Process Control of Animal Feeds

Introduction
Near infrared (NIR) analysis of animal feeds can significantly improve process efficiency to increase profits. Important parameters can be determined quickly and simply that allow operators to trim the process. QCL is in partnership with QInterline A/S of Denmark to bring the latest FT-NIR analysis technology to the UK industry.

FT-NIR Analysis
FT-NIR analysis is a powerful and proven technique for rapid multi-component analysis of bulk materials with little or no sample preparation. Traditional NIR analysis can determine properties such as moisture, protein, fat, starch and fibre. But today’s FT-NIR technology offers a much stronger multi-component analysis solution while also increasing analysis reliability. Using powerful FT-NIR technology Q-Interline focuses on sampling solutions that ensure robust analysis results for the lifetime of the analysis system as well as extensive customer support.

Process Analysis of Feed
A critical element of in-situ process analysis is the method through which the sample is presented to the analysing system. For high accuracy the method must allow a representative portion of the material being analysed to reach the analysis system. A simple flow system, where the materials flows either over or under the analysis window, has a number of drawbacks. Two significant ones are:

1. The measured sample can not be precisely recovered for reference analysis to perform accurate system validation.
2. The sample can be vertically layered by particle size due to vibration, so an unrepresentative view of the material is presented to the analyser.

Q-Interline’s philosophy when designing process analysis systems is that the sampling method is as important as the technology performing the analysis and must be correct. Through careful analysis of a customer’s process Q-Interline designs a system which ensures a large portion of a representative sample is repeatedly analysed with confidence.

Online Feed Sampling System
The online feed sampling method described below illustrates the design principles behind the innovative sampling solutions engineered by Q-Interline. The feed flow is directed down a chute. The analysis cell is placed below the chute (Diagram 1) Under the chute a port is controlled by an activator. When a sample is to be collected, the port opens and sample fills the cell underneath (Diagram 2). As the sample fills the cell, a sensor is activated when it reaches a certain level and the port closes. During analysis the diffuse reflectance probe moves horizontally through the sample measuring a large volume. The side view of the probe means that it measures an area of the sample that has not been compacted (Diagram 3). When the analysis is complete the butterfly valve beneath the sample cell opens. At the point the sample can either be collected in a container for reference analysis or it can be returned to the main flow via a screw mechanism (Diagram 4). When the probe is not measuring a sample it is “parked” and protected by a sheath made of the reference material. The reference is then collected automatically at predetermined time intervals. The references are automatically used to validate the instrument to ensure it is operating correctly.

Diagram 1

Diagram 2

Diagram 3

Diagram 4
FTSW100 On-Line FT-NIR Process Software

FTSW100 is a complete solution for applying FT-NIR analysis technology in process control and process monitoring applications. FTSW100 has been developed with the rigorous expectations of the process environment in mind. FTSW100 accounts for all the requirements of different manufacturing industries, supports a range of data-processing algorithms and is compliant with pharmaceutical PAT guidelines. The interface of FTSW100 is designed to be fast and easy to use where a small production team is responsible for the operation of a multitude of equipment. Large colour coded status displays allows the operator to know at a glance the system’s status.

The complexity of the FT-NIR processing technology is hidden allowing operators to focus on the task at hand without being trained on the specifics of the analyser. Built-in multilevel security prevents unauthorised access to advanced functions and all events are tracked in a full audit log for traceability and diagnostic purposes. FTSW100 can control all aspects of integration into production environments for process control and is designed to run 24/7 unattended. It supports industry standard communication links like Modbus (with fully user-configurable addresses) and OPC to control systems.

Calibration Model Development

Due to the FT-NIR technology used by Q-Interline, calibration models can be potentially shared between online and laboratory analyser systems where the product is constant. This feature can allow calibration model development on a laboratory system prior to online installation, significantly reducing commissioning time. The optimisation of calibration models on specific product data will also ensure superior analytical performance for the system’s lifetime. Initial calibration models for new applications can be rapidly developed based on data supplied prior to installation and commissioning. Superior spectrometer design ensures calibration models are transferred between systems with only minor bias adjustments and instrument component changes have no effect on analytical results. Software tools and training available to users for internal calibration model development and maintenance.

Interferometer Design

The interferometer is a patented ABB Bomem Michelson-type interferometer with 2 cube corner retro-reflectors mounted on a “wishbone” swing arm. The scanning mechanism has a lifetime warranty against breakage. This design delivers smooth, constant velocity and perturbation free scanning. The internal He-Ne reference laser is used for fringe counting for path difference determination, ensuring all interferometers report the correct wavelength over their lifetime irrespective of component replacement. The design has proven highly successful in industry where long-term reliability is a key requirement.