

Analysis of Fermentation Broth Using a Perten DA 7250 Diode Array Based High Speed Analysis System

Introduction

Ethanol production is a fast growing segment of grain processing. To make the ventures profitable, fast and accurate analyses are required to move as much product through the process while optimizing use of raw materials and enzymes. One critical control point is the fermentation vat.

The Near Infrared Reflectance (NIR) technique is particularly suited for measurement of Fermentation Broths, but past instrument limitations have not permitted users to reap the full benefits of NIR. Sample preparation requirements, special cups, and a small analysis area made analyses laborious, time consuming and error-prone.

DA 7250 NIR Analyzer

The DA 7250 is a new full-spectrum NIR instrument designed for use in the ethanol industry. Using novel diode array technology it performs a multi-component analysis in only 6 seconds with no sample grinding or sample preparation required.

During this time many full spectra are collected and averaged. As the sample is analyzed in an open disposable cup, the problems associated with sample cups are avoided and operator influence on results is minimal.

Experimental

Spectral data was collected on over 1000 liquid fermentation broths using multiple DA 7250 Analysis systems. A primary advantage of the DA 7250 is its use of non-contact sampling. Each sample was poured into a disposable sample cup, analyzed, and discarded. The disposable cup removes the need for time consuming cell cleaning, possibilities of cross contamination, and significantly speeds up the analysis process. Additionally, the speed of the analysis does



not allow the sample – which is still fermenting – to change appreciably from sampling to analysis. The HPLC reference analyses used for calibration development were supplied by the processors. Perten Instruments developed calibrations using Honigs regression (HR). Harmonization was used as a pre-treatment to improve the calibration model.

Results and discussion

The DA 7250 results are very accurate when compared to the results from the reference methods. Statistics for the respective parameters are presented in the table below and graphs are displayed on page 2.

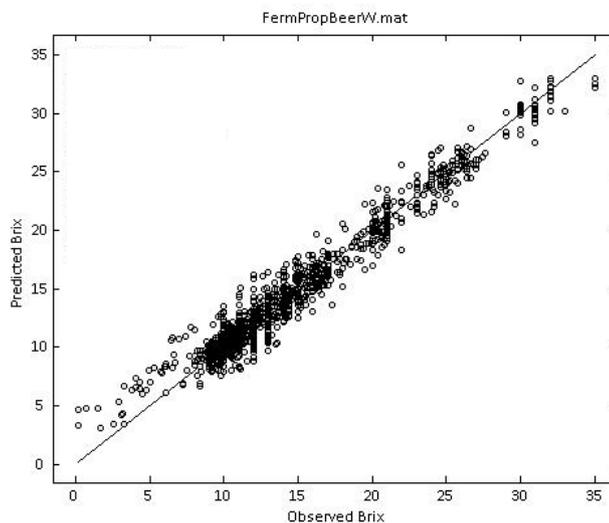
Parameter	Range	Samples	R
Solids	8.92 - 30.19	200+	0.990
Brix	0.20 - 35.00	1350+	0.979
DP4	0.09 - 25.27	1450+	0.966
DP3	0.02 - 2.83	1300+	0.920
Maltose	0.07 - 8.18	2550+	0.912
Glucose	0.01 - 16.81	2550+	0.955
Glycerol	0.00 - 1.80	2550+	0.925
Ethanol	0.04 - 18.90	2550+	0.992

The differences between the DA 7250 and the HPLC results are of the same magnitude as typical differences between two different reference labs. The DA 7250 is a rapid way to verify fermentation results without the need to wait for filtering and sample queue. Replicate analyses are as repeatable as HPLC methods

In summary it is concluded that the Diode Array 7250 can analyze liquid Fermentation Broths for the aforementioned constituents. The disposable sample cups allow users to quickly and accurately analyze samples without any sample prep or subsequent cleaning requirements. The overall sampling speed and analysis speed produce results in nearly real-time allowing for rapid feedback to control the fermentation process at an Ethanol facility

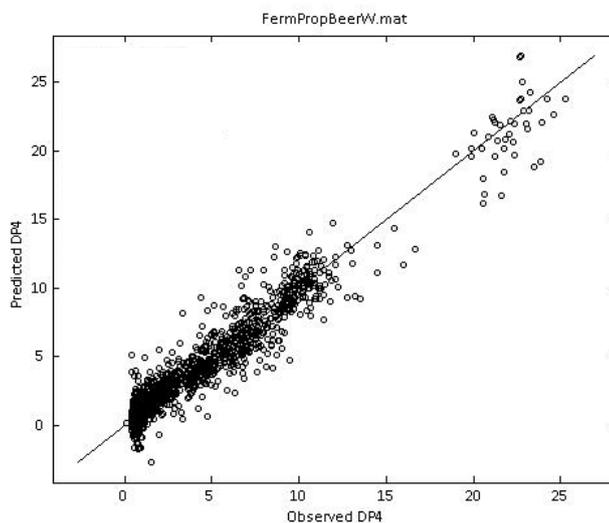
Brix

Brix is readily measured across a wide range of values in only 6 seconds.



DP4

Monitoring DP4 allows users to measure the conversion of starch to sugar. in essentially real-time.



Ethanol

Monitoring ethanol allows users to see when conversion is complete helping optimize production throughput.

