Group Discussion Nottingham

Water

Spraying brewing liquor into the Hot Liquor Tank.

Brewers call their brewing water 'liquor', whereas the word 'water' is used in regard to cleaning and washing.

Originally brewing started up in areas where the local water supply was suitable for the production of various types of beer. Nowadays beer of all types is brewed at breweries in all parts of the country although often the local water in its raw state is quite unsuitable for brewing a particular type of beer. Consequently it is important for both commercial breweries and craft brewers to adjust their liquor in order to make it suitable for brewing.

The first consideration is to find out the composition of our existing local water supply and this can be achieved from information supplied by the local water company. However this aspect is beyond the scope of this discussion.

The treatment of our water takes three main stages;

1. Removal of Chlorine / Chloramines
   This was not discussed in detail at our meeting but can be achieved by either boiling, using carbon filters or very simply, by using ½ / 1 campden tablet in our brewing liquor.

2. Reduction of alkalinity in our brewing liquor

3. Addition of desirable salts to mash

Items number 2 and 3 above were the subject of a presentation by Paul T of Murphys, the basis of which is set out below. The reduction in alkalinity is achieved by using a product called AMS (Acid Mineral Salts). This is the same product which is sold by Brupaks in smaller quantities for the home brew trade, where it is known as CRS (Carbon Reducing Solution).

The addition of beneficial salts is achieved by using Murphys DWB (Dry Water Burtonisation) and again this is marketed by Brupaks as DLS (Dry Liquor Salts). These salts are added to the mash.

The DWB or DLS is a blend of desirable salts when brewing bitters. It is based on the calcium requirement needed to convert our local water into an ideal brewing liquor. Alternatively some home brewers like to add individual salts to their mash water to fine tune their water treatment or to make their brewing liquor suitable for different types of beer.

Liquor Treatment recommended by Murphy and sons

Beer Composition

90% Water

4% Alcohol

6% Fermentation by products

Examples of Typical Liquor Compositions

	SOFT	HARD
Calcium	10	240
Magnesium	2	50
Alkalinity	15	250
Sulphate	5	500
Chloride	5	80

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An Hot Liquor Tank being fired up!

Objectives of Liquor Treatment

To convert the water delivered to us by the local water authority into acceptable brewing liquor.

This we achieve by:

Addition of required ions that are in short supply.
Removal of unwanted ions.

pH

The pH of the water will have very little effect on the pH of the wort and beer.

Alkalinity (Bicarbonate) and calcium are much more important in pH control.

Calcium & pH

Of the ions required for brewing, calcium is by far the most important.

This is due to the acidifying effect that calcium has on wort.

This lower pH :

- **Improves enzyme activity**
- **Reduces extraction of silicates, tannins and polyphenols from the mash.**
- **Encourages the precipitation of proteins during the boil.**
- **Gives beer a greater protection from microbiological spoilage.**

Calcium

Calcium also benefits the brewing process by:

- **Protecting the alpha-amylase enzyme from inhibition by heat**
- **Precipitating oxalates**
- **Reducing colour formation in the copper**
- **Improving beer fining by encouraging yeast flocculation**

Alkalinity

Alkalinity (bicarbonate) causes high pH values throughout the brewing process.

If alkalinity is not treated then the Calcium ions in solution are not optimised and stay attached to CO^{3} ions (bicarbonate) IE Hard Water

By treating the liquor with acid (AMS) the pH is lowered due to the excess of H+ ions, the bicarbonate ions are then driven off to produce water and CO^{2}

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Alkalinity

High alkalinity levels will cause:

- Harsh after-tastes in the finished beer
- Extract will be reduced – poor mash enzyme activity
- Reduced protein precipitation
- Wort and beer more prone to infection due to bacteria growing in higher pH conditions
- Increased extraction of silicates, polyphenols and tannins during sparge

Removal of Alkalinity

Alkalinity can be removed in a number of ways:

- Boiling
- Acid Treatment

pH

Typical pH Measurements in the Brewing Process

•Raw Liquor	pH 6.0 - 8.0
•Treated Liquor	pH 6.0 - 8.0
•Mash	pH 5.2 - 5.5
•1st Runnings	pH 4.8 - 5.2
•Last Runnings	pH 5.4 - 5.6
•Wort in Copper	pH 5.1 - 5.4
•Wort after Boil	pH 4.9 - 5.3
•Beer after Fermentation	pH 3.7 - 4.2

Magnesium

Magnesium is required as a co-factor for production of enzymes at low levels.

Too much can cause:

- Interference with calcium reactions
- Sour and bitter tastes
- A laxative effect

Sodium

Sodium is present in all beers

- Excessive amounts can cause sour and salty tastes.
- More acceptable as a chloride than sulphate

Potassium

Potassium is a co-factor like magnesium.

- It is more acceptable than sodium for flavour
- Up to 4 x more expensive
- Excessive amounts can have a laxative effect

Water

Sulphate & Chloride

- Sulphate gives beer a drier, more bitter flavour
- Chloride imparts flavour on the palate
- Fullness and sweetness

Nitrate

Nitrates can be reduced by bacteria to nitrites, which can react with wort amines to form nitrosamines.

Bitter and Stout

Trace ions

Iron, Manganese, Copper & Zinc

- Higher levels can cause hazes and metallic off flavours
- Utilized by yeast at low levels

Silica

- Causes colloidal hazes

Chlorine

- Reacts with organics to form chlorophenols (TCP)

Ideal ppm levels for different beers

	Bitter	Stout	Lager
Calcium	180-220	120-140	120-140
Magnesium	<50	10	2
Alkalinity	30-50	150	30-50
Chloride	150-300	300	Low
Sulphate	250-400	100	Low

AMS

pts/brl		0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
ml/hl		35	52	69	87	104	121	139	156	174
ml/Brl		57	85	113	142	170	197	227	254	284
AMS	Cl	23	34	45	56	68	79	90	101	112
	SO4	31	47	62	78	93	109	124	140	155
	Alk	-64	-96	-128	-160	-192	-224	-256	-288	-320

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DWB

oz/brl		0.5	1	2	3	3.5	4	4.5	5	5.5	6
g/hl		9	17	35	52	61	69	78	87	95	104
g/brl		15	28	57	85	100	113	127	142	155	170
DWB	Ca	16	31	63	94	109	125	141	156	172	188
	Mg	0.5	0.95	1.9	2.8	3.3	3.8	4.3	4.8	5.2	5.7
	Cl	15	31	62	93	108	123	138	154	169	184
	SO4	32	64	128	193	225	257	289	321	353	385

MCBA members liquor analysis

	Calcium	Magnesium	Sodium	Chloride	Sulphate	Alkalinity ($CaCO_3$)	
Allan	60	13	21	30	75	122	Leicester
Steve	67	16	20	30	70	141	South Staffordshire
Greg	17	2	6	9	12	LOW	Northfield, Birmingham
Martin	113	---	11	22	30	283	St Ives, Cambridgeshire
Peter	141	8	30	43	127	278	Sleaford, Lincolnshire

	Bitter		Additions for 25 Litres
	AMS	**DWB**	
Allan	13ml	20g	
Steve	18ml	20g	
Greg	None	30g	
Martin	35ml	13g	
Peter	35ml	9g	

Conclusions

- Liquor treatment is vitally important to the brewing process
- Get the liquor treatment right and all subsequent steps in the brewing process will be at the optimum pH
- Get it wrong and you will get poor extract and beer that is difficult to fine

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..... *Cheers*