IAOM Regional Seminar

Nairobi

27 – 28 August, 2015

U.S. WHEAT ASSOCIATES

Using Solvent Retention Capacity (SRC) Test in Functionality Testing for Flour

US Wheat Associates
MEENA Region

Thanks and Notes:

- Thanks to you all for coming today – its great to be back to USW for inviting me here today.
- Thanks also to my colleagues from our Singapore office and Dr. Art Bettge for sharing much of their valuable research on this subject.
- Thanks also to the team at the Wheat Marketing Center of Portland, OR for teaching me all about SRC.
- Disclaimer: I am a simple miller and not a cereal scientist and do not pretend to know all about cereal chemistry!

Analogous

Measure

Conclusion

MUST BE A VERY RICH GUY!! **$$$$**

Direct

Measure

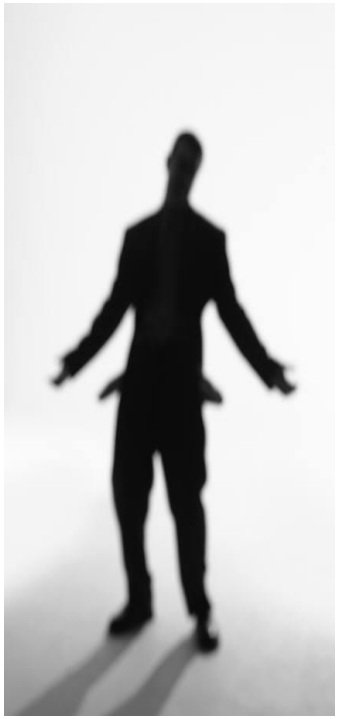
FIRST BANK OF WIKI
1425 JAMES ST, PO BOX 4000
VICTORIA BC V8X 3X4 1-800-555-5555

CHEQUING ACCOUNT STATEMENT
Page : 1 of 1

JOHN JONES
1643 DUNDAS ST W APT 27
TORONTO ON M6K 1V2

Statement period	Account No.
2003-10-09 to 2003-11-08	00005-123-456-7

Date	Description	Ref.	Withdrawals	Deposits	Balance
2003-10-08	Previous balance				0.55
2003-10-14	Payroll Deposit - HOTEL			694.81	695.36
2003-10-14	Web Bill Payment - MASTERCARD	9685	200.00		495.36
2003-10-16	ATM Withdrawal - INTERAC	3990	21.25		474.11
2003-10-16	Fees - Interac		1.50		472.61
2003-10-20	Interac Purchase - ELECTRONICS	1975	2.99		469.62
2003-10-21	Web Bill Payment - AMEX	3314	300.00		169.62
2003-10-22	ATM Withdrawal - FIRST BANK	0064	100.00		69.62
2003-10-23	Interac Purchase - SUPERMARKET	1559	29.08		40.54
2003-10-24	Interac Refund - ELECTRONICS	1975		2.99	43.53
2003-10-27	Telephone Bill Payment - VISA	2475	6.77		36.76
2003-10-28	Payroll Deposit - HOTEL			694.81	731.57
2003-10-30	Web Funds Transfer - From SAVINGS	2620		50.00	781.57
2003-11-03	Pre-Auth. Payment - INSURANCE		33.55		748.02
2003-11-03	Cheque No. - 409		100.00		648.02
2003-11-06	Mortgage Payment		710.49		-62.47
2003-11-07	Fees - Overdraft		5.00		-67.47
2003-11-08	Fees - Monthly		5.00		-72.47
	*** Totals ***		1,515.63	1,442.61	



Look at the bank account

Conclusion

- House Loans
- Business Loans
- HUGE Car Loan!
- No cash.

= POOR MAN

Why am I excited about SRC?

- SRC provides a **quick, inexpensive** way to give us a **Functionality Profile** for flour.
- SRC is based on a more direct measure of the key quality contributors (the bank account).
- Relatively **linear response** gives us the opportunity to use this test to blend.
- **Proven success** with soft wheat, and now on hard (bread) wheat testing.

History

- Developed originally by Drs. Levine & Slade at the Nabisco Company in the 1980s for cookie and cracker flour.
- SRC technology is a unique diagnostic tool for predicting flour functionality, and its applications in wheat breeding, milling, and baking are increasing as a result of its extraordinary power and scope.
- Developed originally for soft wheats, but increasingly SRC is being used in hard wheat applications.

SRC Function

- SRC examines the glutenin, gliadin and pentosan characteristics of the flour, and the level of starch damage in the flour.
- These values describe the flour's ability to absorb water during the mixing process and its ability to release that water during the baking process.
- The combined pattern of the four SRC values establishes a practical flour quality profile useful for predicting functionality and specification conformance.

Solvent Retention Capacity (SRC)
AACC Method 56-11

Flour Composition

Water	**13 – 14 %**
Starch	**70 – 75 %**
Protein	**9 – 14 %**
Pentosans	**< 2 %**
Fat	**< 1%**
Ash	**< 1 %**

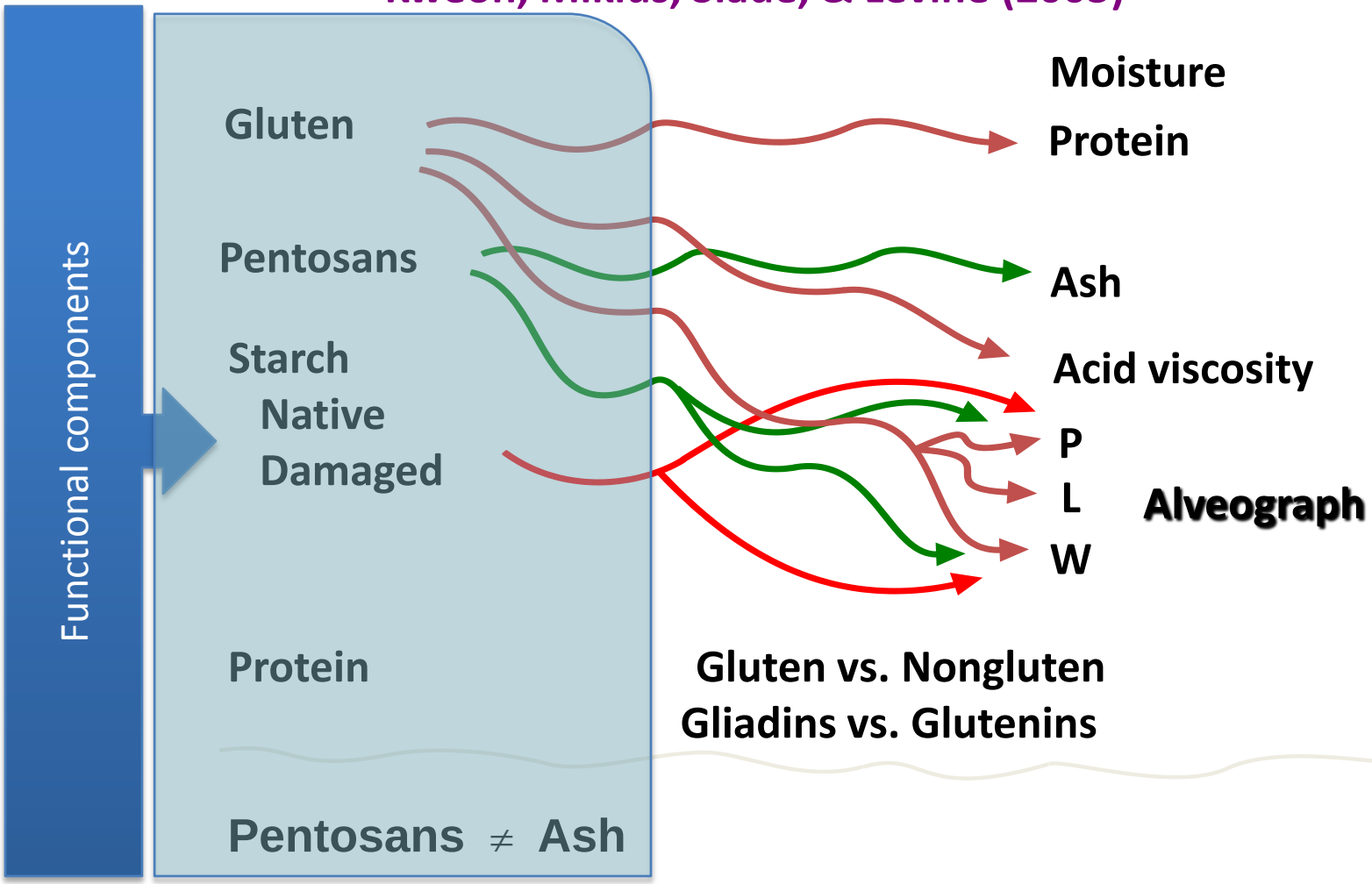
Literature Values for Water Holding Capacity

(Wheat: Chem & Tech, 3rd ed, 1988)

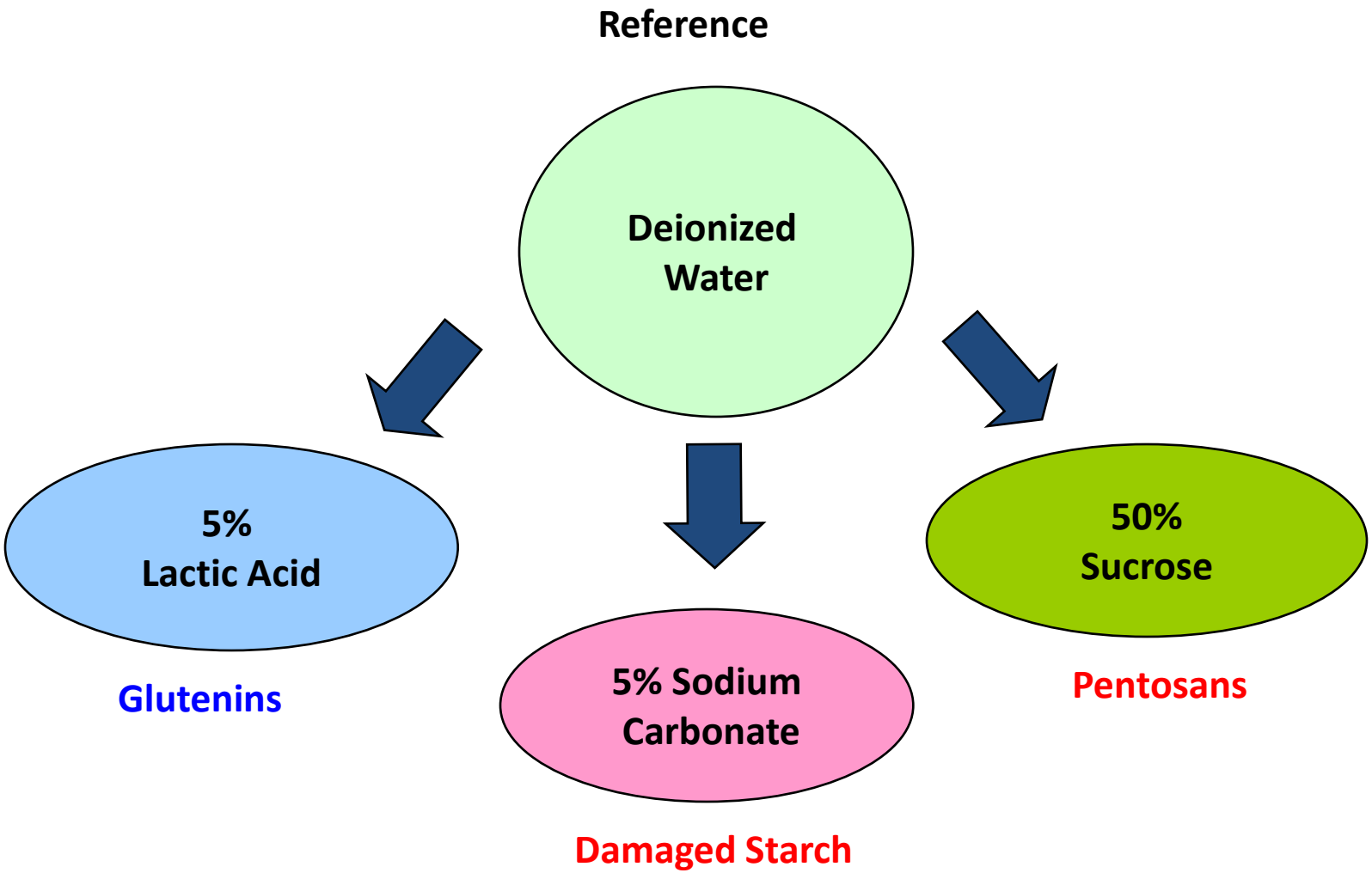
Components	Water Holding Capacity
Gluten (gliadins and glutenins)	2.8 g H_2O / g dry gluten
Non glutenin proteins	Negligible
Pentosans (Soluble and Insoluble)	10 g H_2O / g dry pentosan
Starch	
Native raw	0.3 - 0.45 g H_2O/g dry starch
Damaged raw	1.5 – 10 g H_2O/g dry starch
Gelatinized/pasted	≥ 10 g H_2O/g dry starch

Link Functional Components to Flour Specifications?

Kweon, Miklus, Slade, & Levine (2003)



SRC Standard Diagnostic Solvents



SRC PROCEDURE
(AACC Method 56-11)

Selective Solvation

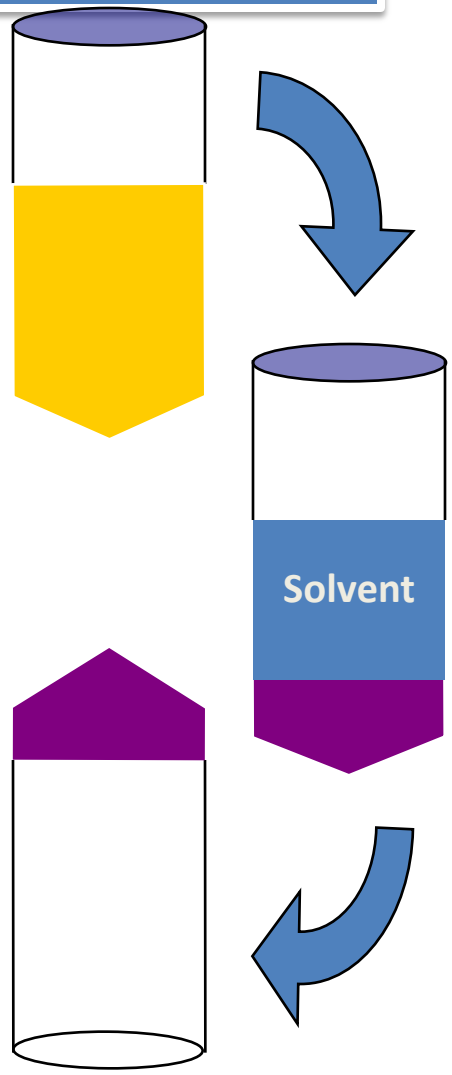
5 g Flour
25 g Solvent
20 min Solvation

Centrifugation

1000 g (Gravity)
15 minutes

Drainage

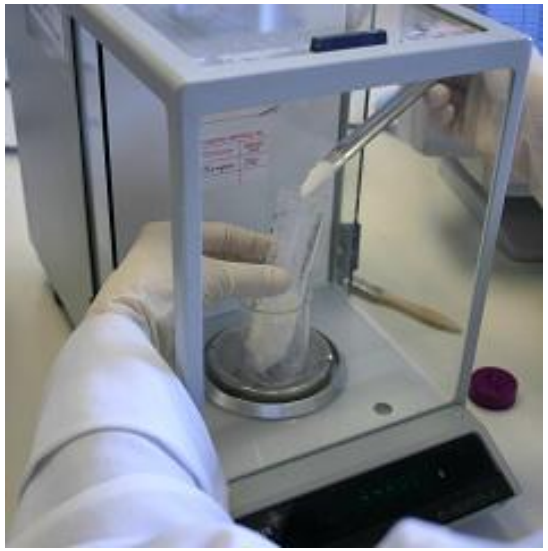
Overturn 180° angle for 10 minutes

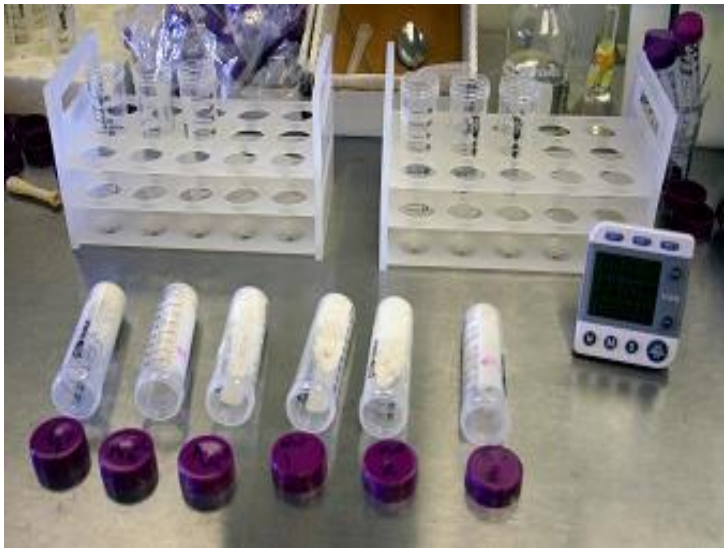


SRC PROCEDURE

Selective Solvation

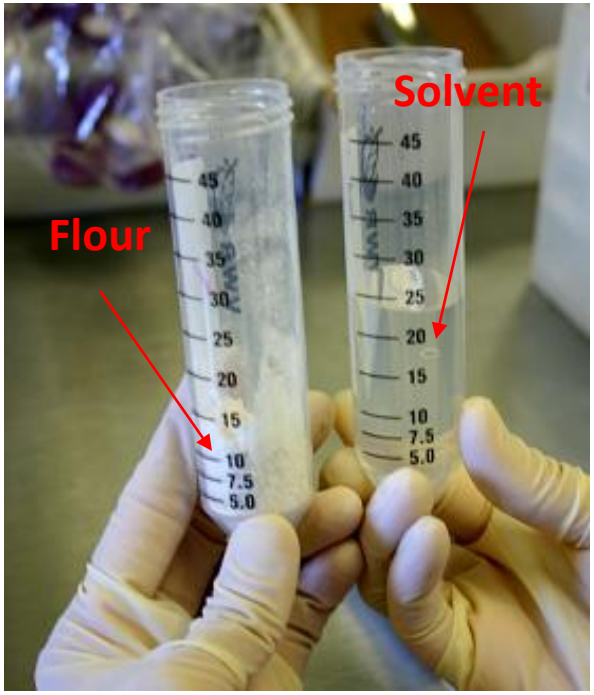
- Weigh 5 g of flour
- Weigh 25 g of each solvent: Water, 50% Sucrose, 5% Lactic Acid and 5% Sodium Carbonate

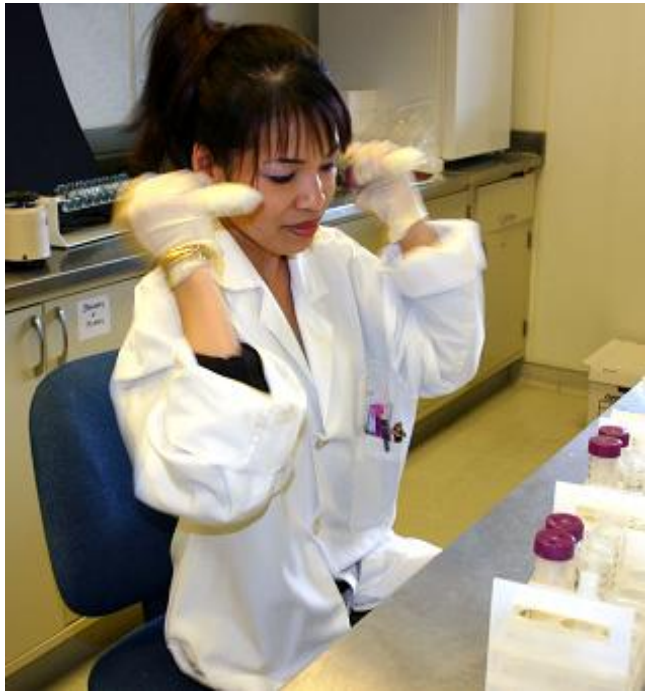




SRC PROCEDURE

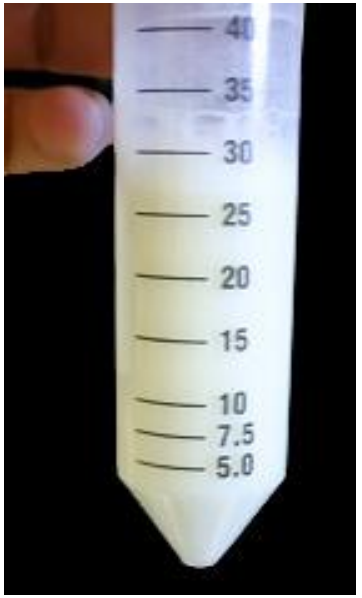
- Start the timer
- Pour the solvent into the flour samples
- Shake the mixture well

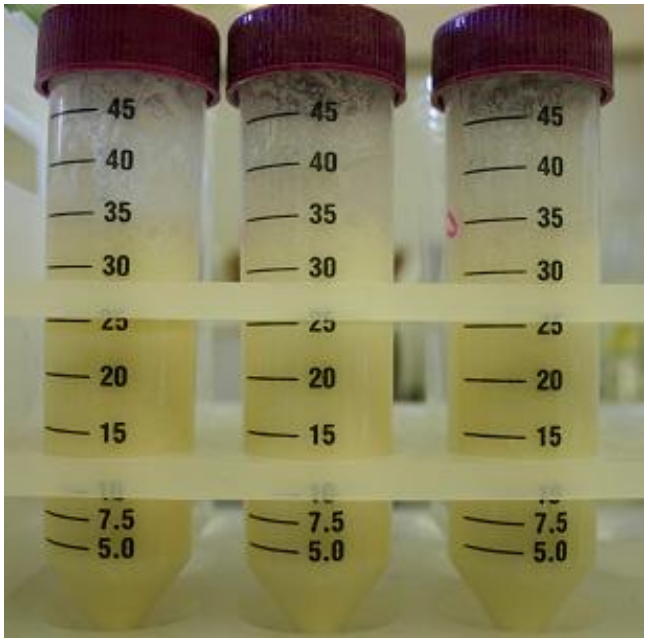




SRC PROCEDURE

- Shake the mixture every 5 minutes
- Shake the mixture for 5 times
- Each time, shake the mixture for 5 seconds

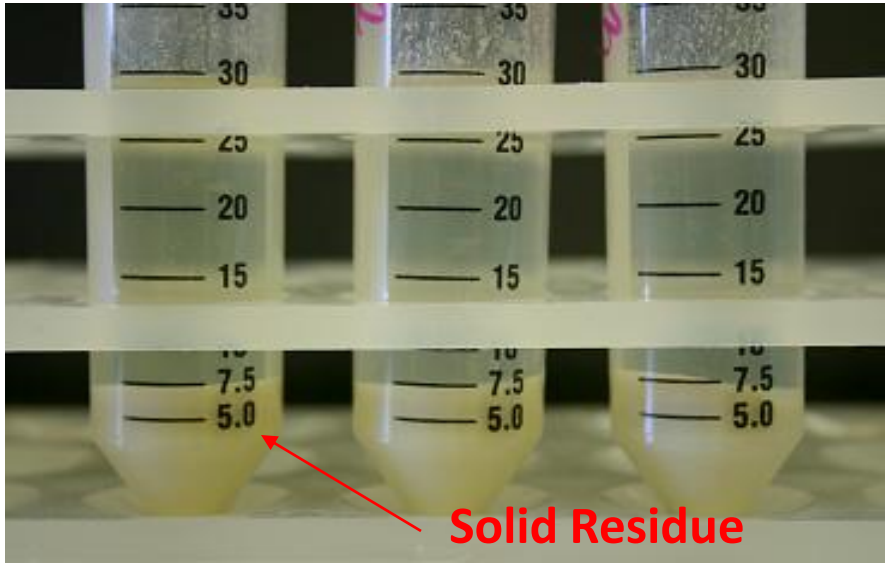




SRC PROCEDURE

Centrifugation

- Place the samples into the Centrifuge
- Centrifuge the samples for 15 minutes at 1000 g



SRC PROCEDURE

Drainage

- Decant supernatant
- Overturn tubes to drain off excessive solvent for 10 minutes
- Cap tubes before weighing

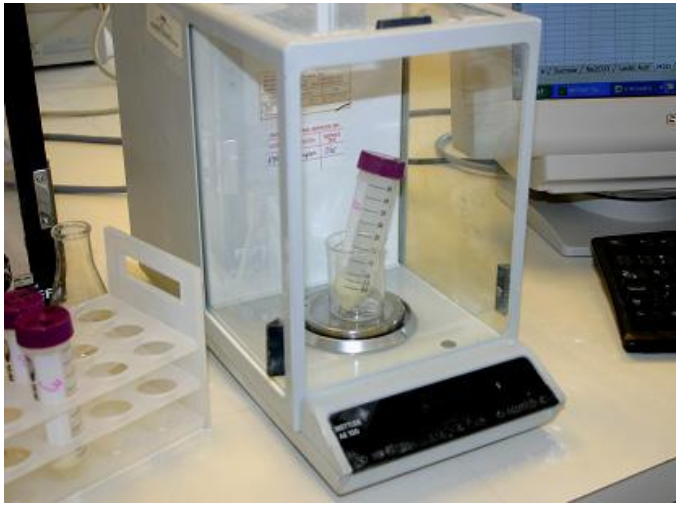
SRC PROCEDURE

- Weigh the drained samples
- Calculate the weight gain - SRC is the weight of solvent held by flour after centrifugation

$$\% \text{ SRC} = \left[\frac{\text{Gel weight}}{\text{Flour weight}} \times \left(\frac{86}{100 - \% \text{ flour moisture}} \right) - 1 \right] \times 100$$

Report:

- SRC Water
- SRC Sucrose
- SRC Lactic Acid
- SRC Sodium Carbonate



Gluten Performance Index

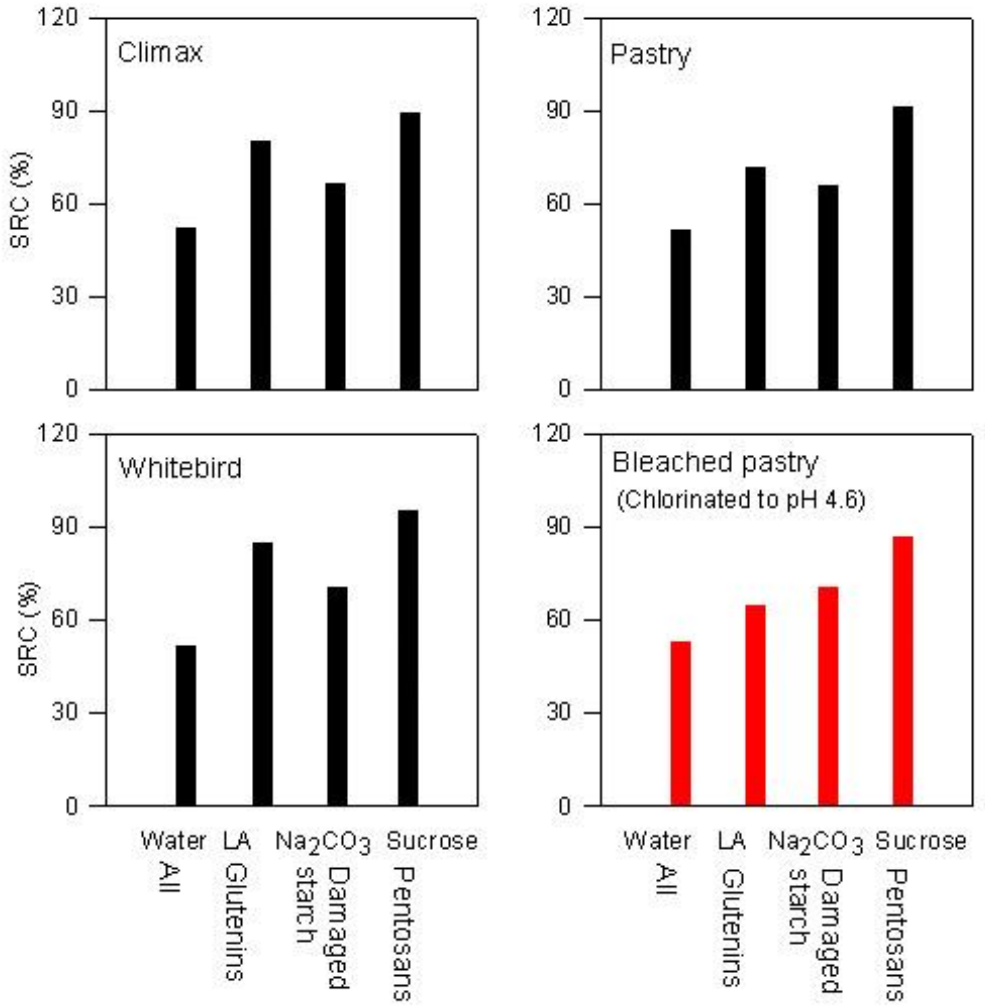
- A new predictive SRC parameter, the gluten performance index (GPI), defined as

$$\frac{\text{lactic acid SRC}}{\text{(sodium carbonate SRC+ sucrose SRC)}}$$

- has been found to be an even better predictor of the overall performance of flour glutenin in the environment of other modulating networks of flour polymers.

* AACC

Flour Functionality = PATTERN of SRC Values



SRC Behavior Patterns

- Serve as a fingerprint
- Predict end-product performance
- Recommend to satisfy end-use requirements

COOKIE SPREAD TEST

Cookie Diameter : 8.6 cm
Top Grain Score : 4.0
SRC Lactic Acid : 96%
SRC Na2CO3 : 93%
Flour Protein : 9.4%

Cookie Diameter : 8.2 cm
Top Grain Score : 1.5
SRC Lactic Acid : 107%
SRC Na2CO3 : 85%
Flour Protein : 9.8%

Cookie Diameter : 8.2 cm
Top Grain Score : 0.0
SRC Lactic Acid : 118%
SRC Na2CO3 : 84%
Flour Protein : 11.4%

Cookie Diameter : 8.4 cm
Top Grain Score : 3.0
SRC Lactic Acid : 111%
SRC Na2CO3 : 83%
Flour Protein : 10.3%

Cookie Diameter : 8.8 cm
Top Grain Score : 5.0
SRC Lactic Acid : 80%
SRC Na2CO3 : 78%
Flour Protein: 10.0%

SRC Equipment & Chemical Costs

Equipment

Analytical Balance	-	$2500
Eppendorf Multi-purpose Centrifuge	-	$4200
Centrifuge Rotor	-	$1205
Centrifuge Buckets	-	$754
Centrifuge Tubes (With Racks)	-	$180

Chemicals

Lactic Acid (500ml)	-	$57
Sodium Carbonate (500gm)	-	$65
Sucrose (1 Kilogram)	-	$32
Grand Total	-	**$8239**

*** Note: Above estimated values are in USD & may vary among suppliers**

Where does SRC NOT work?

- **On ground whole grain** - the test falls apart pretty quickly on this. (i.e. it is not suited for testing at loading of a vessel, as the sample has to be milled to flour first.

- SRC is very effective at determining functionality in soft wheat products destined for cookies, crackers, wafers etc.

- As originally defined, it is not particularly well suited to hard wheat products, GPI goes some way to correct this.

- The SDS Sedimentation test does work on ground whole grain with a very high correlation to bread volume. (R=.92 or higher).

BUT……..

High Protein Specific Solvents

These are not new! They were actually discovered by Drs. Slade, Levine and Bettge shortly after the original SRC test was developed.
These are solvents which look at the functionality of gluten.

Solvent	Measure
0.006% w/w Aqueous solution of Sodium Metabisulfite (NaMBS)	Overall gluten strength
0.75% w/w aqueous solution of sodium dodecyl sulfate (SDS)	Glutenin Macropolymer (GMP)
aqueous solution of 0.75% w/w SDS plus 0.006% NaMBS	GMP without disulfide network. (explores gluten polymerization partly excluding elasticity)
55% w/w aqueous solution of ethanol	For gliadins, which do not form 3-D networks, but are involved in GMP formation and extensibility.

So – how to use SRC in your mill or bakery?

SRC Reference Guide – soft wheat products

Absorption: 100% Distilled Water
Pentosan: 50% Sucrose Solution
Damage Starch: 5% Sodium Carbonate Solution
Glutenin: 5% Lactic Acid Solution

Type of SRC Solvents	Weight of Solvent @ 14% Moisture Basis		
	Cracker Flour	*Cookie Flour*	*Wafer Flour*
100% Water	50 to 70	50 to 70	50 to 70
50% Sucrose	80 to 110	80 to 110	80 to 110
5% Sodium Carbonate (pH 11)	60 to 85	60 to 85	60 to 85
5% Lactic Acid (pH 2)	100 to 120	85 to 100	80 to 100

SRC values for Water, Sucrose, and Sodium Carbonate solvents are preferred to be lower than the figures listed in the table for weakness

SRC value of Lactic Acid solvent in return requires slightly higher than the figures listed in the table to provide some strength to the end products.

SRC Reference Guide – Hard Wheat Flour

Absorption: 100% Distilled Water
Pentosan: 50% Sucrose Solution
Damage Starch: 5% Sodium Carbonate Solution
Glutenin: 5% Lactic Acid Solution

Type of SRC Solvents	Weight of Solvent @ 14% Moisture Basis	
	Bakers Flour Range	**Target**
100% Water	**65-70**	**70**
50% Sucrose	**105-115**	**110**
5% Sodium Carbonate (pH 11)	**80-90**	**Max 88**
5% Lactic Acid (pH 2)	**>140**	**150**
Gluten Performance index	**0.75**	

Table of lab test correlations to bread volume – S. African study

	WhPro	W_Glu	D_Glu	F_Abs	F_Val	F_D_T	F_Stab	E_Area	E_R_Max	E_Ext	A_Str	A_Stab	A_Dist	VOLUME
WhPro	1.000													
W_Glu	0.883	1.000												
D_Glu	0.906	0.978	1.000											
F_Abs	0.409	0.488	0.478	1.000										
F_Val	0.512	0.406	0.473	0.452	1.000									
F_D_T	0.556	0.437	0.499	0.478	0.923	1.000								
F_Stab	0.352	0.191	0.265	0.286	0.872	0.820	1.000							
E_Area	0.397	0.263	0.339	0.184	0.713	0.648	0.746	1.000						
E_R_Max	0.138	0.015	0.083	0.111	0.650	0.549	0.719	0.912	1.000					
E_Ext	0.639	0.568	0.623	0.168	0.499	0.496	0.432	0.690	0.388	1.000				
A_Str	0.421	0.363	0.424	0.443	0.814	0.782	0.741	0.785	0.732	0.525	1.000			
A_Stab	-0.136	-0.056	-0.050	0.576	0.404	0.331	0.343	0.273	0.447	-0.133	0.564	1.000		
	0.628	0.490	0.543	-0.037	0.447	0.464	0.418	0.628	0.403	0.748	0.531	-0.282	1.000	
Volume	**0.521**	**0.562**	**0.582**	**0.122**	**0.408**	**0.387**	**0.253**	**0.350**	**0.180**	**0.537**	**0.464**	**0.005**	**0.531**	**1**

Table of Correlations greater than 70%

	WhPro	W_Glu	D_Glu	F_Abs	F_Val	F_D_T	F_Stab	E_Area	E_R_Max	E_Ext	A_Str	A_Stab	A_Dist	VOLUME
WhPro	1.000													
W_Glu	0.883	1.000												
D_Glu	0.906	0.978	1.000											
F_Abs				1.000										
F_Val					1.000									
F_D_T					0.923	1.000								
F_Stab					0.872	0.820	1.000							
E_Area					0.713		0.746	1.000						
E_R_Max							0.719	0.912	1.000					
E_Ext										1.000				
A_Str					0.814	0.782	0.741	0.785	0.732		1.000			
A_Stab												1.000		
A_Dist										0.748			1.000	
Volume														1.000

Protein:volume 52.1%
W.Gluten:Volume 56.2%
D.Gluten:Volume 58.2%
Extenso Ext: 53.7%

N=547 samples

‘Best Case’ Correlation Table

Single class, variety & State region.

	Wheat protein	Flour Protein	Wet Gluten	Gluten Index	Bake volume
Wheat Protein	100.0%				
Flour Protein	98.0%	100.0%			
Wet Gluten	93.1%	94.7%	100.0%		
Gluten Index	38.3%	40.7%	30.3%	100.0%	
VOLUME	73.0%	73.7%	75.4%	37.0%	100.0%

N= 16,670

PART 2 – a real world implementation of SRC.

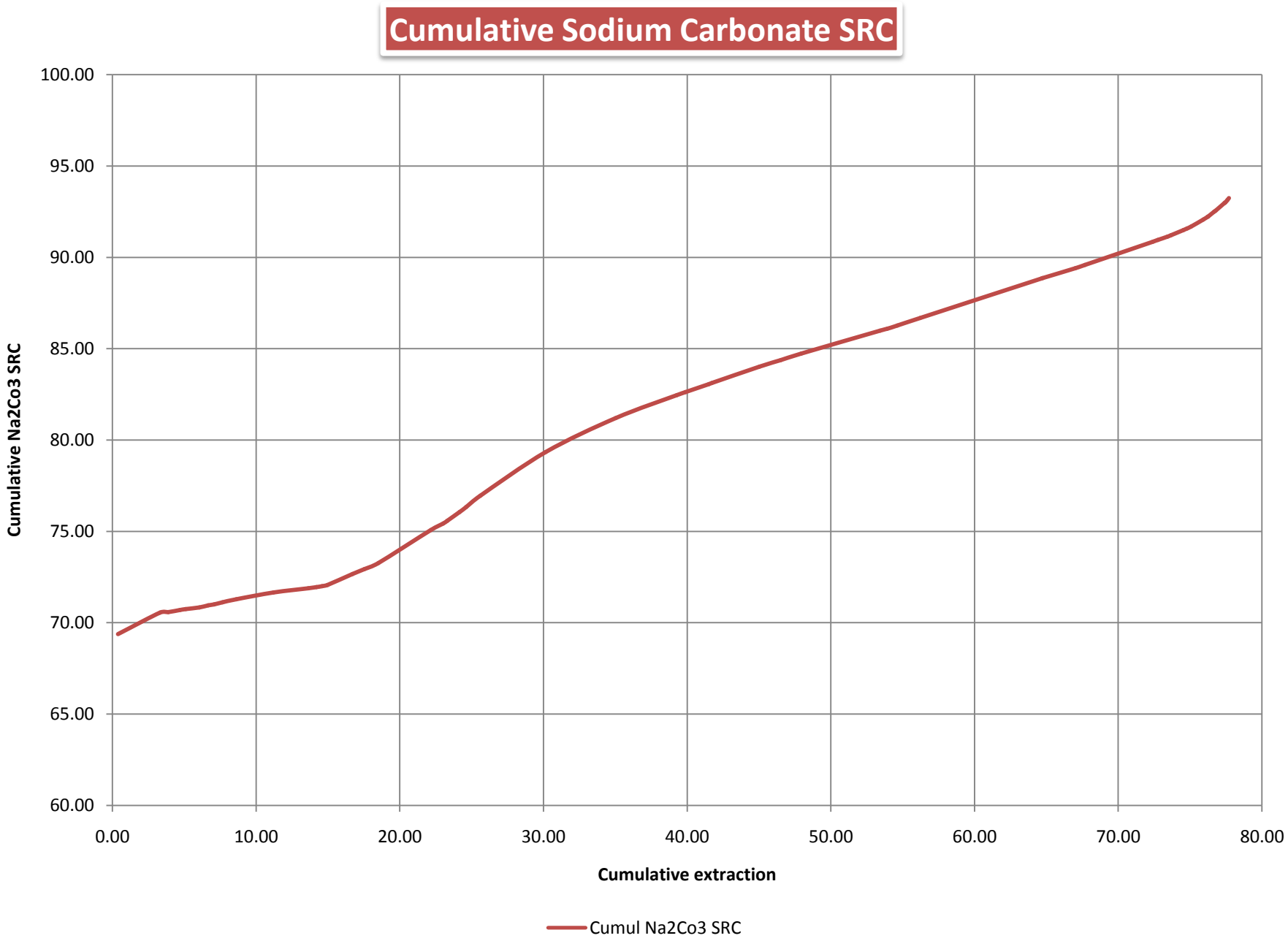
	Protein As is	*SRC Water*	*SRC Sucrose*	*SRC Lactic Acid*	*SRC Na2CO3*	***GPI***	*Water Absorbtion*	*Dev. Time*	*Stability*	*Dept. Time*	*MTI*	*Height NW (cm)*	*height LW (cm)*	*Volume NW (cc)*	*Volume LW (cc)*
Protein As is	1.000														
SRC Water	-0.238	1.000													
SRC Sucrose	-0.214	0.917	1.000												
SRC Lactic Acid	-0.403	-0.235	-0.039	1.000											
SRC Na2CO3	-0.255	0.975	0.923	-0.216	1.000										
Gluten performance Index	-0.083	-0.775	-0.645	0.775	-0.773	1.000									
Water Absorbtion	0.139	0.871	0.827	-0.463	0.874	-0.857	1.000								
Dev. Time	0.116	-0.608	-0.471	0.518	-0.580	0.707	-0.622	1.000							
Stability	0.027	-0.777	-0.668	0.421	-0.773	0.755	-0.805	0.786	1.000						
Dept. Time	0.009	-0.787	-0.648	0.602	-0.749	0.867	-0.801	0.759	0.782	1.000					
MTI	0.122	0.555	0.403	-0.447	0.559	-0.609	0.637	-0.549	-0.864	-0.605	1.000				
Height NW (cm)	-0.179	-0.552	-0.460	0.643	-0.620	**0.778**	-0.709	0.535	0.623	0.625	-0.609	1.000			
height LW (cm)	-0.261	-0.567	-0.447	0.699	-0.620	**0.813**	-0.739	0.538	0.647	0.643	-0.636	0.970	1.000		
Volume NW (cc)	-0.136	-0.585	-0.490	0.620	-0.654	**0.784**	-0.727	0.552	0.640	0.637	-0.613	0.997	0.966	1.000	
Volume LW (cc)	-0.218	-0.595	-0.473	0.680	-0.649	**0.821**	-0.755	0.553	0.668	0.658	-0.650	0.969	0.997	0.969	1.000

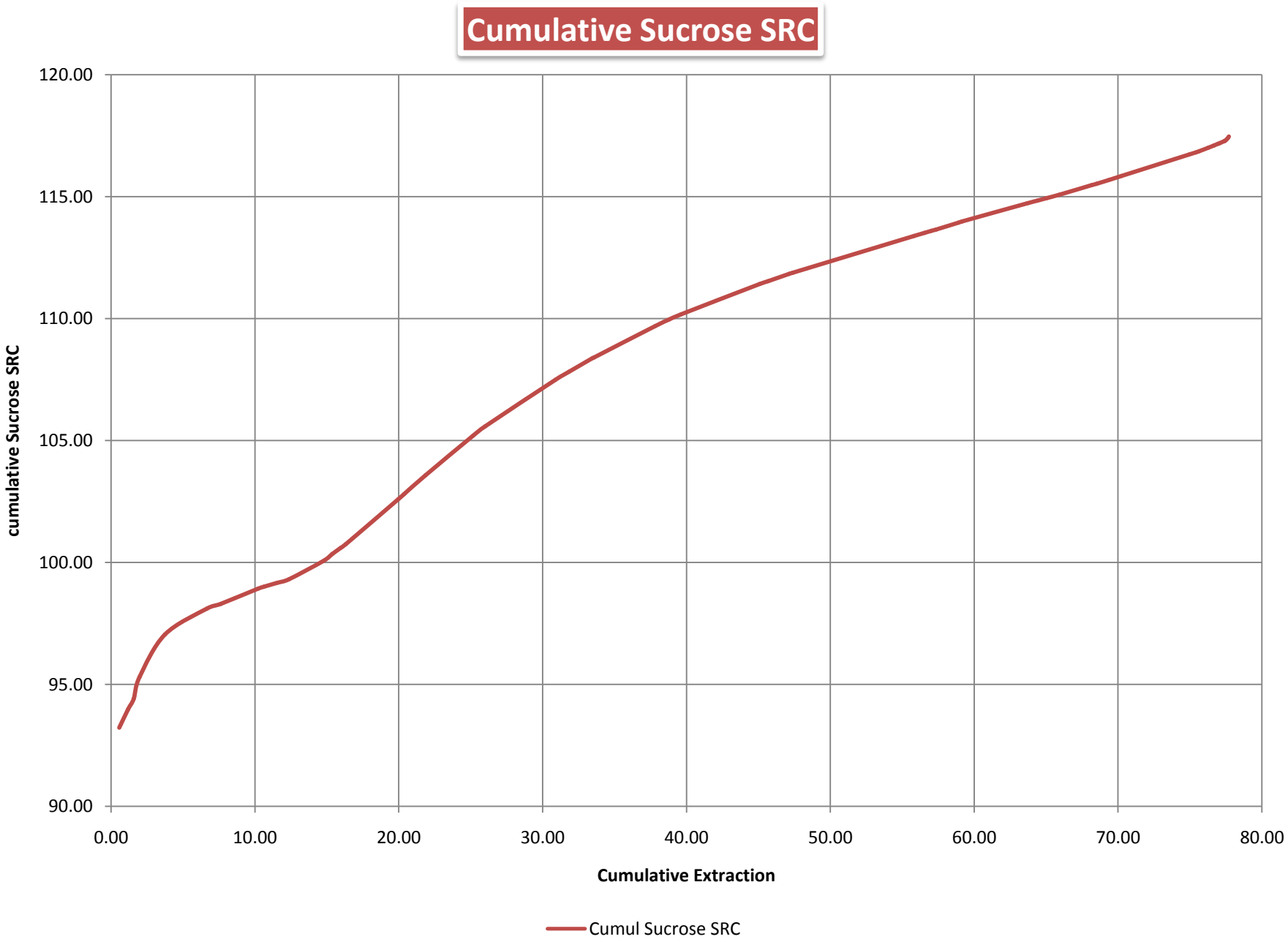
SRC correlations on blended wheat flour from different origins, classes and varieties

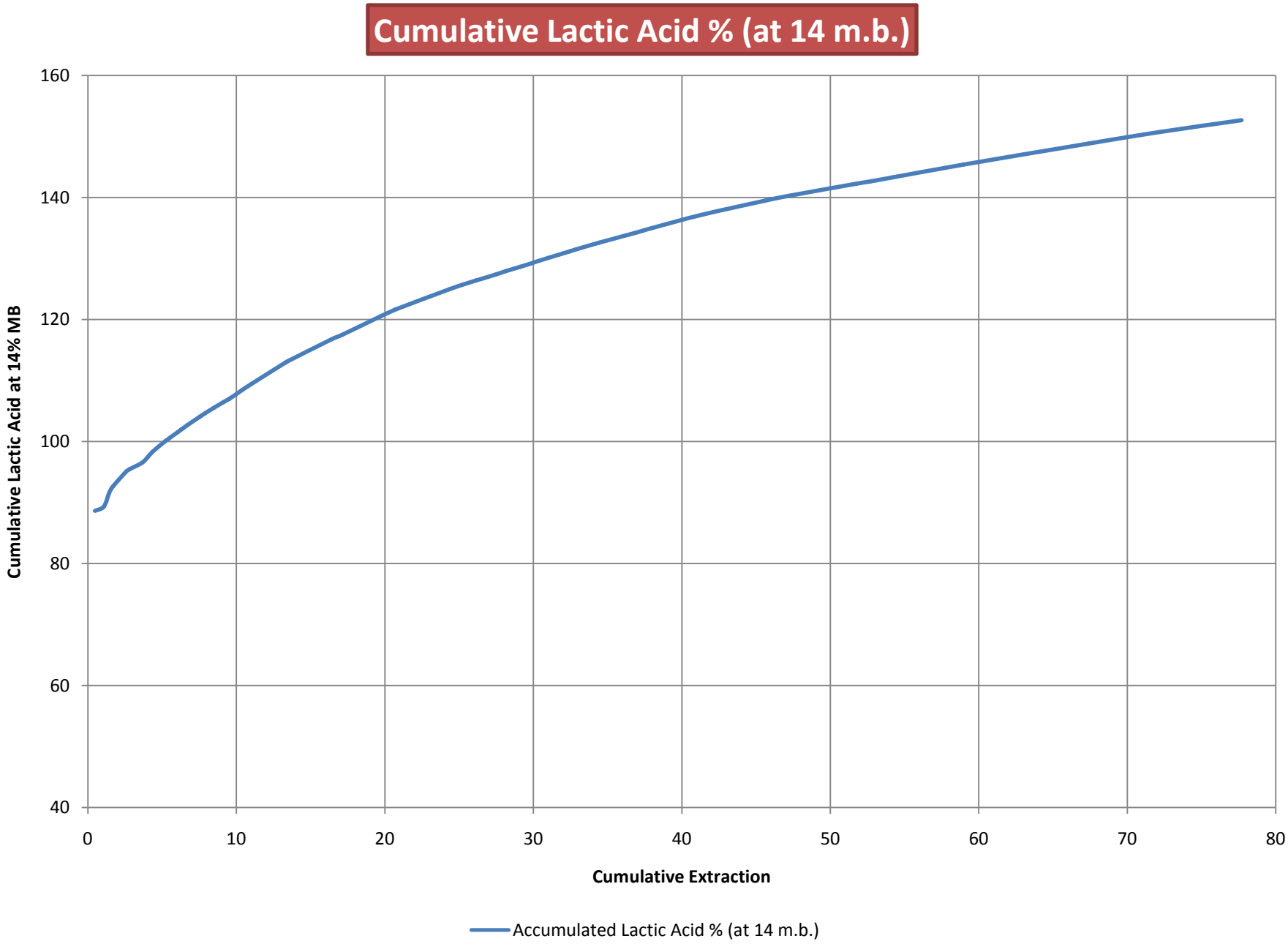
	Protein As is	SRC Water	SRC Sucrose	SRC Lactic Acid	SRC Na2CO3	Gluten performance Index
Protein As is	100.0%					
SRC Water	-23.8%	100.0%				
SRC Sucrose	-21.4%	91.7%	100.0%			
SRC Lactic Acid	-40.3%	-23.5%	-3.9%	100.0%		
SRC Na2CO3	-25.5%	97.5%	92.3%	-21.6%	100.0%	
Gluten performance Index	-8.3%	-77.5%	-64.5%	77.5%	-77.3%	100.0%
Water Absorbtion	13.9%	87.1%	82.7%	-46.3%	87.4%	-85.7%
Dev. Time	11.6%	-60.8%	-47.1%	51.8%	-58.0%	70.7%
Stability	2.7%	-77.7%	-66.8%	42.1%	-77.3%	75.5%
Dept. Time	0.9%	-78.7%	-64.8%	60.2%	-74.9%	86.7%
MTI	12.2%	55.5%	40.3%	-44.7%	55.9%	-60.9%
Height NW (cm)	-17.9%	-55.2%	-46.0%	64.3%	-62.0%	**77.8%**
height LW (cm)	-26.1%	-56.7%	-44.7%	69.9%	-62.0%	**81.3%**
Volume NW (cc)	-13.6%	-58.5%	-49.0%	62.0%	-65.4%	**78.4%**
Volume LW (cc)	-21.8%	-59.5%	-47.3%	68.0%	-64.9%	**82.1%**

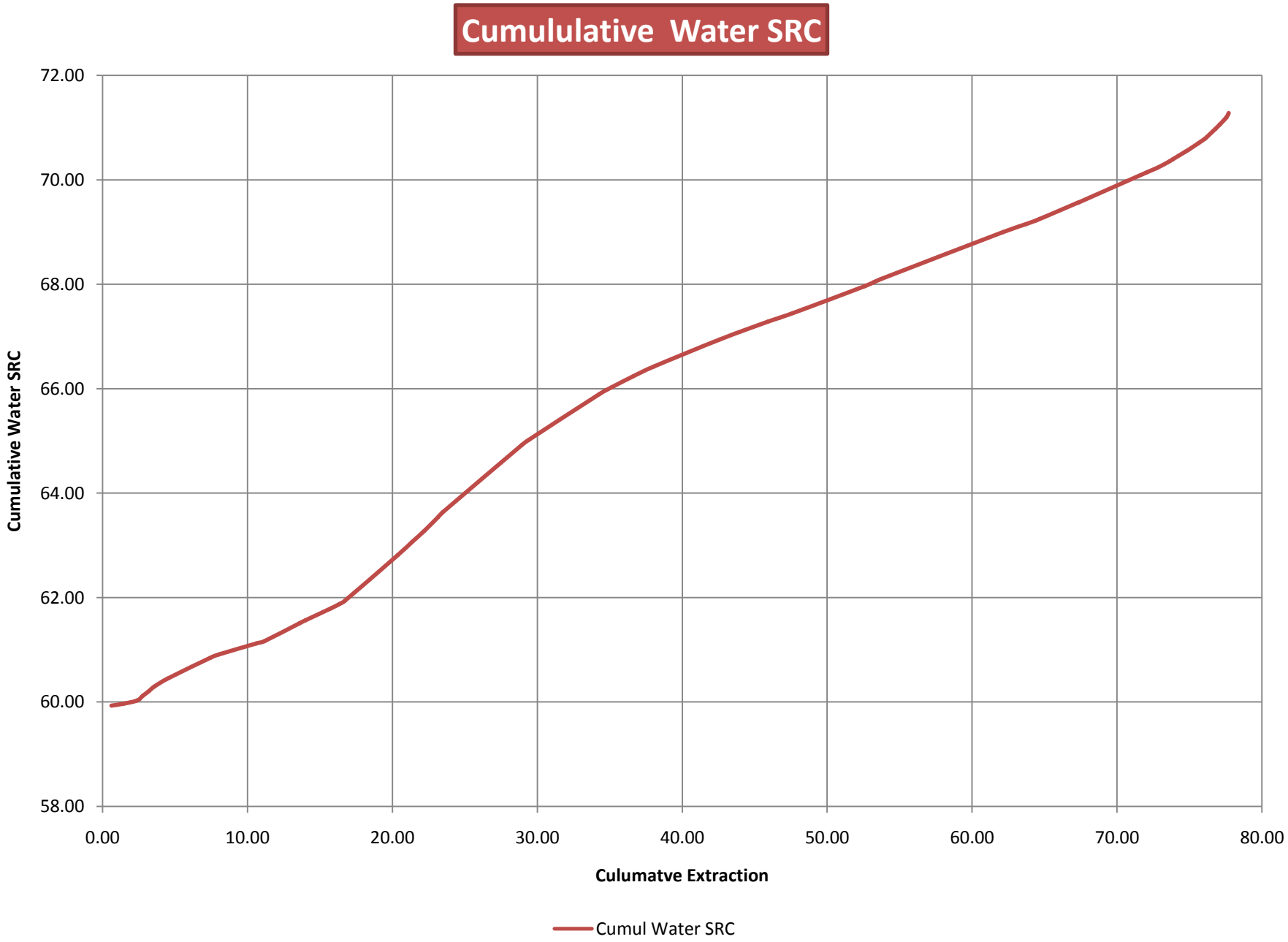
Mill Stream Analysis

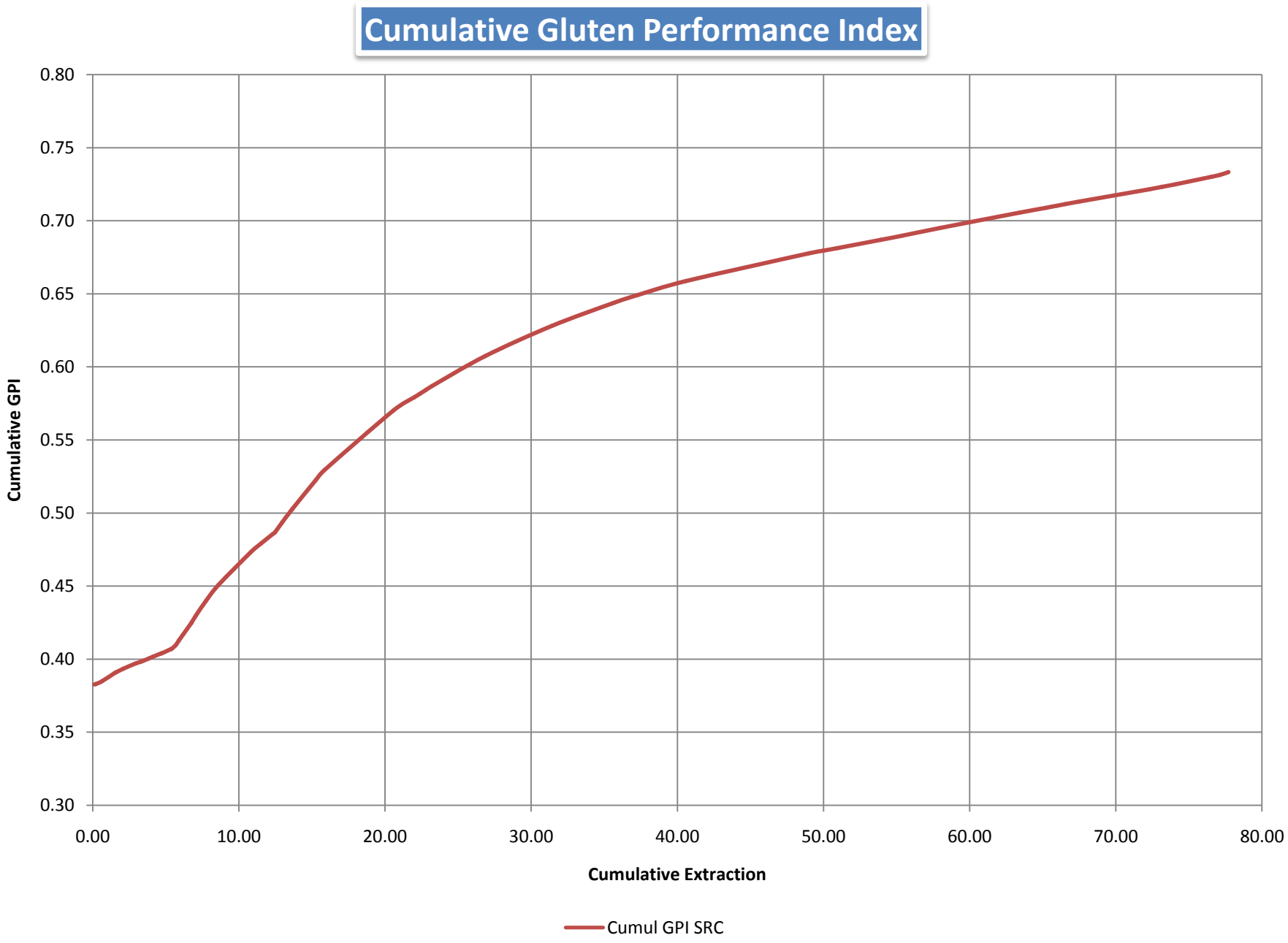
Reduction stages	Yield in %	Moisture (%)	Ash db (%)	SRC			
				Water	Sucrose	Lactic Acid	Na_2CO_3
C3A G (I)	**8.44**	13.08	0.35	74.73	121.83	**173.20**	103.23
C1/2A F (I)	**4.86**	14.80	0.38	71.19	117.62	**177.00**	92.79
C3A H (I)	**4.71**	12.93	0.38	78.38	129.94	**169.18**	109.20
C1/2A H (I)	**5.48**	14.24	0.38	70.48	120.42	**177.94**	96.95
C1/2A F (II)	**0.97**	14.13	0.40	69.66	120.13	**163.80**	92.69
C1/2AH (II)	**1.48**	14.21	0.40	71.22	114.12	**166.05**	95.48
C1/2A G (II)	**1.63**	14.13	0.41	72.06	119.33	**162.80**	93.68
C1/2A G (I)	**3.31**	14.19	0.41	71.62	115.93	**161.78**	95.28
C5 H (I)	**4.25**	13.32	0.43	73.03	119.86	**161.93**	92.80
C5 G (I)	**4.57**	13.44	0.44	71.28	124.54	**162.89**	92.74
C3 B (II)	**1.76**	14.00	0.44	63.60	99.00	**145.60**	77.80
C3 B (I)	**3.65**	14.04	0.47	66.82	110.82	**144.03**	84.22
C1/2B K (I)	**1.58**	13.90	0.48	75.20	124.34	**155.90**	101.17
C3A G (II)	**0.11**	12.41	0.50	78.11	119.34	**130.34**	104.03
C1/2B J (I)	**1.44**	14.04	0.52	71.28	121.10	**154.12**	96.29
C5 H (II)	**0.50**	12.68	0.53	74.72	123.57	**146.61**	96.98
C5 G (II)	**0.71**	13.09	0.53	75.74	123.24	**149.56**	99.29
DIV 1 F (II)	**0.61**	14.39	0.54	59.93	94.68	**117.59**	71.98
DIV 1 E (I)	**2.59**	14.84	0.55	61.78	100.76	**140.35**	72.89
DIV 1 E (II)	**0.57**	14.37	0.56	61.70	93.23	**161.12**	70.73
B2 A (I)	**0.81**	14.75	0.57	60.00	101.36	**147.36**	71.29
B2 C (I)	**0.95**	14.88	0.58	61.05	101.06	**149.76**	71.35
B2 B (I)	**0.97**	18.74	0.58	68.27	118.44	**153.36**	79.28
DIV 3 (II)	**0.36**	14.17	0.58	64.53	107.61	**152.30**	74.95
DIV 1 F (I)	**2.93**	14.46	0.58	61.46	99.47	**133.25**	70.71
B2 D (I)	**0.96**	15.14	0.60	60.12	99.65	**143.83**	72.69
DIV 3 (I)	**2.44**	14.58	0.62	63.10	103.98	**156.93**	72.97
C3A H (II)	**0.04**	11.45	0.62	93.27	148.82	**143.97**	133.28
B1 C (I)	**0.40**	15.39	0.66	60.80	100.85	**125.44**	71.98
B3 C (I)	**0.59**	15.03	0.67	64.17	107.28	**160.72**	72.47
B1 D (I)	**0.40**	14.87	0.68	61.03	98.81	**123.86**	71.33
B3 D (I)	**0.40**	14.76	0.69	63.44	113.28	**155.86**	73.74
B3 B (I)	**0.56**	14.85	0.69	62.00	107.25	**150.68**	73.31
B1 E (I)	**0.39**	15.11	0.70	60.67	95.73	**119.23**	69.39
C4 (I)	**0.68**	13.37	0.74	84.65	124.95	**134.48**	110.46
C6 (I)	**2.25**	13.17	0.84	77.19	126.81	**129.78**	104.82
C6 (II)	**0.67**	12.94	0.88	78.60	124.63	**126.01**	107.05
DF (II)	**0.30**	13.61	1.05	70..23	123.79	**114.43**	87.95

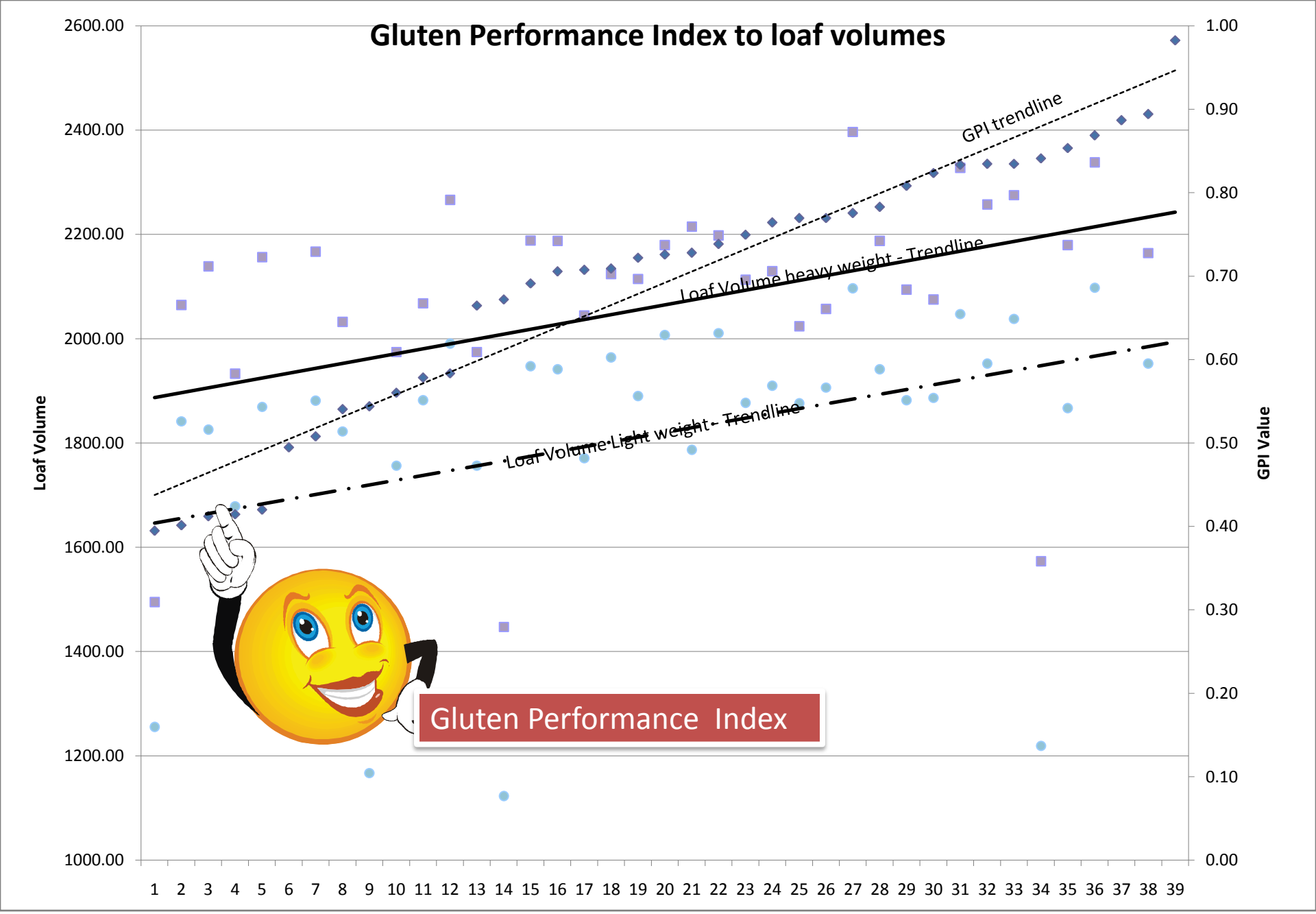

Cumulative Sodium Carbonate SRC
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
Cumulative Na2Co3 SRC
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Cumulative extraction
Cumul Na2Co3 SRC


Cumulative Sucrose SRC
120.00
115.00
110.00
105.00
100.00
95.00
90.00
cumulative Sucrose SRC
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Cumulative Extraction
Cumul Sucrose SRC


Cumulative Lactic Acid % (at 14 m.b.)
160
140
120
100
80
60
40
Cumulative Lactic Acid at 14% MB
0
10
20
30
40
50
60
70
80
Cumulative Extraction
Accumulated Lactic Acid % (at 14 m.b.)

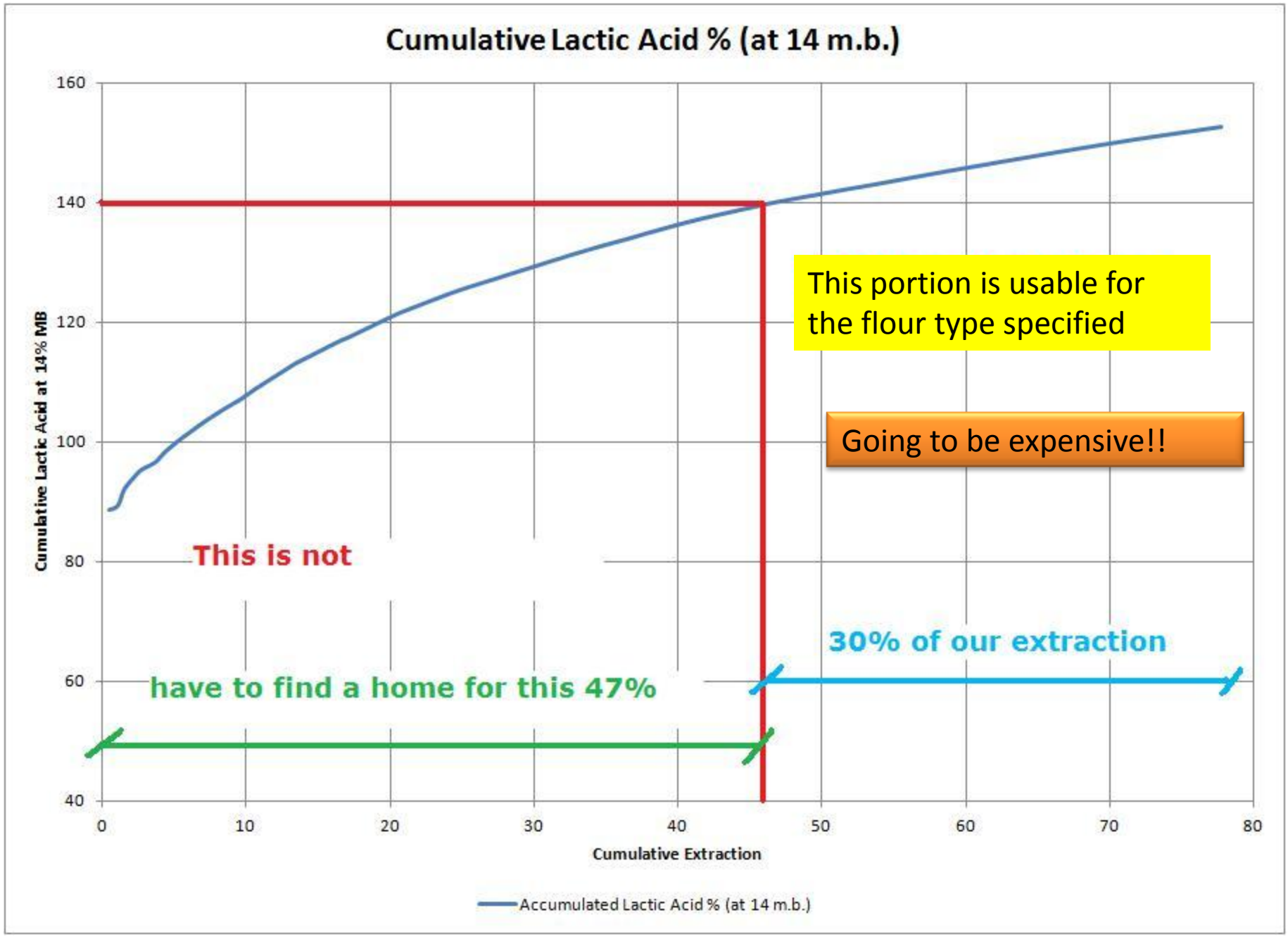

Cumululative Water SRC
72.00
70.00
68.00
66.00
64.00
62.00
60.00
58.00
Cumulative Water SRC
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Culumatve Extraction
Cumul Water SRC


Cumulative Gluten Performance Index
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
Cumulative GPI
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Cumulative Extraction
Cumul GPI SRC

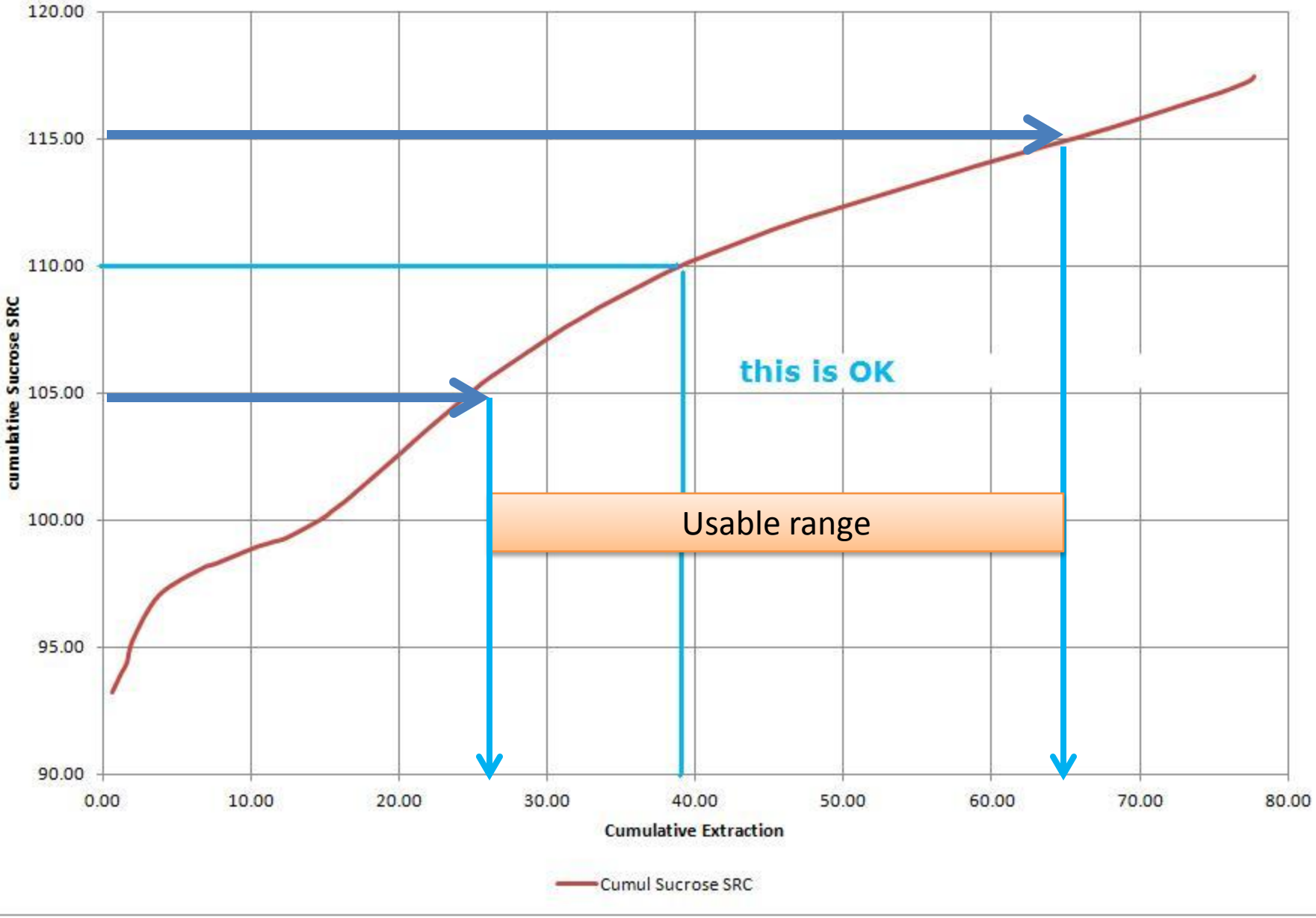

Gluten Performance Index to loaf volumes
Loaf Volume
GPI Value
2600.00
2400.00
2200.00
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
GPI trendline
Loaf Volume heavy weight - Trendline
Loaf Volume Light weight - Trendline
Gluten Performance Index

Can I make this type of flour?

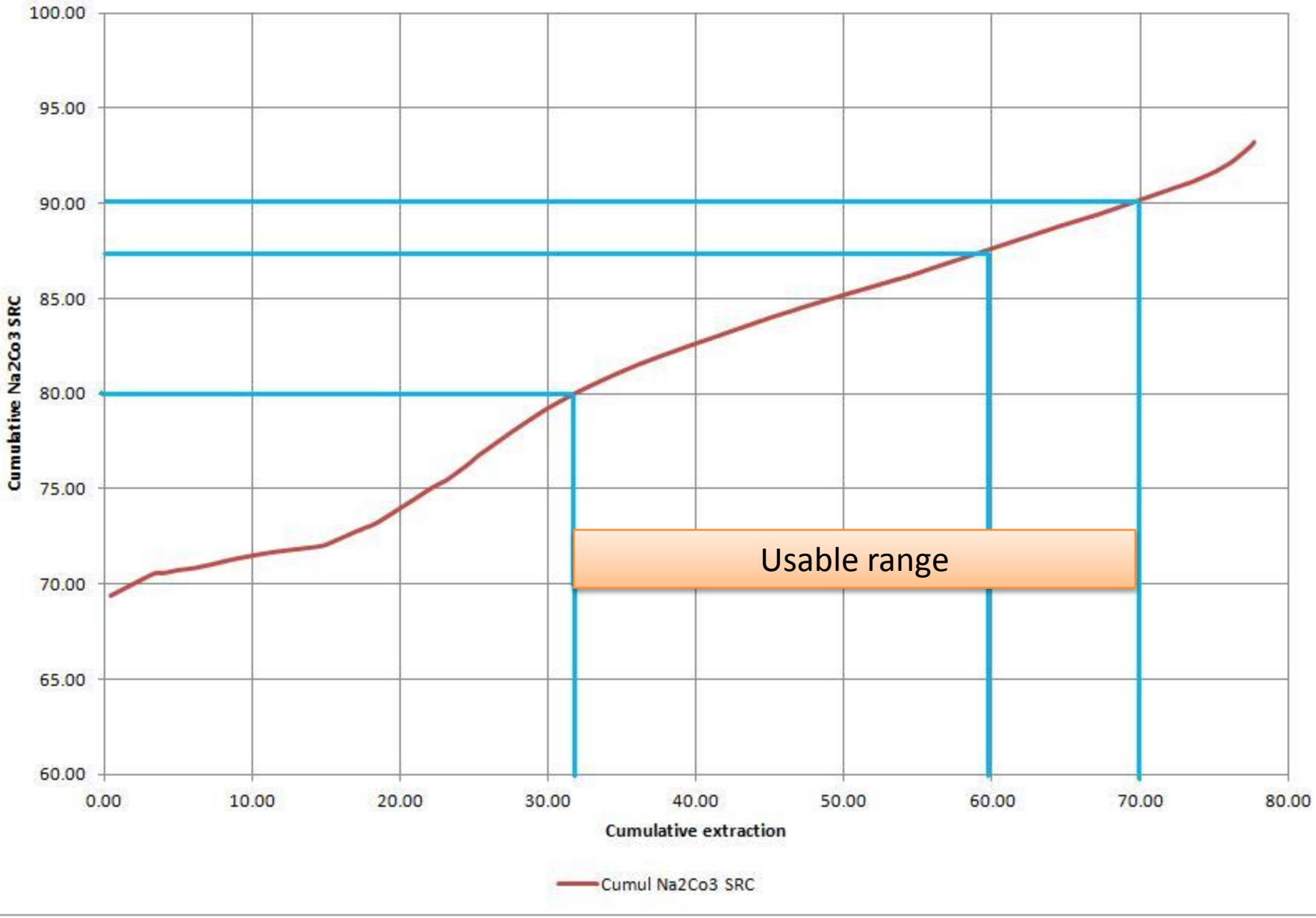
Type of SRC Solvents	Weight of Solvent @ 14% Moisture Basis	
	Bakers Flour Range	**Target**
100% Water	65-70	70
50% Sucrose	105-115	110
5% Sodium Carbonate (pH 11)	80-90	Max 88
5% Lactic Acid (pH 2)	>140	150
Gluten Performance index	0.75	

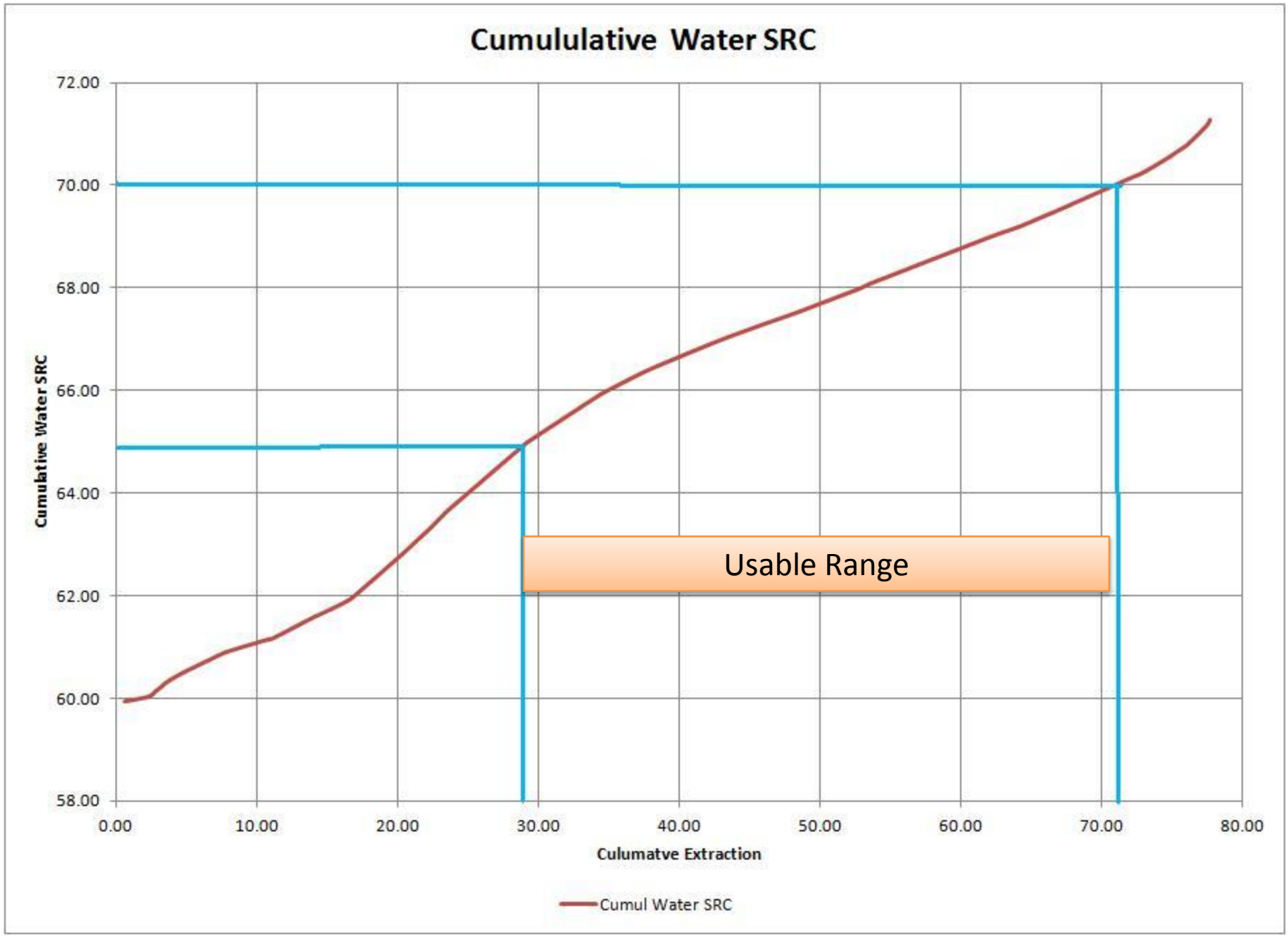

Cumulative Lactic Acid % (at 14 m.b.)
Cumulative Lactic Acid at 14% MB
160
140
120
100
80
60
40
0
10
20
30
40
50
60
70
80
Cumulative Extraction
This portion is usable for the flour type specified
Going to be expensive!!
This is not
30% of our extraction
have to find a home for this 47%
Accumulated Lactic Acid % (at 14 m.b.)

Cumulative Sucrose SRC

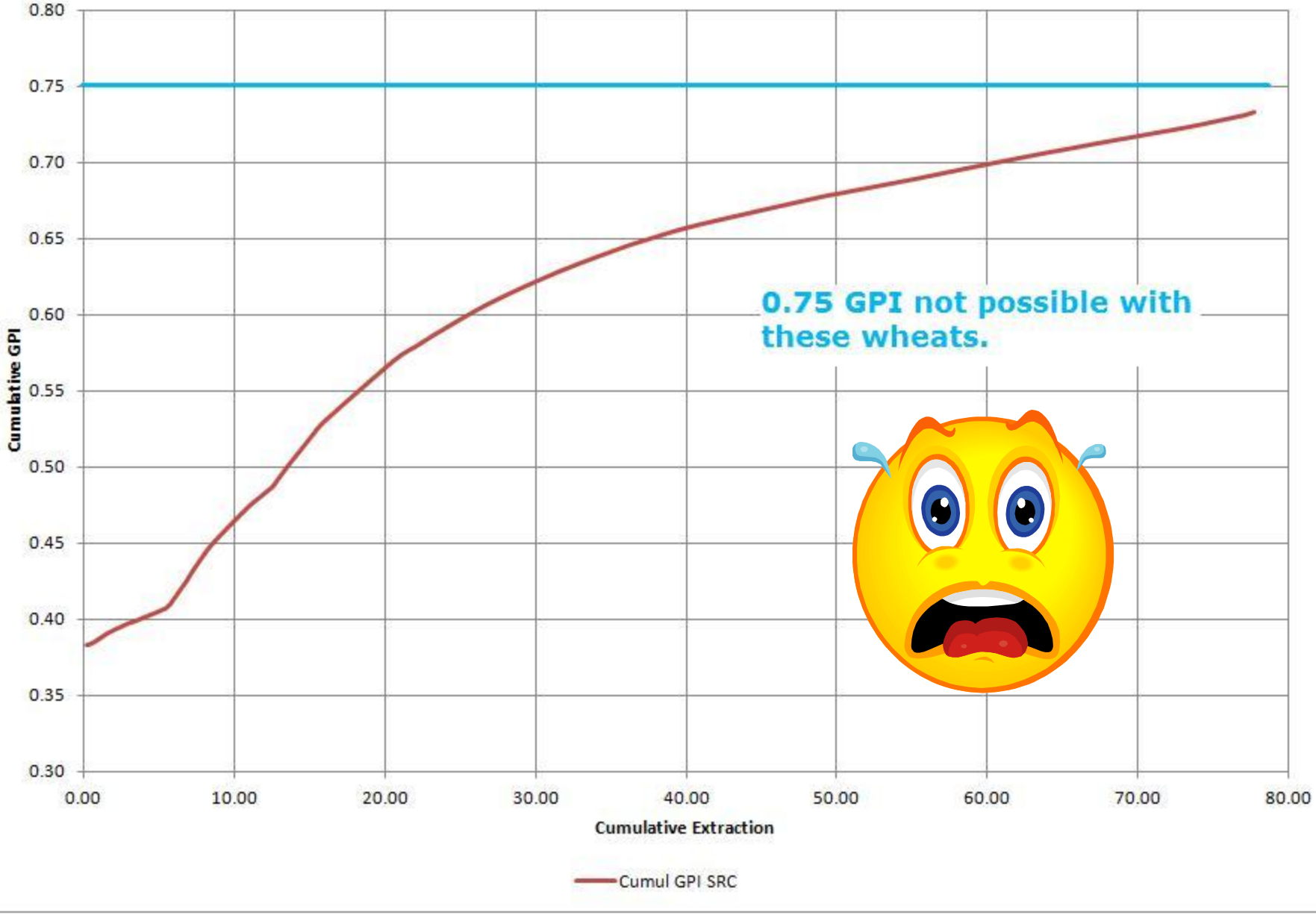


Cumulative Sodium Carbonate SRC




Cumululative Water SRC
72.00
70.00
68.00
66.00
64.00
62.00
60.00
58.00
Cumulative Water SRC
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
Culumatve Extraction
Usable Range
Cumul Water SRC

Cumulative Gluten Performance Index



Conclusions

1. The type of flour specified cannot be made with any streams of the type of wheat we had on the mill!

2. If we were able to make the GPI, then the flour price would be very high due to only 30% extraction.

3. Better to find this out before we supply the customer than afterwards!

Back to the drawing board!

$$$ Opportunities for you!

- Select wheat based on SRC functionality and not ‘conventional’ measures (protein).
- This may give you some significant price advantages i.e. better functional performance at a lower protein (and therefore price).
- Functional consistency of your wheat is very important in this approach.
- SRC is a key to higher customer satisfaction on most industrial flour processes.

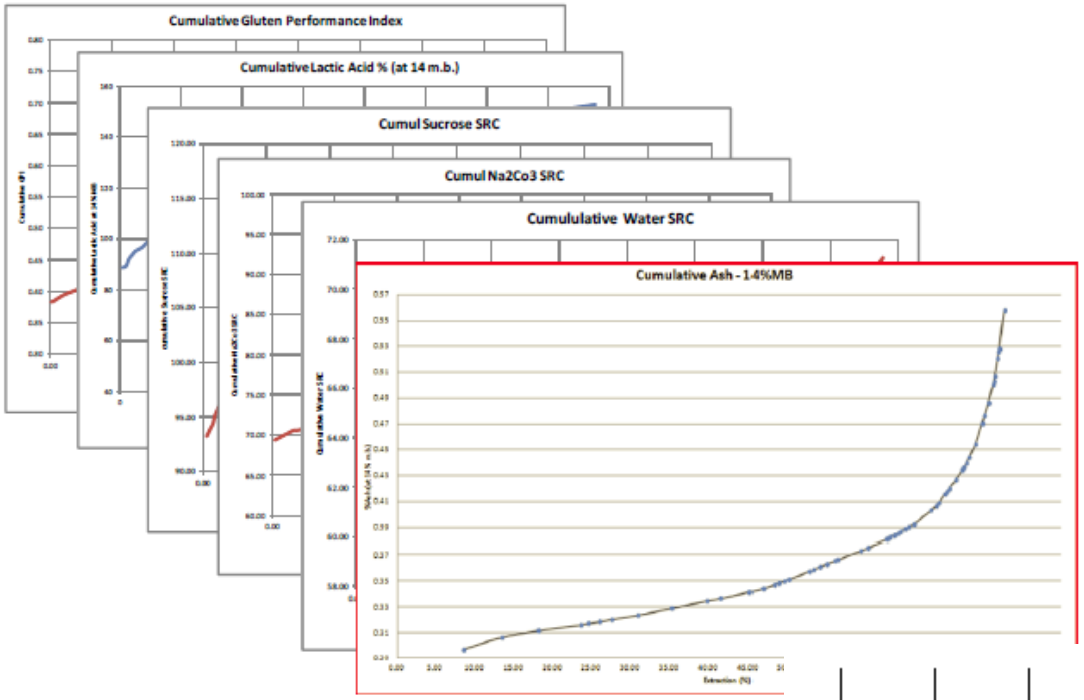
Conclusions

1. The type of flour specified cannot be made with any streams of the type of wheat we had on the mill!

2. If we were able to make the GPI, then the flour price would be very high due to only 30% extraction.

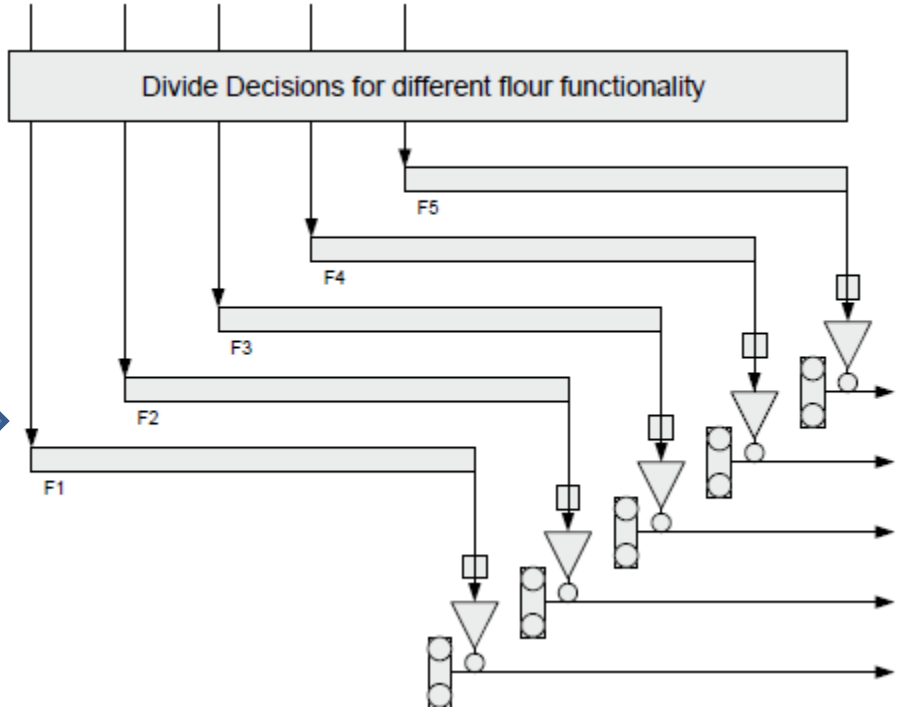
3. Better to find this out before we supply the customer than afterwards!

Back to the drawing board!



Knowing these

You can optimize these!



This means giving the customer what he or she values most!

Further Reading

**OPTIMIZING WHEAT BLENDS FOR
CUSTOMER VALUE CREATION:
A SPECIAL CASE OF SOLVENT RETENTION CAPACITY**

by

NIKOLAS C HAAS
B.S., Kansas State University, 2006

Thank You for your valued business, and for your attention today.
We wish you every success for the future!