



Bioethanol Industry

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

In bioethanol production, whether processing a starch crop, such as corn or cassava, a sugar crop such as sugar cane or beet, or molasses as a sugar by-product, tight quality control is important along the entire production chain to optimize yield and ensure high quality products. FT-NIR can be used for fast and accurate analysis of critical quality and process parameters, starting from the raw material analysis all the way to end-product and co-product testing to achieve both higher margins and higher quality products.

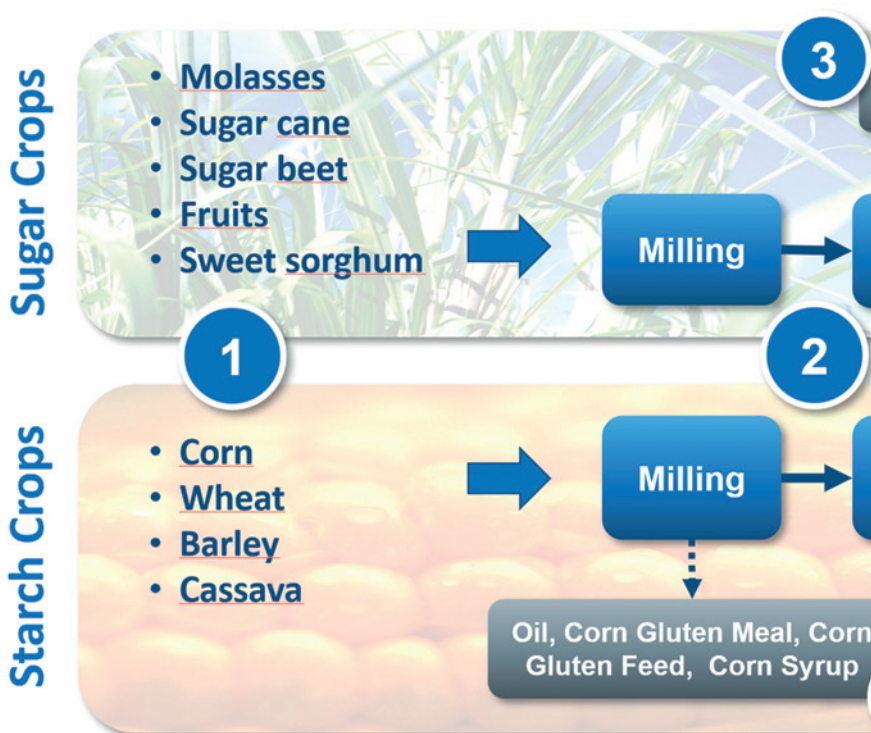
Near infrared spectroscopy provides accurate analysis results of multiple components within seconds. Real-time measurements are easy to perform with minimal or no sample preparation, and the non-destructive method does not require the use of any solvents or reagents. Together, these factors result in huge cost and time savings for processing plants. Both solid and liquid sample analysis is possible at-line or in the lab of a bioethanol plant with the MPA II or TANGO benchtop instruments, or even in-line with the MATRIX-F process analyzer.

1 Raw Material Analysis

A wide range of raw materials can be used for bioethanol production, but regardless of which starting material the plant is processing, FT-NIR can be used to determine quality directly in the unloading area. Bruker has solutions for a wide array of both solid and liquid starting products, including, for example, sugar cane, sugar beets, cassava, molasses and other sugar by-products, corn, wheat, and barley, and can provide analysis for multiple essential components within seconds. Depending on the requirements of the individual plant, including factors such as sample handling and the degree of precision required, samples can be measured in either a ground or an unground state.

2 Material Processing

After receiving materials, the next step is processing the materials to obtain fermentable sugars. For both sugar and starch crops, this starts with milling the material. In



the case of sugar crops, the juice is then extracted and treated before the fermentation, and for sugar by-products, the molasses clarified and processed. In the case of starch crops such as corn or cassava, milling is followed by cooking and liquefaction to prepare the starch for fermentation. In these steps, analysis of the percent solids in the mixture is critical to obtain an optimal composition in the mixture before the fermentation.

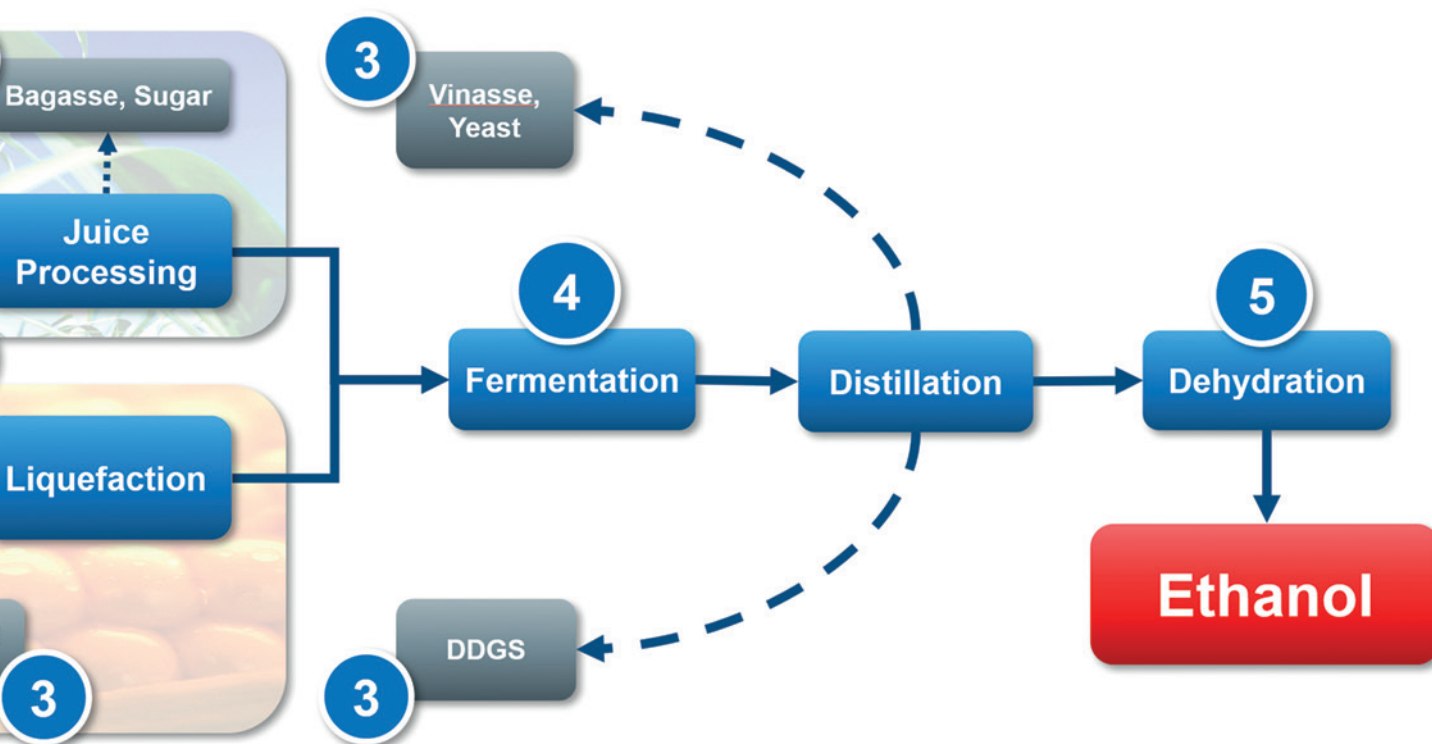
3 By-Product Analysis

In bioethanol plants, monitoring and quality control of by- and co-products, such as those used in the feed industry, can be just as important as that of ethanol. FT-NIR also provides a means for fast and efficient analysis in these cases. Testing carried out throughout the process can be used to assess efficiency in sugar extraction processes and optimize the quality of high-value co-products such as dried distiller's grains (DDGS). In the case of DDGS, a low moisture content is a critical parameter to inhibit bacterial growth, and other parameters such as protein, fat, or starch may also be interesting quality indicators for potential customers; all can be determined simultaneously and in a few seconds with the help of a TANGO-R or MPA II. Monitoring allows plants to optimize efficiency in drying processes for lower costs,



Analysis of solid products (here wheat) on the integrating sphere of the TANGO in diffuse reflection.

• FT-NIR for the Bioethanol Industry



and provide certification of product quality for customers, improving returns. Other co-product analyses which can be completed quickly and easily with an MPA II or TANGO include, for example, analysis of bagasse for energy content in sugarcane mills, % solids in syrup during condensation in corn dry mills, and analysis of corn oil for FFA, moisture and impurities, just to name a few.

4 Fermentation

Whether fermentation is carried out separately or in combination with saccharification of starch-based crops (SSF), in batch or in a continuous process, FT-NIR is a rapid and simple method which can be used to monitor sugar levels and analyze alcohol content to maintain conditions for optimal yeast activity and high yields throughout the fermentation process. The same sample can also be analyzed simultaneously for acetic and lactic acid to monitor for bacterial activity, allowing early corrective action and thereby minimizing the effects of such a contamination. Depending on the needs of the plant, samples can be measured directly in reflection, or filtered in transmission.

5 Distillation and Ethanol Processing

Following fermentation, the ethanol continues to distillation and dehydration to produce the final product. Here, too, process control is essential for plants to meet product regulations. FT-NIR can be used, for example, for fast and precise analysis of water content to test the purity of the final product, allowing plants to minimize resources used in dehydration processes and maximize yield while meeting regulatory requirements and customer expectations.



Analysis of liquid products (here oil) in the sample compartment of the MPA II in transmission.

Bruker's FT-NIR Product Range

FT-NIR offers a practical alternative to the time-consuming, wet chemical methods and chromatographic techniques. It is non-destructive, requiring no sample preparation or hazardous chemicals, making it quick and reliable for quantitative and qualitative analysis.

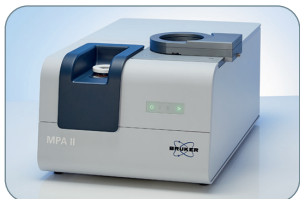
It is ideal for rapid raw material identification and is also a powerful analysis tool capable of accurate multi-component quantitative analysis. Its online capabilities based on fibre optic probe technologies allow a deep look into the process.

Bruker's FT-NIR product line includes TANGO and MPA II spectrometers for lab and at-line applications as well as the MATRIX-F series for process control:



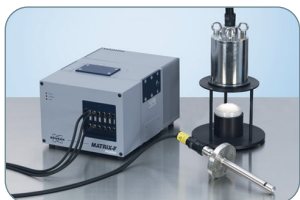
TANGO

Faster, simpler, more secure – with TANGO your NIR analysis speeds up. TANGO has exactly what users require of an FT-NIR spectrometer suitable for industrial use: robustness, high precision and straightforward operator guidance.



MPA II

Choosing the best possible sampling method is crucial when solving a specific analysis task. With the MPA II, you have a complete solution at hand for your daily QA/QC work, but also for sophisticated method development studies.



MATRIX-F

The award winning MATRIX-F FT-NIR spectrometer allows the direct measurement in process reactors, pipelines or over conveyor belts – in contact or contact-less. This will help to gain a better understanding and control of the process.

Technologies used are protected by one or more of the following patents:
US 7034944. Additional patents pending.

**Bruker Optics is ISO 9001
and ISO 13485 certified.**

Laser class 1 product

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