

Introducing NIR-technology

Boost Nordic Biogas aims to help biogas producers simplify and reduce the cost of routine analyses through research, knowledge sharing, and new technologies. Digestate—the organic residue from anaerobic digestion—can be used as fertilizer, but its quality usually requires costly and time-consuming lab tests. With NIR-based analytical instruments emerging as a promising solution, Novia UAS evaluated one such device and demonstrated its practical use to producers in Ostrobothnia.

WHAT IS NIR?

NIR-spectroscopy is an analytical technique that measures how radiation interacts with matter, within the near-infrared region (780nm to 2500nm). When a sample is illuminated with NIR light, a spectrum is generated that reflects the chemical composition and molecular structure of the sample. From this spectrum, it is also possible to quantify specific compounds.

NIR technology has a wide range of uses and is commonly used for monitoring purposes in the food industry, in pharmaceuticals and for agricultural applications. There are many advantages to this technique, but also some limitations. Multiple parameters can be analyzed from one sample at a time, which makes it both fast and cost-effective.

The drawback is that it first requires a calibration model, and developing such models can be both time-consuming and labor-intensive.

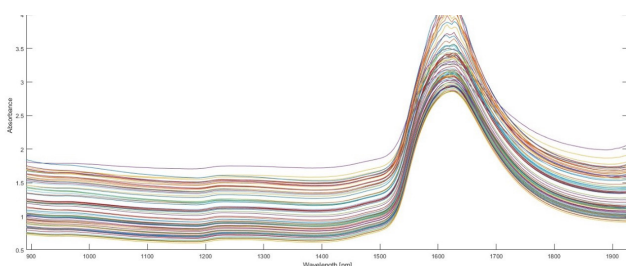


Fig. 1 NIR-spectra from digestate analysis.

Peaks may correspond to chemical bonds, or functional groups. The large peak shown is most likely a -OH peak. See fig 1.

DEMONSTRATION OF MEASURING WITH NIR

During the summer of 2025 Boost Nordic Biogas rented an NIR-equipment, to evaluate its suitability for determining nutrient content in digestate. The device was portable and can be used on-site, or in fieldwork. It had robust encasing with wheels, much like a luggage trunk, which made it easy to move on flat surfaces. It comes with a cloud-based solution, and results are uploaded instantaneously, for easy access from anywhere. Before reliable use of the equipment, it needed to be fine-tuned to the specific digestate in question.

This is a process that requires multiple measurements and verification of the measurements, by comparison to laboratory results from the same samples. The fine-tuning was a lighter version, than a full re-calibration, but because of time limitations that was not an option.



Fig.2 Picture NIR device



Fig.3 NIR device seen from above

See fig 3. The sample is placed into a cup (green arrow), which is positioned above the light source (red arrow). During the analysis, the cup rotates to ensure proper measurement. The entire system is operated and monitored using a tablet interface.



DEMONSTRATION FOR BIOGAS PRODUCERS

On September the 18th, Boost Nordic Biogas arranged a demonstration for biogas producers in the region at Jeppo Biogas in Ostrobothnia.

The attendees were shown firsthand the procedure from sample preparation to measurement results. The parameters analyzed were dry matter, (DM), total nitrogen, (Ntot), ammonium, (NH₄⁺), potassium oxide, (K₂O) and phosphorous pentoxide, (P₂O₅). These are the most relevant for the end users, the farmers.

The general view was that the use of the NIR-instrument seemed effortless, and results were obtained very quickly.

The demonstration was well received amongst the biogas producers and even sparked some conversation about further collaboration interests regarding the use of NIR-technology.



Project researcher Thomas Andersson presented the measurement results to staff from Jeppo Biokraft and Stormossen

EVALUATION

Biogas producers are in a key position to contribute to circular economy and self-sufficiency, as producers of both energy and vital nutrients for the agricultural sector. Digestate contains nutrients in a more readily available form and as an extra plus it gives off less odor than fresh slurry and manure.

To decrease dependency, nutrient recovery will become increasingly important. Use may also become more restricted and more monitoring required.

However, this can also present producers of biogas with new opportunities and business models. By knowing your product, you can add value and NIR-technology can play a part in this.

Boost Nordic Biogas only tested and demonstrated one device, but there are several others on the market, and the number is growing. As the competition increases prices may decrease and payback time will shorten, making it a more worthwhile investment.

The device we used can be summed up as easy to use and it produces stable spectra but still needs a larger library of diversified digestate spectra. This is needed for a more reliable calibration model, which will give more exact quantification of parameters.

To increase the use of digestate as fertilizers the quality must be assured and this is why it is important to continue to find affordable and reliable devices.

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