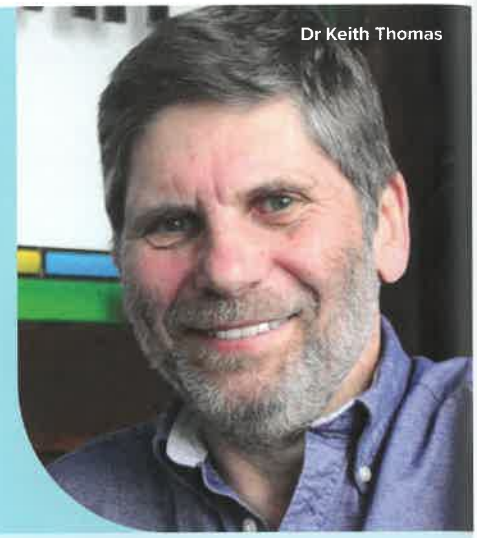
Dr Keith Thomas

Atrocities in Acid

With many quality systems now embedded in the processes modern craft brewers employ, Brewlab's Keith Thomas takes a look back at the history behind the regulations and the tragic incidents that led to them being put in place...

What's the value of regulatory controls? They certainly keep the admin department busy but are sometimes difficult to justify in the steam of an active brew day. Perhaps the case of the sulphuric acid poisoning is the easiest example of relevance.

Sulphuric acid isn't the sort of liquid to drink neat, or even diluted, so common sense gives us a natural regulation. However, we do include it in many of our beers, typically to neutralise the alkalinity in our water so reducing bicarbonate concentrations and controlling pH. Achieving the desired pH in the mash (around 5.3) and in final beer (3.9 – 4.2) are well known targets and often need a dose of acid into the liquor tank either as acid itself or a proprietary treatment.

Such chemistry isn't new or complex and was well understood by Victorian brewers and their chemists who elucidated the effect of mineral salts on beer quality. By the early 1900's recipes were clearly listing salt additions to the mash indicating a formulation for flavour and pH control.

This, of course, was a period when beer quality could be variable and subject to speculation of what caused problems, particularly acidity from microorganisms. In some postulations hygiene was considered valuable but many breweries employed practices which would be unforgivable today but still produced acceptable beer, albeit to different flavour expectations. The lack of effective cleaning and sanitising systems come to mind but extensive oxidation during transfer and storage of beers in wooden fermenters are additional concerns.

Weather was a further culprit of quality being rigorously recorded in brewing legers to assess correlation with beer character. In broad climatic terms this was recognised with breweries before refrigeration having to cease production in warm weather. On a local scale the possibility of weather influencing brewing was considered in terms of atmospheric pressure affecting effervescence in fermentation. Not an impossible cause but probably insignificant in comparison to other influences on yeast activity.

Before 1900 analysis of beer was limited and lacked regulatory control. Considerable discourse was centred on the digestion of starch and nitrogenous materials from malt. Amylase enzymes were recognised as essential in mashing and regularly investigated for their impact on extract values. Other reports addressed water analysis, for example fluoride, but only in the context of mineral character rather than toxicity.

This changed in 1900, however, when the analysis of beer was given a major and infamous exposure. The culprit being sulphuric acid which took the headlines with an adulteration scandal involving the deaths of 70 Manchester beer drinkers and injury of thousands more from arsenic poisoning. Although the specific incidence arose from accidental use of contaminated sulphuric acid from a Liverpool supplier the importance of arsenic analysis was dragged into the legal limelight.

In the subsequent Royal Commission into the tragedy the responsibilities and independence of public analysts were highlighted. In this context the concept of risk was strongly debated since analysis of beers and their ingredients indicated that samples could contain some arsenic irrespective of any accidental acid contamination. Malt was a particularly common contributory adsorbing arsenic from poor quality coke used in kilning. Moreover, incidences of arsenic poisoning from beer had been identified previously in contamination of beer by rat poison in a pub cellar and by storage of army beer in casks previously used to transport arsenic itself! Routine analysis was, however, not a consideration, quite possibly for fear of bad publicity.

This inevitably changed in 1901 and the need for routine analysis was rapidly adapted by brewers stung by accusations of selling beer made cheap with poisonous ingredients. In a speedy response brewers poured out publicity to reassure drinkers of beer's purity. As such the concept of testing became fundamental to quality assurance and has inevitably progressed to an increasing range of contaminants.

Despite this, incidences of harm from hazards in beer have reoccurred. Cobalt added to stabilize head formation in Belgium and Canadian beer in the 1960's led to deaths of heavy drinkers with heart ailments. Other scares include acrylamide, carbamates, chloropropanols and, inevitably pesticides.

One positive development since the cobalt scare was a greater integration of medical awareness and industry response. Identification of groups at risk from specific ingredients or combinations such as additives and alcohol are an important assessment of hazards.

This identification was a difficulty in 1900 when the symptoms observed were initially associated with excess drinking of cheap beer in poor communities and due to the effect of alcohol itself. It took some sound epidemiology to note that similar symptoms were not correlated with the volume of drinking and were not observed in spirit drinkers. 120 years on we accept the value of regular testing and are concerned to reassure customers of purity. Today we not only test for arsenic in beers but other heavy metals, nitrosamines and pathogens and base our production on HACCP principles. Regulation is a requirement we now work with and, hopefully, a prevention against another contamination scare.

Supplier Viewpoint

Innovations in Quality

Keith's colleague at Brewlab, Brian Yorston, offers his personal view on the evolution of quality systems in brewing...

Quality Systems

Quality systems did not really exist in the early 1980's nor did HACCP or COSHH. I cannot even remember risk assessments. Quality systems found their way into breweries due to a number of factors, but it was mainly due to pressure of supplying supermarkets who were taking a much bigger slice of the manufacturing cake. This was due to the reduction in heavy industry causing a decline in beer consumption especially in the pubs and clubs.

At first, I thought that these systems were an unnecessary burden on work. I may have been right on this as I remember that the systems were often over complicated and bureaucratic. Given time I honestly believe it was what the Industry needed. Mistakes became less frequent; accidents were reduced whilst standards were raised. One word of advice - if you are going through a SALSA or BRC implementation at the moment it will be worth it, at the end. Here's just one example of where quality checks have made a difference.

ATNC – the nitrosamine scare of the 1980's

his one may be a surprise to most people, but I believe this "scare" made the biggest impact to the hygiene of the brewery. During the 1980's it was discovered that beer contained nitrosamines. Nitrosamines at low levels (0.5mg per Kg or just a spec in a bag of malt) were found to be carcinogenic.

ATNC is a measurement of nitrosamine compounds one of which is NDMA (N-Nitrosodimethylamine). It was discovered that there were two sources of this compound. One was from the direct kilning of malt which caused the formation of a precursor which the boiling process caused the formation of NDMA. This problem was resolved by the maltsters indirectly kilning malt usually via glass tube to exchange the heat.

> **I honestly believe it was what the Industry needed, Mistakes became less frequent; accidents were reduced whilst standards were raised.**

The other source of NDMA was through the existence of wort bacteria such as Obesumbacterium proteus. This bacterium was generally ignored by brewers as unless it was in large numbers caused little problems or so we thought. What the bacterium did was to convert nitrates in the beer to these nitrosamines. Since it was impossible to remove the nitrates, the solution was to eliminate the bacteria. The result of all this was in my experience a quantum leap in hygiene standards and microbiology monitoring in larger breweries. This increase in standards has carried forward so much so that it has undoubtably improved the beer.

Brian Yorston

ATNC analysis should be done by all breweries once per year and if above acceptable limits then action should be taken. As an example, at one brewery, we operated a teak mash tun and every time we had the beer analysed for ATNC it was above the limit. As the mash tun was Victorian teak we could not clean it using caustic soda as it would destroy such a historic vessel. We tried to clean the vessel with hot water or steam, but the issue persisted. We assumed the O. Proteus was harbouring in the fabric of the wood. The issue was finally resolved by lining the vessel inside with stainless steel so preserving the past but protecting the present.