



Raw Sugar Analysis by Laboratory DA1650 NIR ready to go

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After the successful completion of project 2014051 – Improving mill efficiency through rapid analysis methodologies the SRA near infrared spectroscopy (NIR) support team has continued this work to set up the SRA Mosaic server based at Indooroopilly.

The Mosaic server allows the SRA support team to monitor any the performance of any laboratory NIR instruments remotely, change the scan settings for different products, upload data for calibration development, apply bias adjustments and download calibration updates or calibrations for new products.

We have implemented several successful connections to the Mosaic server during the 2018 season, including; an existing DA1650 instrument at Tully, two roving DA1650 instruments used by Queensland Sugar Limited, an existing FOSS InfraXact instrument at Millaquin Mill and a new DA1650 instrument at Victoria Mill.

There are several options for remote connection to the SRA Mosaic server:

- Always connected, which requires a permanent secure connection through the client's IT firewall.
- Connected for updates, which requires a temporary secure connection through the clients IT firewall or an internet dongle that provides a connection outside the firewall.

- Never connected. In this situation, the instruments would be sent to SRA for updates.

We know from recent research that NIR analysis of key constituents in prepared cane, bagasse, juice and syrup streams, magma, massecuite, molasses, raw sugar and mill mud are feasible. We also know that adequate accuracy and precision to make informed decisions around factory operations had been achieved for the raw sugar, pan products and prepared cane calibrations.

Validation results collected during the 2018 crushing season strongly support these conclusions for the raw sugar and molasses global calibrations, but indicate that the massecuite, syrup and bagasse calibrations require further development. Insufficient data was collected to evaluate the other products.

VICTORIA MILL 2018 VALIDATION RESULTS

NIR data for raw sugar, massecuite, and molasses was collected at Victoria Mill using the SRA DA1650 instrument during the course of project 2014051; how well the global calibrations would transfer to the new DA1650 instrument purchased by Victoria mill had not been previously tested.

The global raw sugar calibration was updated with data from Victoria Mill after 30 samples had been

collected and analysed as is the normal practice, no other product calibrations have been updated. Validation results for all products assessed at Victoria Mill are shown in Table 1.

The validation results for a significant population of raw sugar samples analysed at Victoria Mill show the validation error to be lower than the calibration error with no significant bias indicating that the updated global calibration is fit for purpose for sugar pol and moisture analysis.

The global calibrations for molasses, massecuite and syrup are all showing validation errors higher than the calibration error with various levels of bias indicating that they would all benefit from a calibration update to represent the new DA1650 instrument. The high coefficients of determination (R2) suggest that one calibration update may be all that is required to achieve similar results to those achieved by the updated raw sugar calibration.

TULLY SUGAR LIMITED 2018 VALIDATION RESULTS

NIR data for raw sugar was collected at Tully Mill using the Tully DA1650 instrument during the course of project 2014051. The results obtained from the 2018 data demonstrate the performance of the DA1650 instrument using a localised global calibrations (large percentage of Tully data in calibration) after a

Table 1: Victoria Mill DA1650 2018 Validation Statistics

PRODUCT	CONSTITUENT	CALLIBRATION ERROR	VALIDATION ERROR	R ²	SLOPE	BIAS	RANGE	N
Raw Sugar	Pol	0.12	0.10	0.49	0.65	0.00	98.4 - 99.7	2197
	Moisture	0.03	0.03	0.46	0.66	-0.01	0.07 - 0.41	1599
Molasses	Dry Substance	0.44	0.89	0.72	0.79	-0.06	69.4 - 80.8	108
	Sucrose	1.42	1.47	0.94	1.08	-0.11	33.5 - 53.7	108
Massecuite/ Magma	Dry Substance	0.58	1.09	0.55	1.69	-0.01	90.0 - 93.0	29
	Sucrose	1.30	1.79	0.95	0.97	2.03	59.4 - 83.5	29
Juice/Syrup	Dry Substance	0.55	0.55	0.84	1.16	-1.19	67.2 - 70.4	9
	Sucrose	0.59	0.73	0.86	1.30	-1.93	60.9 - 64.6	9

Table 2: Tully Mill DA1650 2018 Validation Statistics

PRODUCT	CONSTITUENT	CALLIBRATION ERROR	VALIDATION ERROR	R ²	SLOPE	BIAS	RANGE	N
Raw Sugar	Pol	0.12	0.08	0.46	0.86	0.04	98.6 - 99.1	257
	Moisture	0.03	0.03	0.36	0.53	0.03	0.23 - 0.40	261
	Ash	0.02	0.03	0.19	0.47	0.03	0.14 - 0.27	235
	Colour	150	144	0.07	0.26	139	1190-1772	213
	Reducing Sugars	0.05	0.04	0.05	0.29	0.03	0.18 - 0.30	235
	Fine Grain	2.1	2.2	0.35	0.63	-0.72	7.0 - 19.0	230
	Dilution Indicator	3.2	3.9	0.38	0.32	8.7	28-58	261
Molasses	Dry Substance	0.44	1.26	0.40	0.62	-0.08	70.2 - 77.3	70
	Sucrose	1.42	2.24	0.93	1.09	0.17	26.1 - 56.7	68
	Pol	1.18	1.64	0.97	0.99	-0.29	29.9 - 57.1	65
Bagasse Final	Moisture	0.79	1.41	0.20	0.40	1.03	43.6 - 49.8	75
	Pol	0.25	0.20	0.25	0.36	1.58	1.8 - 2.7	75

routine yearly update. Validation results for all products assessed at Tully mill during the 2018 season are shown in Table 2.

The validation results for raw sugar samples analysed at Tully show the validation error to be lower than the calibration error with no significant bias indicating that the localised global calibration is fit for purpose for sugar pol, moisture, ash, reducing sugars and fine grain analysis and that the calibrations for sugar colour and dilution indicator require further updates.

The global calibrations for molasses and final bagasse are all showing validation errors higher than the calibration error, except pol in bagasse, with various levels of bias indicating that they would all benefit from a calibration

update. The high coefficients of determination (R²) for molasses pol and sucrose support the results from Victoria mill again, which suggests that one calibration update may be all that is required. The validation results for molasses dry substance are not achieving the accuracy or precision expected and further investigation is required.

The DA1650 laboratory NIR validation results obtained from both the Tully and Victoria mills suggest that the global raw sugar calibration, when applied to a new instrument, will require one calibration update including a

minimum of 30 local samples, before producing results that are fit for purpose. The ability to transfer calibrations to multiple DA1650 instruments was one of the objectives of project 2014051 and the data suggests that the global raw sugar calibration is ready to go.

The DA1650 laboratory NIR validation results obtained from both the Tully and Victoria mill for the global molasses, massecuite, syrup and final bagasse calibrations suggest that further work is required to achieve similar transferability but the results to date are very encouraging. ■

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