FOSS

Application Note

AN 5421

Rev. 2

NIRS™ DS2500

Bagasse

Bagasse is one of the by-products of the sugar mills. By-products need to be considered in mass balance calculations to determine where the sugar is going. Bagasse is rich in cellulose and may be used for making paper, but most sugar mills use the bagasse as fuel for power generation by burning it. Any remaining sugar in the bagasse will be burnt, resulting in a direct loss. The electric power created makes the mills energy self-sufficient. The excess of power created back into the grid creates a significant income to the mill. Furthermore, a high sugar content will contaminate the power generation boilers with burnt sugar. If the power generation needs to be shut down for maintenance, losses are large. Bagasse analysis is therefore one of the most important things to the boilers and only this application will pay back the investment of a DS2500 shortly.

A high moisture content in the bagasse indicates that it would have been possible to extract more sugar. As a rule of thumb, decreasing the moisture content with one percent will increase the extracted percentage of sugar around 0.1 %. Furthermore, the caloric value of the bagasse is a key factor and it is highly dependent on the moisture content. A rough estimate is that decreasing the moisture one percent increases the fuel value also by 1 %. Keeping the both the sugar and the moisture content at target values is therefore important. Normally, the moisture should be below 50 % and the sugar should be below 2 - 3 %. If the bagasse is tested with a fast analytical method, the millers can quickly detect processing deviations that will affect both their sugar losses and their bagasse fuel value.

This application is suitable to both conventional- and diffuser mills. Dilution of the sample is not necessary and chemicals like dry lead or Octapol are not required. After inserting a cup with a bagasse sample into an NIRS™ DS2500, Pol and Moisture are analysed simultaneously in less than a minute

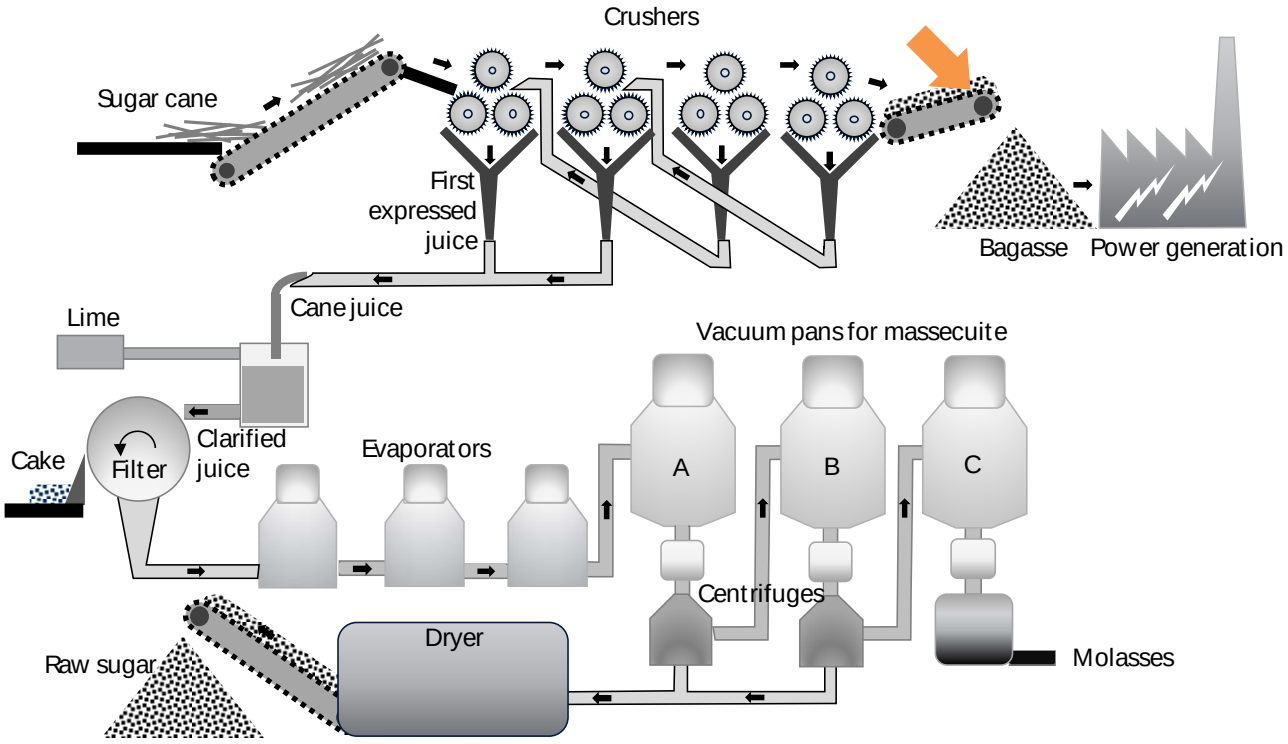

Fig. 1 Conventional mill, measurement points

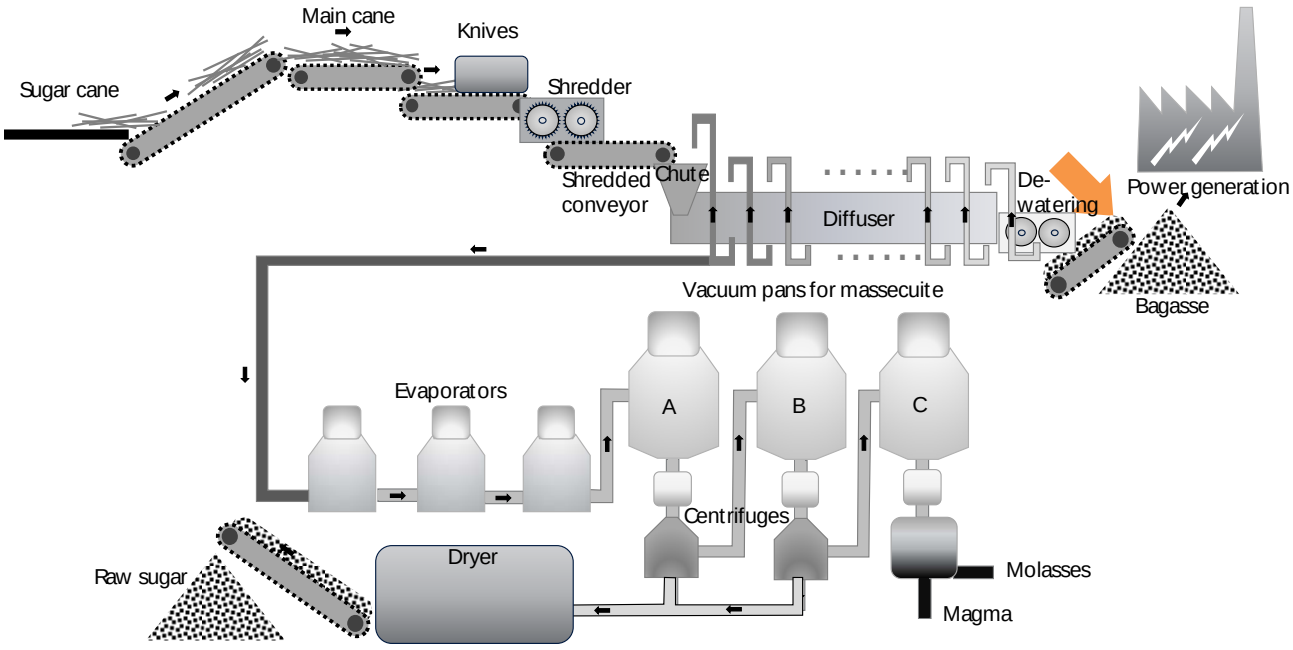

Fig. 2 Diffuser mill, measurement points.

Fig. 3 NIRS DS2500

Sample Description

Reference samples have been collected and analysed over several crushing seasons.

Parameter	Version	Min	Max	N	Model type
Pol	2.0.0.0	0.3	5.8	1449	MPLS
Moisture	2.0.0.0	42.3	64.5	1483	MPLS
Brix	2.0.0.0	0.05	0.88	366	MPLS
Reducing Sugars	2.0.0.0	0.07	0.69	103	MPLS

Table 1 Calibration data.

Performance

Validation statistics is based on samples that were not in the calibration set.

Parameter	Min	Max	N	SEP	RSQ
Pol	0.8	5.8	204	0.32	0.834
Moisture	43.4	57.6	200	1.43	0.853
Brix	0.2	0.81	98	0.10*)	0.664
Reducing Sugars	0.1	0.66	32	0.08*)	0.624

Min.: Minimum reference value in test set.
Max.: Maximum reference value in test set.
N: Number of samples in the test set.
SEP.: Accuracy of test set expressed as Standard Error of Prediction (SEP).
RSQ: Linear correlation between NIRS DS2500 result and reference result.
*) Approximate accuracy due to few calibration- and validation points and limited range.

Table 2 Validation data.

Calibration Performance Graphs

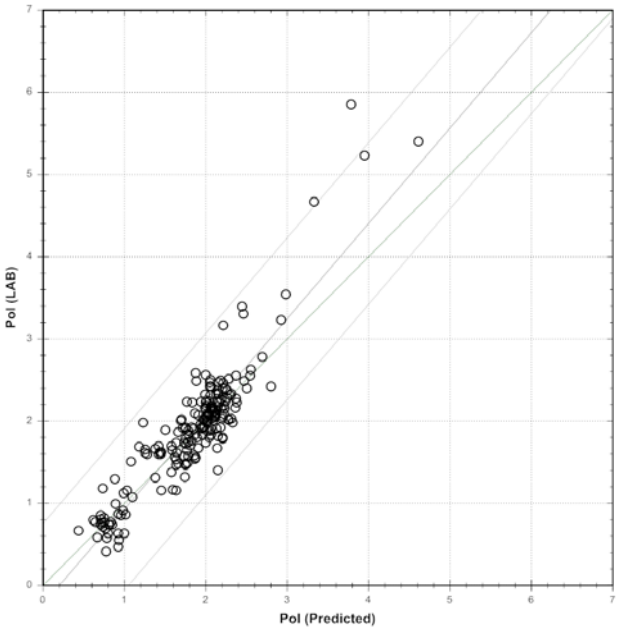

Fig. 4 Pol

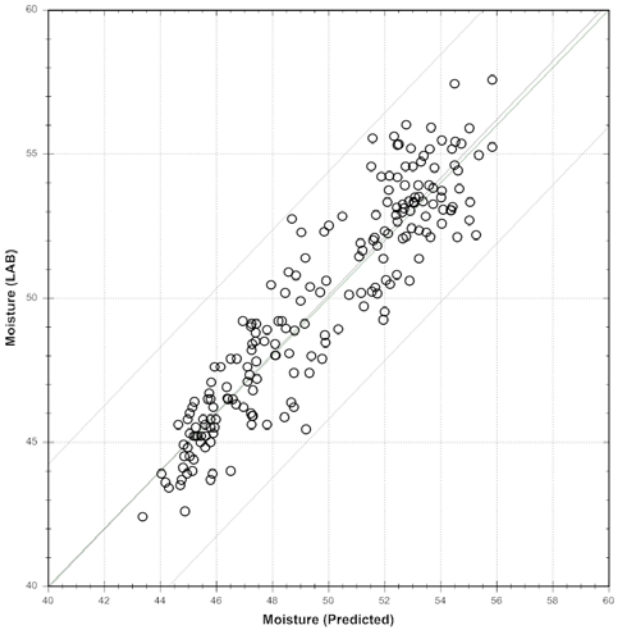

Fig. 5 Moisture

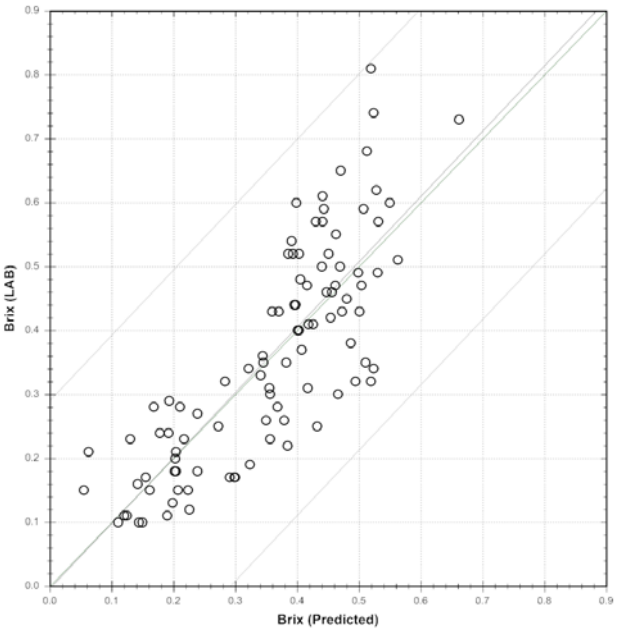

Fig. 6 Brix

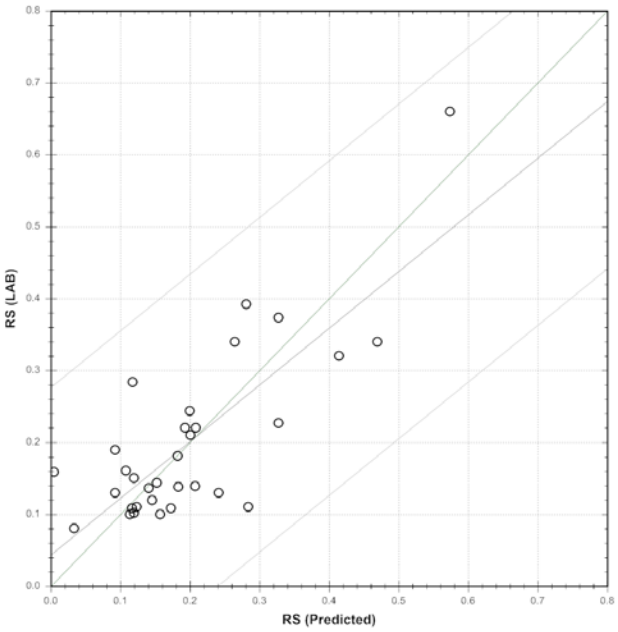

Fig. 7 Reducing Sugars

In the sugar industry, “Pol” is an abbreviation for Polarisation and it is synonymous with sucrose. Because Pol should be below 2 – 3 %, the range of the calibration is restricted leading to apparently low RSQ-values, even if the accuracy measured as SEP(C) is acceptable. The range of the moisture calibration is wide, and the accuracy error measured as SEP(C) appears to be higher than what we see in most other types of samples. The reason is that the moisture content in the bagasse is high and around 50% and the moisture content is quickly changing.

Note:

The performance example outlined in this note should only be regarded as a guideline for the expected performance of new installations. The performance of new installations will always depend on the uniformity of the sample preparation and the homogeneity of the product, as well as the accuracy of the reference method used and the range for the test samples. An indication of the obtainable performance can be found as approximately 1.5 to 2 times the reproducibility of the reference method. If the samples measured exceed the stated calibration ranges, or have non-common variations of other components, this might also influence the performance of the calibrations.

Each sample will be analysed and compared to the calibration database. Three key values will be given as an indicator to how well the unknown sample fit the calibration samples:

- Global H value (GH) - measures how far the spectrum is from the centre of the database. A high GH value corresponds to a sample far from the calibration database, meaning a sample different from the calibration samples. If the GH value exceeds a certain limit, the sample is suspected to be out of the calibration working range.
- Neighbourhood H value (NH) - measures how close the sample is to the nearest sample in the database. A high NH value corresponds to a sample far from the nearest neighbouring sample in the calibration database, meaning a sample different from the calibration samples. If the NH value exceeds a certain limit, the sample is suspected to be out of the calibration working range.
- T-statistics - measures the predicted parameter compared to its calibration range in the database counted as number of standard deviations. A value of zero corresponds to the average of the parameter in the database. A high positive value of more than 3 standard deviations indicates that the predicted value is at the high end or outside the range of the database. A negative value of less than -3 standard deviations indicates that the predicted value being at the low end or outside of what is in database.

Default Warning and Action limits for GH, NH, and T-statistics are set for each prediction model in the software.

Sample Preparation

We recommend using the large cup for analysing bagasse. No special temperature stabilisation has been made so it is recommended to analyse the samples at room temperature.

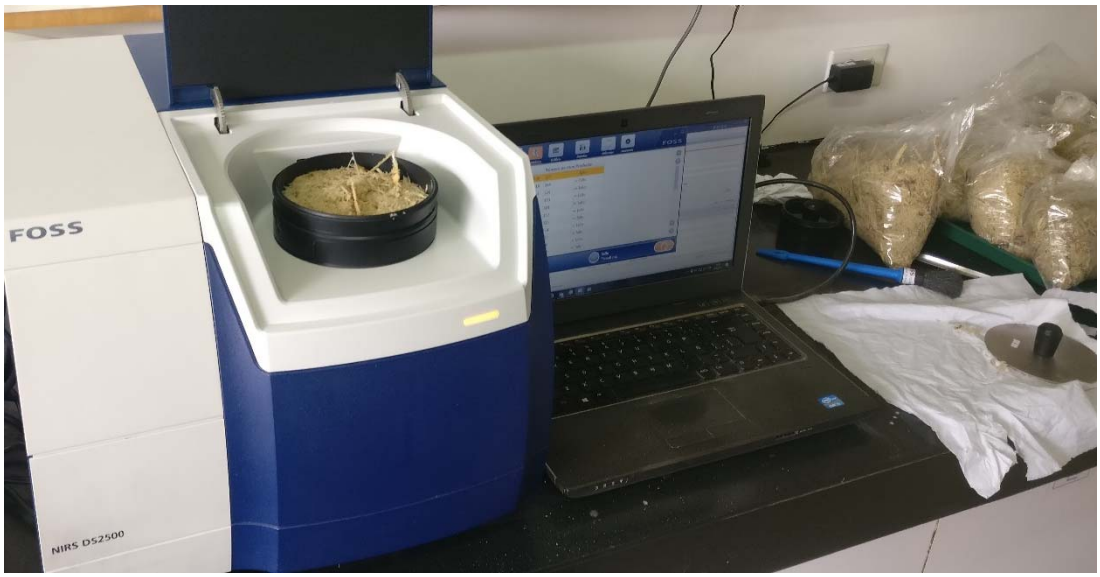

Fig. 8 Bagasse sample in large cup.

Ordering and Further Information

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