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SCANDINAVIAN BREWERS' REVIEW

IN THIS ISSUE: SORGHUM BREWING IN TANZANIA, FRUIT PRODUCTS FOR CRAFT BEER, BASIC QUALITY MANAGEMENT – WORT BOILING, DRY HOPPING HIGH IBU BEERS, MEGABREW, HOPS, HERBS AND MALT – THE NORWEGIAN WAY, NEWSFLASH AND MUCH MORE...

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BIG POLITICS

ANDERS KISSMEYER, TECHNICAL EDITOR, E-MAIL: ANDERS@KISSMEYER.DK

The Scandinavian Brewers' Review is not a political magazine – we have no fixed political basis or cause, as it may. We pay an interest in political developments only when these have specific impacts on our industry – for example, the alcohol policies of the countries in our region that have significant consequences for the brewers. These consequences are very direct in the form of beer taxation as well as the rules governing how we may – or may not in most cases – market our products.

But writing an editorial here at the start, at least as far as the SBR is concerned, of 2017, it is very difficult, if not downright impossible, to ignore the recent events on the global political scene: the Brexit referendum in the UK and the election, inauguration and first active period of Donald Trump as the new president of the USA. All informed commentators and experts read these changes as mere symptoms of some deeper changes in the political landscapes in the Western world. A large group of voters, which is obviously the same as people in general, looks at the evolution these past few decades, particularly the effects of globalization, with a very fundamental skepticism, as they do not see any benefits of these developments having come their way. Quite the contrary, they see things this way: Jobs have been lost in very large numbers. Average incomes in their groups have not gone up. Immigration is seen as a threat because 'the foreigners' not only take a large share of the remaining jobs not requiring particular skills but they also bring a strange and frightening new culture and religion, and they get a special royal treatment with respect to social services and benefits. Crime – maybe even also the risk of terror – increases, and the net result seems to be fear, depression and pessimism.

The solidity of our liberal and democratic society models has for a long, long time been seen as unshakeable. We have been convinced that the 'social contract' between all groups in our societies that our values – tolerance, democratic rights for all, openness, a social security system that ensures everyone a decent quality of living as well as equality of the sexes (regardless of how many new ones may be invented) – were so strong that nothing whatsoever could shake them. And, likewise, we have been convinced that although we all have our individual politically based opinions on how to move our societies forward, we have all shared not just the fundamental values but also the fundamental analysis of what the facts are and how the basic forces of society work and interact. Many of us have been shocked to see that this basic fabric of our societies is very far from being solid – it seems clear that those groups that are against the effects of globalization are more than willing to seek their own 'facts' and their own analysis of the problems based on those 'facts'. In every society at any time in history, such a situation has been fertile ground for populists who not only formulate the 'facts' and analysis in no uncertain terms, but they will also happily point out the culprits, and thus the enemies, and the easy solutions needed to address the problems. When the populists' simplistic, misguided and often self-contradictory ideas are met with 'old fashioned', real fact-based arguments and criticism, this is swept off the board without hesitation by categorizing the opponents as enemy conspirators who only seek to uphold their own privileges and the status quo. How can they be trusted when they got us in this mess in the first place?

To me, it is unquestionable that the governing elite for the past 20–30 years has actually helped create this situation by either totally ignoring the real concerns of those groups of people →

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who have now actually used their democratic rights to say 'enough is enough' or by actually recognizing those concerns, only to arrogantly dismiss them as stupid analyses promoted by stupid people and, as such, nothing that needs to be taken seriously.

So, now, Brexit is a reality, Donald J. Trump is in the Oval Office and, in a few months, Geert Wilders in the Netherlands, Marine Le Pen in France, Frauke Petri in Germany and Beppe Grillo in Italy may be either in office or playing a significant role in the politics of their respective countries. Be that as it may, in that case, it will only be the fair and just results of the way our democracies work, and still hardly a situation that in itself warrants the concerns of an editor of a brewing industry journal in Scandinavia. And I agree – the potential democratic victories of these populists will probably not to any significant degree alter the basic conditions for the brewing industry apart from some annoying increased difficulties and costs (import duties, closed borders, etc.) imposed on trading beer across the borders.

But allow me to take the analysis of recent event in international politics one step further. And I'm not even thinking about the potential breakdown of the European Union that many of the observers are now beginning to see as a real risk. Although this is not something that receives any attention in the media at this point in time, I believe it is relevant to consider what the consequences will be when – and I'm deliberately not saying if – it becomes painfully clear to the supporters of the new populist leaders that they will not be able to deliver on the fundamental promises of a 'resurrection' of the underprivileged classes in terms of vastly improved social conditions, jobs, etc.? Is it at all realistic that the angry supporters will simply realize that the populists are just that and that the simple solutions to extremely complex problems were bound to fail in the first place? And with a shrug of the shoulders fall back into line, either again becoming politically resigned and inactive or going back to the established and despised political forces? I see that as next to unthinkable. Another scenario is that the populists will blame their own failures on resistance and active sabotage by the 'old elite', the immigrants, the media and all the other forces making up 'the enemy' in the eyes of the populists and their supporters. Such a scenario will obviously both build on and further deepen the 'them and us' divide, and the fear is that this might destroy whatever is left of the 'social contract' between the populist supporters and 'the enemy', and a possible next step on behalf of the populists could easily be to declare the total failure of the old open, liberal and democratic model for society, and proclaim a new social order based on autocracy, nationalism and protectionism in the interest of 'the people'. And to those claiming that such a scenario is so far-fetched that it's not worth even considering, may I just point to two very large and very aggressive powers in our vicinity, such as Russia and Turkey. Would it be so unlikely that the populists could point to those and say that autocracy is a viable and effective model for society? How would such a transformation of our societies play out? Would it be relatively peaceful and gradual, or would we see actual social unrest and violence in our streets as a kind of replay of the Arab Spring or even the Russian revolution of 1917? Some very, very scary prospects, if you ask me!

How are such potential changes likely to affect the brewing industry? Will a much more autocratic, isolationist and nationalistic world affect us apart from the aforementioned annoying and perhaps costly import duties on our products? It would not be too difficult to let imagination play freely into aspects such as nationalizations and/or sudden and dramatic limitations on marketing, sales and distribution of alcoholic beverages including beer, but this would not be sober – excuse the expression! What would be not just realistic but almost an automatic consequence if we were to begin seeing dramatic changes in our political systems would be a quick and deep economic recession that would make the last one, beginning in 2007/2008, look like a walk in the park. The world of international business, with the financial sector being the first to react, would react extremely negatively to both the extreme uncertainty that such changes would imply as well as to the generally worsened conditions for international investments and trade.

You may claim that I'm seeing ghosts and behaving precisely as paranoid as the 'elite' has been seen to be reacting already by some observers. And, yes, I do admit that the 'horror scenario' does not currently seem very likely, and it is, in any case, quite a number of years down the road. But can it be discarded as mere paranoia and pessimism? My personal attitude is, as it has always been, actually optimistic, so I attach my hopes to a scenario where the established political classes will reflect very thoroughly over the changes we've already seen and adjust their policies in ways that meet at least some of the expectations and demands of the 'left-behind classes'. However, the fundamental issues causing the problems for these people – lack of education, lack of social mobility and lack of new jobs in the areas that have been hit the hardest – are structural and cannot be solved either easily or quickly. So, addressing the issues is a

monstrous task that will take generations, and, at this point, the patience that might have previously reigned amongst the angry populist supporters is long gone. Will some very clear signals and policies proving that an effort to address the issues has been started, possibly combined with some 'short terms payoffs', work?

Can we do anything ourselves in the brewing industry to support a political movement towards more reason, sanity and predictability? I think we can, although I don't see how we could be 'game changers' or main operators in forming the future models of our societies. But we can act responsibly as individuals, companies and associations in doing whatever little bit we can along the way. And I believe that both the 'big brewing' industry – AB InBev could build a new brewery in West Virginia, for example – and the craft segment, in supporting the local economy at the grassroots level by buying raw materials locally, can make a difference. But we will need a lot more good ideas, we will need them fast, and we'd need to implement them quickly, too! Imagine if the readers of the SBR decided to chip in with ideas and decided to use the magazine as the forum for presenting, discussing and honing the ideas. What an amazing treat for the Technical Editor this would be!

Please remember that we at the SBR very strongly encourage you to comment on anything you wish to comment on in the magazine, but obviously particularly to the editorial. Please forward your comments to anders@kissmeyer.dk.

SORGHUM BREWING IN TANZANIA

BY ANDREAS FALKENBERG, E-MAIL: ANDREAS.FALKENBERG@ROYALUNIBREW.COM AND ANDERS NIELSEN, E-MAIL: ANDERS.NIELSEN@ROYALUNIBREW.COM

Tradition has it that the recipients of the Danish Master Brewers' Guild's Travel Grant publish the results of their travels in the SBR, and the latest of these recipients were the two young Master Brewers Anders Nielsen and Andreas Falkenberg. The two gentlemen chose an untraditional destination for the trip, namely Tanzania, where they set out to study local brewing that relies on sorghum as the main ingredient. This has resulted in a highly interesting article, of which we here bring you the first part. The second part will be published in SBR No. 2/2017. We will also bring the bio on the authors in connection with the part 2 of this article.

PURPOSE OF THE TRIP

In Europe, a new trend has evolved over the last years focusing on the usage of local raw materials in brewing, resulting in local products with terroir – terroir being the flavour of locally produced and grown foodstuffs where specific environmental factors contribute distinct flavours to the foodstuffs. This tendency in developed countries is mainly driven by a trend initially started in the gastronomic society, resulting in these products being highly priced premium products. In developing countries, on the other hand, terroir in beer production has evolved as a way of ensuring the supply of raw materials and lowering cost, hereby producing cheap non-premium brands. An example of this is the usage of sorghum in Africa, where the brewing with this crop entails various technical difficulties and results in very intriguing beverages, which will be discussed throughout the following article.

This article was made possible by the Danish Brew Master Association's Travel Grant, which was utilized to explore three breweries in Tanzania.

WHY USE SORGHUM IN BREWING IN AFRICA?

Sorghum is quantitatively the world's fifth largest cereal grain after wheat, maize, rice and barley. In Africa, however, the importance of sorghum is significantly higher, as sorghum is the second largest cereal in terms of tonnage after maize*. On a continent where famine is well-known, sorghum has its strengths in being highly resistant both to drought and water logging, hereby ensuring a yield despite harsh weather conditions. The needs for fertilization and pesticides are, in addition, very little, making this crop very suitable for a more local agriculture*. The procurement of sorghum by the brewing industry is therefore supporting the local farming as well. Previously, sorghum was delivered straight from the farmers, but this has unfortunately been changed to now having a middle distribution link.

In addition to the robustness of sorghum, the prices are significantly lower than that of malt* and thereby an attractive solution for the non-premium products:

- 700 TZ (0.28€) / kg maize
- 800 TZ (0.33€) / kg sorghum
- 1800 TZ (0.73€) / kg malt

THE DIFFERENCE BETWEEN SORGHUM AND BARLEY

The sorghum grain resembles maize with a small-sized, oval shape, however without a husk. The size and colour of sorghum differs greatly depending on the variety (see picture):

Sorghum varieties with a high concentration of polyphenols will often be coloured red, brown, yellow or pink. These varieties will, in addition, also contain more tannins resulting in a distinct flavour of the foodstuff made from these*.

Photo: Sorghum varieties

Generally, raw sorghum resembles barley, as observed in Table 1*. However, the slightly higher starch concentration in raw sorghum can be attributed to a larger endosperm compared to raw barley. Also worth noticing is the significantly lower amount of beta-glucans and pentosans, which induce a thinner mash and easier filtration.

As observed in the table above, sorghum has a significant disadvantage when malted due to the high losses, which, moreover, should be considered together with the high energy-consuming malting process. The distribution of β-and α-amylases is significantly different to that of barley, having higher α- and lower β-amylase concentrations. This, together with the higher gelatinization point, implies the need for the addition of external enzymes, as the β-amylases will begin to denature at 68°C.

Composition of raw sorghum and barley		
	Sorghum grain	Barley grain
Protein (N*6.25) [%]	10.0	11.0
Starch [%]	70.0	65.0
Lipid [%]	4.0	3.0
β-D-glucan [%]	0.4	3.3
Pentosan [%]	2.5	9.0
Composition of malted sorghum and Malted barley		
	Malted Sorghum	Malted Barley
Malting loss [%]	10-30	8-10
Starch gelatinization temperature [°C]	75	62-63
α-amylase dextrinizing unit [DU]	50	35
Diastatic power [DP], β-amylase mainly	20	80

Table 1: Comparison of raw and malted sorghum and barley.

SORGHUM BEER PRODUCTION

Two main types of sorghum beer are produced in Tanzania under the brands Eagle and Chibuku. Eagle is a mainstream, non-premium strong lager, and Chibuku is a traditional local opaque beer of two varieties: 'Chibuku shake shake' and 'Chibuku Super', Figure 1.

Figure 1: (left) - Eagle lager, (Right) - Chibuku Super

Eagle is produced differently at two sites in Tanzania as a result of the different processing equipment available. A comparison and overview of the main differences can be observed in Table 2 below with more details in the following sections. ➜

	DSM	Arusha	Darbrew
Brand	Eagle	Eagle	Chibuku
Milling	Pre-milled flour	In-line hammer mill	At-line hammer mill
Cereal cooker	Yes	Yes	Combined
Mash conversion	Yes	Yes	
Wort separation	Lauter tun	Mash filter	Decanter
Wort boil	Wort kettle	Wort kettle	NA
Fermentation	Cylindro conical vessel (CCV)	Cylindro conical vessel (CCV)	Fermentation tank
Filtration	Membrane	Membrane	NA / Vibro screen
Packaging	Returnable glass bottle 600ml	Returnable glass bottle 600ml	PET / Keg
Packaging	Returnable glass bottle 600ml	Returnable glass bottle 600ml	PET / Keg

Table 2: Overall Site comparison

Eagle brand is one of the few brands which varies in recipe between different regions and countries, i.e. the percentages of malt, barley and sorghum differ. For both the DSM and the Arusha brewery, the same mashing profile and grist composition with >95% sorghum together with a small amount of raw barley was applied using two vessels, as observed in Figure 2. Firstly, the finely milled sorghum flour, together with the small percentage of raw barley, is processed in the cereal cooker, initiating the mashing with a proteolytic stand at 58°C for 30 minutes. An addition of alpha amylase is carried out at this step. Hereafter, a short 15 minutes stand at 68°C is applied as an effect of the barley ratio followed by the liquefaction by a rise to 85°C and held for 30 minutes. The liquefied mash is afterwards transferred through a mash cooler lowering the temperature to 58°C before entering the mash vessel. Here, external enzymes are added in order to convert the carbohydrates into fermentable sugars. This conversion stand is 90 minutes before mashing off at 77°C where two more enzymes are added, one to gain a high maltose yield and the second to achieve a high glucose yield in order to reach RDF levels above 83%.

Dar es Salaam brewery (DSM) – Tanzania Breweries Ltd. The first visit was the Dar es Salaam-based brewery located in the middle of the city, the Ilala district, with an annual capacity of ~1.5 m hl (see Figure 3). The majority of the brands produced were premium lagers, i.e. Kilimanjaro, Ndovo, Safari, Castle, and smaller volumes of the non-premium brand sorghum-based Eagle including NAB malt products and a license brewing contract for a European brand. The brewhouse is based on the lauter tun principle as observed in Table 2, which is the main difference between the DSM and Arusha plants. Sorghum can be used as an adjunct when brewing regular lagers at the DSM plant, where the addition is made manually into the mash vessel. We were informed that a maximum of 30-50% milled sorghum can be

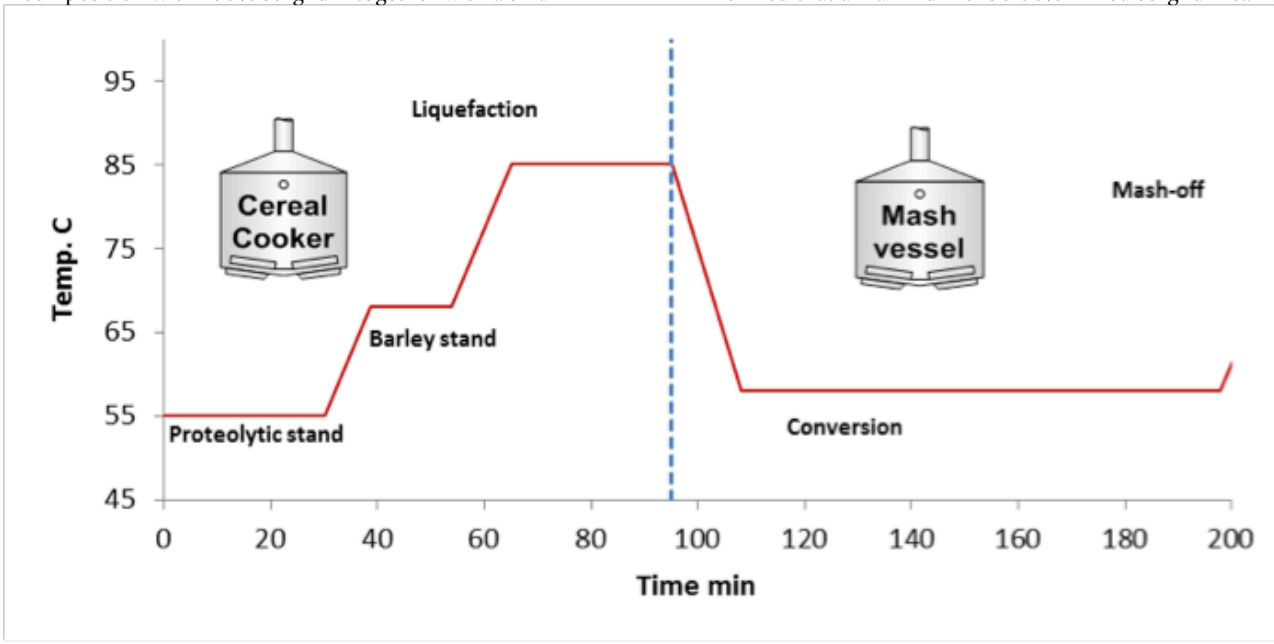


Figure 2: Simplified Eagle mash profile from DSM and Arusha brewery

Figure 3: Brewhouse at DSM plant

Figure 4; Arusha plant brewhouse. From the left; Jakob Mgowe, Andreas Falkenberg, Anders Nielsen

added without causing major runoff issues during lautering. Producing Eagle, which is close to 100% sorghum grist, using a lauter tun entails certain difficulties caused by the lack of sorghum husk. To overcome this difficulty, Eagle is processed after a production of low gravity lager, hereby leaving the spent grains in the lauter tun functioning as a lauter bed for the sorghum mash. Previously, projects have involved drying of spent grains for the purpose of later addition back into the lauter tun to act as a filter bed for the following sorghum mash. However, it was proven unsuccessful and, therefore, the method using the previous spent grains of a low gravity larger is preferred. Nonetheless, this causes difficulties in planning the productions of Eagle, as it has to be brewed in between the other brands. The problem is generally overcome by moving the main production to the Arusha site, where the market for Eagle is, in addition, larger. Hence the production in DSM is mainly focused on premium lager due to the surrounding markets being the Dar Es Salaam region and touristy Zanzibar.

ARUSHA

The Arusha plant is located in the north of Tanzania near Kilimanjaro and Serengeti, where there is a high production of sorghum and, at the same time, a bigger market for the non-premium Eagle sorghum strong lager (see Figure 4).

Here, the plant is set up with a mash filter and an in-line hammer mill, manually fed with 25 kg bags of raw sorghum, enabling the use of a 100 % sorghum grist. After the mashing profile described in Error! Reference source not found, the mash is so thin and low in viscosity that the mash filter process is completed in less than an hour. After wort extraction, the following processes are identical for the DSM and the Arusha plant.

Dimethyl sulfide (DMS) is not a concern when producing sorghum beer, enabling a short boiling time of only half an hour. After the whirlpool, the wort is chilled to 20 °C, pitched with the house lager yeast after fermentation is carried out in CCV unitanks, where the temperature is maintained at 20°C for a maximum of 6 days before reaching final attenuation. There is no maturation necessary as the Diacetyl concentration is below the flavour threshold. A higher level of mercaptans is, however, observed, preventing, among other factors, the reuse of the lager yeast in other larger brands. Better filtration compared to malt-based lagers is observed for the sorghum lager as a result of, but not limited to, less β-glucans and pentosans (Table 1) along with a high level of external enzyme addition during mashing. Beer membrane filtration at 4°C is applied. No silica additions are needed pre-filtration to reach the same haze specification as for the premium lagers. All in all, a fast and cheap run-through is achieved enabling a lower price for the final product.

To be continued…

The authors of this article have a complete list of references for the background statements and results referred to in the article (these will be marked by an asterisk *). The list of references can be obtained by contacting the authors.

FRUIT PRODUCTS FOR CRAFT BEER

PART 3

BY SØREN KJÆR, HANS KJÆR TRADING A/S, AND ANDERS KISSMEYER, TECHNICAL EDITOR, E-MAIL: ANDERS@KISSMEYER.DK

This is the third and final part of this article, which aims at giving the reader an all-round historical background of fruit-containing beers and an increased understanding of using fruit and fruit products in the brewing process. The article is co-written by Søren Kjær of Hans Kjaer Trading A/S, the leading Danish supplier of natural fruit products, who contributes know-how on the fruit and fruit products, and your Technical Editor, who has contributed the practical brewers' perspective on the use of fruit in brewing. The article has been divided in three parts. The first part (SBR No.3/2016) covered the history, reasons for using fruit in contemporary beers, main considerations when using fruit in beer, and production and specifications for fruit products. The second part, published in No. 4/2016, covered 'Guidance to recipe development with fruit products'. And this final part lists some practical cases and examples and gives the conclusions.

CASES AND EXAMPLES

After having covered all the theory and discussion related to the use of fruit and fruit products in beer, we round off the article with some practical examples from two different breweries. We have chosen a few examples from the beer portfolios of one of the authors, 'Kissmeyer Beer', and from the Swedish brewery Dugges Ale & Porterbryggeri, which is a customer of Hans Kjaer Trading A/S.

1. Dugges

   Inspired by participation in the New Nordic Beer network meetings and a trip to Belgium, Dugges started experimenting with brewing beers without hops. In order to create balance in these beers, Dugges soured them with lactobacillus to use additions of fruits and berries. This series of beers made with Nordic fruits and berries was called 'Nordic Sour'. The initial beers in the series were the following:

The 'Berliner' series:

- **Bärliner** – Berlinerweisse with raspberries, brewed with raspberry juice concentrate (from Hans Kjaer Trading A/S). The name 'Bärliner' is a play on words, as the Swedish word for 'berry' is 'bär'
- **Blåbärliner** – Berlinerweisse with blueberries, brewed with blueberry juice concentrate (from Hans Kjaer Trading A/S). 'Blåbär' is obviously the Swedish word for 'blueberry'
- **Lingonbärliner** – Berlinerweisse with lingonberries, brewed with lingonberry juice concentrate (from Hans Kjaer Trading A/S). 'Lingon' is the Swedish word for 'lingonberry'

The 'Nordic Sour' series:

- **Pear are you Jonathan** – A sour ale with pear, brewed with pear juice concentrate (from Hans Kjær Trading A/S)
- **Reign in Raspberry** – A sour ale with raspberries, brewed with raspberry juice concentrate (from Hans Kjaer Trading A/S)

- **Choose Cherry** – A sour ale with cherries, brewed with cherry juice concentrate (from Hans Kjaer Trading A/S
- **Black Currant** – A sour ale with blackcurrants, brewed with blackcurrant juice concentrate (from Hans Kjaer Trading A/S)
- **Syrligt** – A sour ale with lingon berries and rhubarb, brewed with juice concentrates (from Hans Kjaer Trading A/S). 'Syrligt' is the Swedish word for 'sour', or rather 'tart', i.e. with a positive connotation.

Other fruit beers brewed by Dugges:

- **Tropic Thunder** – A sour ale with mango, passion fruit and peach, brewed with juice concentrates (from Hans Kjaer Trading A/S)
- **Red Raven** – A 'clean' (unsoured) Bock style beer brewed with cherry juice concentrate (from Hans Kjaer Trading A/S)

In all these beers, Dugges has added the fruit concentrates post primary fermentation.

Dugges' objectives as regards the character of the finished beer were different from beer to beer. In the Berlinerweisses, the aim was a subtle fruit character, while a more powerful fruit character was desired in the other beers.

Asked how and where in the process Dugges chose to add the fruit products, Mikael Dugge Engström, the founder and CEO of Dugges answered this way:

'In the first beers we used frozen berries, but it was extremely demanding and labour intensive to both brew and to subsequently clean the plant afterwards. The concentrated fruit products are much easier to dose in order to achieve the desired result, as well as much easier handling- and cleaning wise.'

Our next question to Mikael was this: How did you determine the dosing rates and where in the process to add the fruit products? With this, we may have stepped a little too close to prying into Dugges' proprietary know-how related to their processes, because the brief answer was this: 'We always add the fruit after primary fermentation!'

Our next question was 'How many and which trials and test batches did you go through before you ended up with the desired results?' And, in line with the previous answer, Mikael replied, 'Not that many!'

And, to our final question about how the results were as compared to the objectives, the answer was equally short, but this time fully comprehensive: 'In principle as we wanted them to be!'

Dugges has continued to develop a lot of new exciting craft beers with the help of fruit products from Hans Kjaer Trading A/S after the interview was done – some of which will be launched this year.

2. Kissmeyer Beer

We have chosen to bring the following three cases, the two first beers released under the 'Kissmeyer Beer' brand, and the last one a beer designed by Anders Kissmeyer on a consultancy basis for his current employer, Royal Unibrew.

- Kissmeyer Nordic Apple Lager (12.0% P, 5.0% ABV, 25 BU, Colour ~ 10 EBC) – a traditional lager beer with a Nordic 'twist' in the form of additions of apple and quince juice concentrate (from HK Trading)
    a. Description of the finished beer: 'A traditional lager beer brewed with a healthy dose of apple concentrate and fresh quince for added fruitiness, acidity and freshness. This very accessible and highly drinkable beer is dry, crisp and fruity with subtle maltiness and low to medium bitterness, making it an excellent companion to both modern and classic Nordic foods based on fish, shellfish and poultry."
    b. Dosing rates and times of fruit products:
        i. Apple Juice Concentrate, 65% Brix – 18.5 Kgs per 1000 L of wort
        ii. Quince Juice Concentrate, 65% Brix – 2.0 Kgs per 1000 L of wort

Both additions are made in whirlpool in order to, on purpose, eliminate part of the most intense aromatics, leaving mainly the 'fruitiness, acidity and freshness'. Dosing rates of concentrates were calculated based on an initial test batch (homebrew volume) of the beer where single strength apple juice and raw quince had been used.

The desired effects on aroma, taste and flavour were, besides the above, only to add complexity and not noticeable apple or quince character. The consumer should not, if unaware of the recipe, be able to tell that apple and quince had been added.

No particular effects on strength and colour of the beer were aimed for, but the acidity of the fruit concentrate was a desired effect in the beer in order to distinguish this beer from 'normal' lagers in the form of the fruitiness and crisp freshness.

- Kissmeyer Nordic Coast Blonde Ale (12.0% P, 5.0% ABV, 20 BU, Colour ~ 20 EBC) – a novel style Nordic style blonde ale with the Nordic character coming from additions of rose hips, rhubarb and sea buckthorn
    a. Description of the finished beer: 'A pale, refreshing Nordic aperitif beer with delicate fruity aromas, achieved by infusing rose hips and rhubarb in the wort at below boiling temperature to preserve their volatile aromas, and "dry fruiting" with sea buckthorn during maturation. The aroma and flavour is light and fruity, the taste crisp and slightly fruity tart with medium bitterness and malt character and a pleasant, snappy finish.'
    b. Dosing rates and times of fruit products:
        i. Rose hips (frozen) – 6.0 Kgs per 1000 L of wort – added in whirlpool at below 90°C
        ii. Rhubarb (frozen) - 5.0 Kgs per 1000 L of wort – added in whirlpool at below 90°C
        iii. Rhubarb (frozen) - 2.0 Kgs per 1000 L of wort – added in to secondary fermentation (bottled beer pasteurized)
        iv. Sea Buckthorn (frozen) - 2.0 Kgs per 1000 L of wort – added in to secondary fermentation (bottled beer pasteurized)

The additions in whirlpool were made here in order to ensure practical sterility and with the purpose of maximum 'integration' of the fruit character into the beer. Further, both rose hips and rhubarb are not overly aromatic, but have more impact on the flavour and taste than on the aroma.

The reason for the two separate dosings of rhubarb is quite simply that the recipe for the production batch of this beer was made without previous trials or test brews. Thus, the initial rhubarb dosing was done 'conservatively', and the tasting of the fermented beer revealed a too-low rhubarb impact, so more was added along with the sea buckthorn in secondary fermentation. The reason for adding the sea buckthorn in secondary was not a consideration related to the character of the resulting beer, but a simple consequence of the fact that the sea buckthorn could not be sourced on brewday!

The desired effect on aroma, taste and flavour was to add significant fruity character and tartness to the beer, but, again, without any of the fruits being individually identifiable. Instead, the aim was to add significant complexity to the beer.

Why was raw fruit (although frozen) used in this beer instead of fruit concentrates? Again, this was not at all a consideration

related to the character of the resulting beer, but a simple consequence of the fact that, at the time of brewing this beer (2013), I was unaware of the availability, advantages and quality of fruit concentrates. If I were to brew this beer again, I would go entirely with dried rose hips (added in the whirlpool after re-hydration) and juice concentrates of the rhubarb and the sea buckthorn added in secondary fermentation, and the dosing rates would be as follows:

i. Rose hips (dried*) – 3.0 Kgs per 1000 L of wort – added in whirlpool at below 98°C
ii. Rhubarb concentrate, 65% Brix - 1.5 Kgs per 1000 L of wort – added in whirlpool at below 90°C
iii. Sea Buckthorn concentrate, 65% Brix - 0.5 Kgs per 1000 L of wort – added in to secondary

*) A practical bit of advice to brewers wishing to brew with dried rose hips: Always chose whole or cut rose hips and never powder. The powder is extremely hydrophilic creating sticky lumbs that are almost impossible to dissolve/disperse when re-hydrated in hot water or wort.

- Schiøtz Mørk Mumme (Dark Mumme) (16.0% P, 6.5% ABV, 30 BU, Colour ~ 80 EBC) – Inspired by the historic German beer style, Braunschweiger Mumme, this beer is an innovative hybrid between a Belgian Dubbel and an English/American brown ale as far as the malt impact, body and balance, while the aroma and flavour – beyond the solid malty backbone – is slightly Nordic in the shape of a subtle berry and spicy character.

a. Description of the finished beer: *'Full bodied with delicate malty/fruity sweetness, balanced by medium bitterness and a slight tartness, The aroma is dominated by fruity maltiness with caramel and dried fruits, supplemented by natural berry notes and a subtle complex spiciness from juniper and sloe berries with background hints of hops. Berry flavours on top of the rich malt taste with balancing hop bitterness. Subtle notes of dark chocolate, coffee and licorice, and a lightening berry tartness. A quite long, fruity aftertaste with some bitterness and a slight herbal spiciness. High drinkability for the malty richness and alcoholic strength.'*

a. Dosing rates and times of fruit products:

i. Blackcurrant Juice Concentrate, 65% Brix – 1.0 Kgs per 1000 L of beer, added in secondary fermentation

ii. Rose hips (dried) – 2.0 Kgs per 1000 L of wort – added in whirlpool at below 98°C
iii. Sloe Berries (dried) – 1.5 Kgs per 1000 L of wort – added in whirlpool at below 98 °C
iv. Juniper berries (dried) – 0.5 Kgs per 1000 L of wort – added in whirlpool at below 98°C

The additions in whirlpool were made here in order to ensure both sufficient re-hydration of the dried berries (before addition, these berries were soaked for 20 mins in hot wort) and practical sterility. As with the rose hips and rhubarb in the previous example, the dried berries used in this beer are not overly aromatic, but come through more in the flavour and taste than in the aroma.

The desired effect of the additions on aroma, taste and flavour was, as indicated above, to lighten up the palate of an otherwise very malty and sweet beer with the noticeable tartness contributed by the blackcurrant, the rose hips and the sloe berries. And to add a complexity through the combined effects of the fruity contribution from black currants and rose hips and the herbal spiciness of sloe berries and juniper.
The black currant concentrate give a slight contribution to the colour of the beer, but no significant effect on the beer strength was aimed for. Also in this beer, the acidity of the fruit concentrate and the dried rose hips was a desired effect, as described above.

This beer won a bronze medal at the 2015 European Beer Star competition.

CONCLUSIONS

Through this three-part article, we hope that you have been inspired and have gotten an insight into the world of fruit and beer in combination. Combining fruit and brewing is no new feature. They have been joined through thousands of years. And, currently, the popularity is growing and growing, and for one simple reason: it works!

There is an endless road of opportunities; each one defines the final product in one way or the other. Everything is allowed; it is just a matter of imagination and your wishes regarding taste, aroma and colour.

We have described some technical factors that one needs to consider when using fruit as raw fruit, concentrate, puree or single strength juice. And we can conclude throughout that there are advantages in using fruit in a liquid and standardized form. You are sure to receive the same result every time, so the nice recipe that you have made will give consistent results - with fresh or frozen whole fruit there will be a much larger variation. Also, the handling of concentrates is very convenient. Many products are delivered in a 25 kg aseptic bag-in-box, which does not have to be stored frozen. The box size also makes it easy to dose the concentrates without having leftover material that needs to be discarded, repacked or frozen.

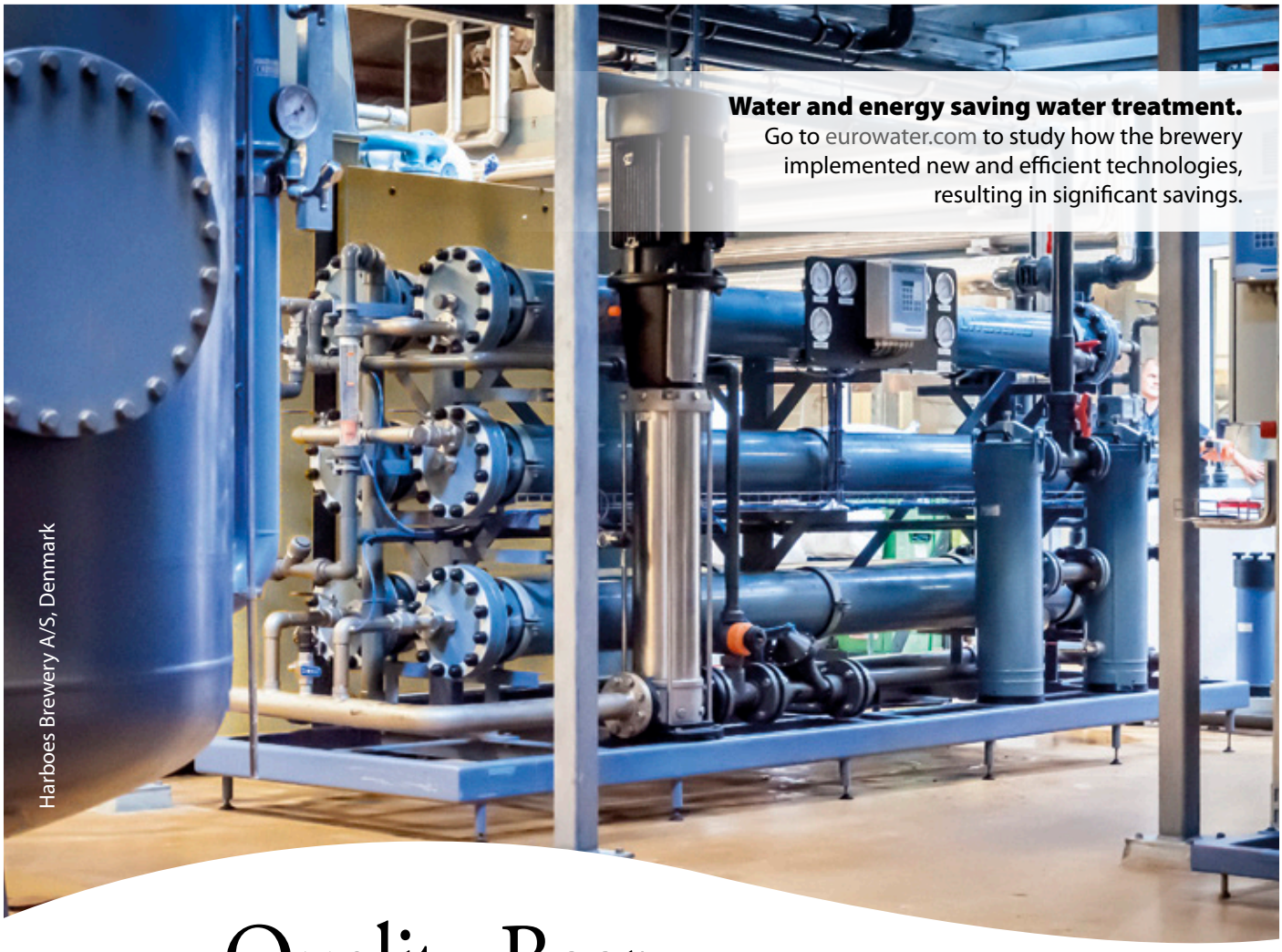
In the second part, you learned how and when to add the fruit into the brew depending on the various factors. Basically, it can be added anywhere and anytime, but certain guidelines should be kept in mind.

Finally, in this third and last part, we have shown you a few case examples of how specific brewers, such as the co-author of these articles, Anders Kissmeyer, are using whole or concentrated fruit to achieve great results in the world of craft beer.

ABOUT THE AUTHORS

Søren Urhøj-Kjær is second generation in the company Hans Kjær Trading A/S, which has been selling and distributing conventional and organic fruit and vegetables in various forms for almost 30 years. The distribution is based on long-term partnerships with a carefully selected network of producers. It started out in conventional products, but the company has been a part of the organic movement over since the beginning. At Hans Kjær Trading A/S, quality is key. Quality in service. Quality in products. Quality in delivery assurance. Further, we consider ourselves as being highly flexible and a 'one stop shop'. We have a broad range of products in many different packaging sizes that make it much easier for the customer, as they only have to 'visit' one place to get their needed fruit and vegetable concentrates, purees, juices, etc. All inquiries are considered equally important, as we try to look at things from the perspective of our customers. We hope that we can help our customers become successful, and we are fully aware of our responsibility, as our products are a part of our customer's products!

Anders Kissmeyer – read Anders' bio on page 35.



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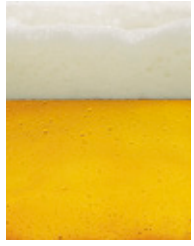

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BASIC QUALITY MANAGEMENT – WORT BOILING

GETTING SET FOR EFFICIENT FERMENTATION – PART 3

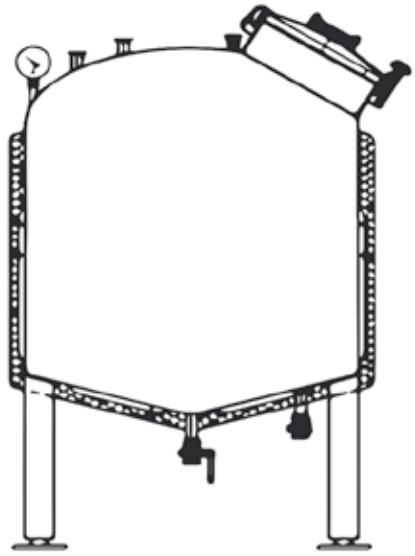
BY DR. GARY SPEDDING, AMBER WEYGANDT, BSC., AND MATTHEW LINSKE, BSC.[1], E-MAIL: INFO@ALCBEVTESTING.COM

[1] BREWING AND DISTILLING ANALYTICAL SERVICES LLC (BDAS, LLC)

We started on the series of articles from our friend Gary Spedding and his co-workers on the wort boiling, cooling and clarification processes with part 1 (introduction, the wort composition at the start and sterilization/biological stabilization of wort) in the SBR No. 3/2016, we continued with part 2 ('Color and flavor development' and 'Maillard reactions, melanoidins and chemistry') in the previous issue – No. 4/2016, and here follows part 3 on 'pH of Wort', 'Polyphenols', 'Hops' and 'Lipids'. There are 3 more parts in this series, all on the wort boiling, -cooling and clarification that will follow in coming issues. Due to the long spread this amazing article has, we've decided to repeat the abstract at the top of each part.

ABSTRACT

Following on from our last article on lautering we have now come to the next important topic – that of the manipulation of the sweet wort into a boiled and clarified hopped wort. The topic covers the wort and its composition, the chemical reactions (some partially completed during the heat applied in the malting and mashing phases) and the physical processes that take place during the boiling of the wort itself, including hop acid isomerization. This is then followed by a description of the clarification and cooling steps required to produce a quality wort set for an efficient fermentation.



Wort: Wort: an aqueous solution of fermentable sugars (including glucose, maltose and maltotriose) obtained by the enzymatic hydrolysis of starch derived from malt extraction or from other cereal sources (such as wheat, maize and rice) – or adjuncts – (sugars and syrups). Wort boiling: The hop boiling takes place in copper or stainless steel tanks (the kettle) and aims to precipitate wort proteins (ultimately for colloidal stability), to sterilize the wort, to remove volatile off-flavors by steam distillation and rather importantly, to transform the alpha acids extracted from hops into beer-soluble and bitter iso-α-acids. The final conversion to a stable solution from a sweet to a cooled and clarified hopped and bitter wort ready for fermentation.

PH OF WORT

pH changes occur throughout brewing, with boiled wort being typically around pH 5.5. It is important to attain the required decrease in pH during wort preparation as it affects wort and, in turn, beer character. Boiling promotes a drop in the pH due to the precipitation of proteins and secondary phosphates, as well as via the dissolving of hop bitter acids due to their isomerization during heating, and the formation of melanoidins (see Maillard reaction, melanoidins and chemistry). The magnitude of the drop depends on the buffering capacity of the wort, the type of water treatment used in the wort production, and the malts used in the grist formulation. For example, darker malts lead to a lower final pH than Pilsen malts. The more basic the original pH of the wort, the more significant the pH drop. Standard worts show a typical drop of 0.20 to 0.25 pH units, while acidified worts show a reduction of about 0.1 unit. A lower pH value leads to improved protein coagulation,

impacts the reduction of diacetyl and other Vicinal Diketones (VDK), encourages yeast growth, and helps limit the growth of contaminating microorganisms. At the same time, it also results in decreased solubility of hop constituents and reduced color formation. Hot break formation during boiling will be insufficient if wort pH is too high, decreasing colloidal stability. Normal pH values for cast-out wort are in the range of 5.3-5.6. If biological acidification is performed during the brewing operation, the cast-out wort pH ranges maybe 5.0-5.4. Some breweries using Kettle Souring or other such techniques to produce sour beers may produce worts as low as pH 3.2-3.5.

POLYPHENOLS

Unprocessed hops contribute up to 40% of the total polyphenol content in boiled wort and most are removed as hot and cold break (trub). The remainder of the polyphenols arise from grain (mainly the husk fraction) and being less polymerized, are not as easily removed. Most simple tannins and malt polyphenols, which are a complex and diversified structural class of plant monomeric, dimeric and larger polymeric molecules, are soluble in boiling wort and moderately soluble in cold water. Polyphenols can be readily oxidized and polymerized to form higher molecular weight complexes and are also referred to as wort tannins. Polyphenols are present in worts at concentrations up to several hundred ppm. As they bind to proteins, they eventually form visible matter which can result in chill haze and permanent haze (see Beer chill haze and permanent haze under Hot break and Cold break). Polyphenols also give rise to astringent notes which increase as beer ages, protect other flavor compounds by acting as antioxidants and free radical scavengers, and may be considered contributors to the "fresh" taste of newly produced beer. The choice of raw materials greatly affects the quality of the polyphenol contribution to the final product.

HOPS, COMPONENT EXTRACTION, AND HOP ISOMERIZATION

The humble hop provides the most significant source of flavor development during wort boiling, with alpha acids playing a major role in bittering. Not surprisingly, they are also the best-known hop bitter acids. Humulone is the main alpha-acid, though in fact there are multiple isomeric forms for each type of acid. Full chemical descriptions are not provided here, but in general terms the alpha-acids are represented by three main classes known as humulone, cohumulone and adhumulone (see Figure 2). The beta acids - lupulone, colupulone and adlupulone - are also illustrated in Figure 2 and are not further discussed here.

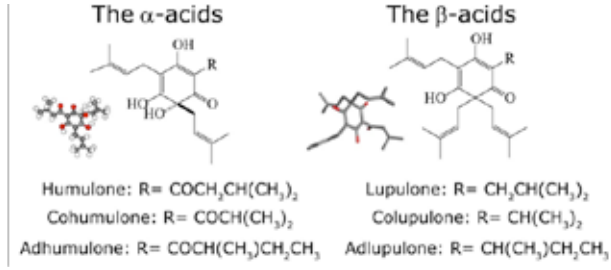


Figure 2. The hop alpha and beta acids and their isomeric forms.

Under the chemical conditions of wort, the hop alpha acids are poorly soluble, but in the boiling process they are transformed, via isomerization, into the iso-alpha acids, which are more soluble in the wort medium. Consequently, only traces of alpha acids remain in beer. The iso-alpha acids remain as the hop derivatives, which contribute mainly to the beer bitter taste. In fact, six major iso-alpha acids are present in beer because of the isomeric conversion of the three-major alpha-acids – humulone, cohumulone and adhumulone (see figures 2 and 3).

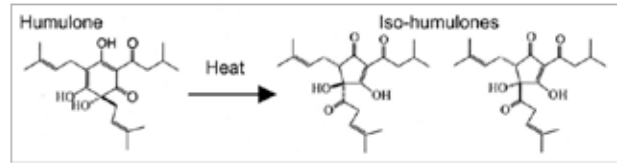


Figure 3. The hop alpha acid to iso-alpha acid conversion. Shows the isomeric structural rearrangements to give the bitter acid principles of the isomerized acids. Only two of the multiple form iso-humulones are shown.

Beer bitter character does not differ very much among the iso-alpha acids, which represent more than 80% of all hop components occurring in beer; the concentration varies from 15 to 80 mg/L. Figure 3 illustrates a schematic of the isomeric conversion of alpha acids and the structural differences between humulone and iso-humulone isomers. As the degradation rate of iso-alpha acids is more temperature dependent than the isomerization rate, very high temperatures will lead to dramatic breakdown of iso-alpha acids. Moderate temperatures (90-100°C) still lead to substantial isomerization without heavily affecting breakdown allowing for a greater yield of bittering compounds than possible at higher temperatures. A classical diagram of the extraction of alpha acids and the rate limiting (slower) isomerization of alpha-acids during wort boiling at atmospheric pressure is also shown in Figure 4.

In earlier conventional processing of wort, the boil, conducted at atmospheric pressure, would last from 1 to 2 hours. This was considered sufficient to attain extraction of most of the alpha-acids. However, as noted above and illustrated in Figure 4, isomerization of the alpha-acids to their isomerized forms →

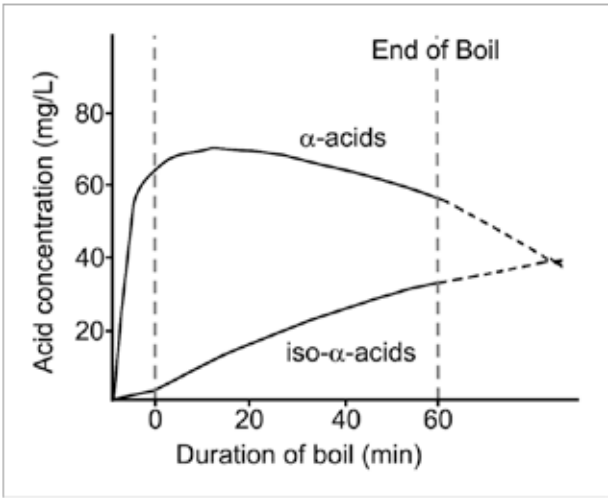


Figure 4. Rate of isomerization of alpha-acids during the wort boil. The slow rate of isomerization of the alpha acids is the main factor causing poor hop utilization while brewing – not their rate of extraction during the boil. Adapted from the EBC Manual of Good Practice Hops and Hop Products and the EBC Symposium on Wort Boiling – Monograph XVIII (1992).

(iso-alpha-acids) is slow particularly under normal wort pH of 5.0 to 5.5, but most isomerization will take place during the boiling period. The solubility of alpha-acids is clearly also pH dependent, and examples show at pH 5.9 a solubility of 480 mg/liter of acids but only 60 mg/liter at pH 5.0 (100°C). Some isomerization will occur post-boil but at much slower rates.
The isomerization process in the kettle involves some losses, as noted above, which are primarily influenced by several factors including temperature, rigor of the boil, length of boil, pH of wort, and Specific Gravity (SG). Differences in hop rate (amount added; higher rate = lower utilization), hop products used, and the influence of kettle design on the rate of alpha-acid extraction are also important considerations. Overall hop usage may be reduced by up to 10% if external wort boilers are used due to increased utilization and reduced losses of the bittering substance adhering to protein break. Adjuncts increase the utilization likely due to reduction in the amounts of solids compared to malt extract. If pre-isomerized extracts or other, alternative bittering substances are used in place of hops, this will change how the above factors are prioritized.
Beer requiring a long shelf-life and good physical stability will require longer boiling, efficient cold conditioning and sometimes the use of various stabilizing/clarifying agents (See A brief note on copper or kettle finings in a later section). For beers requiring only a short shelf-life, for example draught beers, only short boiling times are needed as the physical stability is not a primary objective here. In this case, hop isomerization would become the rate limiting step of the boiling process.
The length of time each hop addition is boiled depends upon the desired effect – usually bitterness or aromatic qualities and occasionally for foam enhancement. But it also depends on the variety of hop and the type of hop product used. As noted above, to attain the desired bitterness during wort boiling, the addition of the hops must be at or near the start of the wort boiling process for maximum isomerization. However, for hop flavor, as most hop oils responsible for the aromatic qualities are lost during boiling, late kettle hopping or even hop addition to the whirlpool are required. And, in modern craft brewing, all manner of additions can occur later in the brewing process and even at dispense of beer from the tap. As usual, key references are available from the authors covering more on this topic.

HOP OILS – FLAVOR COMPONENTS

The essential oil fraction of hops provides hundreds of complex volatile flavor compounds to wort and beer despite the huge losses of aroma substances in a normal boiling process.
Potent flavor compounds such as linalool, α-terpineol and sesquiterpenes will add a distinct "hoppy" flavor to beer. In order to retain such beneficial aroma compounds in the wort, the moment of hop addition is strictly regulated. However, care must be taken, since there are also less-pleasant flavors present in hops that can equally contribute to the product. The moment of addition of bitter and aroma hops, and the choice of extracts, pellets or essences will therefore be a determining factor for the final hop aroma in beer. While the nuances of hop aromatics are many, for a distinctive note of hops (due to volatiles loss in boiling), whirlpool hopping (see details on the Whirlpool in a later section) is an effective hopping technique, though usually little or no extra bitterness is added with efficient whirlpool operation.

Besides the wealth of flavor compounds in the essential oil fraction, other flavor compounds will be generated from oxidative breakdown of hop acids, especially isohumulones, and terpenoids during the kettle boil. Oxidized terpenoids and oxyterpenoids are said to impart the so-called kettle hop aroma to beer. Kettle hop aroma is a late hop character or "spicy hop note" whose intensity and nature depends on the hop product and brewing process. Evidently, the amount of these kettle hop compounds will be dictated by the amount of heat load in the brewing process, the moment of hop addition, and the extent of evaporation. This also highlights the incredible complexity of chemistry which takes place during this phase of the brewing process.

LIPIDS

Wort lipids, while present at concentrations of only a few parts per million, can have an impact on yeast viability, ester formation, gushing, foam stability and flavor staling. Lipids

adhere to trub particles, which may be 50% lipid in nature, and to filter materials. A relationship between wort lipid content and turbidity is now well established. Wort lipids are mainly derived from malt, though the contribution of lipids from hops depends on the actual lipid and alpha-acid contents of the hop, the hopping rate, and the lipid extraction yield. It has been estimated that 5-15% of the total hop lipid content is extracted from whole hops or pellets, while in extracted hop products up to 100% of the lipids are retained. Turbidity and lipid content of boiled wort are strongly dependent on wort boiling and clarification. About 90% of the lipids in wort can be removed during the wort boil and clarification processes. However, some unsaturated fatty acids and sterols in wort serve as important yeast nutrients. Sterols can reduce the oxygen demand at yeast pitching time, again showing how one brewing process is intricately linked to many others.

Other components derived from lipids can be involved in subsequent beer oxidation and staling. For example, the oxidation of unsaturated fatty acids leads to carbonyl off-flavor compounds. This is an often overlooked but important topic only receiving detailed research attention within the past few years. An increased use of hops and dry hopping is adding to the lipid extraction and turbidity issue. Lipids, of course, can also adversely affect the foaming properties of beer via their binding to foam-active proteins. We again note that the lipid-turbidity relationship is dependent on the specific brew house and beer formulation (raw materials used, filtration or clarification steps, etc.). If working conditions are modified, the wort turbidity-lipid relationship changes. This is maybe one reason why super-dry hopping used by some craft breweries is yielding massive sediment and haze issues. However, this is becoming a preferred style by some consumers.

Hot break formation is also related to wort lipid content. Lipids are not very soluble in aqueous solutions, and favor binding to the hydrophobic regions of denatured proteins. This effectively keeps the lipids in solution initially. As more coagulation of proteins occurs during the boil, additional lipids bind and heavier and larger particles are formed which then influences subsequent clarification. It is noted that up to 80% of the lipids will be carried away as they become bound to particles during the heating phase, to precipitate out as trub.

To be continued…

ABOUT THE AUTHORS

Gary Spedding, Ph.D. (Biochemistry - University Leicester, UK), **Amber Weygandt,** B.Sc. (Biology, Minor in Chemistry - California State University Sacramento) and **Matthew Linske**. B.Sc. (Bacteriology - University of Wisconsin-Madison), represent a highly dedicated team testing alcoholic beverages primarily, though not exclusively, for the US brewing and distilling industries. The three combined offer biochemistry, biology, microbiology and chemistry expertise along with backgrounds in beverage testing – beer, wine and distilled spirits, water testing, microbiology and sensory evaluation.

Spedding, after directing the Siebel Institute of Technology Laboratories in Chicago, in 2003 founded Brewing and Distilling Analytical Services LLC (BDAS, LLC), where he applies analytical chemistry in testing beverages and beverage raw materials.

Linske, after learning the brewing process as an assistant brewer, joined BDAS, LLC in 2012 as lead microbiologist and yeast and microbe detective.

Weygandt joined BDAS, LLC in 2013 as lead chemist and GC Mass Spec guru, hunting down all manner of components in beverages. She had prior experience also in the water testing field and at a large winery laboratory in California.

The team supports brewers, distillers and winemakers in all manner of quality assurance and quality control. Contact them at info@alcbevtesting.com

DRY HOPPING HIGH IBU BEERS

AND ITS EFFECT ON BEER BITTERNESS

Hopsteiner
COMMITTED TO THE BREWER

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Surprise! This short, but very interesting article from Hopsteiner documents a very surprising relation between the actual – measured as well as perceived – bitterness of very bitter beers when these are cold (dry) hopped with significant quantities of hops. Contrary to the general consensus and the intuitive view, the bitterness of these beers diminish, as the cold hopping material actively absorbs the main bittering iso-alfa acids, taking them out of the solution in the beer. And not only marginally, but up to about 25 %! The overall picture is complicated, as other bittering compounds – with a lot lower bittering potential, though – are released into the beer through the cold hopping. Read all the interesting details below, and please note that this intro allowed your technical editor to flash his latest crusade: What was previously known as 'dry hopping' should henceforth by known as 'cold hopping' as this term, in opposition to the old one, actually describes what the procedure is about!

High IBU beers (40 ppm of isoalpha acids or more) that are heavily dry hopped, with 1 lb of hops per barrel (0,381 kg/hl) or more, can experience significant changes in hop acid composition. When dry hopping high IBU beers, the leaf material of hops or hop pellets absorb and remove significant amounts of isoalpha acids and add significant amounts of low bitter humulinones and very low bitter alpha acids.

Humulinones are reported to be 66% as bitter as isoalpha acids and alpha acids about 1/10th as bitter as isoalpha acids. Dry hopping also causes an increase in a beer's analytical IBU, which would imply the beer is getting more bitter, however, the IBU test results are misleading. Because dry hopping causes a change in the beer's hop acid composition one should calculate the perceived bitterness by taking into account the relative bitterness of all three hop acids.

This calculated bitterness can be accomplished by measuring the concentration of the individual hop acids via High Performance Liquid Chromatography, HPLC. The below table contains the HPLC analysis of a control beer treated with 0.5 lbs, 1.0 lbs, and 2.0 lbs of Cascade hop pellets for five days at 16 oC. The Cascade hops assayed 0.26% humulinone and 5.6% alpha acids. HPLC analysis of the beers show that as the dry hop dosage goes up the isoalpha acid concentration goes down as well as the beer's calculated bitterness.

It should be noted that as the isoalpha acid concentration drops to ~ 30 ppm, the addition of more hops and the subsequent removal of more isoalpha acids becomes less efficient. The below results show that dry hopping with one pound of hops removes about 22 ppm of isoalpha acids but the addition of two pounds only removes 26 ppm isoalpha acids. This is because isoalpha acids are very soluble in beer at lower concentrations and are less likely to be removed via leaf absorption which readily occurs at higher concentrations.

What this means, is if one dry hops a low IBU beer, that is a beer containing less than 20 ppm isoalpha acids, leaf absorption and removal of isoalpha acids from the beer will be minor. Yet the addition of humulinones and alpha acids to the beer will still occur. This means dry hopping a low IBU can increase a beer's bitterness. These results will be reported in next month's newsletter. To learn more please do not hesitate to contact us.

Hop (lbs) per barrel	kg/hl	Iso (ppm)	α-acids (ppm)	Humulinone (ppm)	Calculated Bitterness*
0	0	51	9	4	55
0.5	0.191	42	22	10	50
1.0	0.381	29	27	14	40
2.0	0.762	25	34	23	42

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ARE YOU OVER-INSURED OR UNDER-INSURED?

FACT CHECKING FOR INSURANCE VALUES

BY RÜDIGER HORNUNG[1], E-MAIL: RUEDIGER.HORNUNG@TUEV-SUED.DE AND DR. ROLF ZÖLLNER[2], E-MAIL: ROLF.ZOELLNER@TUEV-SUED.DE
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Perhaps insurance is neither the most common nor the most sexy topic for an article in the SBR. However, sometimes the importance of a topic overrides the popularity of it. And certainly, when we were reading the abstract of this article from the renowned and trusted German body offering technical and certification services, we were convinced that reminding our readers of their insurance issues is a worthwhile thing to do. If only one or two of you brewers and brewery owners out there actually grab the opportunity of being reminded to take a look at your insurance situation, perhaps even decide to reduce the risk by having an independent valuation of your current insurance status compared to the company's assets, we have done some good! And, as the article illustrates, the valuation done for insurance purposes creates a fresh and comprehensive overview of the status of buildings, production equipment and utilities, serving also as a good management tool for investment planning and review of maintenance standard and policy.

Breweries don't always readjust the sums insured when buildings and technical assets are modified. Or they rely on the updated, non-calibrated values from existing broker models. The risks: In case of over-insurance, they regularly pay excessively high premiums; in case of under-insurance they will receive only a fraction or no compensation at all in the event of damage. The following example shows how these risks can be reduced with independent valuations on site.

While a valuation of technical and property assets by independent experts is common practice in the Netherlands, the same does not apply in other European countries. Partly, valuations are only carried out by insurances. Often, external experts with not only business knowledge but also comprehensive technical know-how can determine even more precise values for assets with complex production facilities.

In addition, existing values in the insurances' and brokers' models are updated every year, but, however, they are not calibrated and may differ from actual values. Thus, it is worthwhile to have experts check and calibrate the values on site. This also strengthens the company's position when negotiating with insurance companies.

In particular with regard to new production halls, office buildings and structural changes such as demolitions or extensions, it is important to adjust the sum insured. But, also, other value determination situations can be perfectly combined with an insurance valuation. For example, when the market value needs to be determined for the acquisition or sale of a brewery or when a valuation is carried out for accounting purposes.

The following example shows an on-site valuation by independent experts. As a central contact person for the client, a TÜV SÜD project manager coordinated the team of mechanical engineers, building technicians, process engineers and business economists.

ON SITE IN A LARGE-SCALE BREWERY

After a takeover some years back, the individual locations of a brewery group had partially grown extensively. This was the reason for a new valuation of property and technical assets. Coordination-related and concept-related tasks, such as data procurement, ranked first. Further steps followed: inspection of the data, plans and information submitted and coordination of further procedures with the responsible parties. Step 2: On-site inspections of the property, the machinery and technical assets. Step 3: Systematic calculation of the replacement value by the independent experts based on the results obtained in steps 1 and 2.

The replacement value is the amount that would be necessary in order to purchase an equivalent machine or facility on the market or have it produced today. The acquisition value (purchase price or production costs) form the basis for this calculation. The depreciation value is also taken into consideration. The related insurance value can be determined based on parameters such as age, condition, equipment and market value.

CLOSE EXAMINATION OF PROPERTY ASSETS AND BUILDING TECHNOLOGY

Next to the warehouses, brewery buildings and offices also the special facilities such as museums and canteens were assessed. A total of 13 properties were inspected. The team classified them by their differing functions – examples: entrance area with security gate, administrative building or filling station – and by the building type – examples: office building, high-bay warehouse or production halls.

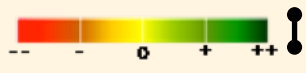
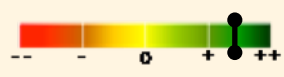
With regard to the property assets, the experts inspect the building structure and the technical building installations, which comprise lifts, refrigeration, air-conditioning and sanitary technology. Technical assets were disregarded, even when they were firmly installed in or connected to the building. This shows the major importance of the coordination of property and technical assets valuation. This is the only way to ensure that elements are neither recorded twice nor that parts are overlooked.
The replacement value was determined for the property assets and the building technology based on the current customary CCI (Construction Cost Index). Furthermore, the general terms and conditions of the fire insurance formed an important basis for the determination, just as further information on insurances regarding trade and industry as well as the relevant building price indexes. As it is usually the case in the commercial sector, value determination was realised without VAT, but including a safety tolerance per square meter price. The specific variation of local construction costs are also taken into account.

Example brewery: valuation of the property asset

The property assets and outdoor facilities were quantified in total just under 155 million euros. For this purpose, the experts analysed the value in use, year of construction, materials and fittings and qualified them based on their condition.

The bases for the calculation of the replacement value of one of the brewery buildings were valuation criteria such as size (approx.

TABLE 1: EVALUATION TABLE TECHNICAL ASSETS

Asset name and original value from VAT in brackets	Acquisition value [EUR]	Replacement value [EUR]	Evaluation of technical asset condition Evaluation of residual lifetime expectation
#01 Asset group			
#01.01 Asset subgroup 01	##,###,###	##,###,###	
#01.02 Asset subgroup 02t	##,###,###	##,###,###	
Subtotal #01 Asset Group:	##,###,###	##,###,###	

→

12,000 m²), stairs, façade, ceiling, number of floors, flooring (reinforced concrete, sealing with epoxy resin) and equipment such as heating/ventilation, automatic doors or the chimney incl. base:
Result: approx. EUR 18,000,000 replacement value

TECHNICAL ASSETS EXAMINED STEP BY STEP

The technical equipment of the assets amounted to nearly 275 million euros. These items included, among others, tanks and pipelines, the CO_2 plant, pallet machinery, and the brewery equipment.

Evaluation tables helped in recording and presenting the interim results for the respective technical assets. These include the name of the technical asset and an assignment with regard to the overall plant. A description of particularities, the acquisition and replacement value are included as well as a scale showing the condition and the expected residual lifetime (see table 1 below). In the present case, the first column organises the existing assets in asset groups and the technical assets in six function-related sub-groups. 1. brewery and tanks, 2. bottling plant, 3. packaging and sorting machine, 4. supply facility, 5. warehouse, and 6. auxiliary installations and facilities. The tanks sub-group includes, for example, several silos for malting barley, pressure tanks, fermentation tanks, malt silos with mounted filters as well as diverse water tanks for temperatures from 10 to 80 degrees centigrade.

The individual assets' values were validated and consolidated by means of an Excel tool used by the brewery's financing department. Deviations from an asset's stated cash value and the determined acquisition value were shown in brackets in the spreadsheet. Not included are expenses for outstanding optimisation or maintenance measures as well as realised investments for already acquired machines and installations.

The third column shows the relevant replacement values at a key date in the last year. These are decisive for the insurance values. The calculation includes possible price developments by taking into account inflation and is adjusted based on current statistical data available for production facilities in the brewery industry. If an asset is no longer state-of-the-art, a comparable state-of-the-art machine or technical asset or possible investments for the required engineering or manufacturing are researched.

Column four and its values regarding condition or the expected residual lifetime result from the on-site inspection. Five stages are distinguished:

++ Excellent condition based on state of the art
+ Good condition based on state of the art
o Condition sufficient to meet state of the art, more modern assets and procedures are used, modernisation is recommended
- Bad condition, state of the art still met, modernisation is recommended
-- Very bad condition, no state of the art, modernisation or replacement is recommended

Example brewery: Valuation of technical equipment

There were two sub-categories:

1. Sub-category "Tanks and silos": Silos for brev wing barley, roughly 30 beer tanks for product storage, fermentation tanks, malt silos equipped with dedusting filters, hammer mill, water tanks: acquisition value approx. EUR 11,500,000; replacement value approx. EUR 13,000,000; condition of installation / expected lifetime: ++ (excellent condition based on state of the art)
2. Sub-category "Brewery equipment – diverse": Brewery and filtration equipment made of stainless steel: acquisition value approx. EUR 33,000,000; replacement value approx. EUR 38,000,000; condition of installation / expected lifetime: between + and ++ (good to excellent condition based on state of the art)

Overall result: approx. EUR 51,000,000 replacement value

DEFECT UNCOVERED, OPTIMISATIONS RECOMMENDED

The on-site inspection showed that the brewery buildings and the technical assets were in a good condition. Apart from a few exceptions, the state of the art common in the industry is met and appropriate maintenance and repair measures are carried out based on a suitable overall strategy. In the course of the assessment, individual defects were detected and optimisation recommendations were made. Coordination was realised on site, saving time and cost.

Among others, TÜV SÜD recommended having the sustainability of the property assets, machinery and technical assets, which already meet high criteria, certified based on

Photo: TÜV SÜD

recognised standards. This primarily involved the energy efficiency. Possible effects of technical measures can be better quantified with more precise measurement techniques for energy and material flows. Thus, it is easier for operators to prioritise measures since the realisable savings become more transparent just as the related ROI.

An additional recommendation: If the brewery expands its existing error statistics in the framework of systems operations, it can implement a risk-based maintenance strategy with the new data. The already collected MTBF (mean time between failures) figures for maintained units form the core. With a deeper analysis by means of a root-cause approach and in combination with physical models significant savings become possible.

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EUR 430M OVERALL RESULT

A value of nearly EUR 430 million was recorded in the overall report for property and technical assets. Thus, the brewery was able to check and adjust former values insured. They now have a realistically assessed insurable asset value. It is based on an independent valuation and is accompanied by more planning security as well as a profound, calibrated database for future developments.

The long-standing experience of the experts and the close cooperation between the real-estate professionals and the experts for systems and plant engineering played an equally important part during the evaluation. The stringent procedure from a business point of view and the interdisciplinary know-how as well as the close cooperation with the client were very important. The experts recommended that the brewery continues to check and adjust the sum insured at regular intervals in the future. This offers the advantage that the brewery can keep an eye on future purchases and extensions or expansions.

ABOUT THE AUTHORS

Mr. Rüdiger Hornung serves as Chief Executive Officer/Managing Director of TÜV SÜD ImmoWert GmbH. Mr. Hornung promotes the internationalization of property valuation in the Real Estate Division of TÜV SÜD AG, the global provider of technical services. Mr. Hornung worked as a real-estate valuation surveyor in a global network. His primary activities include valuation of commercial property and real-estate portfolios, support of international clients and the field of sustainability certificates.

Dr. Rolf Zöllner is Senior Project Manager for Technical Advisory Services and Technical Due Diligence in TÜV SÜD Industrie Service GmbH. Further fields of his activities are consultancy resp. on the European CE-requirements and functional safety. Dr. Zöllner has broad experience in technical consultancy related to risk assessment and risk management.

MEGABREW

THE AB INBEV TAKEOVER OF SAB MILLER – PART 4

BY ANDERS KISSMEYER, TECHNICAL EDITOR, E-MAIL: ANDERS@KISSMEYER.DK

This is the last part of my article on the AB InBev takeover of SABMiller, started precisely a year ago (!) in the SBR No. 1/2016. The newsfeed on this unbelievable takeover has kept appearing throughout this year, and the text is thus mainly a copy/paste from the media – Brauwelt International first and foremost – which have covered the merger very closely. My aim has been to look into what such a merger will mean to the world of brewing in general. So parts 1, 2 and 3, published in SBRs Nos. 1, 2 and 4/2016 respectively, dealt with the history of how the deal developed, the consequences for mid-size brewing companies and 'divestments' as well as consequences for the management team at SABMiller' and the first part of 'MegaBrew seen in a world beer market perspective', which is concluded in this Part 4 of the article, finishing with my 'Personal Afterthoughts'.

First of the last: Since Part 3 of this article was issued in the SBR No. 4, 2016, the following late news related to the MegaBrew deal has appeared:

February 2017: AB InBev offers SABMiller's managers severance packages

Following its takeover of SABMiller, AB InBev has embarked on its ambitious cost-cutting programme. One of its more public measures is offering managers at South African Breweries (SAB) voluntary severance packages.

Under the agreement with South Africa's competition authorities, AB InBev cannot make any forced retrenchments and there may be no voluntary separation arrangements for employees at the bargaining unit level until 2021, it was reported.

However, South African media were leaked an internal memo in January 2017 which says that the brewer had offered more than 1,000 managers in South Africa voluntary severance.

Of course, it is still uncertain how many people may opt for the voluntary offer. But who will have the strength and the wisdom to turn it down if they know that their jobs are already considered superfluous?

In 2015, AB InBev agreed to buy SABMiller for over USD 100 billion and the deal was officially passed in September 2016 after months of antitrust clearance around the world, which saw SABMiller offload many of its international units like China, North America, and Europe.

AB InBev has already said that it plans to cut about 3 percent of its enlarged workforce in the three years after the takeover of SABMiller. The reductions – about 5,500 jobs - will be implemented gradually and in phases, it announced. They shall help AB InBev reach its ambitious cost-cutting target of USD 1.4 billion.

The voluntary redundancies come at a time when analysts at Deutsche Bank are voicing their doubts that AB InBev can turn SABMiller's African markets into a quick winner.

Through disposals, AB InBev has already recouped a quarter of the price it paid for SABMiller. But the remaining SABMiller stub – Africa, Latin America, Australia - has higher margins than AB InBev, the bankers said. This puts into question some of AB InBev's synergy targets. Moreover, AB InBev has paid dearly for SABMiller. Reports said the transaction value for the whole of SABMiller amounted to a multiple of 17 times profits/EBITDA. Yet,

for what now remains of SABMiller, AB InBev in fact paid a multiple of 28 times EBITDA, according to Deutsche Bank.

How AB InBev plans to squeeze out more profits from Africa by applying its usual operational model isn't clear to Deutsche Bank. "Despite contrary multiple pronouncements by the company, Africa is not Brazil, nor Mexico. It's a continent, not a country; unlike the Anheuser-Busch and Modelo deals, we question the applicability of the single market organizational model," the bank revealed.

January 2017: AB InBev divests SABMiller's Coke businesses

On 21 December 2016, Coke and AB InBev reached an agreement regarding the transition of AB InBev's 54.5 percent stake in Coca-Cola Beverages Africa (CCBA) for USD 3.15 billion, thus solving potentially conflicting interests. AB InBev is a Pepsi bottler in Latin America and had inherited the stake in CCBA when it took over SABMiller.

CCBA includes the countries of South Africa, Namibia, Kenya, Uganda, Tanzania, Ethiopia, Mozambique, Ghana, Mayotte and Comoros.

In addition, the companies have reached an agreement in principle for The Coca-Cola Company to acquire AB InBev's interest in bottling operations in Zambia, Zimbabwe, Botswana, Swaziland, Lesotho, El Salvador and Honduras for an undisclosed amount.

The transactions are subject to the relevant regulatory and minority approvals and are expected to close by the end of 2017.

Coke plans to hold all of these territories temporarily until they can be refranchised to other partners.

With the sale of CCBA, AB InBev has now raised about USD 27 billion from divesting parts of SABMiller, recouping about a quarter of the USD 100 billion plus it paid for SABMiller, reports say.

MEGABREW SEEN IN A WORLD BEER MARKET PERSPECTIVE

May 2016 - AB InBev to sell SABMiller's central European unit

Those who wondered if AB InBev were to keep SABMiller's Pilsner Urquell brand after the takeover can now rest assured: ➜

Brewers' market shares in central and eastern Europe. Source: Euromonitor

they won't. On 29 April 2016 AB InBev announced it has offered to sell all of SABMiller's assets in Hungary, Romania, the Czech Republic, Slovakia and Poland, including the rights to Pilsner Urquell outside the United States. Within the U.S., AB InBev has already agreed to sell Pilsner Urquell to Molson Coors as part of a larger deal divesting its stake in MillerCoors. The job lot also includes brands such as Polish beers Tyskie and Lech, Hungarian beer Dreher, and the Romanian beer brand Ursus. The assets could fetch between USD 5 billion and USD 8 billion, according to analysts' estimates.

Again, AB InBev justified its decision to offload these assets in order to gain regulatory approval. The European Commission, which is the European Union's antitrust regulator, is set to deliver its verdict on the takeover of SABMiller by 24 May 2016.

But historically, central Europe's beer markets have not been of interest to AB InBev, which sold its own regional operations to the private equity firm CVC in 2009. These have since ended up with Molson Coors.

Beer consumption in central Europe has been on the decline and SABMiller's local assets haven't performed too well as a consequence. Lager volumes in Europe were down 1 percent in SABMiller's past fiscal year.

This makes the region much less attractive than the growth markets of Africa and Latin America. That's why AB InBev wants SABMiller, which generates 64 percent of operating income from Latin America and Africa.

SABMiller is currently the third-largest brewer in central and eastern Europe, with a market share of roughly 15 percent, according to Euromonitor, while AB InBev trails behind with a share of 7.9 percent.

It will be interesting to see who snaps up these assets. Both Carlsberg and Heineken, the number one and number two brewers in the region, are unlikely to buy many of the assets due to regulatory hurdles. Besides, Carlsberg may be strapped for cash as is Molson Coors.

Instead, analysts point to Asahi and private equity firms as likely buyers.

October 2015 - MegaBrew will be a global beer monopoly

It took the head of The Public Investment Corp (PIC), a South African state-owned pension fund and SABMiller's fourth-largest shareholder, to point out the obvious: a takeover of SABMiller by AB InBev would not only create a global brewer, which controls about 30 percent of the world's beer volumes and a mind-blowing 58 percent of all beer industry profits, it would above all establish a monopoly that is too dominant and thus will hurt consumers.

In actual fact, a merger would see a single beverage empire controlling the number one or number two position in 24 of the world's 30 biggest beer markets, according to bank Exane BNP Paribas.

By any measure this translates into a monopoly as 97 percent of all beer is produced in merely 40 countries.

"Quite frankly I'm not in favour of it," PIC CEO Daniel Matjila told Bloomberg on 6 October 2015. "We may be creating some kind of a monopoly going forward which may have a serious impact on the global economy and beer market in general."

Mr Matjila must have had Africa in mind when voicing his concerns. For the first time, on 7 October 2015, AB InBev showed its true colours when it explained the rationale for the takeover. Its public offer states that it regards the African continent as critical driver of future growth.

With 140 million hl beer produced in 2014 according to the Barth Report, African countries together only brewed as much beer as Brazil alone and circa 7 percent of the world's output. On average, Africans drink nine liters of beer per person, per year, compared with a global average of 45 liters. Africans prefer fortified wines, rice wine and, quite often, cheaper homemade alcohol. Illegally made alcohol continues to dwarf the legal market in Africa, according to SABMiller, because of price.

Although SABMiller has chosen low price points for some of its beers to lure Africans away from moonshine, beer is still relatively expensive. Eight hours of work is needed for the average African to make enough money to buy a beer, compared to just eight minutes in Europe. As a result, SABMiller's strategy has hinged on fewer price increases with a greater focus on volume.

This is not to say that in its African markets, where it often enjoys monopolist positions, SABMiller acted like a charity. In its past financial year (ended 31 March 2015) it reported that 30 percent of its group profits or USD 1.9 billion (EBITA) came from Africa.

But Mr Matjila and perhaps other South Africa institutional investors, which together own 20 percent of SABMiller's shares (according to bank Credit Suisse) fear that SABMiller's culture of doing business, which always paid special attention to African sensibilities, could be swept aside by AB InBev's more profits-oriented approach, which would affect African consumers adversely.

"Doing business in Africa, for example, is very different to anywhere else. Knowhow and relationships are crucial. AB InBev has neither with regards to doing business in Africa", Exane BNP Paribas pointed out in a March 2015 report.

AB InBev together with SABMiller would have a number one or two position in 24 out of the 30 largest beer markets. Source: Exane BNP Paribas

October 2016 - Will risks outweigh the benefits of Megabrew?

"As the talks between AB InBev and SABMiller drag on, more and more critical voices can be heard via an all too willing international media, arguing that the drawbacks in this transaction would counter the advantages.

For one, buying SABMiller, which has operations in around 80 countries, will be a much more complex transaction for AB InBev than its previous two deals – its 2008 acquisition of U.S. brewer Anheuser-Busch and its 2013 takeover of Mexican brewer Grupo Modelo.

For another, the assumed high price AB InBev will have to pay for SABMiller could lead to value destruction. The RBC analyst James Edwardes was quoted as saying that an offer for SABMiller of GBP 42 a share (totaling about USD 103 billion) or higher would bring the deal into the "realms of value destruction".

Another issue is how the deal can be structured. SABMiller's two major shareholders face potential capital gains taxes, so may want to get paid in shares, which would conflict with AB InBev's controlling shareholders' desire to limit the dilution to their control that would come with issuing new shares, Reuters said.
Not enough, AB InBev will also have to navigate a variety of likely antitrust concerns in jurisdictions such as the U.S. and China.

As to synergies from the deal, they could be small compared to AB InBev's past transactions. AB InBev has a reputation for wringing costs out of the businesses it acquires. However, SABMiller is widely seen as an efficiently run business.
Then there is the issue of scale to contend with. SABMiller's dominant position in Africa – where it operates on its own or through partnership in 37 countries – is regarded as the main reason for AB InBev's interest in the company, but some analysts argue that operating on the continent would present new challenges for AB InBev.

On the whole, margins in Africa, except perhaps for South Africa, are lower than what AB InBev is used to. Moreover, the structural costs in Africa are higher. AB InBev will need to run breweries in each country, often producing a few million ➜

hl beer only. This does not fit with AB InBev's business model, which is about scale and efficiency.

Some analysts have suggested that AB InBev could sell SABMiller's sub-Saharan business, which would reduce the complexity of a deal but would equally significantly reduce the combined company's prospects for growth.

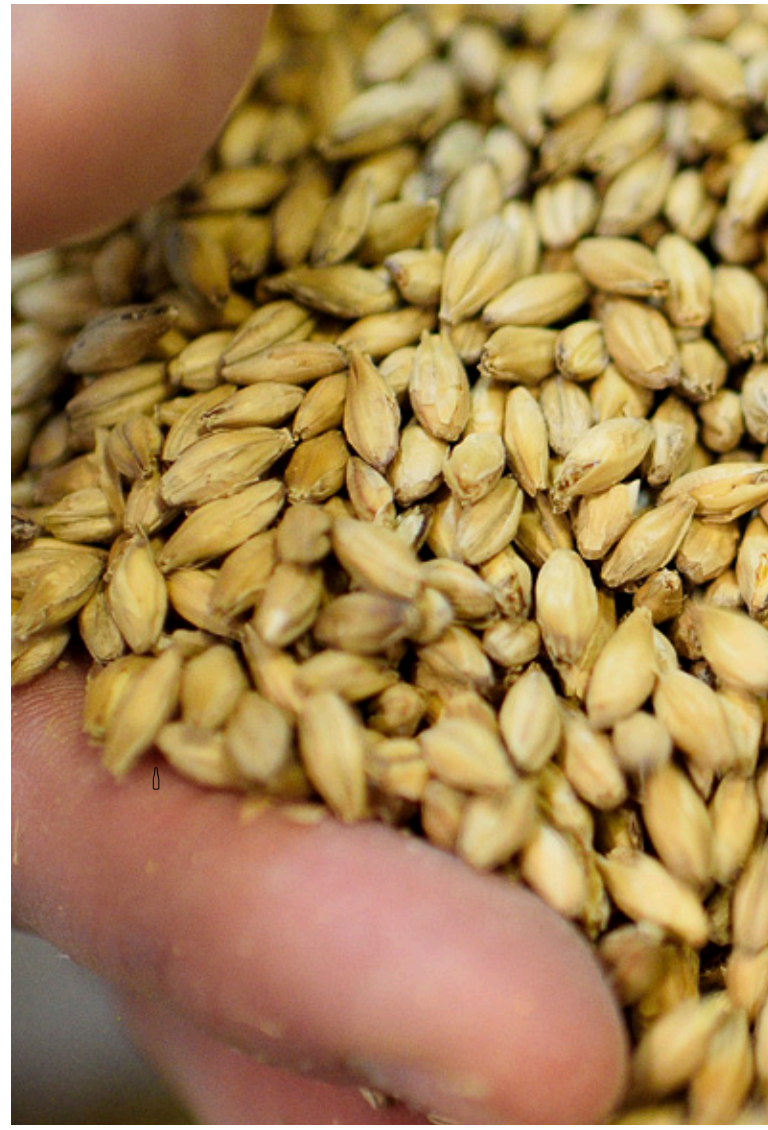
Unclear is also the future of SABMiller's recent strategy swing towards soft drinks. If soft drinks were to take a back seat in the combined company this would amount to a major strategy change. Soft drinks make up 22 percent of SABMiller's total sales by volume, while AB InBev gets 10 percent from its sales by volume from the non-beer category, including soft drinks and cider. Lastly, and perhaps most fundamentally, the two companies differ culturally when it comes to control. While SABMiller does not mind to be the junior partner in certain businesses, AB InBev likes to be in charge. It was reported that roughly 30 percent of SABMiller's earnings last year came from entities it doesn't control (its joint venture in China plus its stakes in Anadolu Efes and Castel). By comparison, AB InBev's share of such income was just 0.1 percent.

In sum, most analysts still think that a deal will be clinched. However, reservations remain. "In a transformational deal you would expect some sort of give-and-take on the overall strategy, but this would be more than a give-and-take, it would be a fundamental overhaul," one analyst said.

AFTERTHOUGHTS BY AN OVERWHELMED TECHNICAL EDITOR…

What can one say after having sawed through all of this? Well, besides thinking that, right at the time of a deal like this, life as CEO in one of these companies seems bearable. After all, USD 65 million would compensate for quite a bit of overtime and sleepless nights! To me, certainly, all the numbers floating around in the air are, literally, impossible to grasp. USD 107 billion as the price for SABMiller – who on earth can even vaguely understand a number that big? And 'Residual Goodwill' valued at USD 71 Billion! Something as fluffy as goodwill valued at the annual GDP of a mid-sized European country… a projected USD 1.3 billion in annual savings from synergies? I'm sure that the people who did the math on this are extremely highly qualified and experienced. But still…? Do you believe that even the most skilled economists can fathom all the factors going into a calculation like that? I have a hard time believing so, I admit. And although I'm moving quite a bit out of my comfort zone, where malt, hops and yeast are my biggest challenges, I do remember terms like 'sensitivity analyses' and 'unforeseen circumstances' in relation to big business deals. And simple common sense tells me that those people presenting the numbers to their boards and directors have moved a bit out of their own comfort zones when those numbers become as big as they do. And when the actual business details behind those numbers include hundreds of brands on almost as many markets all over the globe. Is it a steadfast belief that all those details are under control, and that the outcome of such a deal is actually predictable?

My daughter just finished her thesis on large-scale international mergers and acquisitions for her masters' degree in International Business at the Copenhagen Business School, and her dad got the job of proofreading the paper. And besides the fact that the theory and methodology in



such a piece of work – apart from the advanced lingo used by economists – is actually not that hard to understand, I was intrigued to learn that one of the motivations that is recognized by the experts as an important factor in such mergers is actually what they call 'Empire Building'. In other words, mine to be precise, the megalomania, personal economic gain and need to boost egos on the polished floors of the boardrooms are real factors involved when deals like MegaBrew are made. In spite of the fact that none of my money is at stake here, I truly find this scary.

I'm left with an overall impression that a deal like the formation of MegaBrew is like an absurd theatre piece. I'm anything but left-wing in terms of political views – those days are far gone – but, having tried to digest all the above (plus a lot more I chose not to include in this article), I still find it hard to fathom why these moves to become over-worldly large and strong can continue, as I'm sure this wandering will also roam many places in the brewing business. When will one of these deals fail really big-time and leave hundreds of thousands of employees as victims? Well, your answer is as good as mine.

ABOUT THE AUTHOR

Anders Kissmeyer has M.Sc.s in brewing and Chemical Engineering. After 16 years at Carlsberg, Anders, in 2001, started the Nørrebro Bryghus project, one of the first Danish craft breweries. From 2010 until July 2016, Anders was in charge of his own brewing, consulting and communications company, Kissmeyer Beer & Brewing. In July 2016, Anders became 'Head of Craft Beer Creation' on a half-time basis at Royal Unibrew A/S, which at the same time acquired the brand Kissmeyer Beer. Besides this, Anders continues his consulting and communications activities under the name 'Anders Kissmeyer, Master Brewer'.

Anders is the Technical Editor of the Scandinavian Brewer's Review, has served on the EBC Council, is a former ExCom and board member in the Danish Brewer's Association, teaches at the Scandinavian School of Brewing, and judges international beer competitions. Anders was named 'Best still active Master Brewer in the World' by the Scandinavian School of Brewing in 2011 and an 'Honorary Beer Sommelier' by the 'The Beer Academy' in the U.K. in 2013. And, in 2016, he was awarded the Danish Brewers' Association's Jubilee Award for an outstanding contribution to the industry.

NEWSFLASH

CARLSBERG CONTINUES TO IMPROVE ITS SUSTAINABILITY PERFORMANCE

The Carlsberg Group achieved its 2017 reduction targets for energy, CO2 and water ahead of schedule and is on track to deliver its 2017 target on responsible drinking information, according to its 2016 Sustainability Report. Since 2015, the Carlsberg Group has delivered reductions of 6% in energy consumption (kWh/hl), 14% in CO2 emissions (kg CO2/hl) and 6% in water consumption (hl/hl). Meanwhile, 17% of the Group's energy consumption now comes from renewable sources such as biomass, solar power and certificates with guarantees of origin. The Group has also inaugurated a solar panel installation at its facility in Dali, China, that is the fourth largest brewery installation of its kind in the world.
– In 2016, we continued our efforts to improve our sustainability performance by further reducing energy consumption, CO2 emissions and water usage. We're pleased that all three areas delivered progress faster than anticipated, and we are now taking our sustainability efforts even further as part of our Group Strategy, SAIL'22" says Simon Boas Hoffmeyer, Sustainability Director, Carlsberg Group.

The Carlsberg Group also further expanded its efforts to reduce drink driving, prevent sales to people under the legal age and provide consumers with more detailed and easily accessible information about ingredients, nutrition and responsible drinking. A further 31% of the Group's beers now carry responsible drinking information, bringing this to 85% of total volumes and in reach of the 2017 target of 100%.

Source Carlsberg Group

THE SIGN OF THE NEW TIMES IN CRAFT BREWING: REDUNDANCIES

Craft breweries are facing slowing growth in the US. After years of two digit growth rates, long-established craft brewers are facing stiff competition from an explosion of small breweries to over 5000 and behemoth brands that have refreshed their offerings to compete.

"2015 seemed to be the first year that growth may be reaching a plateau," said Nick Petrillo, senior analyst at IBISWorld. During the first half of 2016, craft beer sales rose by 8 percent only, according to the Brewers Association.

Market research company Nielsen's so-called "off-trade" data, which cover about two-thirds of the overall US beer market, showed that craft beer sales rose 4.2 percent in 2016.

Californian craft brewer Stone, which ranked 10th among US craft brewers and raked in more than USD 200 million in sales in 2016, has responded to market pressures by laying off about 60 employees in October. That's roughly 5 percent of its 1,200-employee workforce, it was reported.

Dominic Engels, who took over as CEO of Stone from founder Greg Koch in September, was quoted as saying: "With business and the market now less predictable we must restructure to preserve a healthy future for our company."
"Restructuring was a necessary course correction we needed to do to match our growth trajectory and spending trajectory," he said. "Pressures from Big Beer are a reality in the craft industry and will continue to impact the industry's growth."

Source: BRAUWELT International

BEER PLAYS MAJOR PART IN EU ECONOMY

At their sixth annual Beer Serves Europe event in November 2016, The Brewers of Europe presented two new publications, the 180-country study "Beer Connects Europe with the World" and the 2016 edition of "Beer Statistics", highlight how beer is accompanying Europe's economic recovery and flowing increasingly towards fast growing areas of the globe.

Total consumer spending on beer was over 110 billion EUR in the EU in 2014. The latest statistics confirm that the European brewing sector is now firmly on the path to prosperity. Consumption and production are not just stable, but improving with year-on-year rises in EU countries from 2014 to 2015 of 1 % in consumption and 1.4 % in production. Meanwhile beer is growing at the fastest rate among the top 10 food and drinks products in the EU by export value. There were 588 new microbreweries established in the year from 2014 to 2015, a rise of 13 %. The European brewing sector is a key actor for job creation and the economy. Beer adds the equivalent of the GDP of Luxembourg, or around 51 billion EUR, annually to EU output. The sector provides over 120000 direct jobs in the EU alone.

"The Brewers of Europe are proud of the major part they play in the European economy, generating considerable employment and boosting trade both within the EU and beyond. Supportive policies will enable brewers to continue contributing to the overall competitiveness of the European economy and sustained growth," said Pavlos Photiades, President of The Brewers of Europe.

Source: BRAUWELT International

HOPS, HERBS AND MALT

THE NORWEGIAN WAY

BY METTE GOUL THOMSEN, NIBIO, E-MAIL: METTE.THOMSEN@NIBIO.NO, TORE NYBØ, NØGNE Ø, E-MAIL: TORE@NOGNE-O.NO, MAURITZ ÅSSVEEN, NIBIO, E-MAIL: MAURITZ.ASSVEEN@NIBIO.NO AND RAGNAR ELTUN, NIBIO, E-MAIL: RAGNAR.ELTUN@NIBIO.NO

The New Nordic Beer movement is rolling on, not least in Norway. In November 2016, the Norwegian Institute of Bioeconomy Research (NIBIO) hosted a conference in Drammen where there was focus on the results and findings of a large and long-running Norwegian project looking into several aspects of sourcing of local, Norwegian raw materials for brewing. Your Technical Editor had the pleasure – not least the evening tour of and dinner at the local Aas Brewery – of attending the two-day conference, presenting the status of the Danish New Nordic Beer activities. And I was lucky to persuade the hosts into contributing to the SBR with an article on the Norwegian project. The result is published here:

In Norway, the trend of local food/Nordic food has gained a dramatic interest in recent years. This includes a great interest in brewing. Today, 100 farm- and microbreweries (members of the Brewer's Association, BROD) produce approximately 9-10 million litres of beer annually (approximately 4% of the total beer production in Norway). Following this tremendous interest in the brewing of good Norwegian beer, there is also a high demand for local/Norwegian ingredients.

We do know that brewing has been a widespread activity throughout Norway for more than 900 years and that cultivation of barley as well as hops and use of a range of herbs were common in earlier times. However, the knowledge about both hop cultivation as well as local malting ended in Norway years ago, apart from the traditional production of smoked malt in Trøndelag and a few locations on the West coast.

A group from the Norwegian Institute of Bioeconomy Research (NIBIO), in cooperation with a number of microbreweries, in 2013 started a project focused on the basics, looking into the ingredients hops, herbs and barley. The aim has been to reintroduce commercial cultivation of hops and malting barley, to increase the understanding and use of Norwegian plant material including herbs and to give local brewers a genuine product.

HOW WE HAVE REINVENTED CULTIVATION OF HOPS

For our experiments, we selected clones from the Norwegian germplasm collection of hops. The clones were selected both in order to represent a South to North gradient and also focusing on clones that had been observed to develop ripe cones, and on those that looked least susceptible to diseases (Table 1).

Hop clone	Locality	MASL	°N°E
6	Luster	10	61°29'N 07°36'E
7	Ringsaker	140	60°55'N 10°42'E
27	Nome	100	59°13N 09°14'E
37	Vevelstad	10	65°43'N 12°3'5E
40	Kvinesdal	60	58°20'N 06°57'E

Table 1. Origin of clones of Norwegian hops selected for this study

Since the summer may be cold and wet many places in Norway, we wanted to find out if it was possible to grow hops in plastic tunnels and how this would affect the yield and development. Hops were therefore grown in open field, all five clones, or in plastic tunnels, clones 7, 37 & 40 (pictures 1 and 2). We did not use any pesticides in the experiments, as there are none registered in Norway for hops.

During the three growing seasons covered by the project, we have seen that there are major differences between the clones we selected as well as between the cultivation systems, open field and plastic tunnel. The yield is approximately 2-3 times higher in tunnels than in open field. In average over the three years, the three clones grown in both tunnels and in open field yielded, respectively, 616g and 226g of dry cones per plant. Clone number 40 gave the highest yield (900 in tunnel vs. 300 g/plant in open field), followed by 37 (580 vs. 200 g/plant) and 7 (360 vs. 170 g/plant).

The hops have been laboratory-tested for aroma in dry cones (Table 2) and in a number of different brews. There are individual differences and preferences, but, overall, the brewers have found that the Norwegian hops can create a good and interesting aroma in the beer.

Dry hops	Clone				
Aroma, % of participants	6	7	27	37	40
Citrus	50	44	63	30	0
Flower	38	70	85	80	44
Fruit	38	40	50	60	33
Spicy	75	64	63	60	67
Woody	75	60	63	60	56
Bitter	38	40	25	30	44

Table 2. Aroma in dry cones

HERBS – ENDLESS VARIATION AND POSSIBILITIES

We have tested a number of herbs (Table 3) in both beer without hops and in a neutral, hopped ale. The antioxidant activity in some of the herbs, such as Origanum, noticeably slowed down the fermentation process. A. vulgaris was found to add sweetness and fruitiness to the beer, while A. millefolium was the one, in general, best-liked.

Artemisia vulgaris (mugwort)	Calluna vulgaris (heather)
Filipendula Ulmaria (meadowsweet)	Achillea millefolium (yarrow)
Salvia officinalis (sage)	Carum carvi (caraway)
Origanum vulgare (oregano)	Rhodiola rosea (rose root)
Angelica archangelica (angelica)	Leuzea carthamoides

Table 3. Herbs tested

NORWEGIAN MALTING BARLEY, OLD AND NEW VARIETIES

In Norway, varieties of 6-row barley are dominating in areas with short growing seasons, as 2-rowed varieties mainly are suited for growing in the better grain districts. Early varieties →

are also advantageous because the grain most likely can be harvested under more favourable conditions. We have selected old varieties that may or may not have been used for malting and new varieties known as malting barley (Table 4). We have looked at aspects such as growth conditions, mountainous/low land areas, fertilizer level and organic/ conventional growing.

Variety	
Dønnes	Old 6-row variety from before 1900. From Dønna in Nordland, Norway
Maskin	Early, 6-row variety from Møystad. Came on the market in 1918
Varde	Norwegian, early 6-row variety approved in 1941. Dominating variety in the 1960s
Domen	Semi late 2-row variety from Møystad, approved in 1952
Arve	Norwegian, early 6-row variety, approved in 1990
Olsok	Norwegian, early 6-row variety, approved in 1994
Lilly	Early 2-row variety developed at Løken. Used in Iceland, high tolerance to the climate
Saana	Semi late, Finnish 2-row variety, approved in Norway in 1999
Barke	Semi late, German 2-row variety. New in Norway
Marthe	Semi late, German 2-row variety. New in Norway
Quench	Late 2-row variety developed in the United Kingdom. New in Norway
Tamtam	Late 2-row variety developed in the United Kingdom. New in Norway

Table 4. Varieties of barley tested for cultivation and malting in Norway

WHICH OF THE BARLEY VARIETIES DID WELL?

We have during these tests seen significant differences between varieties both with regard to yield and grain quality. It was not expected that the old varieties could compete in yield with the modern varieties, however, especially Arve and Olsok did very well and, at the best, yielded at nearly the same level as a number of the 2-rowed varieties. In addition, Varde has given reasonable yields. Of the old varieties, Domen has the best grain quality, with test weight and 1000-grain weight at the same level as modern 2-rowed varieties and with protein content fairly well fitted for malting. The experiments show great variation in protein content between varieties, locality and year. The trials with varieties and N-fertilization show that N-levels of 120 kg N/ha gave the highest yield and the most optimal protein content for most varieties in 2013 and 2015. In 2014, 80-100 kg N/ha gave a more optimal protein content.

The old barley varieties can be extra challenging to grow because of their long and weak straw, which may result in lodging, germination of the grain in the field and spoiled malt quality.

MALTING QUALITY - OLD IS BUT GOOD IS...

Old varieties can be used for malting and have given satisfying results in the tests. Of these, Domen and Varde have given the highest extract yield and lowest saccharification rate. In general, the modern malt varieties give higher extract yield than the old varieties, and Quench is, so far, the one with the best malting properties. Grain size analysis shows that, in general, the 2-rowed varieties have a better grain size distribution than the 6-rowed varieties.

Two varieties of Norwegian barley: Domen at the left and Dønnes to the right.

Nitrogen	Yield (kg/Ha) and protein content (%)					
	2013		2014		2015	
	Yield	Protein	Yield	Protein	Yield	Protein
60 kg N/Ha	4080	8,7	5550	10,1	4010	8,3
80 kg N/Ha	4560	8,7	5650	10,3	4730	8,5
100 kg N/Ha	5370	9,0	5950	10,4	5390	8,8
120 kg N/Ha	5960	9,7	6820	11,9	5860	9,2

Table 5. Yield and protein content related to fertilizer

Marthe and Quench are the best 2-rowed varieties, while Arve has a larger proportion of large grain than the other 6-rowed varieties.

NORWEGIAN BEER ON NORWEGIAN INGREDIENTS?

So far, we have no reason to believe that the microbreweries and production of local beers cannot be made from mostly Norwegian-produced ingredients. Did we mention the yeast? Yeast has not been part of this project, but there is activity into this and old Norwegian yeast cultures are still in use in traditional brews as documented by Lars Garshol in his 2016 book, "Gårdsøl" (farmhouse beer). All in all, we see a bright future for the brewing originality in Norway.

ABOUT THE AUTHORS

Mette Goul Thomsen, PhD. Mette works as a Research Scientist at The Norwegian Institute of Bioeconomy Research (NIBIO). She works with plant biology/plant cultivation in herbs and vegetables and with weed management. She has participated in a number of projects related to use of herbs in produce and product development.

Tore Nybø. Tore was one of the founders of Nøgne ø and is now Managing Director at the microbrewery. Nøgne ø is Norway's leading and largest supplier of craft beer and the first and only producer of sake in Europe. Their mission is to create fantastic full-bodied and handcrafted beers. Knowledge, quality and a constant search for new flavours makes Nøgne ø one of the world´s leading craft breweries.

Mauritz Åssveen graduated as a Cand. Agric. from The Agricultural University of Norway in 1981, and as DSc from the Agricultural University of Norway in 1992. Thesis: Competition effects in barley (Hordeum vulgare L.). Mauritz works as a Research Scientist at the Norwegian Institute of Bioeconomy Research (NIBIO). His main competence is research into grain cultivation and varieties. Mauritz is leading the Norwegian VCU testing programme.

Ragnar Eltun is head of the Department of Grassland and Livestock at the Norwegian Institute of Bioeconomy Research. He has been the scientific leader of the project "Norwegian malt, hops and herbs – the taste if Norwegian beer".

KRONES EQUITHERM

– PRODUCTION HEAT REQUIREMENT REDUCED BY 36 PER CENT IN THE MURAU BREWERY

BY: HELMUT KAMMERLOHER, MICHAEL FRIEDRICH, KRONES AG, AND DR.-ING. GEORG F. SCHU

From Krones AG, we have received the following article, which we at the SBR feel has significant relevance and importance in this era of focus on sustainability and energy conservation. So, although it is borderline with respect to covert advertising, we have decided to publish it. With Krones EquiTherm, a concept involving heat storage and distribution through low-temperature, pressurized hot water is now available. The concept assures a holistic optimisation of the thermal balance in the brewery production process, and thus utilizes the warm water surplus mostly encountered in the brewhouse. And in this specific application, the heat requirement of the Murau brewery was reduced by 25.7 per cent.

In 2013, the Murau eGen Brewery in Styria, Austria decided to change over its energy supply step by step to regenerative energies. Together with the Murau Municipal Utilities and Krones AG, the cooperative brewery in Murau has now written history in the field of brewing technology. This has been made possible by a complete change-over to low-temperature process heat in the form of hot water. The hot water comes from a biomass cogeneration plant newly built by the Murau Municipal Utilities in 2011, fired exclusively with wood from the surrounding region. Krones has enabled this heat to be utilised in the brewhouse as well, by converting it to the EquiTherm system. Since the end of April 2014, the cooperative brewery has been producing its beer 100 per cent with heat from the biomass cogeneration plant of the Murau Municipal Utilities. The results of a recent energy-efficiency expertise following completion and optimisation of the modification work concerned now show that the measures taken for converting the brewery's energy systems have proved exceptionally effective.

THE LOW-TEMPERATURE BREWERY

The crucial factor behind the Murau Brewery's energy concept was the decision of Murau's town council, with its subsidiary Murau Municipal Utilities, to build a biomass cogeneration plant. To render this commercially viable, the operator was compelled to find customers who require the heat all the year round. This condition was met by delivery agreements with the nearby health clinic and with the brewery. However, to enable a brewery to be supplied completely with locally produced district heat, all internal brewery heat consumers had to be checked beforehand in regard to the heat flow needed and the temperature requirements. In the actual case, it was necessary to change over all steam consumers to low-temperature hot water at max. 115°C. Only the brewery kegging line still needed steam, now provided by a separate small boiler, which can be heated with biogas, but also by electricity.

For Krones, a low-temperature brewery is defined as one featuring a maximum heating-medium temperature of 115 °C with hot water as the heat carrier in a closed system. The energy is provided via a central heat storage tank, enabling the energy carrier to be re-used repeatedly and the temperature thus to be reduced to about 80°C. Due to the low temperature level in the storage tank, it is much simpler to integrate recuperative or renewable energy. And

incorporating a unit-type cogeneration plant is for this reason easy to implement.

MODIFICATION MEASURES REQUIRED

Since the brewery wished to retain the traditional character of the existing brewhouse, with its copper hoods, Krones integrated the leading-edge technology into the existing vessels. The mash kettles and the major part of the wort boiling system were converted to incorporate the latest Steinecker technology, and the existing wort cooler had an EquiTherm system added. The two mash tuns were modified to feature the energy-economical ShakesBeer EcoPlus system. At the same time, Krones installed a new mash mixer for each of them, visually matched to the copper hoods.

The modification measures specifically:

Mash kettles: In the shape of EquiTherm, a system has been developed that withdraws energy from the brewing process at an appropriate point and feeds it back in again upstream in the process. With the energy recovery system thus created, enormous savings of up to 30 per cent in thermal energy and 20 per cent in electricity can be achieved in the brewhouse for both infusion and decoction processes – and in fact even more given ideal preconditions.

The EquiTherm system comprises three individual process units connected to each other:

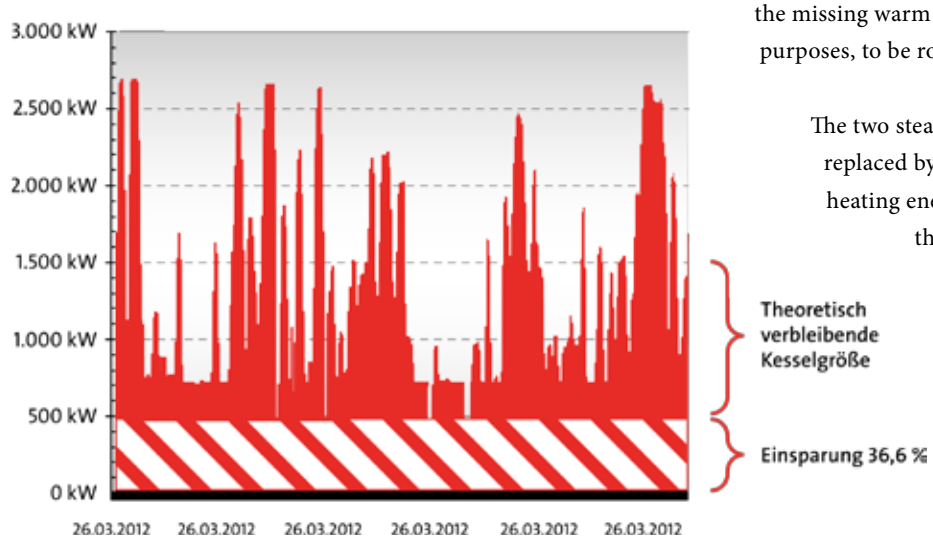


Fig. 1. Low-temperature brewery with EquiTherm and a central energy storage tank, able to halve the boiler rating to be installed.

- The ShakesBeer EcoPlus: In the mash tun system, hot water is used as the heat carrier and the heat flow is increased using a counterflow heat exchanger principle. The turbulent flow pattern on the product side improves the heat transfer to the mash, and thus the heating rate.
- The central pressurised energy storage tank is the system's heart, featuring stratified charging pipes, optimizing the density/temperature-dependent storage and withdrawal of the heat carrier.
- Two-stage wort cooler: the crucial factor for the functioning of the EquiTherm system's energy recovery capability is the interaction between the ultra-efficient ShakesBeer EcoPlus mash kettle with its low return temperatures and a defined energy recovery rate at the wort cooler.

EquiTherm ensures that at the Murau Brewery in a first stage of the wort cooler energy storage tank water is heated up to 95°C. The hot wort is in this additional stage pre-cooled from 98°C to a minimal 83°C. The energy is placed in interim storage at the newly installed pressurised energy storage tank. The wort cooler is now supplied with mash liquor at a temperature of 6°C instead of the previous 3 to 4°C. The increased temperature means additional savings in terms of refrigeration energy, and thus in the amount of electricity used to power the cooling compressor. In order to achieve the desired pitching temperature, more mash liquor is now passed through the wort cooler. This enables the missing warm mash liquor, removed for heating purposes, to be roughly compensated for.

The two steam-heated mash kettles were replaced by the ShakesBeer EcoPlus. The heating energy comes from the first stage of the EquiTherm wort cooler, in which, for each brew, approx. 300 kWh of heat at a high temperature level are removed.

Intermediary wort heater: In the past, the wort from the lautertun was heated up by means of live steam through a first stage of the external boiler. An intermediary wort heater has now

been installed, in which the wort is brought up to boiling temperature.

Wort boiling: As previously, the wort is boiled using an external boiler, which is supplied by a mechanical vapour compressor. The wort copper has been changed over to incorporate the Stromboli wort boiling system and fitted with additional heating surfaces. The challenge here was the initial boiling phase for the mechanical vapour compressor, which used to employ live steam. The formerly steam-heated stage of the external boiler was modified so that today it can be operated with a heating-water supply temperature of 115°C. After initial boiling in the first external boiler stage, the second stage is supplied with compressed vapour steam. A heating medium temperature of 115°C is thus required only for initial boiling of the wort and for heating up the part-mash in the decoction process. All other consumers are supplied with 105°C or lower.

Vapour condensate cooler: The vapour condensate from the wort kettle had not previously been thermally recycled, despite a total evaporation of 6 per cent. An appropriate vapour condensate cooler was retrofitted here, which serves to compensate completely for the reduced quantity of warm water at the wort cooler due to EquiTherm.

Biogas utilisation: For utilising the biogas, today a separate small biogas boiler is used for steam generation. Steam is now required only in the kegging line for sterilising the kegs. If no steam is currently required, then a circuit is run via the stratified heat storage tank, and the surplus energy is stored there. The room heating system also takes energy from the storage tank during the heating period. If steam is required, although insufficient biogas is available or none at all, the steam boiler can be heated by means of a heating element. The power requirement involved is recorded separately using a meter. Previously, outside the heating period (in summer), the biogas mostly had to be flared off. Biogas utilisation is currently running at almost 100 per cent.

Dismantling a steam boiler: Before the change-over, there were two steam boilers installed. One of these was dismantled, while the second was "cold"-conserved. This means the standstill losses normally occurring have been completely eliminated. The conserved boiler can in an emergency, or in the event of scheduled overhauls at the cogeneration plant, be started up and heat the stratified heat storage tank.

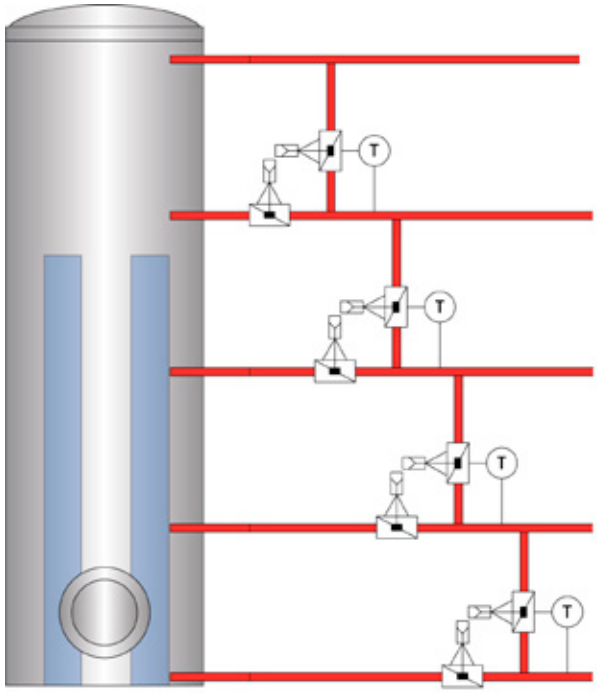


Fig. 2. Optimal heat utilisation thanks to a cascaded configuration. For supplying a brewery's consumers, process considerations will mostly entail four different temperature levels. With the cascaded configuration of the energy storage tank, the supply temperatures to consumers can be variably set in response to individual needs. Charging pipes optimise storage and withdrawal of energy, while the heating medium is utilised in stages several times over. This results in efficient utilisation of the heat available, responsively tailored to the consumers concerned, with low return temperatures.

Stratified heat storage tank: The heart of the system is the stratified heat storage tank, which holds 110,000 litres. Here, firstly, the heat from the EquiTherm is stored, and secondly, the precise amount of thermal energy needed for the various heat consumers can be removed from the different temperature strata. A cascaded blending function enables some of the heating water to be used repeatedly, which means the return temperature can be gradually reduced to about 80°C. Thanks to the low return temperature, a heat flow of more than 2,000 kW can be transferred from the cogeneration plant 2.5 km away via the DN 150 district heat pipeline installed, with only a heat flow of somewhat more than 1,000 kW being required on average (Fig. 3).

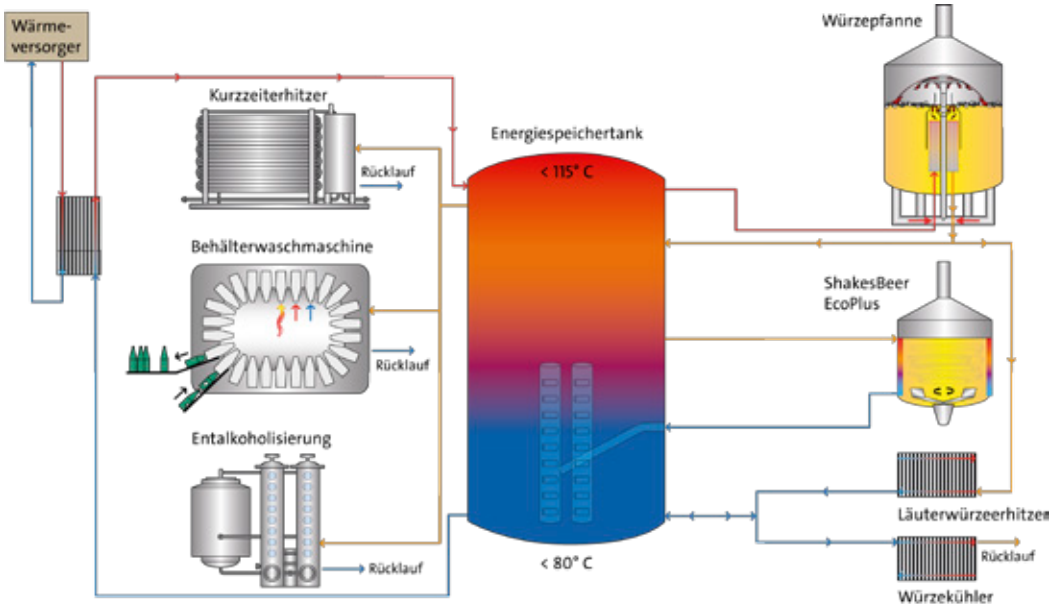


Fig. 3. A central energy storage tank as the interface for all processes.

SUMMARY: TARGET ACHIEVED – EXEMPLARY ENERGY SAVINGS

The energy requirement was validated before and after the modification work, enabling the effects of the low-temperature process heat to be assessed. The comparison between the consumption levels measured is referenced to the fuel energy used.

Thanks to the measures described above, the specific heat requirement was reduced by 25.7 per cent. This figure includes the heat required for the administration space and the brewer's museum as a plant-specific consumption item. Nowadays, the plant is supplied with heat generated solely by means of regenerative energies, i.e. locally produced district heat from biomass and its own biogas.

At the brewery's request, it was also alternatively determined how the specific energy requirement for the production process itself has developed when the heat for the administration space and the brewery's museum is excluded. Then, the specific heat requirement fell to under 18 kWh/hl, and thus on a like-for-like comparison is even 36.6 per cent lower (Fig. 4). In terms of its specific power requirements the plant performs at 10.8 kWh/hl.

Fig. 4. Since the brewery wanted to preserve the traditional character of the existing brewhouse with its copper hoods, Krones integrated the state-of-the-art technology into the existing copper vessels.

ABOUT THE AUTHORS

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The authors would like to thank the Murau Brewery and the Murau Municipal Utilities for their assistance in conducting the analyses.

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THE SCANDINAVIAN SCHOOL OF BREWING – COMING ACTIVITIES	
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Packaging (Module 3)	9 - 20 February
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BIOGRAPHICAL

50 Brewmaster **Stenholm Katharina** turned 50 on 14 January.
Brewmaster **Jan Kinov** turned 50 on 18 February.
Brewmaster **Espen Tyrihjell** turnes 50 on 17 April.
Brewmaster **Tuokkuri Veli-Matti** turnes 50 on 5 May.
Brewmaster **Viitaniemi Sam** turnes 50 on 8 May.
Brewmaster **Steinar Kvam** turnes 50 on 22 July.

60 CEO Brewmaster **Mikael Engström** turnes 60 on 24 March. Brewmaster **Stefan Peter Stadler** turnes 60 on 28 April.
Diploma Brewer **Flemming Bie** turnes 60 on 25 May.

70 Brewmaster **Carsten BrydeAndersen** turnes 70 on 23 April.

80 Brewmaster **Harald K. Olafssøn** turned 80 on 12 February.
Brewmaster **Sopo Martti** turnes 80 on 28 April.

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