Application Note 188. CropScan 3000F Grain and Flour Analyser Calibration and Prediction Data

Introduction:

There are many instruments available around the world for the analysis of whole wheat and there are instruments that analyse flour but generally speaking there is no one NIR instrument that analyses both whole wheat and flour in the same instrument. The major problem is that the sampling system used for whole grain NIT analysis is different to the
Sampling system used for powders or ground materials.

The CropScan 3000F Grain and Flour Analyser has been developed in order to offer flour millers with a single instrument that measures both whole grains, the finished flour and the meal products involved in the milling of wheat.

This application note presents the calibration data for protein and moisture in whole wheat and protein, moisture, ash and water absorption in flour.

Description:

The CropScan 3000F Grain and Flour Analyser, figure 1, uses a rotating sample dish to collect the Near Infrared Transmission spectra through whole grain and flour. The dish is rotated into 10 different positions in order to average the NIT spectra and provide the best representative spectra.

A 15mm deep dish is used for wheat grains. The wheat is poured into the dish, the excess scraped off and then the dish is placed into the sample drawer. When the system is ready, the operator is prompted to push in the drawer. 10 sub scans are collected in approximately 45 seconds and the average protein and moisture is displayed on the screen.

A 5mm deep dish is used for measuring flour. The flour is poured into the dish and the excess scraped off. The dish is placed into the rotating sample drawer and when prompted the operator pushes the draw in. 10 sub scans are collected in less than 60 seconds and the results for protein, moisture, ash and water absorption are displayed on the CropScan 3000F touch screen display.

The CropScan range of NIT whole grain analysers is pre-calibrated based on thousands of grain samples collected over many years. These calibrations for wheat, barley, sorghum, oats, canola, soybean and corn, are transferred from the master CropScan 3000B to any CropScan slave instrument. The CropScan 3000F Grain and Flour analyser has the latest wheat calibration models installed. A set of 5 wheat samples of Certified Reference Materials, GrainCorp, Narrabri, NSW, were used to transfer the master calibration to

the CropScan 3000F. A slope and bias adjustment was calculated for both protein and moisture. A set of 5 wheat Certified Reference Materials were then analysed in duplicate to establish the accuracy and precision of the CropScan 3000F for measuring whole grains of wheat.

50 samples of wheat flour were sourced from an Australian flour milling company. These samples were tested for protein, moisture, ash and water absorption. The 50 flour samples were scanned on the CropScan 3000F in duplicate with repacking the samples. The NIR spectra for these samples, ie, 50 x 2 = 100 were uploaded into NTAS (NIR Technology Analysis Software) along with the reference values for protein, moisture, ash and water absorption, so that a Partial Least Squares Regression analysis could be performed. Calibrations models were developed for each constituent.

10 samples of flour were then analysed using the calibrations models developed above in duplicate with repacking each sample. The predicted protein, moisture, ash and water absorption data was then used to determine the accuracy and precision of the CropScan 3000F for the analysis of flour.

Results:

Wheat Calibration:

Figure 2. shows the master calibration plots for protein and moisture in whole wheat.

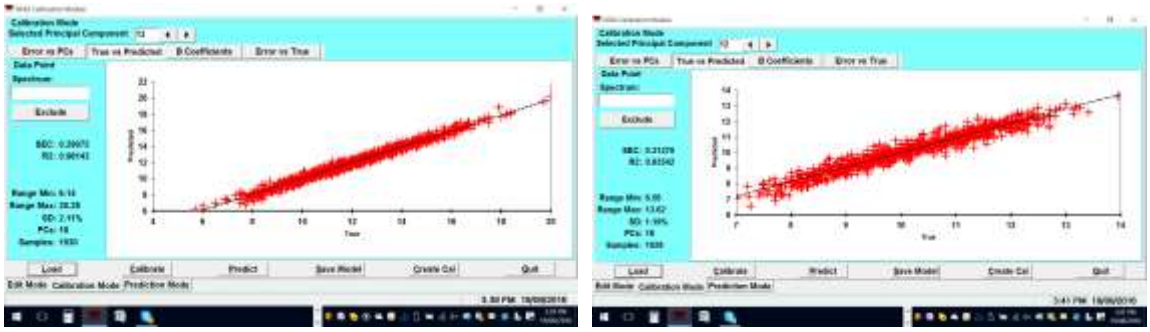

Figure 2. Calibration Plots for the CropScan 3000B Master instrument.

Figure 3 shows the Slope and Bias plots for protein and moisture in transferring the master calibration from the CropScan 3000B to CropScan 3000F.

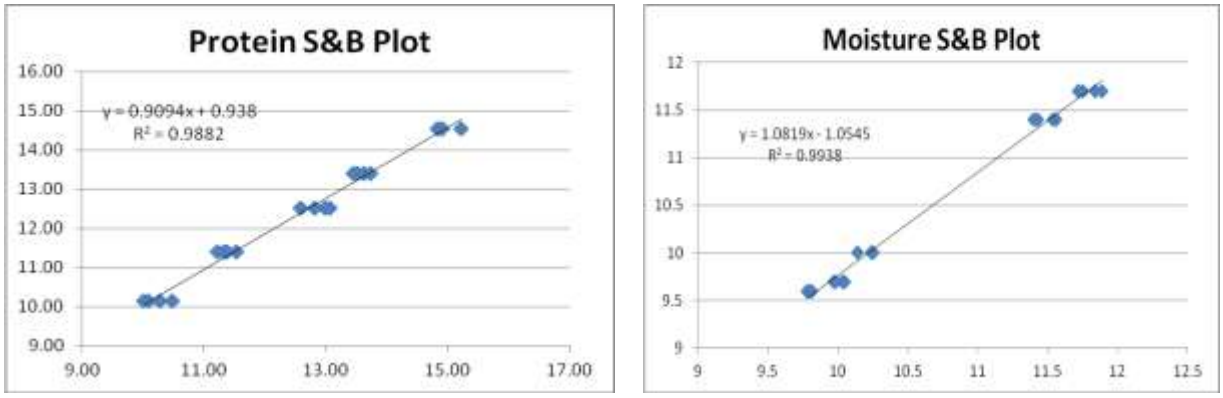

Figure 3. Protein and Moisture S&B Plots

Table 1. shows the predicted protein and moisture for 5 Wheat Certified Reference Materials using the CropScan 3000F Grain and Flour Analyser.

Sample ID	Cr Protein	Ref Protein	Diff	Duplicate	Cr Moisture	f Moisture	Diff	Duplicate
W1A15Q4	9.88	9.8	-0.08		9.655	9.9	0.24	
W1B15Q4	10.08	9.8	-0.28	0.19	9.82	9.9	0.08	0.16
W2A15Q4	10.70	10.8	0.10		9.369	9.5	0.13	
W2B15Q4	10.69	10.8	0.11	-0.01	9.6	9.5	-0.10	0.23
W3A16Q1	11.82	11.7	-0.12		11.173	11.6	0.43	
W3B16Q1	11.64	11.7	0.06	-0.18	11.569	11.6	0.03	0.40
W7A15Q4	12.54	12.6	0.06		9.27	9.5	0.23	
W7B15Q4	12.37	12.6	0.23	-0.17	9.402	9.5	0.10	0.13
W7C15Q4	12.50	12.6	0.10		9.534	9.5	-0.03	
W12A15Q	13.89	14.2	0.31	-0.22	10.106	9.7	-0.41	0.37
W12B15Q	14.33	14.2	-0.13		10.172	9.7	-0.47	
W12C15Q	14.54	14.2	-0.34	0.21	10.15	9.7	-0.45	-0.02
		SEP	0.20				0.29	
		SDD		0.19				0.16

Table 1. Prediction data for 5 wheat CRM's in duplicate.

The data in Table 1 shows that the accuracy, SEP, is .20% for protein and .29% for moisture, and the precision, SDD, is .19% for protein and .16% for moisture.

Flour Calibration:

Figure 4 shows the NIT spectra of flour.

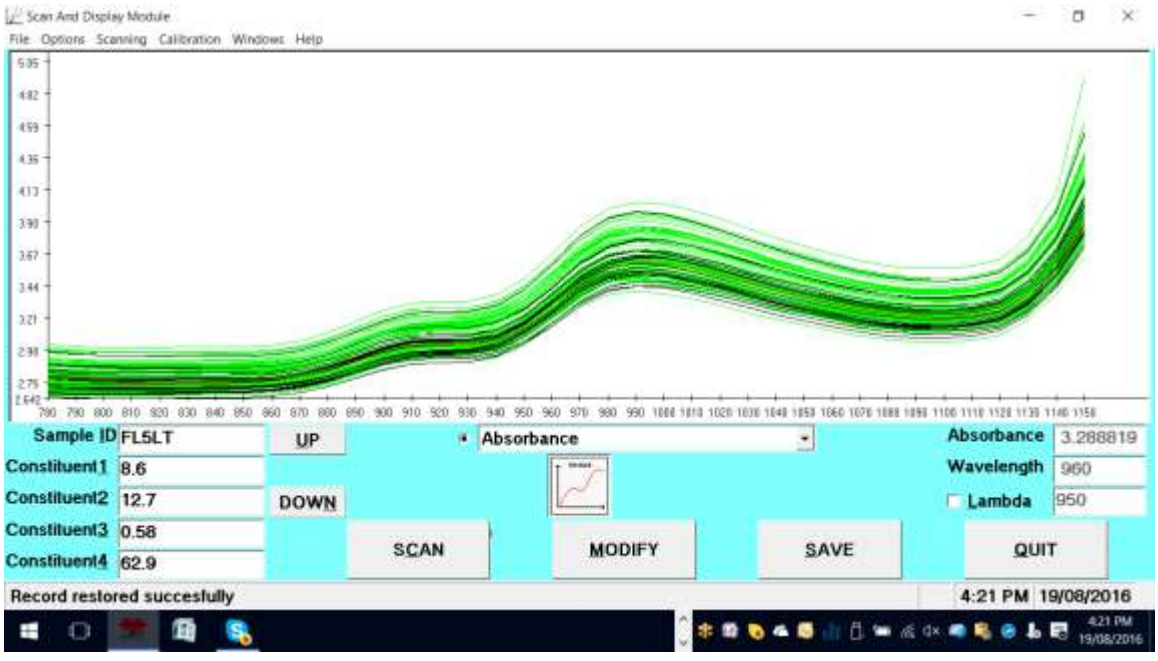

Figure 5. shows the calibration plots for protein, moisture, ash and water absorption.

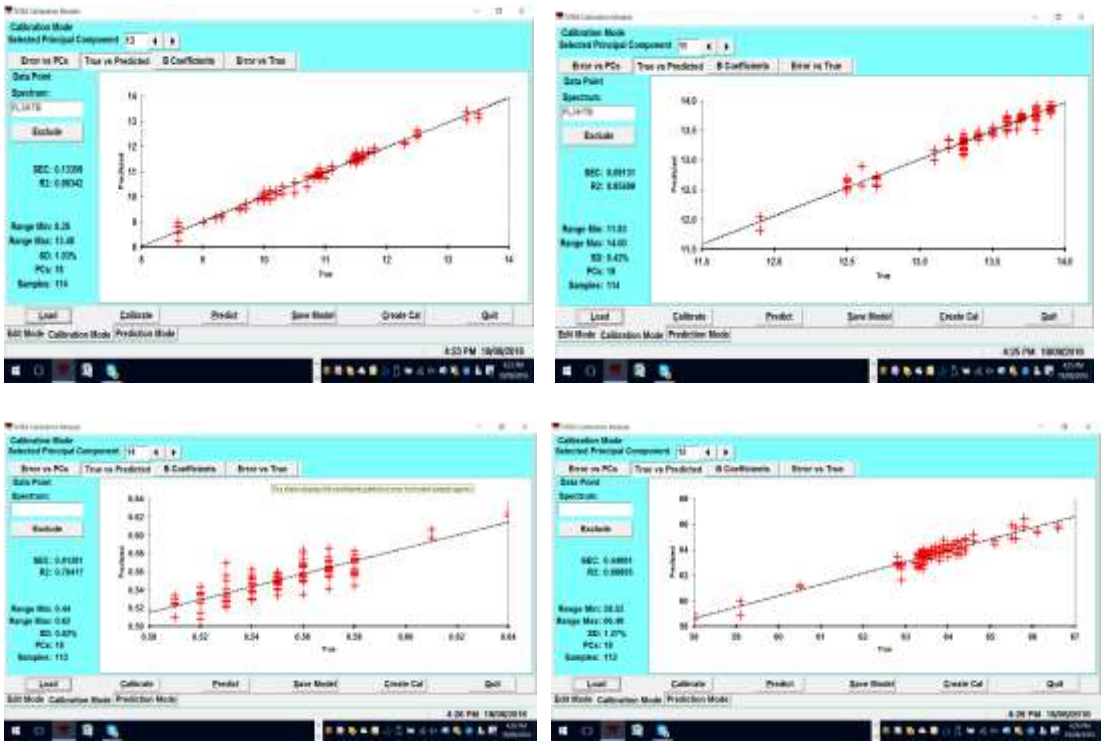

Figure 5. Calibration Plots for Protein, Moisture, Ash and Water Absorption in Flour.

Table 2 shows the prediction results for protein, moisture, ash and water absorption in 10 flour samples.

Sample ID	Ref Protein	Cr Protein	Diff	Duplicate	Ref Moistu	Cr Moistur	Diff	Duplicate	Ref Ash	Cr Ash	Duplicate	Ref WA	Cr WA	Diff	Duplicate
FL1A	12.30	12.09	0.21		13.30	13.43	-0.13		0.56	0.01		65.10	64.19	0.91	
FL1B	12.30	12.03	0.27	-0.06	13.30	13.35	-0.05	-0.07	0.56	0.02	-0.01	65.10	64.53	0.57	0.34
FL2A	9.00	8.81	0.19		13.20	13.29	-0.09		0.51	-0.03		60.50	61.56	-1.06	
FL2B	9.00	8.90	0.10	0.08	13.20	13.27	-0.07	-0.02	0.51	-0.01	-0.02	60.50	61.06	-0.56	-0.50
FL3A	11.80	11.79	0.01		12.50	12.70	-0.20		0.55	-0.01		65.50	64.77	0.73	
FL3B	11.80	11.83	-0.03	0.04	12.50	12.62	-0.12	-0.08	0.55	0.00	-0.01	65.50	65.22	0.28	0.45
FL4A	11.50	11.35	0.15		12.60	12.81	-0.21		0.54	-0.03		65.60	64.96	0.64	
FL4B	11.50	11.40	0.10	0.04	12.60	12.81	-0.21	0.00	0.54	-0.02	-0.01	65.60	64.77	0.83	-0.19
FL5A	8.60	8.76	-0.16		12.70	12.60	0.10		0.58	0.05		62.90	62.00	0.90	
FL5B	8.60	8.73	-0.13	-0.03	12.70	12.63	0.07	0.03	0.58	0.04	0.01	62.90	61.95	0.95	-0.05
FL6A	10.70	10.65	0.05		12.50	12.63	-0.13		0.64	0.06		63.90	62.82	1.08	
FL6B	10.70	10.51	0.19	-0.14	12.50	12.66	-0.16	0.03	0.64	0.06	0.00	63.90	63.12	0.78	0.29
FL7A	13.30	13.29	0.01		12.50	12.64	-0.14		0.53	-0.05		65.80	66.14	-0.34	
FL7B	13.30	13.46	-0.16	0.16	12.50	12.61	-0.11	-0.03	0.53	-0.03	-0.02	65.80	66.22	-0.42	0.08
FL8A	12.50	12.55	-0.05		13.67	13.83	-0.16		0.57	0.00		64.60	64.31	0.29	
FL8B	12.50	12.46	0.04	-0.09	13.67	13.74	-0.07	-0.08	0.57	-0.01	0.01	64.60	64.85	-0.25	0.54
FL9A	10.90	11.17	-0.27		13.10	13.22	-0.12		0.56	-0.01		63.70	63.21	0.49	
FL9B	10.90	11.10	-0.20	-0.07	13.10	13.20	-0.10	-0.02	0.56	-0.01	0.00	63.70	63.29	0.41	0.08
FL10A	10.90	11.11	-0.21		13.30	13.23	0.07		0.54	-0.01		63.40	63.54	-0.14	
FL10B	10.90	11.02	-0.12	-0.09	13.30	13.21	0.09	-0.02	0.54	-0.02	0.01	63.40	63.71	-0.31	0.17
		SEP	0.16				0.10			0.03				0.60	
		SDD		0.09				0.04			0.01				0.31

Conclusion:

The CropScan 3000F Grain and Flour Analyser offers the accuracy and ease of use required by technicians in the flour milling industry. Without compromising either the whole grain analysis or the powder analysis, the CropScan 3000F provides flour millers the ability to have one instrument to measure the incoming grain and the finished flour. As well the CropScan 3000F can be used to measure wheat after conditioning in order to provide better control in the milling process.