FOSS

Application Note

AN 5422

Rev. 4

NIRS™ DS2500

Cake

Cake is one of the by-products of conventional sugar mills. By-products need to be considered in mass-balance calculations to determine where the sugar is ending up. Cake is rich in cellulose and it looks like a moist cloth or a brown-greyish paper mash. It is mostly used as a soil fertilizer in the cane fields. It can also be used as fuel at the sugar mill when blended with bagasse. Either way, any remaining sugar is a direct loss. If the filter cake is tested with a fast analytical method, the millers can quickly detect processing deviations that will affect sugar losses like loss of vacum in the filtering, and a poor clarification.

This application is suitable to conventional 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.

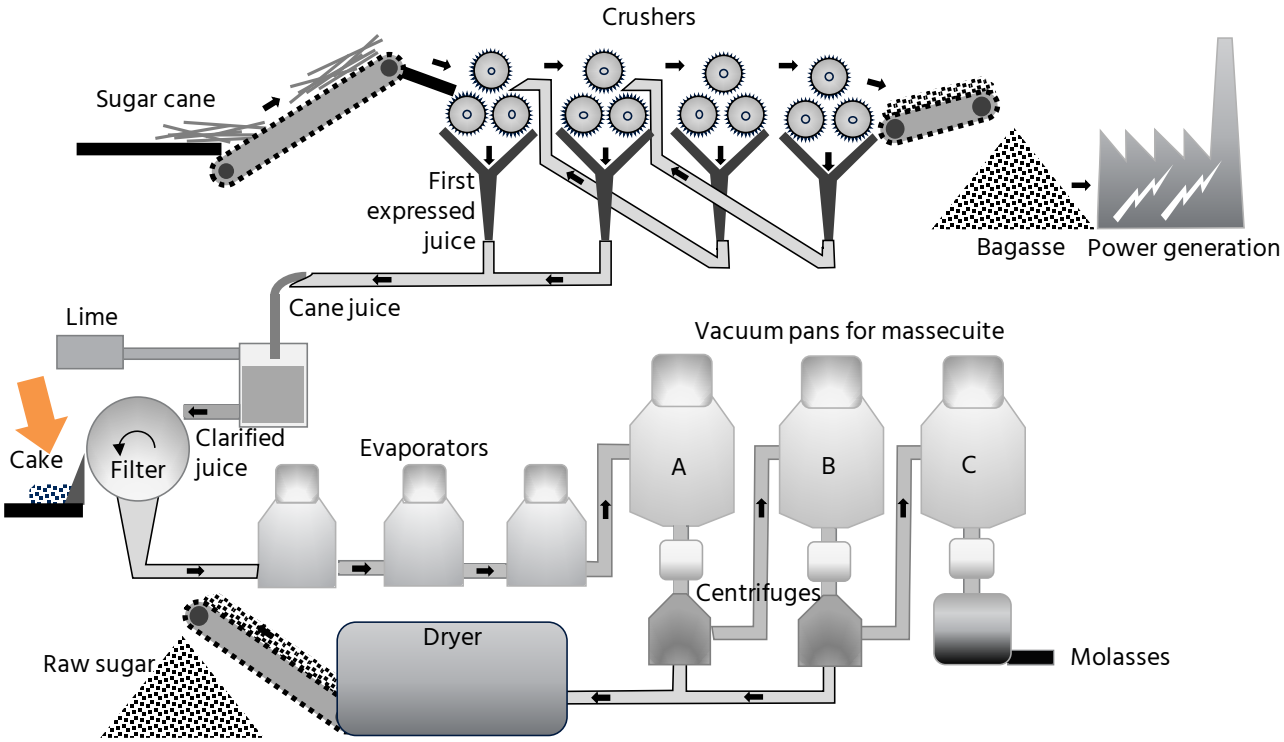

Fig. 1 Measurement points (conventional mill)

Sample description

Reference samples have been collected in Brazil, India, and Japan, and they have been analysed over several crushing seasons.

Parameter	Version	Min	Max	N	Model type
Pol	2.6.0.0	0.1	11.4	2421	ANN
Moisture	2.6.0.0	34.6	83.2	1844	ANN

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	0.1	10.9	409	0.49*)	0.909
Moisture	44.5	81.0	299	3.55**)	0.682

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.
*) For Pol ~2% the SEP is ~0.4; for Pol ~7%, the SEP is ~1.1, (sampling issue).
**) For Moisture ~50-70%, SEP is ~5.4 (sampling issue); for Moisture ~75%, SEP is ~1.2.

Table 2 Validation data.

Calibration Performance Graphs

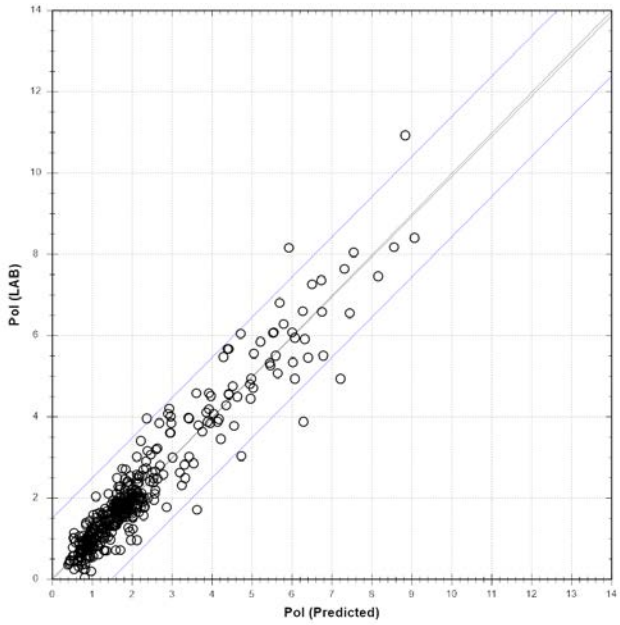

Fig. 2 Pol

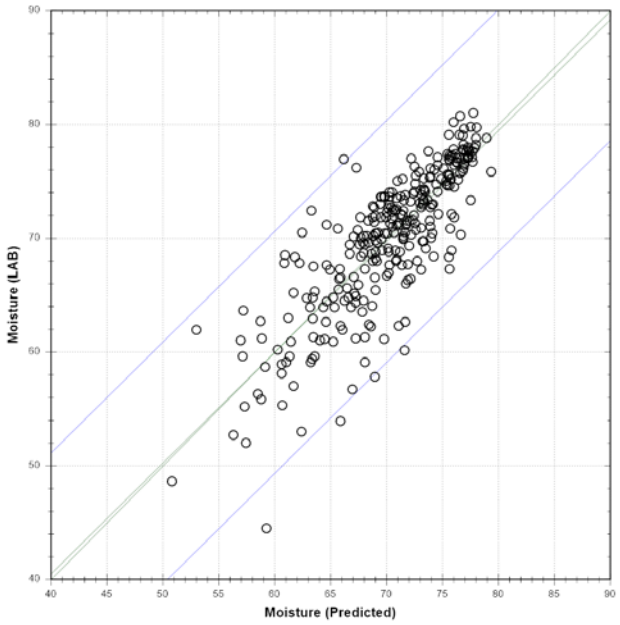

Fig. 3 Moisture

Due to differences between laboratories, it is recommended to apply slope and intercept adjustments to all parameters, but if the range of samples used for the adjustment (max - min) is less than 1, then set slope = 1, and adjust the intercept only using 10 different samples. Slope- and intercept adjustment for Brix and Pol are best performed when using a wide range of samples. For the cake parameters, this is difficult to obtain so keeping the slope = 1 and adjusting the intercept only is recommended.

In the sugar industry, Pol is an abbreviation for Polarisation and it is synonymous with sucrose. The concentration range of Pol is wide but for the high-Pol samples we had sampling issues. These sample samples had moisture levels around 65% or less. Although these samples disperse the data, they were added anyway to make the range wider.

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.

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 cake. No special temperature stabilisation has been made so it is recommended to analyse the samples at room temperature.

Fig. 4 Cake sample in Large Cup.

Ordering and Further Information

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