Using near infrared transmittance network and on-line systems in grain segregation and process control

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Introduction

Improvements in near infrared (NIR) reflectance/NIR transmittance calibrations for feed and grain, together with special requirements from the grain and feed industry, have pushed the future waves in a direction of putting the Infratec Analyzer into network systems and into on-line systems. Here the actual operator of the instruments have very little chance to change any parameters affecting the result.

Background

During the last 15 years, NIR reflectance/NIR transmittance instruments have been sold to the feed and grain industries. In the feed industry this has been to control feed ingredients and feed mixes to optimize and control production. In the grain industry, the instruments are used to segregate different qualities. These applications of NIR reflectance/NIR transmittance have fulfilled many of the requirements of the industry. The result is better quality and better economy.

Today's demand from the grain and feed industries is focusing on how to administer and maintain these instruments efficiently. Demands for integration of information from the instruments and central computer systems are raised. Efficient utilization of calibrations is also important. Not only because of all the money and time invested in the calibration but also because using the correct calibration ensures the quality of the results.

The grain industry needs to have analysis results available quickly to direct incoming grain to the correct silo and to use the results for efficient administration of payment to farmers. Another important issue is the stability of the instrument. The grain quality has to be determined with the same accuracy when it arrives at the receiving station, when it leaves it and when it's delivered by the buyer. The feed industry has a need for analyzing mixed feed on-line to be able to quickly adjust in-let of ingredients for optimizing feed composition and raw material costs.

There are two ways of meeting the demands above that I will discuss here: instruments connected in networks and instruments used on-line.

Network

There are a number of reasons to connect instruments to a network. One is, of course, to be able to administer all instruments from one location and to control several receiving stations centrally. Another reason is to ensure that the farmer gets a correct grading of his crops and thereby gets a fair payment, irrespective of which receiving station he goes to. By using a uniform calibration on all the instruments in a network, the farmers can trust the grain trader and the customer's need for a consistent product is fulfilled.
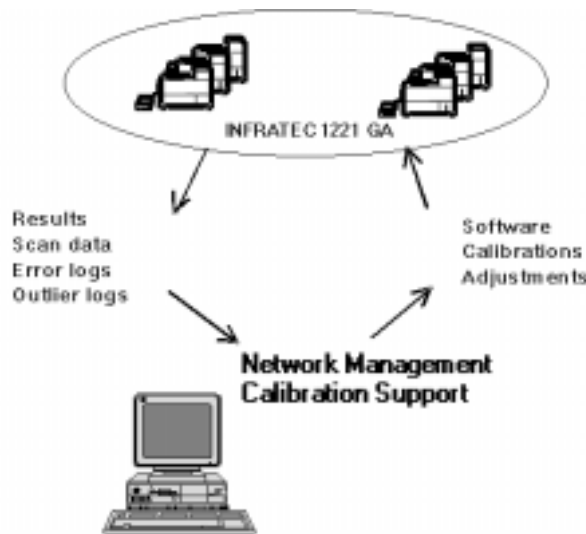
Figure 1.

Description of an Infratec network

All instruments in the network are connected to one central computer via modems. The network is administered from the PC with the help of a modern Window program. The program knows all the details about each instrument in the network. The program can send to up to eight modems simultaneously and can administer several networks (see Figure 1).

Typical information that can be sent from the PC to the instruments are:
- calibrations, with individual adjustment for each instrument, if desired
- software updates
- passwords
- instrument constants

Information that will be sent from the instruments to the PC are:
- scans from samples used for creating/updating of calibrations and standardisation
- results
- outlier results and codes
- error codes

Standardization can briefly be described as a method where the small individual differences in bias between each instrument and a master instrument are compensated for in the calibration. The PC program stores this information for each instrument. This method will assure that all instruments give exactly the same result for one and the same sample.

Why use a network

Today networks are used in two ways. The first is to have the network to control the performance of each instrument fully to make sure that all instruments give the same result for one and the same sample. Another way of using the network is to use it only as a means of sending software updates and new calibrations to the instruments. In the latter case the instruments are more or less stand-alone instruments, where the local operator can make adjustments to the calibrations on the instrument.

The advantages of a network are:
- It makes application model updates on all instruments easily.
- By standardization you can control all the instruments to give exactly the same result on the same sample.
- Quick sample collection with a good geographical coverage for updating and creating calibrations.
- It makes it possible to concentrate the competence to one location. This may mean that calibrations for new constituents or new products can be made.
- These new calibrations can then be implemented for a large number of users very efficiently by the network.
- You can collect results stored on the instruments.
- Simple man–machine interface allows temporary staff to run advanced analyses.

Examples of networks today

The networks can be divided into two groups; open and closed networks. Anybody can attach their instrument to an open network while closed networks are private.

Examples
- Australia, Barley Board (grain)
- Austria, farmers co-op (grain)
- Canada, Canadian Grain Commission (grain)
- Denmark, official NIT-board (grain)
- France, GIE Infratec (grain)
- Germany, farmers co-op (grain)
- UK, farmers co-op, official NIT board (grain)
- USA and Canada, Manitoba Wheat Pool (grain)
- Canada, UGG (grain)
- France, Ceralliance (grain)
- Germany, Doemens (malt)
- USA, Busch Ag (barley
- USA, Busch Ag (rice)
- USA, Dupont Agri (corn)

On-line

The demand for, and interest in, completely automated analyses are quickly increasing in the feed and grain industry as well as in other areas.

NIR reflectance/NIR transmittance is one technique that now starts to move into process environment and usually as on-line applications. Using on-line means that the sample is taken out of the process stream and transported to the instrument, where analysis is made, and finally the sample is discharged back to the process or collected for storage or laboratory control (see Figure 2).

Description of Infratec on-line

The system consists of the following parts:
- an Infratec
- one or several samplers
- a PC to remotely control the system and to display the results
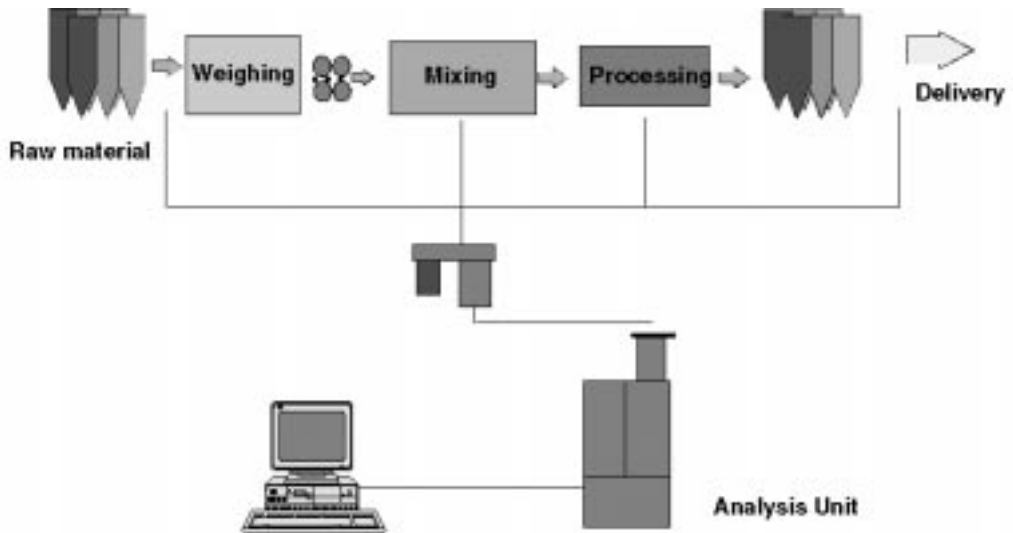- a transport system
- a mill when necessary

Figure 2.

    The sample is taken from the process stream with a sampler and transported to the instrument. When the sample arrives at the instrument it can be analyzed directly or ground before the analysis if necessary. When the analysis is completed the results are transferred automatically to the PC, which controls the instrument, and the sample can be discharged back to the process or taken out for storage or laboratory analysis.
    The PC-program is a modern Windows program that is easy to use. It can communicate with PLC, modems and LAN. It shows you trends and gives you alarms if the result exceeds limits set by you or if something in the system breaks.
    Advantages of an on-line solution, with a PC used for remote control, are:
- everything is controlled from the control room
- the results can quickly be used to adjust incoming materials, thereby reducing raw material costs
- results and trends are displayed clearly to the process control people
- easier transfer from process to lab
- the results can be distributed quickly to the laboratory and quality control department
- it is possible to collect samples from several locations in the process and transport them to one instrument
- possibility to connect several instruments to one PC.

Summary

    If we look at the demands that we try to meet:
- Efficient utilization of calibrations
- Efficient administration and maintenance
- Integration of information from the NIR reflectance/NIR transmittance instruments with existing computer systems

We see that both the network and the on-line solution helps us with this in different ways.

The network helps us to administrate the instrument centrally. It is easy to update calibrations. It allows you to concentrate your calibration and wet chemical know-how. By getting scans and results from the instrument you can easily use this information with other applications.

With the on-line system we have a tool to help us with quick decision making to control feed composition and raw material costs. The results can easily be transferred to other applications or stored and the sample can easily be transferred from the process to lab or for storage.