

Nottingham Water Treatment Notes March 2014

This topic was lead by Dominic Driscoll from Thornbridge Brewery. Members were encouraged to focus on Chlorides and Sulphates, whilst using lactic acid to control mash pH. Dominic observed that the commonly used AMS is typically a combination of two thirds sulphuric acid and one third hydrochloric acid, meaning it substantially increases both sulphate and chloride ion levels. A reasonable pH meter or test strips were advocated as a means to measure liquor and mash pH.

Tim L. our chairman for the day had brewed four identical English Pale Ales using four classic British waters. These had been created by adding being salts to Tesco Ashbeck water, and the results of AMS titrations were shown to illustrate the alkalinity of the different water types (see presentation and hand-out notes below). The group tasted the four beers, which differed subtly, and feedback was often conflicting without any clearly evident characteristics However, when asked to vote on which profile they most and least preferred, the feedback was much clearer:

Which would you most like to drink? – Burton (15 in-favour, 0 against)

Which would you least like to drink? – London (0 in-favour, 18 against)

Brewing Water Comparison – MCB March 2014 Meeting

Source Water – Tesco Ashbeck Water

UK sourced and, judging by low mineral content, possibly purified through a reverse osmosis process. Chosen for this universally low mineral content and ease of availability at reasonable cost (22p per litre). Tesco claim pH 6.1 and it was measured as pH6.7, falling to pH6.3 when Campden added. However, consistency problems were experienced with the pH meter in the latter part of brewday, so readings should be viewed with caution (refer to titration).

The following mineral content is stated on the bottles and, whilst this was not tested, it is expected that, as this is assumed to be a product from a manufacturing process, it will have a relatively consistent composition.

Calcium	Magnesium	Bicarbonate	Sulphate	Sodium	Chloride
Ca+	Mg+	HCO ₃ ⁻	SO ₄ ⁻	Na+	Cl ⁻
10	2.5	25	10	9	12

Salt additions were made to achieve the four classic UK water profiles.

Comparison Ale Recipe

Using grain bill from Peter Fawcett's entry to CCB "Chiswick Challenge"; an Ordinary English Bitter. This was chosen as a malt bill which could be different things to different waters. A total volume of 6 litres treated liquor applied to the following, with 65C mash at 2.5L/kg:

- 900g Maris Otter Pale Malt
- 60g Crystal Malt 150 EBC
- 30g Amber Malt 100 EBC
- 25g Flaked Maize
- 25g Mount Hood 5.4% AA for 15mins (pressure cooker)

A 15g pack of Malt Miller West Coast yeast was split evenly between the batches; pitching at 20C. The yeast was chosen for its reported low flavour; allowing the hops and malt flavours to be better understood. Fermented in a steady 18C environment.

The following original gravities were measured:

London OG 1050
 Edinburgh OG 1045
 Burton OG 1047
 Dublin OG 1048

London - High temporary hardness.

Calcium	Magnesium	Bicarbonate	Sulphate	Sodium	Chloride
Ca+(ppm)	Mg+(ppm)	HCO3-(ppm)	SO4-(ppm)	Na+(ppm)	Cl-(ppm)
52	32	104	32	86	34
90	4	246	58	24	18
50	20	n/a	80	100	60
52	16	156	77	99	60
100	5	265	50	35	60
52	32	104	32	86	34
70	6	166	40	15	38
55	8	158	57	37	36

Salt Addition	grams/litre
Chalk CaCO3	0.1
Baking Soda NaHCO3	0.1
Gypsum CaSO4	0.05
Calcium Chloride CaCl2	0.05
Epsom Salt MgSO4	0.05
Canning Salt NaCl	-

Edinburgh

Calcium	Magnesium	Bicarbonate	Sulphate	Sodium	Chloride
Ca+(ppm)	Mg+(ppm)	HCO3-(ppm)	SO4-(ppm)	Na+(ppm)	Cl-(ppm)
100	18	160	105	20	45
n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a
120	25	225	140	55	20
100	18	235	105	20	45
125	25	225	140	55	65
100	20	285	140	55	50
103	23	238	144	29	42

Salt Addition	grams/litre
Chalk CaCO ₃	0.35
Baking Soda NaHCO ₃	-
Gypsum CaSO ₄	0.1
Calcium Chloride CaCl ₂	-
Epsom Salt MgSO ₄	0.2
Canning Salt NaCl	0.05

Treated liquor pH8.1, mash pH 6.0 (see warning on pH meter)

Burton - High sulphate

Calcium	Magnesium	Bicarbonate	Sulphate	Sodium	Chloride
Ca+(ppm)	Mg+(ppm)	HCO₃-(ppm)	SO₄-(ppm)	Na+(ppm)	Cl-(ppm)
352	24	320	820	44	16
268	62	282	638	30	36
294	24	n/a	800	24	36
295	45	300	725	55	25
270	41	270	720	113	85
352	24	320	820	54	16
275	40	270	610	25	35
306	42	285	724	52	36

Salt Addition	grams/litre
Chalk CaCO ₃	0.25
Baking Soda NaHCO ₃	0.15
Gypsum CaSO ₄	1.0
Calcium Chloride CaCl ₂	0.05
Epsom Salt MgSO ₄	0.4
Canning Salt NaCl	-

Treated liquor pH7.9 (see warning on pH meter)

Dublin - High carbonate alkalinity

Calcium	Magnesium	Bicarbonate	Sulphate	Sodium	Chloride
Ca+(ppm)	Mg+(ppm)	HCO₃-(ppm)	SO₄-(ppm)	Na+(ppm)	Cl-(ppm)
118	4	319	54	12	19
80	19	328	5	1	1
120	4	n/a	54	12	19
115	4	200	55	12	19
110	4	280	53	12	19
118	4	319	54	12	19
120	4	315	55	12	19
111	3	298	38	9	12

Salt Addition	grams/litre
Chalk CaCO ₃	0.45
Baking Soda NaHCO ₃	-
Gypsum CaSO ₄	0.05
Calcium Chloride CaCl ₂	-
Epsom Salt MgSO ₄	-
Canning Salt NaCl	-

Treated liquor pH7.7, mash pH 5.8 (see warning on pH meter)

Notes

For each of the profiles, a number of differing sources were accessed to determine the concentration of the six principal brewing ions for the style, these are identified as follows.

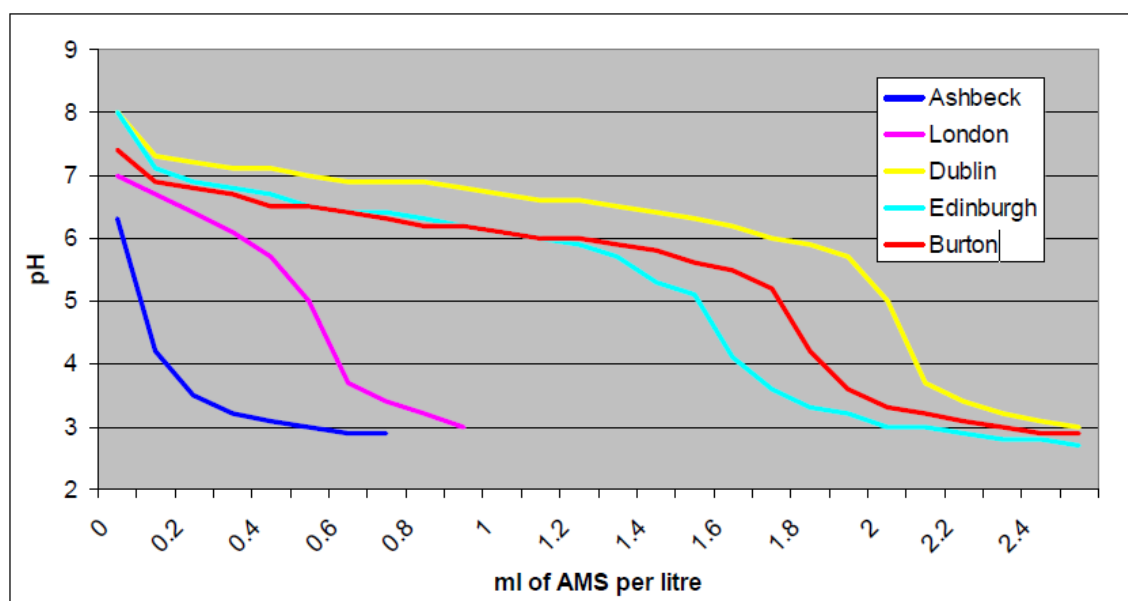
- 1st row – John Palmer (How to Brew website)
- 2nd row – Ashton Lewis (BYO website)
- 3rd row – Brewer’s Lair website
- 4th row – Beersmith website
- 5th row – Brewer’s Friend Calculator website
- 6th row – Water –Table 15 (John Palmer and Colin Kaminski)
- 7th row – Water –Table 16 (John Palmer and Colin Kaminski)

The final (emboldened) row on each table details the mineral profile resulting from the addition of the stated salts.

Observations

- Chalk is very difficult to dissolve and the liquor remained cloudy even after heating. (Palmer & Kaminski advises this approach is ineffective)
- A 15 minute boil in a pressure cooker with Protofloc gave an acceptable hot and cold break.
- The Burton wort initially fermented with a cleaner and paler yeast head, even after rousing all four worts. All fermentations finished at the same time.

Due to issues with the pH meter on brew-day, water samples were subsequently re-created and titrations conducted using AMS:



Water Comparison Brewing

Tim L

Aims of Exercise

1. Understand water mineral composition
2. Understand “British” water profiles
3. Understand the impact on a beer

Challenges

- a) Need water samples
 - b) Can't split a brew four ways
 - c) Making identical batches
 - d) Only 24 hours in a day!
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Sourcing Water

- Impractical to travel Britain
- Obtain cheap low-mineral base water
- Find means to calculate salts



Calcium	Magnesium	Bicarbonate	Sulphate	Sodium	Chloride
Ca ⁺	Mg ⁺	HCO ₃ ⁻	SO ₄ ⁻	Na ⁺	Cl ⁻
10	2.5	25	10	9	12

Choosing & Creating the Profiles

- Chose the basic four “British” profiles
- Information on composition varies
- Chalk difficult to dissolve:

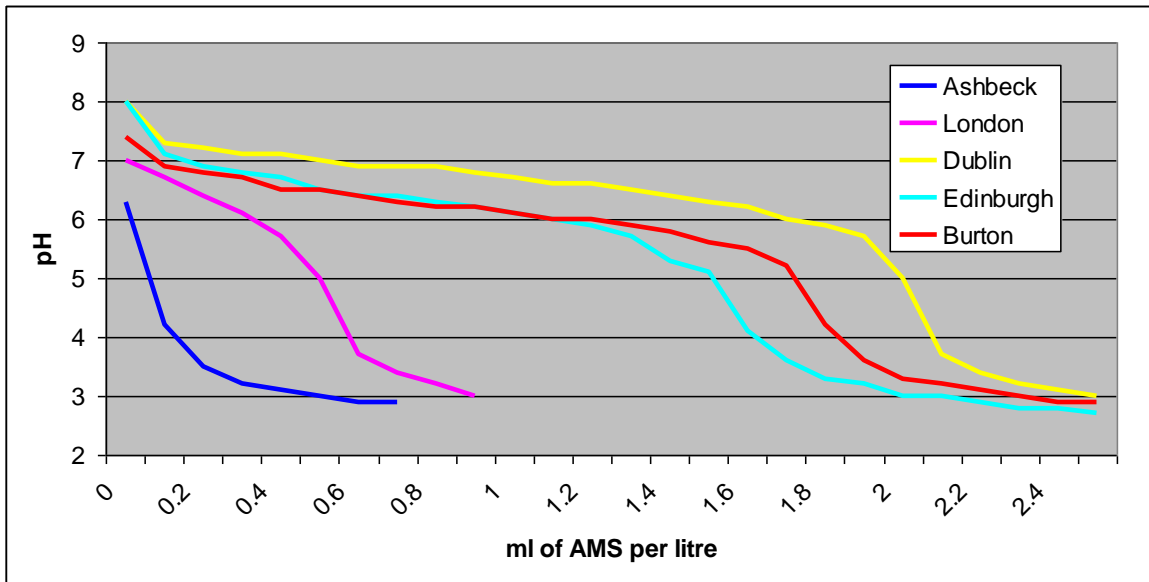


Modifying the Water

Salt Addition grams/litre	London	Edinburgh	Burton	Dublin
Chalk CaCO_3	0.1	0.35	0.25	0.45
Baking Soda NaHCO_3	0.1	-	0.15	-
Gypsum CaSO_4	0.05	0.1	1.0	0.05
Calcium Chloride CaCl_2	0.05	-	0.05	-
Epsom Salt MgSO_4	0.05	0.2	0.4	-
Grinding Salt NaCl	-	0.05	-	-

	Calcium Ca^+ (ppm)	Magnesium Mg^+ (ppm)	Bicarbonate HCO_3^- (ppm)	Sulphate SO_4^- (ppm)	Sodium Na^+ (ppm)	Chloride Cl^- (ppm)
Ashbeck	10	2.5	25	10	9	12
London	55	8	158	57	37	36
Edinburgh	103	23	238	144	29	42
Burton	306	42	285	724	52	36
Dublin	111	3	298	38	9	12

Water Titration Results



Chalk Haze disappeared at Ph5 for all titrations – the major buffering element?

Correcting to pH 5.8 with AMS

	Calcium Ca ⁺ (ppm)	Magnesium Mg ⁺ (ppm)	Bicarbonate HCO ₃ ⁻ (ppm)	Sulphate SO ₄ ⁻ (ppm)	Sodium Na ⁺ (ppm)	Chloride Cl ⁻ (ppm)
Ashbeck	10	2.5	25	10	9	12
				19		18
London	55	8	158	57	37	36
				92		62
Edinburgh	103	23	238	144	29	42
				260		126
Burton	306	42	285	724	52	36
				848		126
Dublin	111	3	298	38	9	12
				207		134

Choosing a recipe (thanks Peter!)

900g Maris Otter Pale Malt

60g Crystal Malt 150 EBC

30g Amber Malt 100 EBC

25g Flaked Maize

25g Mount Hood 5.4%AA for 15mins

2.5 litres/kg mash at 65C

6 litre brew length

Malt Miller West Coast yeast

FVs Included – thanks Tesco!

Why
Different?

London
OG 1050

Burton
OG 1047

Dublin
OG 1048

Edinburgh
OG 1045



The water treatment survey was completed by 21 of our members with the following results:

1. All respondents use tap water except Peter F and Allan G. Peter uses Asda Smartprice for mashing due to the high carbonate and nitrate content of his water in Lincolnshire. Allan normally uses tap water but a 50/50 mix of tap water and Aqua Pura when brewing Lagers.
2. Only one of our members (Russell P) uses Reverse Osmosis water and another (Alan Q) uses a Charcoal Filter for his 100 litre plant.
3. Although brewing books regard the removal of chlorine as essential, 40% of respondents take no steps whatsoever. 50% leave their water to stand, with or without a Campden tablet, for varying lengths of time. Only 35% use a Campden tablet and 2 rely on agitation of the water. An investigation into best practice seems to indicate that a Campden tablet will remove the chlorine straight away, with any residue helping to prevent staling of the beer in storage. There therefore seems to be no disadvantage in using a tablet as a matter of course.
4. Apart from the removal of chlorine, 2/3rds of respondents treat their liquor in one form or another.
5. 75% of respondents are aware of the relevant minerals that their brewing liquor contains. This information usually comes from Water Board Reports. One member (Russell P) uses a home test kit.
6. 50% of members know how to use Water Board Reports to work out their alkalinity.
7. With regard to the relevant mineral/alkalinity requirements of the different styles of beer, 2/3rds of us are aware of this with information coming from various sources, including brewing books and Murphys technical literature.
8. 2/3rds of us have compared the mineral requirements of particular beer styles with those contained in our liquor source.
9. Calculations for adding the correct amount of minerals to our brewing liquor come from various sources, including technical data sheets, CBA factsheet and Murphys.
10. Respondents add a variety of minerals to their brewing liquor. No consistent replies here.
11. 40% of us check our mash efficiency and 40% our Ph to confirm our liquor treatment is correct.