CMBTC™
CANADIAN MALTING BARLEY TECHNICAL CENTRE

Technical Report

Report of the Malting and Brewing trials with the 2010 Quality Scoop Barley Samples

Summary

Quality scoop (QS) barley samples (blend of barley from all selection areas for 2010 harvest) of AC Metcalfe and CDC Copeland barley were provided by the CWB to CMBTC. CMBTC conducted routine barley analysis, pilot malting and brewing trials with these QS barley samples. The objective of these trials was to examine the malting and brewing performance of a composite of these newly harvested barley samples. Additionally, the data generated would be used for developing the processing guidelines for the 2010 crop barley for the customers of Canadian malting barley.

2010 QS AC Metcalfe and CDC Copeland barley samples showed average overall quality. The samples had desirable protein contents, very good thousand kernel weight, good plumpness, good germination energy, but recorded significant water sensitivity. In addition, RVA values for these samples were very low: indicating that the barley suffered from some pre-harvest sprouting damage and the barley could rapidly lose its germination during storage, particularly when the barley is stored at high temperature. Therefore, it is recommended to avoid storing these barleys for an extended period.

In the pilot malting trials, under the trial malting conditions no major process problems were encountered, 2010 QS AC Metcalfe and CDC Copeland barley samples produced malts with overall quality close to or comparable to last year's crop, although the overall malting performance and quality of the resultant malt varied from variety to variety and from trial to trial.

Malt produced from 2010 QS AC Metcalfe exhibited poorer overall malt quality than 2009 QS samples as indicated by a low friability value and higher beta-glucan content, although the malt showed comparable values in extract yield, soluble protein and FAN, enzymes and color.

2010 QS CDC Copeland samples produced malts with quality comparable to 2009 QS samples although they recorded higher beta-glucan content and noticeably higher malt color.

1365-303 Main Street • Winnipeg, Manitoba, Canada R3C 3G7 • Telephone 204-984-4399 • Fax 204-984-5843
Email cmbtc@cmbtc.com • Website www.cmbtc.com

Malting trial results suggested that 2010 crop AC Metcalfe and CDC Copeland barleys can be processed under normal processing conditions for Canadian two-row malting barleys. However, processing conditions that are known to effect malt friability and beta-glucan content should be closely monitored throughout the malting process. Since 2010 QS AC Metcalfe and CDC Copeland barley samples showed strong water sensitivity, when processing 2010 crop barley, it is necessary to avoid long wet periods at steep (>9 hours per wet period), particularly for the first wet period. In addition, make sure that the barley is provided with good aeration during steep wet periods and good CO_2 suction during steep dry periods to encourage even chitting and growth. In germination avoid high temperature and excessive watering to control acrospire growth and protein breakdown. In kilning a lower curing temperature (80-82°C) should be considered to avoid excessive malt color formation.

CANADIAN MALTING BARLEY TECHNICAL CENTRE

Technical Report

1. Barley Quality Analysis

Three QS samples of two barley varieties were provided to CMBTC by CWB, which were to represent the overall quality of 2010 crop AC Metcalfe and CDC Copeland readily available to the customers of Canadian malting barleys. CMBTC was not involved in the collecting and blending these barley samples.

When these QS barley samples arrived at CMBTC, quality of the barley samples was examined quickly and the test results are summarized in Table 1. Please note that all the testing results reported in Table 1 were generated from a single test except for the germination testing.

Table 1. Quality evaluation of the 2010 quality scoop barley samples

Variety/ Barley ID	Moisture, %	Protein, %	Germination, % (4ml, n=2)	Germination, % (8ml, n=2)	1000 Kernel wt, g	Sizing, %			RVA
						>6/64 sieve	>5/64 sieve	Through	
Average of 2010 QS									
B-10-166 AC Metcalfe	13.6	12.9	98.5	85.0	47.8	94.5	3.78	1.52	76.0
B-10-167 CDC Copeland	13.1	11.3	95.0	69.5	44.1	96.9	2.3	0.95	16.6
B-10-183 CDC Copeland	13.4	11.3	97.5	95.5	45.5	91.3	5.7	1.66	30.1
Average of 2009 QS									
AC Metcalfe	12.75	11.4	100	89	46.55	93.2	5.39	0.83	56.0
CDC Copeland	12.65	11.25	100	94	48.65	94.85	4.09	0.71	30.0
Average of 2008 QS									
AC Metcalfe	13.1	12.25	97.5	94	45.5	94.7	3.86	1.03	102
CDC Copeland	12.9	11.3	99.5	93.5	47.5	96.4	2.84	0.75	120

General comments on barley quality

The 2010 QS samples of AC Metcalfe and CDC Copeland all recorded acceptable moisture content and very desirable protein content (Table 1). The barley samples also recorded good germination energy, but exhibited variable degrees of water sensitivity. All barley samples showed excellent thousand kernel weight and plumpness. All of these barley samples showed no signs of mould infection and/or staining. However, all of the samples reported low RVA values (<135), which suggested that the samples could have been affected by pre-harvest sprouting damage. The RVA value for 2010 QS AC Metcalfe barley was slightly higher than 2009 QS AC Metcalfe; the RVA value for 2010 CDC Copeland were lower or comparable to 2009 QS CDC Copeland. This indicated that there could be some challenges in storability of 2010 crop Canadian malting barley. These barleys should be malted quickly and should not be stored under high humidity and high temperatures for prolonged periods.

In general, the 2010 QS barley samples showed an acceptable overall quality. In comparison with 2009 QS barley samples, 2010 QS barley had similar protein content but had lower values in germination energy and stronger water sensitivity. AC Metcalfe showed higher 1000 kernel weight and plumpness than the 2009 QS sample, while CDC Copeland showed 1000 kernel weight lower than the 2009 QS samples and plumpness similar to 2009 QS samples. RVA values for 2010 QS samples were comparable to 2009 QS barleys.

2. Pilot-Malting Trials

One pilot malt trial of 60 kg cleaned barley was conducted on each of these 2010 QS AC Metcalfe and CDC Copeland barley samples without duplication due to the limited quantity of these barley samples available. The processing conditions used in each of these pilot malting trials are detailed in Table 2. Please note that steeping and germination conditions varied slightly from trial to trial, but kilning conditions were identical in all of the pilot malting trials. Two example charts showing the temperature profiles for the germination and kilning are also given below for reference.

Table 2. Malting conditions for processing 2010 AC Metcalfe and CDC Copeland

	AC Metcalfe	CDC Copeland	
	Sample 1	Sample 1	Sample 2
Steeping			
Steep temp. (°C)	15	14	14
1st Wet Time (hrs)	7	7	7
1st Dry Time (hrs)	12	14	14
2nd Wet Time (hrs)	9	8	8
2nd Dry Time (hrs)	14	12	12
3rd Wet Time (hrs)	1.5	2	2
Total Steeping Time (hrs)	44	43	43
Germination			
1st day Germ Temp (°C)	15	15	15
2nd day Germ Temp (°C)	15	15	15
3rd day Germ Temp (°C)	14	14	14
4th day Germ Temp (°C)	14	14	14
Total Germ Time (hrs)	96	96	96
Kilning			
Kilning Time (hrs)	21	21	21
Temp(°C) at the end kilning	82	82	82

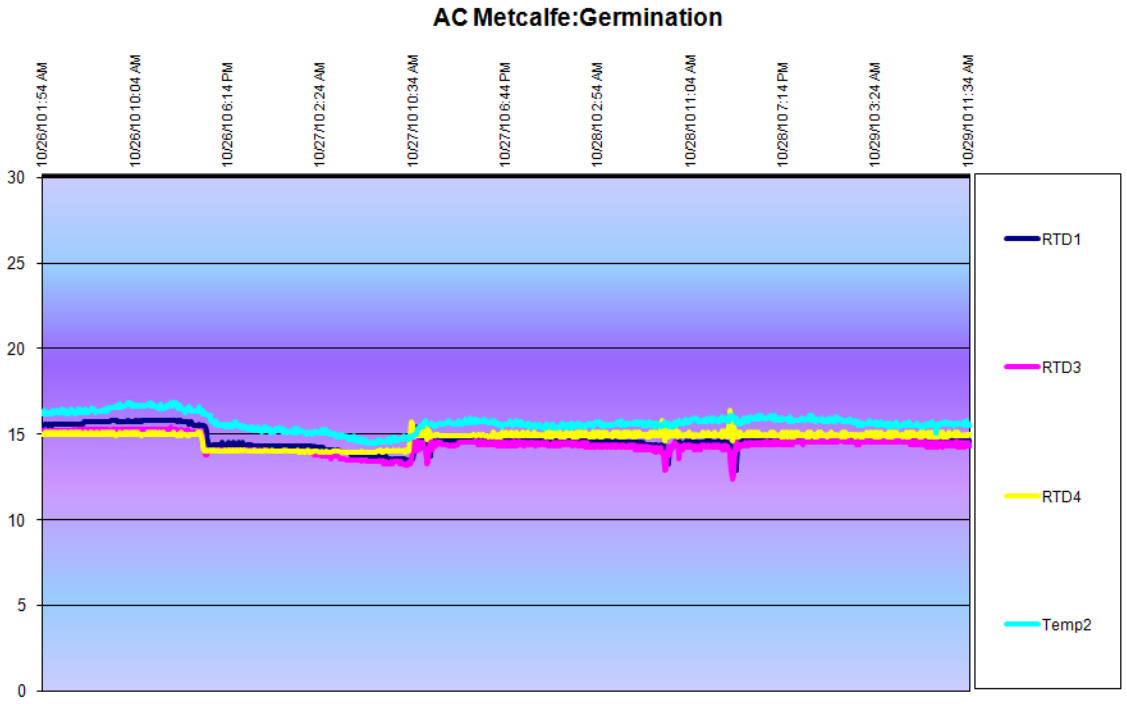
3. Malting Performance

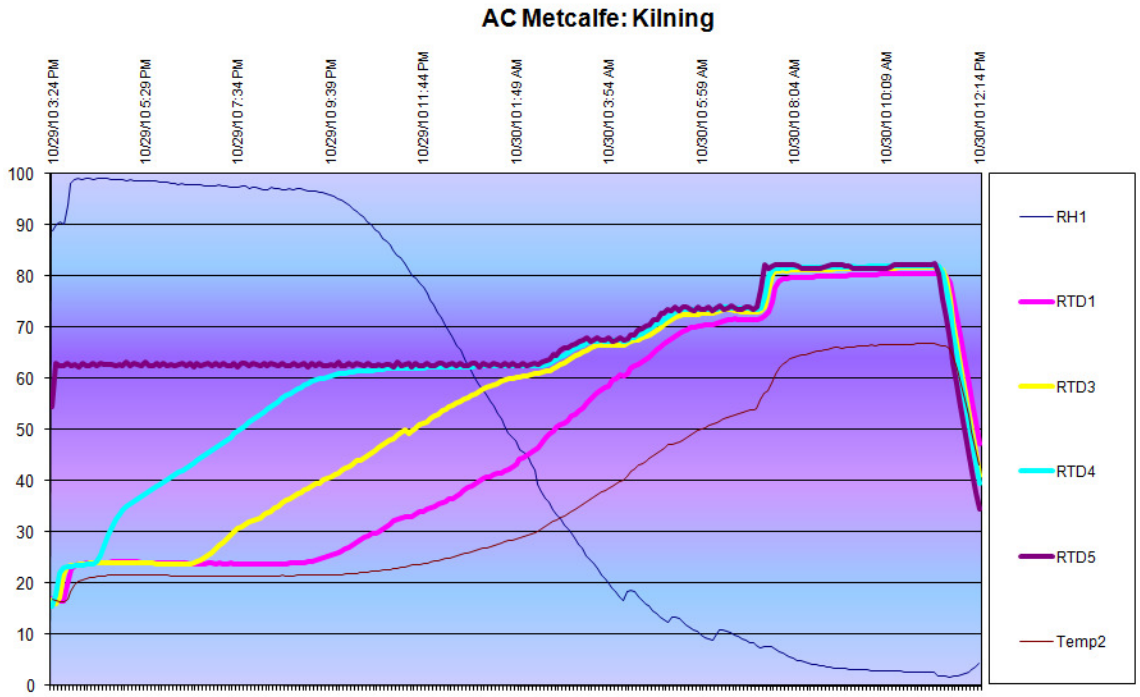
AC Metcalfe

At steep the 2010 QS AC Metcalfe barley sample obtained satisfactory steep-out moisture content and a very good chitting rate (Table 3). During germination, it showed good growth of acrospires and good progress of modification. In comparison with 2009 QS samples, 2010 AC Metcalfe showed similar water up-take, but lower chitting rate at steep. During germination it showed faster growth than the 2009 QS AC Metcalfe.

Table 3. Steep-out moisture content and chitting rate and acrospire growth of 2010 QS AC Metcalfe barley

2010 AC Metcalfe		Steep-out Moisture (%)		Chitting rate (%)	
		44.0		95	
Acrospire growth					
	0-¼ (%)	¼-½ (%)	½-¾ (%)	¾-1 (%)	>1 (%)
24 hours	0	20	60	20	0
48 hours	0	15	40	45	0
72 hours	0	0	30	70	0
96 hours	0	0	15	50	35
2009 QS AC Metcalfe (Mean n=2)					
AC Metcalfe		Steep-out Moisture (%)		Chitting rate (%)	
		44.7		100	
Acrospire growth					
	0-¼ (%)	¼-½ (%)	½-¾ (%)	¾-1 (%)	>1 (%)
24 hours	20	42.5	37.5	0	0
48 hours	0	12.5	50	37.5	0
72 hours	0	0	17.5	77.5	5
96 hours	0	0	10	82.5	7.5


AC Metcalfe:Germination
10/26/10 1:54 AM
10/26/10 10:04 AM
10/26/10 6:14 PM
10/27/10 2:24 AM
10/27/10 10:34 AM
10/27/10 6:44 PM
10/28/10 2:54 AM
10/28/10 11:04 AM
10/28/10 7:14 PM
10/29/10 3:24 AM
10/29/10 11:34 AM
30
25
20
15
10
5
0
RTD1
RTD3
RTD4
Temp2


AC Metcalfe: Kilning
10/29/10 3:24 PM
10/29/10 5:29 PM
10/29/10 7:34 PM
10/29/10 9:39 PM
10/29/10 11:44 PM
10/30/10 1:49 AM
10/30/10 3:54 AM
10/30/10 5:59 AM
10/30/10 8:04 AM
10/30/10 10:09 AM
10/30/10 12:14 PM
100
90
80
70
60
50
40
30
20
10
0
RH1
RTD1
RTD3
RTD4
RTD5
Temp2

Complete malt analysis was carried out for this pilot malting trial, and the analytical results are given in Table 4. For comparison, the table also includes the average malt analysis of AC Metcalfe malting trials carried out at CMBTC with 2009 QS barley samples for reference.

Table 4. Malt analysis and quality evaluation for 2010 QS AC Metcalfe barley sample

Parameter	2010 QS AC Metcalfe	2009 QS AC Metcalfe
Malt moist, %	4.0	3.8
Friability, %	71.8	85.5
Fine-extract, %	79.9	80.4
Coarse-extract, %	78.8	79.8
F/C Difference, %	1.1	0.6
Soluble protein, %	5.14	5.09
Total protein, %	12.31	11.29
Kolbach Index, %	41.8	45.05
Beta-Glucan, ppm	190	95.5
Diastatic power, °L	143	169
α-Amylase, D.U.	59.3	67.3
Wort colour, ASBC	2.11	1.94
Wort pH	5.95	6.02
Fan, mg/L	185	236

CANADIAN MALTING BARLEY TECHNICAL CENTRE

Technical Report

Malting Summary

- **General modification:** The values for friability and beta-glucan content indicated that the malt produced from this 2010 QS AC Metcalfe was under-modified, although it showed good values in extract yield, F/C difference, soluble protein content, enzymes and FAN.

- **Extract yield and enzyme levels:** In comparison with the averages of 2009 QS samples, the malt produced from this 2010 QS AC Metcalfe sample exhibited slightly lower extract yield. Its enzymes were adequate but its α-Amylase and diastatic power was lower than 2009 QS samples.

- **Soluble protein, free amino nitrogen (FAN) and malt colour:** The malt produced from this 2010 QS AC Metcalfe barley sample exhibited protein modification lower than 2009 QS samples as indicated by the Kolbach Index. The malts also developed adequate FAN, but the levels were lower than in 2009 QS samples. Its malt colour was significantly higher than 2009 QS samples.

Comments on the malting process

During the malting process, no major difficulties were recorded for the crop 2010 QS AC Metcalfe barley sample. 2010 AC Metcalfe barley was processed under normal Canadian two-row malting barley processing conditions. However, please pay attention to processing conditions that affect malt friability and beta-glucan. Maltsters may need to adjust processing conditions to lower the malt beta-glucan content.

Since this barley showed strong water sensitivity, it is necessary to avoid long wet periods at steep (>9 hours per wet period), particularly for the first wet period. In addition, in order to encourage even chitting and growth, make sure that the barley is provided with good aeration in wet periods and good CO_2 suction during dry periods.

At steeping target a steep-out moisture of 43-44% and over 85% chitting rate. The steeping cycle should consist of 2 or 3 wet periods at 14-16 ℃. In germination avoid high temperature and excessive watering to control acrospire growth and protein breakdown. In kilning a lower curing temperature (80-82℃) should be considered to avoid excessive malt color formation.

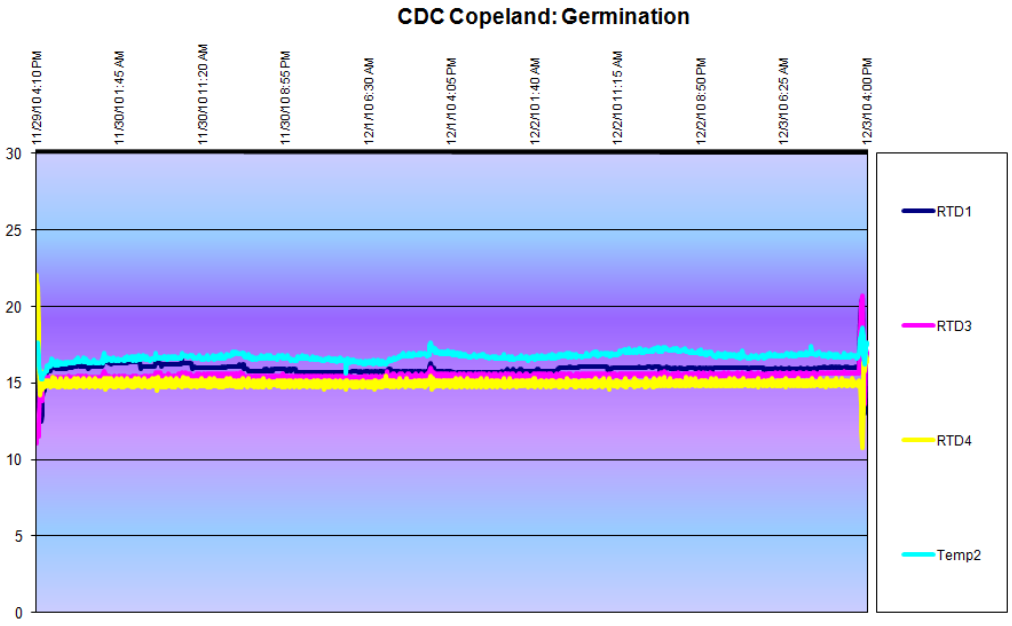
1365-303 Main Street • Winnipeg, Manitoba, Canada R3C 3G7 • Telephone 204-984-4399 • Fax 204-984-5843
Email cmbtc@cmbtc.com • Website www.cmbtc.com

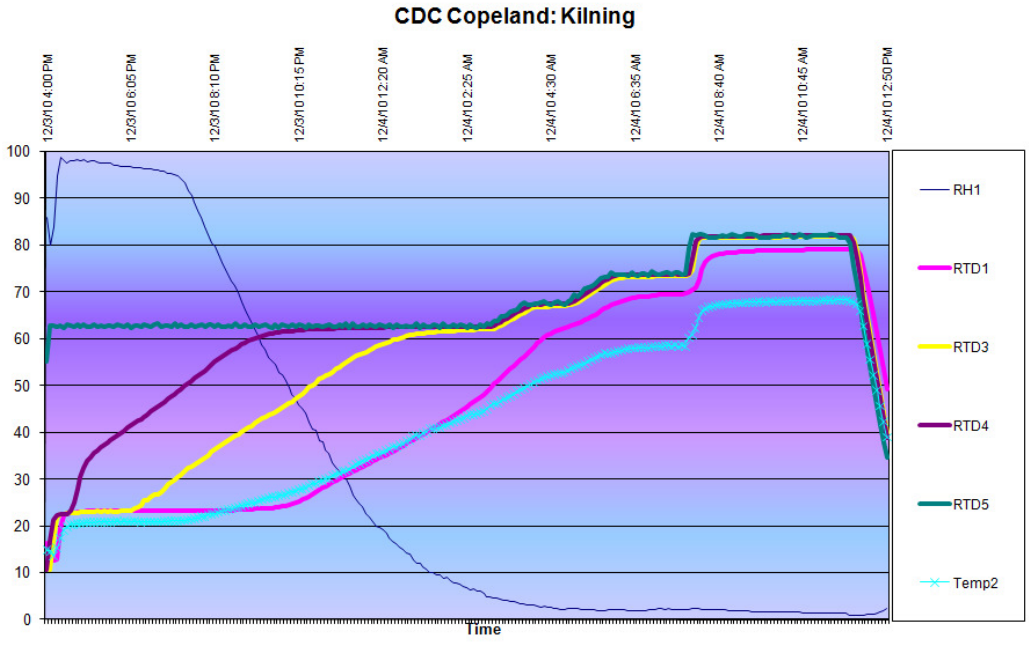
CDC Copeland

At steep these two 2010 QS CDC Copeland barley samples all obtained satisfactory steep-out moisture content and excellent chitting rate (Table 5). During germination, sample #1 showed excessive acrospires growth, while sample #2 showed normal acrospire growth. In comparison with 2009 QS Copeland samples, 2010 QS CDC Copeland showed comparable water up-take and chitting rates at steep, and showed acrospire faster growth than the 2009 QS AC Metcalfe during germination.

Table 5. Steep-out moisture content, chitting rate and growth of 2010 QS CDC Copeland barley

2010QS CDC Copeland #1		Steep-out Moisture (%)		Chitting rate (%)	
		43.8		100	
Acrospire growth					
	0-¼ (%)	¼-½ (%)	½-¾ (%)	¾-1 (%)	>1 (%)
24 hours	5	50	30	15	0
48 hours	0	0	40	60	0
72 hours	0	0	10	90	0
96 hours	0	0	5	30	65
2010 QS CDC Copeland #2		Steep-out Moisture (%)		Chitting rate (%)	
		43.9		100	
Acrospire growth					
	0-¼ (%)	¼-½ (%)	½-¾ (%)	¾-1 (%)	>1 (%)
24 hours	0	30	70	0	0
48 hours	0	15	45	35	5
72 hours	0	0	20	70	10
96 hours	0	0	0	90	10
2009 QS AC Metcalfe (Mean n=2)					
CDC Copeland		Steep-out Moisture (%)		Chitting rate (%)	
		44.5		100	
Acrospire growth					
	0-¼ (%)	¼-½ (%)	½-¾ (%)	¾-1 (%)	>1 (%)
24 hours	10	57.5	27.5	5	0
48 hours	0	30	30	40	0
72 hours	0	5	25	70	0
96 hours	0	0	7.5	87.5	5


CDC Copeland: Germination
11/29/10 4:10 PM
11/30/10 1:45 AM
11/30/10 11:20 AM
11/30/10 8:55 PM
12/1/10 6:30 AM
12/1/10 4:05 PM
12/2/10 1:40 AM
12/2/10 11:15 AM
12/2/10 8:50 PM
12/3/10 6:25 AM
12/3/10 4:00 PM
30
25
20
15
10
5
0
RTD1
RTD3
RTD4
Temp2


CDC Copeland: Kilning
12/3/10 4:00 PM
12/3/10 6:05 PM
12/3/10 8:10 PM
12/3/10 10:15 PM
12/4/10 12:20 AM
12/4/10 2:25 AM
12/4/10 4:30 AM
12/4/10 6:35 AM
12/4/10 8:40 AM
12/4/10 10:45 AM
12/4/10 12:50 PM
100
90
80
70
60
50
40
30
20
10
0
Time
RH1
RTD1
RTD3
RTD4
RTD5
Temp2

Complete malt analysis was carried out for the two pilot malting trials, and the analytical results are given in Table 6. For comparison, the table also includes the average malt analysis of CDC Copeland malting trials carried out at CMBTC with 2009 QS CDC Copeland barley samples for reference.

Table 6. Malt analysis and quality evaluation for 2010 QS CDC Copeland barley samples

Parameter	2010 QS CDC Copeland			2009 QS CDC Copeland
Pilot-malting #	PM-10-042	PM-10-050	Mean	Mean
Malt moisture, %	3.9	3.6	3.8	3.9
Friability, %	90.7	82.6	86.7	87.3
Fine-extract, %	80.6	80.1	80.4	80.8
Coarse-extract, %	80.2	78.5	79.4	80.3
F/C Difference, %	0.4	1.6	1.0	0.5
Soluble protein, %	5.14	5.25	5.20	5.27
Total protein, %	10.86	11.88	11.37	11.34
Kolbach Index, %	47.3	44.2	45.8	46.5
Beta-Glucan, ppm	120	146	133	103
Viscosity, cps	1.42	1.43	1.43	1.41
Diastatic power, °L	133	129	131	146
α-Amylase, D.U.	44.5	51.6	48.1	54.9
Wort colour, ASBC	2.19	2.49	2.34	1.85
Wort pH	5.90	5.91	5.91	5.92
Fan, mg/L	250	201	226	257

CANADIAN MALTING BARLEY TECHNICAL CENTRE

Technical Report

Malting Summary

- **General modification**: The values for friability, F/C difference and soluble protein all suggested that the two 2010 QS CDC Copeland barley samples produced malts with very good modification. However, the elevated beta-glucan content in sample #2 indicated that the malt produced from this sample was under-modified.

- **Extract yield and enzyme levels**: In comparison with the averages of 2009 QS samples, the malts produced from 2010 QS CDC Copeland samples exhibited slightly lower extract yield. They developed good enzymes, but their α-amylase and diastatic power were lower than in 2009 QS Copeland samples.

- **Soluble protein, free amino nitrogen (FAN) and malt colour:** The malts produced from the 2010 QS samples exhibited slightly lower protein modification than that of 2009 QS samples. The malts also developed FAN levels lower than in the 2009 QS samples. Malt colour for 2010 QS barley was significantly higher than in 2009 QS samples.

Comments on the malting process

During the malting process, no major difficulties were recorded for the QS CDC Copeland barley samples. 2010 CDC Copeland barley can be processed under normal Canadian two-row malting barley processing conditions. However, please pay attention to processing conditions that affect malt friability and beta-glucan.

Since CDC 2010 Copeland barley could have strong water sensitivity, it is necessary to avoid long wet periods at steep (>9 hours per wet period), particularly for the first wet period. In addition, in order to encourage even chitting and growth, make sure that the barley is provided with good aeration at wet periods and good CO_2 suction at dry periods.

At steep, target a steep-out moisture of 44-45% and over 85% chitting rate. The steeping cycle should consist of 2 or 3 wet periods at 14-15 ℃. In germination avoid high temperature and excessive watering to control the growth of acrospires and protein breakdown. In kilning the curing temperature can be similar to that used for processing AC Metcalfe (80-82℃). 2010 QS CDC Copeland did not show the tendency of producing lower malt color.

1365-303 Main Street • Winnipeg, Manitoba, Canada R3C 3G7 • Telephone 204-984-4399 • Fax 204-984-5843
Email cmbtc@cmbtc.com • Website www.cmbtc.com

In conclusion, under the trial malting conditions all the 2010 QS barley samples exhibited good water uptake and good chitting rates at steep, and showed good growth during germination. The malts produced from these QS barley samples all showed satisfactory values in friability, extract level, soluble protein, enzymes, FAN and color, however, beta-glucan content was higher in all of the finished malts. Special attention in processing may be required to ensure lower beta-glucan content. Compared with the 2009 QS barley samples, all 2010 QS barley samples showed satisfactory overall malting performance and produced malts with quality close to or comparable to the 2009 QS barleys.

For more information, please contact CMBTC:

Rob McCaig, Managing Director and Director of Brewing
Tel: (204) 983-1981
Email: rmccaig@cmbtc.com

Yueshu Li, Director of Malting Technology
Tel: (204) 984-0561
Email: yli@cmbtc.com

Fax 204-984-5843