

# Modern diode array NIR

## Saves money and improves aquafeed quality

By Stefan Tordenmalm, Product Manager – NIR, Perten Instruments AB

The more information and understanding you have of your raw materials and your production process, the more efficient you will be at processing variable ingredients into aquafeed of a high and consistent quality. Analyzing the nutritional content is critical for this understanding, and many aquafeed plants have found that advanced near-infrared spectroscopy (NIR) can save them money.

NIR instruments determine the composition of ingredients for cost-efficient formulation, and help you monitor your process to maximize production and save on expensive raw materials. Recent advances have made these tools more accurate, easier to use, and robust enough to place them in the production process, which makes them an excellent investment also for smaller plants. Before we discuss the applications and benefits, we will explain the basics of NIR.

### **NIR – Introduction and recent advances**

The basic principle of infrared spectroscopy is that different chemical compounds such as water or protein absorb infrared light of certain wavelengths. The effect is that each compound will have its specific infrared color, and an NIR instrument can recognize moisture or protein in a sample simply by analyzing which infrared colors the sample shows.

Of course it's not enough to know that there is moisture or protein in a sample. We need to know the concentration. A simple example can be found in the picture of glasses filled with tea. The darker color is absorbing more light meaning it is higher in concentration.



An NIR instrument performs a similar sort of analysis as our eyes in this instance, but looking at infrared colors instead of the colors we see with our eyes. A darker protein color means a higher protein concentration. In this way, NIR can be used to determine moisture, and organic compounds such as protein, fat and more in ingredients and finished feeds.

NIR has been used in the industry for years, but it's only with recent advances that its full potential has been reached. Modern diode array NIR technology makes it possible to analyze samples as they are with no grinding required, and does not need glass cups thus removing the need for cleaning cups between samples. Diode array instruments perform analysis in a few seconds, are more robust, and are generally easier to use than previous NIR models. These properties mean that greater accuracy is achieved, and that NIR is no longer confined to the lab, but can be used by process operators and placed at the factory floor.

The speed and robustness of diode array NIR technology also means it is perfectly suited for on-line use, measuring a moving product directly in the process line in real-time. While there have been on-line NIR instruments in the past, they have not been accurate or robust enough to become widely used. In contrast to earlier NIR technologies, diode array technology contains no moving parts in the optics, and is thus robust enough for harsh process environments.

## Where and how to save money

### Buying the right ingredients

Many users of NIR instruments have saved back the investment simply by monitoring suppliers and make claims when specifications are not met. When a shipment arrives, it is tested for compliance before it's even unloaded. If it's out-of-spec it can be rejected immediately, and immediate rejections tend to be more effective than rejections when wet chemistry results are available the next day. As modern NIR instruments don't require grinding even for analysis of grain or other inhomogeneous samples, much labor is saved on grinding of samples.

### Formulating

Agricultural products are not uniform and to be able to account for this variability in formulations it's necessary to have nutritional information for each shipment. As modern NIR instruments can test ingredients in seconds with no sample preparation required, this information is within reach for the nutritionist and formulations can be more accurate, providing great savings on raw materials at the same time as customers will experience a more consistent product.



DA 7250 At-line diode array NIR instrument ([see details](#))



DA 7300 In-line diode array NIR sensor ([see details](#))

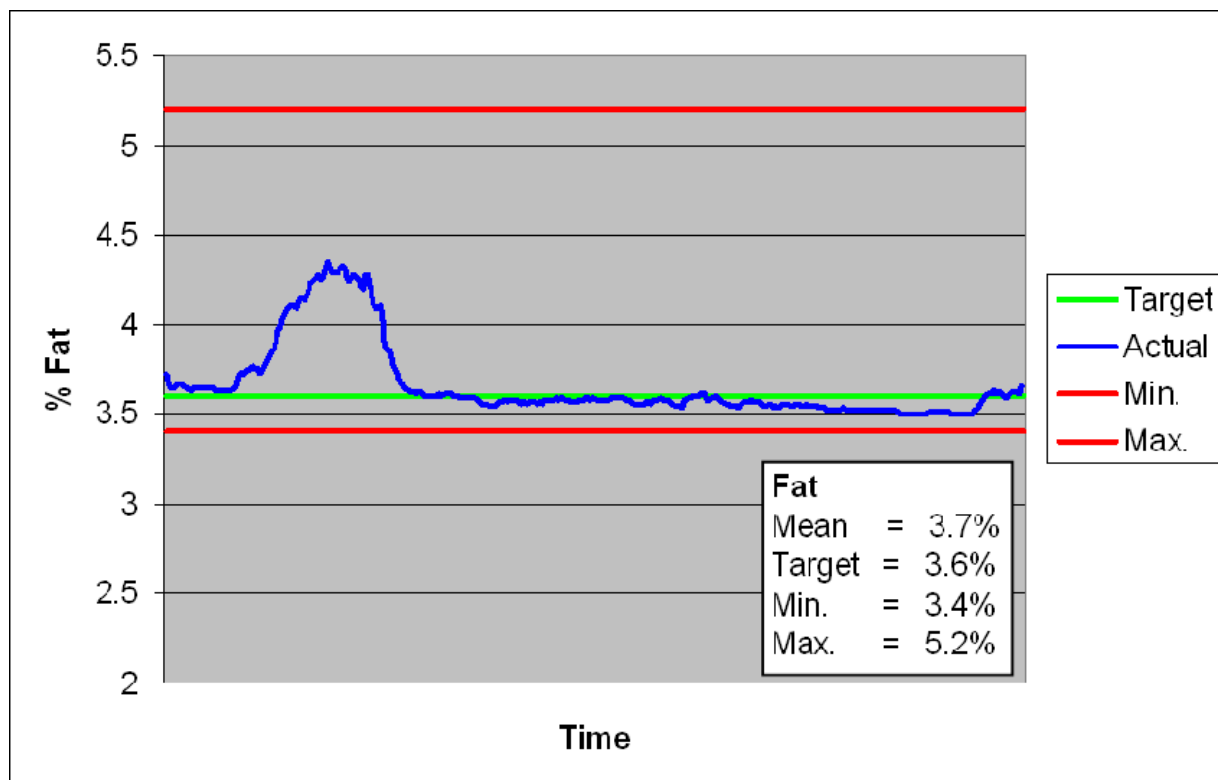
### Process optimization

Perhaps the greatest savings in process optimization are those where the moisture, protein and fat contents are monitored and optimized. Keeping all of them as close to targets as possible is always highly desirable.

With traditional wet chemistry analysis the actual composition of produced feeds is often not known until a day or two has passed. This makes it impossible to react and make changes. Modern NIR instruments provide the information in seconds, and can be used at-line by process operators. With on-line NIR the measurements are even done in real-time and can also be connected to plant control systems.

The most obvious money saver is controlling moisture to stay as close as possible to the upper limit. Increasing average moisture content by a tenth of a percentage point means that production volume increases by a tenth of a percent at no extra cost. At a plant with 100,000 ton per year production volume this means 100 extra tons and tens of thousands of Euro in profit increase. Most of the time the production increases are far greater than 0.1% Protein and fat also offer substantial potential for savings and product improvements. Much of these savings can be realized when using a modern bench-top NIR instrument, but on-line analysis brings additional benefits, especially for larger plants.

Consider the graph below, which comes from a factory where on-line NIR had been installed but not yet connected to the control system. It shows fat content over time in multiple batches of one recipe, and makes it very clear that while the average is close to target, the product is highly inconsistent. If only one sample had been taken for analysis, it would almost certainly have been at least slightly misleading, and if taken during the



peak it would have given a very incorrect picture of fat content. With the detailed information on-line NIR provides, the problem is seen and it's possible to start investigating.

For more information, please contact: [Stefan Tordenmalm](#), Product Manager – NIR, Perten Instruments AB

### Verifying finished product

Before shipping to customers, the finished product needs to be verified against specifications. When NIR is used throughout the production process, it is natural to add a final test before shipping products. With diode array-based NIR instruments this step takes practically no time and serves as a final check-point to prevent any off-grade product from being delivered to customers.

### Summary

An improved understanding of your raw materials and your process unlocks great savings potentials. By using modern diode array-based NIR, you will be able to use ingredients more efficiently and improve product quality.

NIR has taken the leap from the lab to the process. Not only are modern instruments robust and easy enough to use to be placed at the factory floor, they can also be used on-line for real-time monitoring of the processes.

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