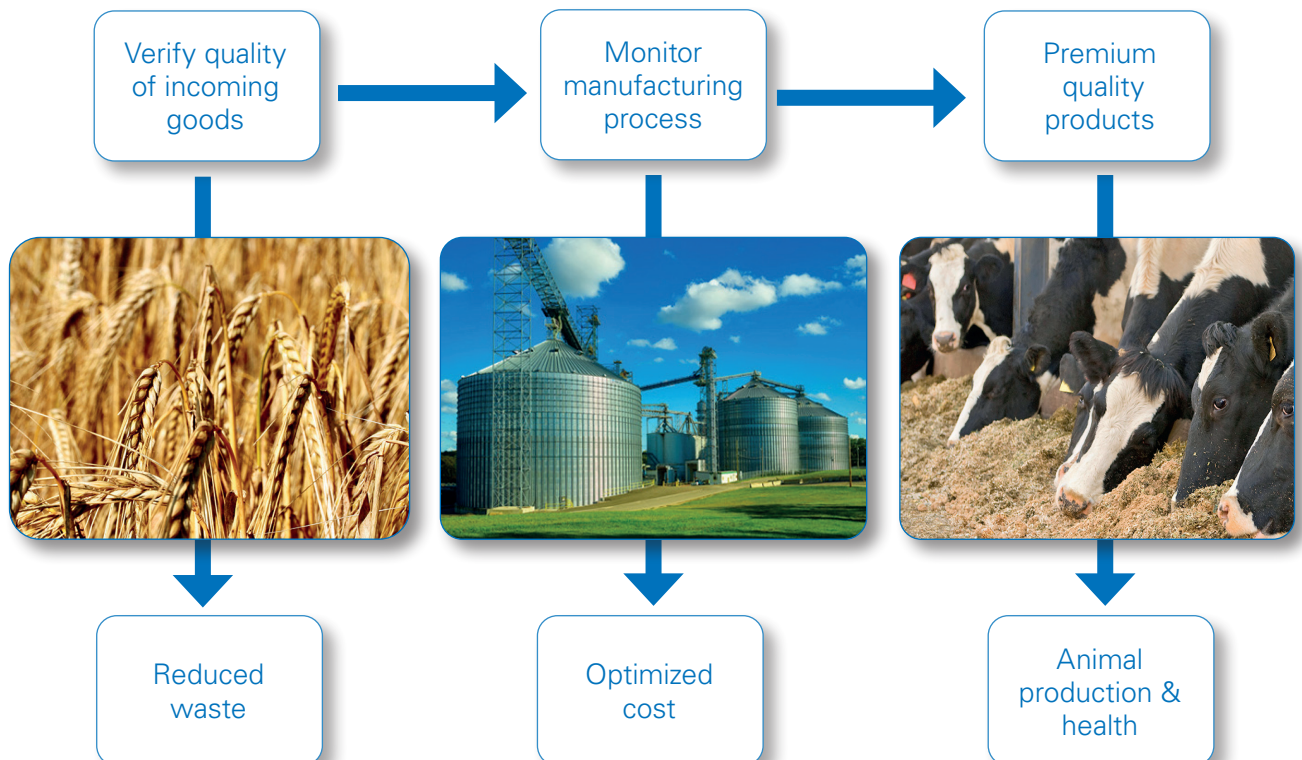
With the ISO 12099 standard, the feed industry now has a reliable guidance on how to apply NIR technology for quality control. A community of users and experts, including Bruker, agreed on how to describe the principles, evaluated various terms, and provided guidelines for application and validation of NIR solutions for feed and ingredients. Bruker provides comprehensive calibration packages developed following the ISO 12099 guideline.

Bruker - your partner for lab and process analysis

For more than 50 years, Bruker has been driven by the idea to always provide the best technological solution for each analytical task. We offer the most comprehensive range of FT-NIR solutions for quality control and formulation adjustments from raw materials to finished products.

The portfolio ranges from the small footprint, touch screen operated analyzer TANGO to a flexible multi-purpose instrument MPA II to fully automated in-process systems of the MATRIX series for closed loop control at any stage of production, from storage to milling, mixing, drying and pelleting.

Moreover Bruker provides complementary analysis solutions for fat and moisture by TD-NMR, elemental analysis by x-ray fluorescence (XRF), foreign objects by FTIR microscopy or contaminants by LC/MS.



• Integrated Feed Business

Raw ingredient costs are one of the largest input costs associated with feed manufacturing for poultry and swine integrators. Being able to effectively manage these input costs is key for balancing animal performance with corporate financial performance.

FT-NIR is the most widely used technology on the market, specifically designed to support the feed industry and optimize the business model of integration. It gives the integrator, real-time, accurate nutrient values analyzed in the lab or directly in the process that can be used for many purposes and under the ISO 12099 guideline.

Assuring inbound purchasing standards, providing current ingredient nutrient data for formulation, and confirming finished product quality are some ways an on-site FT-NIR helps reduce costs and increase savings. Many advancements are also being made to enhance production efficiencies using FT-NIR technology.

Eight Points of FT-NIR Use in Integrated Systems

1 Feed Ingredients

Ingredient manufacturers use FT-NIR for process control and determining nutritional specifications on ingredients sold to feed mills. Use of FT-NIR creates a more consistent product and saves money on claims.

2 Feed Mills

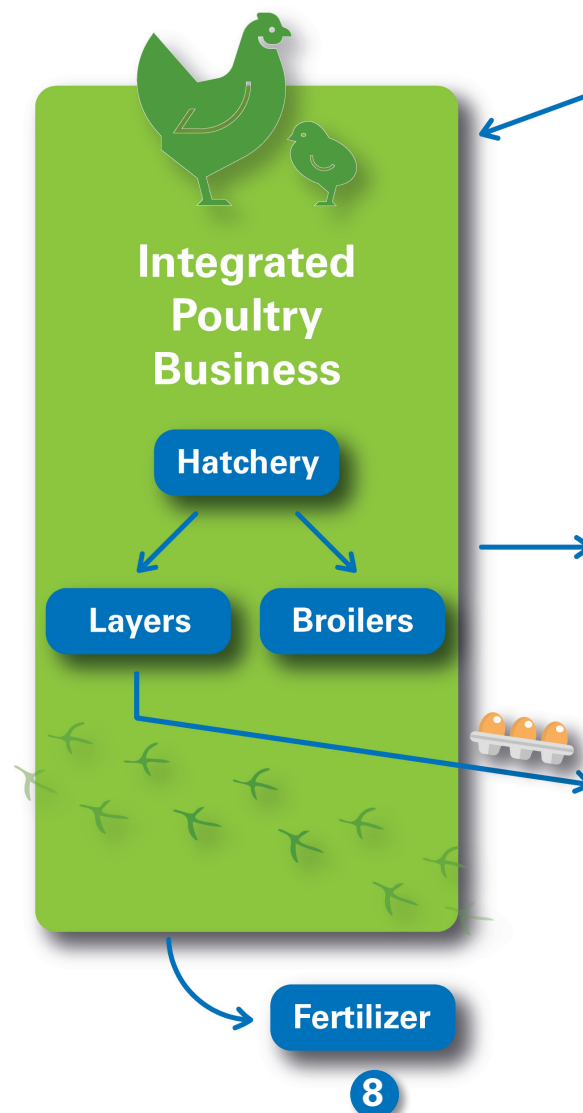
Feed mills use FT-NIR to monitor inbound ingredient quality, update ingredient formulation values and monitor process control measures such as composition check after mixer, pellet quality, added moisture and fat levels.

3 Forage Rations

Bruker has both wet and dry forage calibrations on FT-NIR to balance rations onsite. As the industries become more consolidated, onsite nutritional services are critical for animal performance. Why wait for 2 weeks turn around with wet chemistry when you can have a fully balanced ration in less than 24 hours?

4 Slaughter & Processing

Physical characteristics based on chemical properties which correlate to processing and handling can be analyzed. For example, Iodine Value in pork bellies are an indication of soft cutters and linoleic acid levels in the diet.



5 Rendering Plants

Rendering facilities use FT-NIR for ingredient manufacturing and blending. The quality of rendered products is highly variable and FT-NIR helps to assure quality parameters are met. Beside protein content of various meals, the animal fat quality is often analyzed via FT-NIR for sale into the pet food industry.

6 Pet Food

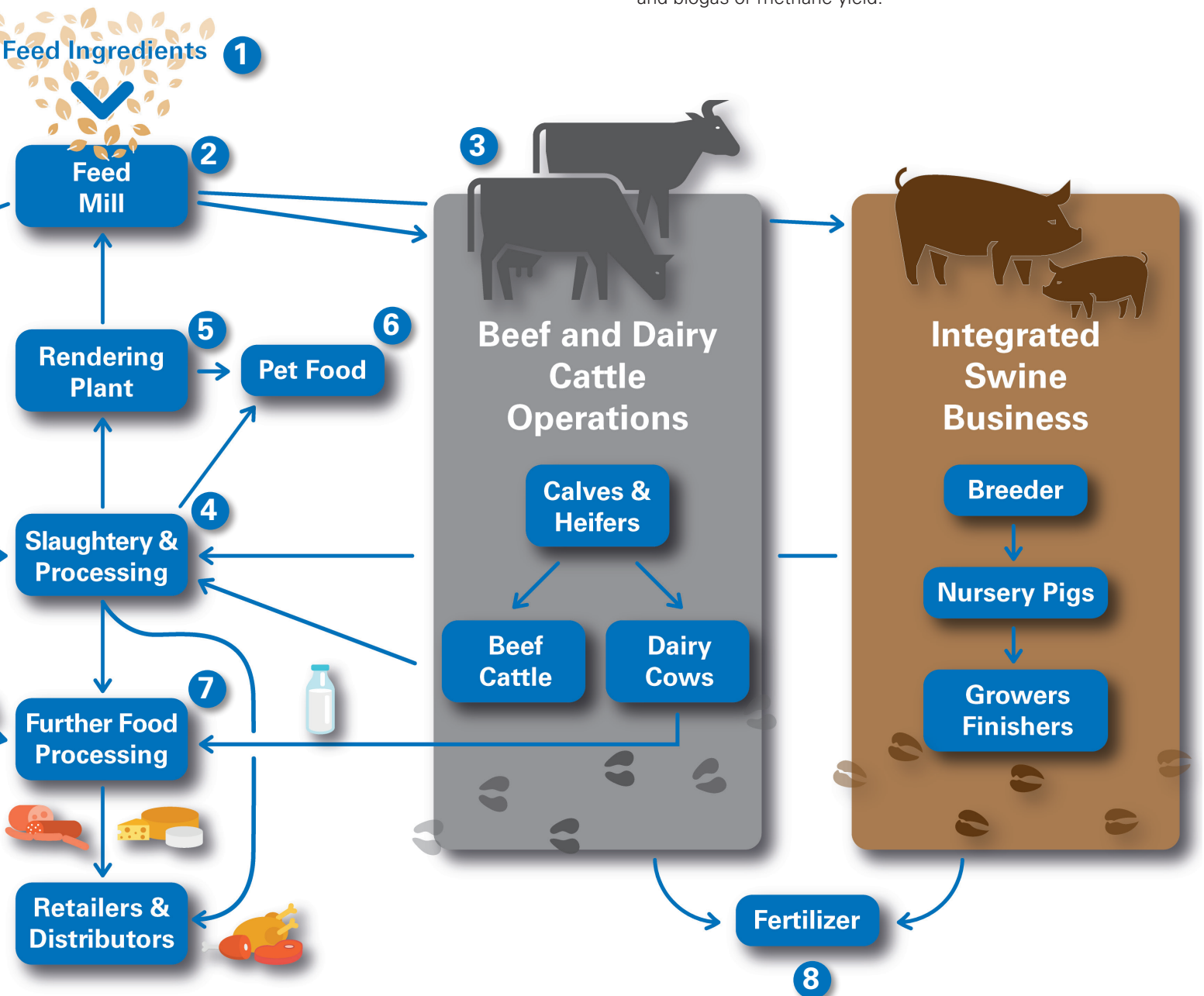
Almost every pet food or pet treat manufacturer uses NIR in their quality systems for monitoring inbound ingredients, updating ingredient formula values and assuring finished products meet nutritional guarantees and quality standards. FT-NIR has application across all pet food manufacturing segments.

7 Food Processing

Meat blending is a common use for FT-NIR in food processing. Factors such as percent of protein, fat, moisture and collagen are often analyzed. Almost all Dairy producers use NIR to analyzing fat levels to pay farmers. Further processed products like cream, cheese and specialty products like ice cream are also analyzed on FT-NIR.

8 Fertilizers

FT-NIR can be used to determine N, P, K in inorganic compound fertilizers to prove the quality before usage. Organic fertilizers like milled slaughter wastes or manure are other analyzed sample types. Manure nutrient and solids concentrations are important to optimize biomass energy conversion and biogas or methane yield.



• Feed Ingredients

The cost of animal nutrition represents the largest operating cost for most commercial livestock producers. In order to maintain an optimum balance between feed costs and productivity, all feed ingredients should be analyzed for nutrient concentration and these values are then used to formulate the rations and required supplements.

The included feedstuffs can however vary widely in composition, due to origin, seasonal changes or year. Fourier Transform Near Infrared spectroscopy (FT-NIR) provides a fast and effective solution for analyzing raw materials as well as finished feeds in order to optimize the production steps and monitor the final product quality.

For a quick start, a set of universal FT-NIR calibrations for the analysis of a wide range of raw materials in the feed industry is available. These calibrations help you to achieve a superior quality control, leading to an enhanced performance of your products.

„Bruker Optics offers the most comprehensive range of FT-NIR solutions for quality control and formulation adjustments.“

Samples can be analyzed non-destructively in seconds, saving costs by reducing time and reagent use. Analyzing by FT-NIR in the lab or at-line close to the production requires just filling an easy-to clean cup with the solid sample and presenting it to the analyzer. Liquid samples like oils or molasses can be analyzed in disposable vials with the same spectrometer.



Analyzing feed ingredients (here: wheat) with in an aluminium cup with quartz glass bottom using the MPA II FT-NIR spectrometer



What can be analyzed?

FT-NIR spectroscopy offers a rapid, accurate and non-destructive tool for the most common feed ingredients:

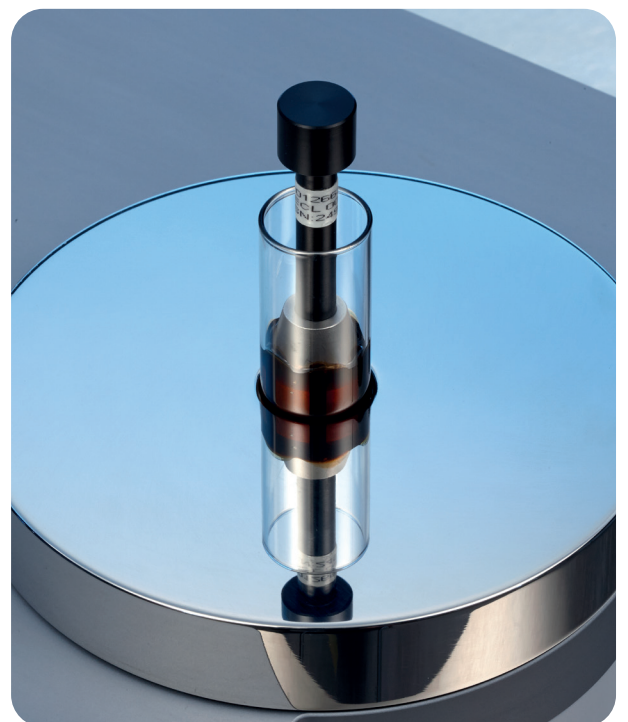
- Cereals (Barley, Corn/Maize, Rice, Sorghum, Triticale, Wheat)
- Cereal By-products (Corn/Maize Gluten Feed, Meal, Wheatfeed Middlings)
- Oil Seeds, By-products and Expellers (Rapeseed/Canola, Soybean, Sunflower and expellers)
- Other By-products (Biscuit Meal, DDGS)
- Animal Proteins (Blood Meal, Bone Meal, Feather Meal, Fish Meal, Meat and Bone Meal, Poultry By-product Meal)

Since Bruker Optics strives to continuously optimize its portfolio of calibration methods, additional products may already be available on request.

A list of commonly analyzed parameters include:

- Moisture
- Fat
- Protein
- Fiber
- Ash
- Starch
- Total Sugar
- ADF
- NDF

In addition Bruker FT-NIR instruments are supported by 3rd party suppliers of more specialized calibration packages and of special services, e.g. analysis of Amino Acids in feed ingredients.



Analyzing molasse in a disposable glass vial on the integrating sphere of the TANGO FT-NIR spectrometer.

● Feed & Forages

Bruker Optics offers the most comprehensive range of FT-NIR solutions for quality control and formulation adjustments. Samples can be analyzed non-destructively in seconds, saving costs by reducing time and reagent use.

Feed

The cost of animal feed can account for 50% or more of the variable costs in an animal production business. To keep the competitive edge, it is important to minimize the cost of feed, hence maximize its nutritional quality.

Analyzing by FT-NIR in the lab or at-line close to the production is fast and simple. It requires just filling an easy-to clean cup with the solid sample and presenting it to the analyzer. Liquid samples like oils or molasses can be analyzed in disposable vials with the same spectrometer.

FT-NIR spectroscopy offers a rapid, accurate and nondestructive tool for the analysis of various types of feed:

- Ruminant Feed (Calf, Dairy & Beef Cattle)
- Poultry Feed (Chick, Broiler, Breeder, Layer)
- Pig Feed (Piglet, Weaner, Grower, Finisher, Sow)
- Horse Feed
- Aqua Feed

The following parameters can be determined in seconds with only one measurement:

- Moisture
- Protein
- Ash
- Fat
- Fiber

„The availability of reliable and reproducible analytical data is the key for a safe and cost-effective feed formulation.“

More specialized parameters like starch and minerals are available on request. For a quick start, a set of universal FT-NIR calibrations for the analysis of a wide range of raw materials in the feed industry is available. These calibrations help you to achieve a superior quality control, leading to an enhanced performance of your products.

Forages

When formulating diets for e.g. dairy cattle, the goal is to maximize the use of forages and then add missing nutrients with additional feedstuffs to guarantee the best feed quality according to the animal requirements. Hence, an accurate analysis of forages for their nutrient content is essential.



Analyzing feed pellets in an aluminium cup with quartz glass bottom on the TANGO FT-NIR spectrometer



A typical forage analysis consists of multiple parameters such as protein, fiber, starch, digestibility, NDF, ADL, ADF, ash and moisture content as well as calculated energy parameters. FT-NIR spectroscopy allows the rapid determination of these and more nutrients in wet and dry forages.

Compared to wet chemical analysis, FT-NIR does not require any expertise in analysis and due to its speed with analysis times of less than a minute, more samples can be analyzed. The faster procedure of analyzing fresh wet forage gains importance for screening especially due to increasing number of samples during harvest.

Depending on whether you test wet or dry forage, the optimum sample preparation is different. The new MPA II Multi Purpose Analyzer comes with different accessories for both types of forages:

Dry forage analysis is performed by grinding the a sample to achieve a homogenized powder which is easily and reproducibly measured in a 50mm diameter sample cup with a quartz window on the bottom. The cup is rotated during measurement enlarging the sampling area for maximum reproducibility.

The standard sample preparation procedure for **wet forage** is drying and grinding the

sample. This is precise but labor intensive and time consuming. Moreover the composition changes due to loss of volatile components and chemical reactions. However, wet forage is inhomogeneous and requires a suitable handling and sample presentation for reliable NIR results. Here Bruker developed an extra large rotating sample cup for the MPA II with a diameter of 370mm (see below) and a matching weight to compress the forage samples. It allows the easy analysis without any sample preparation.

The measured sample area is 100 times the area of a static sample and thus enables the analysis of such inhomogeneous samples efficiently and with only one filling per analysis.



Analyzing silage in a large sample cup on the integrating sphere of the MPA II FT-NIR spectrometer

● Pet Food

Pets are today an important part of people's lives. Therefore consumers trust in brands which guarantee the best quality for their individual animal, since pets of different breed, size and age often need a special nutrient profile in their diet. Pet food producers have to provide a vast variety of different products, produced at an acceptable cost.

From raw materials to finished pet food

The biggest challenge in pet food production is to keep track of the different recipes subject to the availability of the raw materials. Depending on origin and season, they often show huge batch-to-batch variability. Nevertheless, adjusting formulas with valid compositional data is essential for consistent nutrition. FT-NIR is a fast and accurate tool, providing results in seconds for the highest level of quality and consistency for your pet.

„When it comes to pet food, consumers expect top quality for their loved ones. FT-NIR helps to guarantee that all nutritional values are within specification.“

The pet food ingredients include raw materials like cereals, vegetables and derivatives such as protein extracts as well as other materials.

Bruker offers solutions based on FT-NIR spectroscopy for a fast and reliable quality control of incoming pet food ingredients as well as the finished pet food.

FT-NIR spectroscopy offers a rapid, accurate and non-destructive tool for the analysis of:

- Moisture
- Protein
- Ash
- Fat
- Fiber

Analyzing fresh meat

Fresh meat is a key ingredient in prime pet foods. FT-NIR is a proven analysis method for the determination of moisture, fat, protein and salt content in various types of meat. The rapid analysis results will enable the pet food producer to make informed process decision to optimize the yield without compromising on quality.

Compositional analysis of rendering products

Approximately 40-50% of the weight of any slaughtered animal is not fit for human consumption. This material is mostly transformed by the rendering industry into highly nutritional ingredients, e.g. for the pet food production. FT-NIR is well established for the analysis of the clas-



Analyzing rabbit food in an aluminium cup with quartz glass bottom on the MPA II FT-NIR spectrometer



sical constituents like moisture, fat, protein, fiber and ash as well as more specialized parameters like energy values or amino acid profiles.

Analyzing fat quality

The fat content in pet food mainly derives from the protein source (e.g. the fat in poultry) but also from added fats e.g. lard, tallow, vegetable or fish oil. Quality pet foods will use good sources of fat and ensure they provide an optimized level of omega-3 oils. Here FT-NIR spectroscopy can help to determine the amount of EPA, DHA and total omega-3 in fish oils. Moreover, the fat quality in general in terms of trans fatty acids (TFA), free fatty acids (FFA) and fatty acid composition can be analyzed.

Easy sampling and measurement

Solid samples like raw materials and finished pet food are filled in cups with a quartz glass bottom, placed on the integrating sphere of the MPA II or TANGO-R spectrometer and measured from below. This way, the product has an even surface and for highly reproducible results, it is rotated during the measurement. Liquid samples like oils and fats are simply filled in 8mm glass vials and are measured in the sample compartment of the MPA II or TANGO-T. Alternatively, the liquids can be measured on the integrating sphere of the TANGO-R, if the sample number is low.



● Premixes & Additives

Inadequate animal nutrition is a major cause for low profitability of any livestock operation. Individually tailored feed premixes can ensure an optimal dosing of additives for better nutrient availability and help to formulate customized rations so that animals are getting the recommended nutrient levels.

By utilizing premixes in feed formulation this optimal nutrient composition can be secured and adapted during formulation depending on the actual available raw materials and ingredients.

„Premixes offer a huge added value for feed if the specification and quality is right. Bruker helps you to analyze premixes and additives fast and cost-effectively.“

Premixes are complex mix of vitamins, minerals, trace elements, enzymes and other nutritional additives to incorporate in feed between e.g. 0,5 and 8%. Its main objective is to deliver the micro ingredients in a manner desired by the consumer. Premixing requires sustainable safety and high quality checks for the ingredients which may have certain potency and the premix consistency and homogeneity.



Identification

Feed premixes are complex mixtures which are often customized and can contain additives with an high impact. In general, premix ingredients can be identified by NIR to ensure only right materials at the right amount are mixed in premix batches. A great variety of organic substances can be identified, e.g. vitamins, amino acids, enzyme formulations etc. Moreover, many inorganic substances or minerals can be differentiated due to the fingerprint of the adsorbed water or defined crystal water.

Conformity & Homogeneity Analysis

In addition to identification, a conformity test can also assure a quality mix and identify mis-manufactures or contaminants present. The Bruker uniquely designed software compares an unknown spectrum to a set of reference spectra. This evaluation is specific for each data point in a spectrum and therefore very sensitive depending on the set threshold. The conformity test allows a real fingerprinting and screening to investigate deviations from previous samples and batches.

This method can be used for pure ingredients or for finished premixes assuring inbound product quality as well as finished blending quality, offering additional checks and balances for a complete quality system.

Quantification Analysis of Premixes

Quantification of constituents or sample properties is very likely the most common application in NIR spectroscopy and is applied for moisture analysis in ingredients, composition analysis of vitamin or amino acid content in premixes and more. The calibration work requires samples and reference values which are used in the OPUS QUANT2 package to create calibration models. QUANT2 is a comprehensive framework to setup, calibrate and validate models with certain tools, plots and statistics.

• Trusted Solutions with Our Partners

„Bruker Optics has teamed up with world class partners to provide the optimum solution for animal nutrition.“



Evonik Industries

Evonik's AMINONIR® service uses near infrared reflectance spectroscopy

(NIRS) to predict the crude protein and amino acid content in more than 60 important feed ingredients. Its predictive calibrations draw on a large and global set of diverse samples to estimate crude protein, dry matter, essential and nonessential amino acids for all major feed ingredients.



Adisseo PNE

Precise Nutrition Evaluation (PNE) is a NIRS service offered by Adisseo. PNE

enables to monitor the raw materials quality through in vivo - based calibrations and manage accurate formulation with savings. Ideal decision-making tool for nutritionists, formulators, purchasers and quality control managers.



AB Vista

AB Vista is an animal nutrition technology company offering pioneering products and technical services to the global animal feed industry. Since its establishment

in 2004, AB Vista has grown to be a top-three player in feed enzymes and is also one of the largest suppliers of natural betaine to the global animal nutrition industry.



BIPEA

BIPEA is a European non-profit organization

located in France. Gathering nearly 2500 laboratories in the world (throughout 120 countries), it offers more than 150 regular proficiency testing programs. Through its ISO / IEC 17043 accreditation and ISO 9001 certification, it guarantees laboratories of its competence to organize proficiency testing programs.



MG2MIX

MG2MIX is an independent French premix producer, specialized in the manufacturing of premixes, mineral feeds and nutritional specialties for poultry, swine, ruminants, rabbits, horses, pet-food and aquaculture, as well as in advising their customers from feed formulation to monitoring animal performances on farm.

TECHNA



TECHNA FRANCE

NUTRITION is the

subsidiary responsible for

feed expertise activities, TECHNA Group's traditional business, supporting the development of its customers via three core fields of expertise: precision nutrition, livestock technology and economics of production.



● ONET Software for the Administration of Spectrometer Networks

Near infrared spectroscopy has become an extremely important tool for quality control. Method development and the management of large spectrometer pools can, however, be challenging, since it is virtually impossible to have expertise in spectroscopy at every single laboratory or production site. Therefore, a central method development and administration is essential.

With ONET, all methods can be centrally set up and maintained for the distribution to the instrument network, reducing the need for local expertise and training. By this, procedures and results are harmonized and based on the same setup and methods.

Calibrations and updates can be rolled out to all instruments inside the company network or specific versions can be assigned to a limited number of spectrometers. This enables the creation of a global instrument network, where adjustments for local needs can still be done if required.

„ONET is a server application accessed via a browser-based web user interface (WebUI), allowing to set up, administrate and control a network of FT-IR or FT-NIR instruments from anywhere in the world.“

Moreover, all spectra and results from all instruments are pooled in the central ONET database for further actions. For all networked instruments, the diagnosis information and performance test results are monitored in ONET and can be checked anytime. The performance tests can be defined and carried out according to scheduled routines in ONET.

The user management is centrally organized in ONET for the network application itself and for all OPUS users of all networked instrument PCs.

Features and benefits

The power of ONET lies in the easy distribution of calibrations to the instruments, the intuitive user management and the central data pooling for spectra and results, still allowing a local sample analysis, even if disconnected.

Calibration management

- Central calibration development and validation ensure harmonized results
- No local expertise for calibration development required

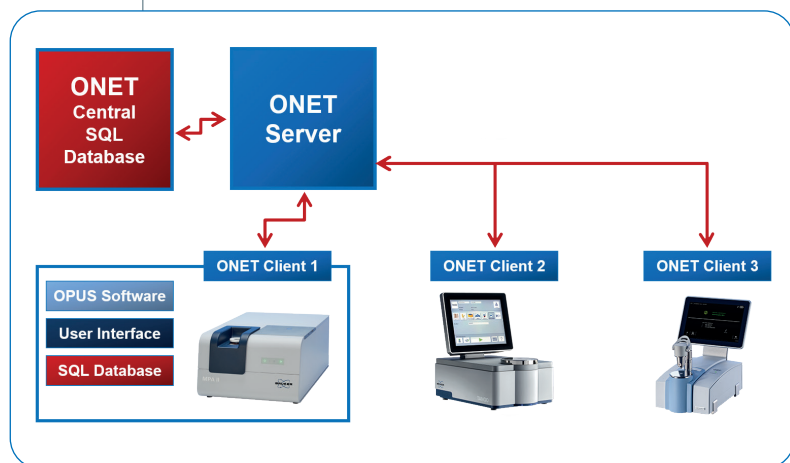
- Distribution of generally used or individual methods for each instrument

Centralized database

- Central database storage for all spectra and results
- Enhanced security due to simplified backup of central data base
- Global view on operations from raw materials to finished products

Network administration and usage

- Administration of instruments by defining and assigning users, products, and spectrometers
- Grouping of users and spectrometers simplifies the administration work
- Full, central control of local setup including user management
- Monitoring of local instrument status test results
- Analysis of local sample even when disconnected from network
- Simplified local workflows
- Cost savings by ensuring system integrity



● ONET Case Study

Cherkizovo, Russia's largest producer of meat products and animal feed are raising the product quality and the production efficiency using Bruker's networking solution ONET.

A company that started as a small-scale meat processing plant in the mid 70's has become Russian's meat products and feed producer giant. This fast-paced evolution of the company was made possible with the continuous investment in new technologies which were responsible not only for increasing the production but also in quality control and assurance.

„ONET has created a unified quality control network across all laboratories where the incoming raw materials and the finished products are constantly monitored.“

In 2015 the Cherkizovo Group has opened an innovative R&D center which includes laboratories for veterinary and sanitary examination, feed control and agricultural chemistry. Each laboratory is equipped with analytical devices from the leading global manufacturers.

Dr. Sergey Shapovalov, the director of the R&D center of the Cherkizovo Group, has started an ambitious project to perform the quality control in all plant laboratories of the agricultural division using near infrared (FT-NIR). The collaboration between Bruker and Cherkizovo started in 2015 with the purchase of 6 TANGO spectrometers, 1 MPA spectrometer and Bruker's new networking software, ONET. In the meantime, 4 additional TANGO were ordered, showing the company's confidence and satisfaction with the solution provided by Bruker.

Implementation of ONET at Cherkizovo

Each of the feed plants located in central Russia currently has a TANGO spectrometer installed. The master equipment, MPA, was installed in the R&D center where also the wet chemistry measurements take place. These reliable values are used to create and optimize NIR calibration models which are later distributed via ONET to all 10 TANGOs. The calibrations cover almost 60 products for feed ingredients, poultry, swine, and ruminant feed.

This network created by the R&D center enabled the definition of target values for each product in Cherkizovo's NIR network. This has helped reduce errors in the local plants and to secure product quality and batch consistency.

Company-wide benefits of ONET

The use of ONET in Cherkizovo has brought advantages to several departments of the company. Quality assurance and production costs were reduced as the operator error rate went down and the cost with wet chemistry analysis was reduced greatly with the adoption of NIR. Since ONET pools and stores data from all spectrometers in the network it was

possible for the purchasing department to track the quality of purchased raw materials over time from different vendors in their respective regions and to find the best compromise between quality and price. Furthermore, ONET led to cheaper and better feed formulation as the recipe could be dynamically adjusted according to the batch of used raw materials. This, in turn, led to improved poultry growing indexes.

As a further sign of confidence in the Bruker products the R&D department joined the Association of Analytical Centers – Analitica – in 2017 as a member of a national inter-laboratory proficiency tests in the field of NIR spectroscopy for the quality control of raw materials and finished feed products.



● Process

Optimizing the formulations with permanently varying raw materials is an ongoing challenge for the feed and pet food industry. Here online FT-NIR spectroscopy is a valuable tool for gaining direct information from incoming materials and for optimizing process control to maximize efficiency and yield.

In the feed and pet food industry there has been a rapid adaptation of near infrared spectroscopy for laboratory use from the first commercially available NIR analyzers to today's modern networked FT-NIR spectrometers. In the recent years, more and more process instruments are implemented to automate the analysis in order to more insight into the process. These process analyzers are able to provide the same information as lab or at-line instruments about identity, conformity, and quantitative chemical composition of the ingredients and products. In contrast to manual analysis the main constituents of interest, such as fat, protein and moisture can be analyzed continuously on the spot to help to optimize the various production stages.

“On the spot, real-time analysis gives you a direct insight into the process and helps to optimize the different production steps.”

Using online FT-NIR spectroscopy will provide key advantages e.g. by

- Checking the quality and variability of incoming raw materials
- Controlling the formulation accuracy and batch consistency
- Analyzing moisture during mixing and drying process
- Monitoring composition pre and post pellet mill and extruder
- Evaluating the total fat levels when adding extra fats or oils.

Raw material analysis

The raw material quality is the most important information for the adaptation or creation of customer specific formulations. A tight process control during unloading and storing generates a much better view compared to a manual check with limited sample volume. This will help to detect the variability across

the incoming raw materials. Therefore it enables you to achieve the required specifications more accurately rather than detecting irregularities later in the production process. It also helps to discover low quality segments in a supplied material or even segregation.

Formulation and processing control

Based on the analysis results of the ingredients and the required specifications the formulation is optimized and can be monitored with FT-NIR during the mixing process for blend conformity and composition analysis. Especially the moisture level is an important target to ensure a good quality and maximum profitability. The quality and mixing results can be monitored before pelleting or extruding for feedback and adaptation of the next batch partition.

The NIR analysis after the press or extruder and especially after a conditioner is advised to check the final products right off the production line before packaging.

A tight process control with FT-NIR will lead to:

- Savings on ingredients
- Optimization of product quality and consistency, enhancing customer satisfaction
- Increased product margins and avoidance of costly reworks

Process technology

The MATRIX-F is a dedicated FT-NIR process spectrometer that can directly withstand harsh and dusty environments. The instrument uses state-of-the-art optics for outstanding sensitivity and stability in a compact module.

Its innovative design provides consistent high quality results, less downtime, direct methods transfer and the possibility of new applications that less sensitive and precise instruments are incapable of.

Up to six probes and sensor heads can be connected monitor different stages in the production process. By using fiber optics technology, difficult to reach measurement points can be accessed to guarantee an easy integration into your feed



operation. The measurements are triggered by the process control system and results are directly linked back for real time decisions.

NIR sensor head for contact-less measurements

The Q413/A is a Near Infrared (NIR) sensor head illuminates the sample and the scattered light is collected and guided through a fiber optic cable to the spectrometer. This way, a contact-less measurement can be performed remotely, opening a whole array of new applications. The sensor head can either be installed over a conveyor belt or flanged to a chute/hopper using a customized adaptation. The automated background measurement allows for instrument checks during the running process.

Depending on the application, the sensor head can be operated in two different modes:

- Standard mode: Both light sources are used simultaneously to gain the maximum amount of signal. This is important for samples with low reflectivity, e.g. dark or very coarse samples.
- Single source mode: Only one light source is used, which is sufficient for most sample types, e.g. light and fine powders. In case of source failure, the second light source will be activated automatically, allowing for uninterrupted operation with double run-time.

Contact-less measurement head
for measuring in chutes, pipelines
or over conveyor belts

Reflection, transfection and transmission probes

Apart from contactless measurements a true in-line measurement can be required. Bruker offers probes with different measurement modes for various points in the process stream:

- Reflection probes for powder analysis in dosing systems or at silo outlets
- Transfection probes where slurries or emulsions need to be analyzed
- Transmission probes for monitoring of incoming liquids, like fats, oils or molasses

A wide choice of probe materials and geometries is available for optimal measurement results.



• Dedicated Measurement Accessories

Choosing the best accessory for reliable results

When measuring heterogeneous samples, like feed pellets or even silage in diffuse reflection on the integrating sphere, the use of sample rotators significantly increases the accuracy of the results.

Bruker Optics offers a wide range of different rotators and sample cups to find the best solution for a solid samples. The various sample cups are easy to fill and to clean.

- **Small cup (IN311):**

Aluminium sample cup with low OH quartz window, 51mm diameter, for finely ground samples and smaller sample volumes (TANGO and MPA II spectrometers).

- **Large cup (IN312):**

Aluminium sample cup with low OH quartz window, 97mm diameter, for ground or unground samples, grains and feed pellets and larger sample volumes (TANGO and MPA II spectrometers).

- **Extra-large cup (IN313):**

Aluminium sample cup with low OH quartz window, 370mm diameter, for forage, silage, hay and straw samples (MPA II spectrometer only).

Moreover, cost-effective plastic sample cups (ABS) and also disposable Petri dishes are available for the small and large rotating devices.

Occasional liquid samples like oils or molasses can be measured in diffuse transfection on the integrating sphere utilizing a stainless steel stamp.

- **Transfection stamp (IN481S):**

Diffuse reflecting device made from stainless steel with precise 1mm spacers yielding a 2mm optical pathlength. Ideal for the reproducible measurement of liquids in disposable 22mm vials (TANGO and MPA II spectrometers).

If liquid samples are measured more frequently, transmission measurements in the sample compartment of the MPA II are preferable to transfection measurements. Here, an optimal temperature control of the liquid during the measurement in disposable 8mm vials can be achieved, leading to an enhanced reproducibility of the results.



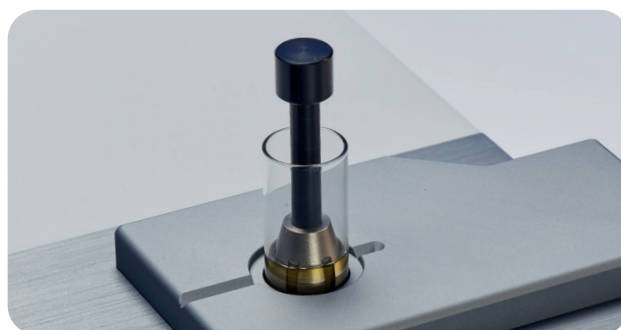
Small rotating cup (IN311) for ground or other homogeneous samples on the integrating sphere.



Large rotating cup (IN312) for ground and unground samples on the integrating sphere.



Extra-large rotating cup (IN313) for straw and silages on the integrating sphere.



Transfection stamp (IN481S) for the measurement of liquids on the integrating sphere.

• Our Service Promise

Know how meets service

Bruker Optics is the leading manufacturer and worldwide supplier of Fourier Transform Infrared, Near Infrared and Raman spectrometers for various industries and applications. For years, we set new standards on the market when it comes to precision and efficiency, ergonomics and ease of operation, consulting and services.

Always more than you expect

We are never satisfied with the common market standards. This is where our own research and development departments play a major role: here new ideas are turned into innovative products - in more precision, advanced user comfort and unrivalled reliability. To us, it is obvious that these highest demands are also valid for our production process. High quality materials, careful workmanship and, if necessary, especially developed production processes and test routines ensure the quality that is common to all Bruker Optics spectrometers. No matter which new products we design, we place the very highest demands on them all.

We are there where you need us

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Technologies used are protected by one or more of the following patents:
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