FOSS

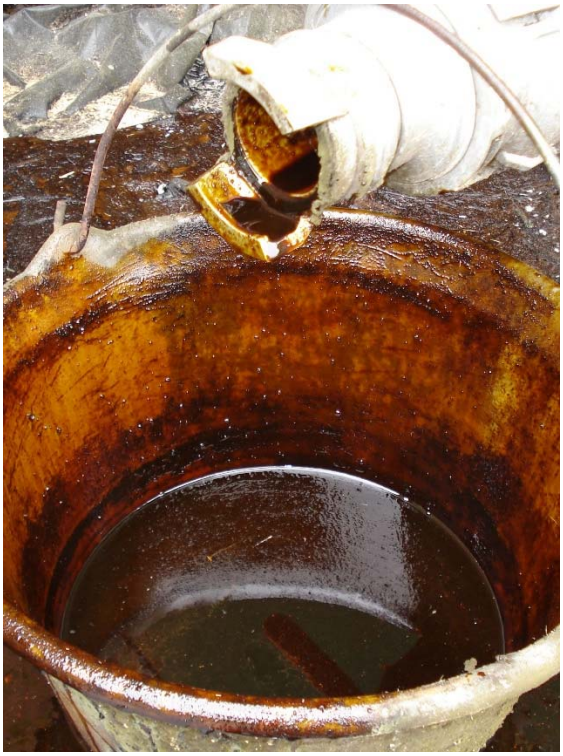
Application Note

AN 5425

Rev. 2

NIRS™ DS2500

Molasses



Molasses is one of the by-products of sugar mills. It is a viscous, dark brown liquid. Sugarcane molasses is sold for sweetening and flavouring of foods, as an ingredient in feed production, but recently mainly as a raw material for ethanol for biofuel - or for drinking liquors. Feed mill by-products need to be considered in mass balance calculations to determine where the sugar is going.

After the massecuites have reached their target level in terms of amount of sugar crystals, they are sent to a centrifuge and separated into sugar crystals and molasses. The A-, B-, and C-molasses are different in their sugar content and when sugar mill staff refer only to "molasses", they mean the C-molasses.

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 sample of molasses into a NIRS™ DS2500, Brix, Pol, Purity, and Reducing Sugars are simultaneously analysed in less than a minute.

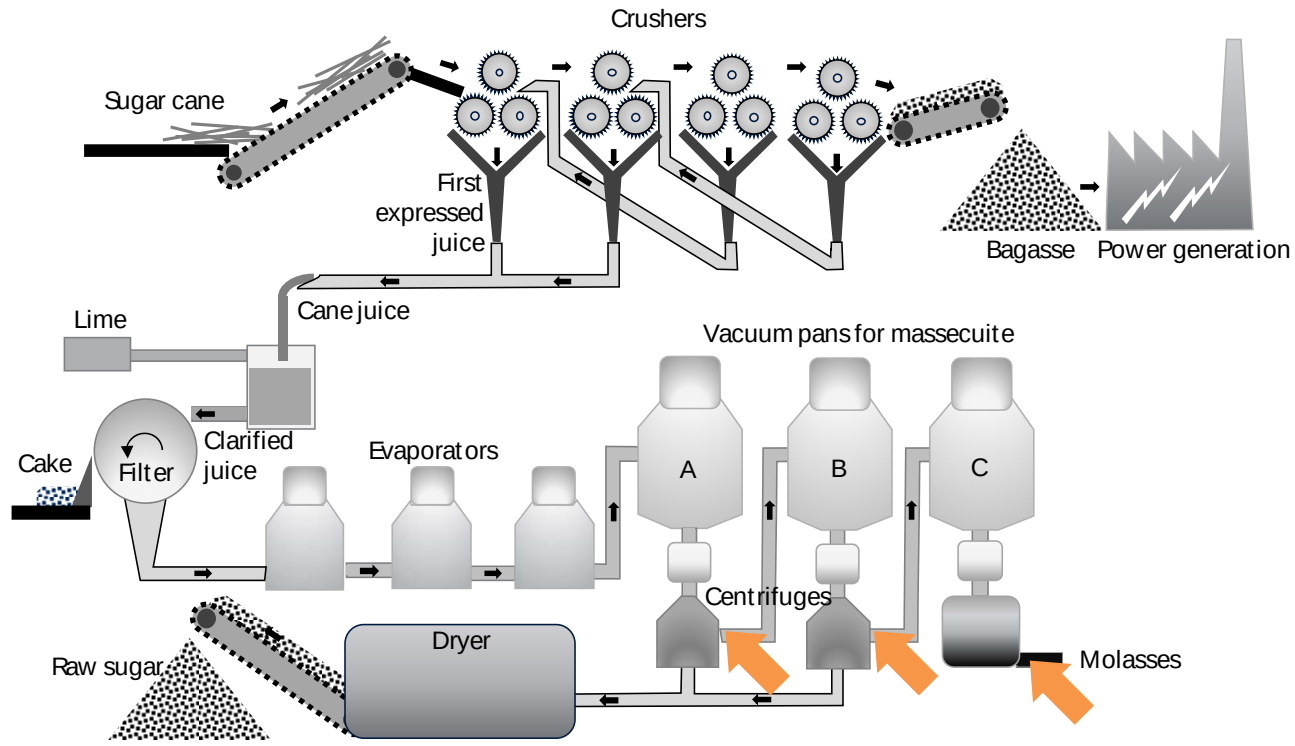


Fig. 1 Conventional mill, measurement points.

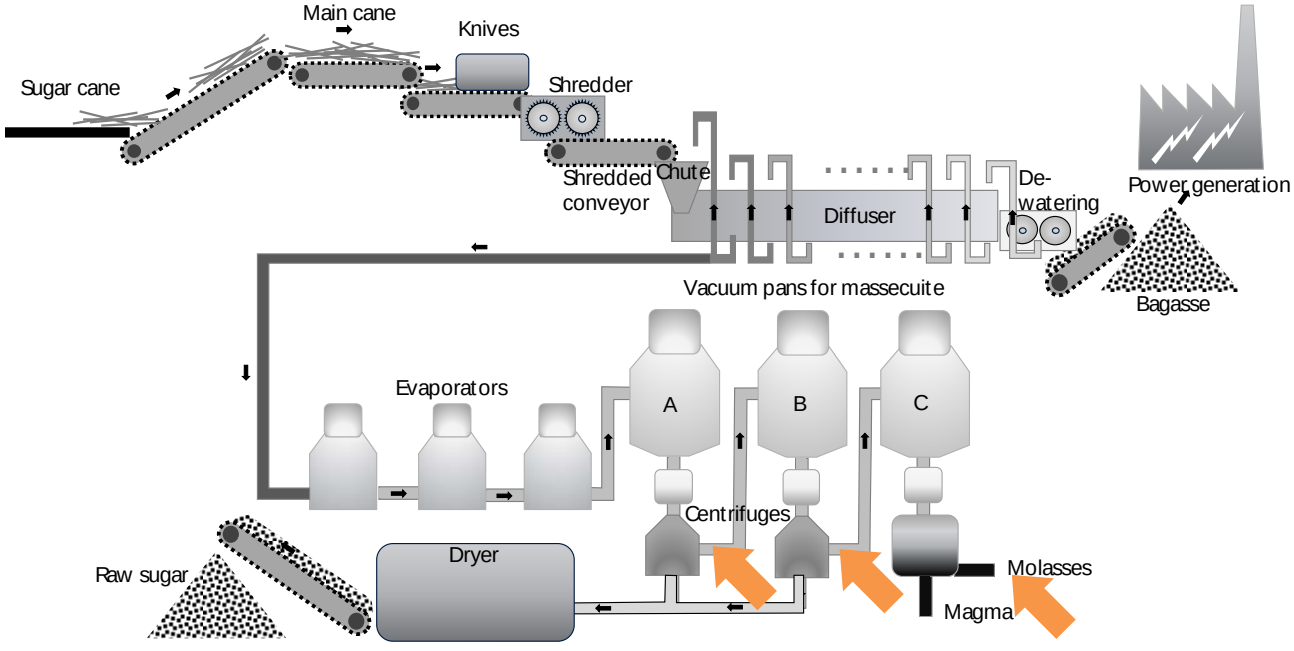


Fig. 2 Diffuser mill, measurement points.

Fig. 3 NIRS DS2500

Sample Description

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

Parameter	Version	Min	Max	N	Model type
Brix	2.0.0.0	67.0	90.2	1640	MPLS
Pol	2.0.0.0	33.8	66.4	1632	MPLS
Reducing Sugars	2.0.0.0	2.7	12.4	324	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
Brix	71.6	90.0	108	0.529	0.984
Pol	35.2	63.1	101	0.64	0.991
Reducing sugars	3.3	9.1	15	0.44	0.948

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.

Table 2 Validation data.

Calibration Performance Graphs

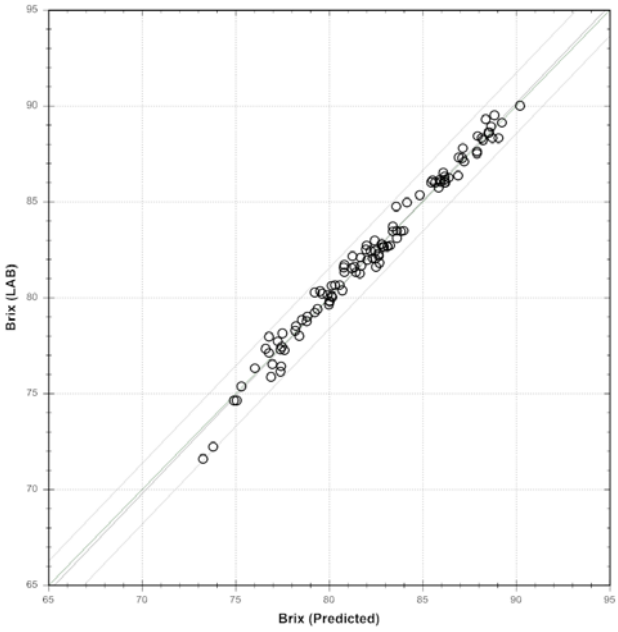


Fig. 4 Brix

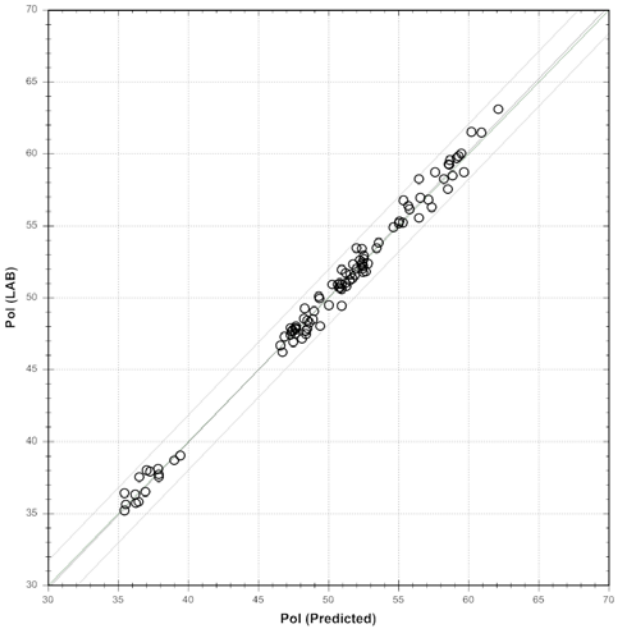


Fig. 5 Pol

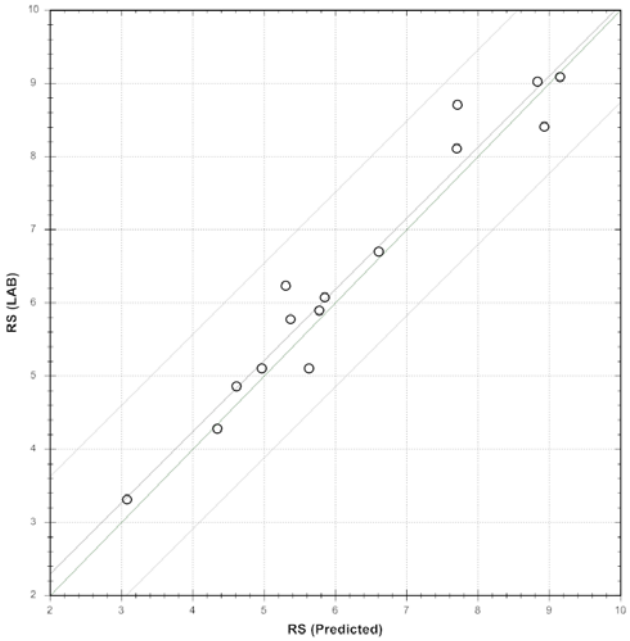


Fig. 6 Reducing Sugars

In the sugar industry, “Pol” is an abbreviation for Polarisation and it is synonymous with sucrose. “Brix” is synonymous with Total Dissolved Solids. Purity is a key for process optimisations and we strongly recommend to add it as a calculated parameter:

Purity = Pol/Brix*100 %

The amount of Reducing Sugars (“RS”) is another quality indicator. RS or “Invert Sugars” consist mainly of glucose and fructose originating from sucrose inversion. The less RS, the better. All the four molasses calibrations are built on good concentration ranges. Molasses has a high viscosity. Sampling is therefore an issue that is contributing to the rather large SEP(C) values of the Pol and the Brix calibrations, but also because their levels are high, near 100%.

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 measuring 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 slurry cup with a 0.5 mm gold reflector for analysis of molasses. No special temperature stabilisation has been made so it is recommended to analyse the samples at room temperature.

Fig. 7 Sample handling.

Ordering and Further Information

Please contact Henrik Hansen, Head of Market Innovation, hha@foss.dk.