EUROPEAN BREWERY CONVENTION

SYMPOSIUM 2016
MODERN BREWHOUSE TECHNOLOGIES AND WORT PRODUCTION

Sofitel Old Town
Wrocław, Poland
18 – 20 September 2016

www.ebc-symposium.org
FOR OUR FIRST EVENT IN POLAND WE WOULD LIKE TO THANK

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Browary Polskie

The Brewers of Europe

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Browar STU Mostów

SOFITEL LUXURY HOTELS
On behalf of the European Brewery Convention it is a great pleasure to welcome you to this year’s EBC Symposium in Wroclaw. You may be aware of the fact that Wroclaw is one of only 2 European Capitals of Culture for 2016; the other one being San Sebastián in Spain.

Our series of meetings (Symposium, Brewing Science Group technical meeting and the ERAB / EBC meeting) will take place mainly at the Sofitel Hotel, conveniently situated in the old part of this historic city. The venue chosen provides an excellent setting for our technical lecture programme and presentations. A most attractive social programme has been elaborated by our team in Brussels and Warsaw: You have a guided city walk, a boat trip (including beer and barbecue on board!), as well as 2 visits to breweries to look forward to. The latter includes our partners from Browar Stu Mostów, an innovative young craft brewer from Wroclaw, who were much involved with the Silesian beer recreation project (“Schöps”) generating lots of positive press articles and drawing welcome attention to our EBC events.

May I thank the individuals who have made these events happen? These include the following:

- The EBC Executive Officer, John Brauer, for his general project management,
- The secretariat of The Brewers of Europe, assisting with the registration system under the helpful direction of Nathalie Bosmans,
- The team at Browary Polskie, the national association of brewers in Poland, in the form of Danuta Gut and Olga Franco-Adamiak,
- The Foundation for Alcohol Research, ERAB (Janet Witheridge and Prof. Dr. Sascha Venturelli)
- Our marketing and brewing press consultant, Jan Lichota,
- Our IT specialist of 2B.com, François Bellens,
- All our sponsors and partners

So, all that remains for me is to wish you all the best for a good symposium, effective knowledge transfer and, last but not least, excellent networking opportunities under an autumn sun with a very central-eastern European flair. Don’t forget to already mark next year’s EBC Congress in your calendars: 14-18 May 2017 in Ljubljana / Slovenia. See you hopefully there!

Tiago M. Brandão
EBC President
It is with honor and great pleasure that we welcome the delegates of EBC Symposium 2016 to Wroclaw. With Poland being the third largest beer producer in Europe and the country of long beer tradition and thriving beer culture it is only natural for us to host such prestigious and recognizable brewing technical event. The growing demand for diversity and variety in beer requires constant development of modern brew house and wort production technologies.

The Union of Brewing Industry Employers in Poland – Polish Brewers is a trade organization associating the leading breweries in Poland. For years The Union has been providing its members with expertise and consulting related to the broad based legal, economical and business environment. Our role is to secure industry’s continued right to brew, market and sell its products to adult consumers and to protect consumers’ right to choose, drink and enjoy beer.

We appreciate the opportunity to share with you some of the best things that Wroclaw has to offer. With European Capital of Culture being located here this year there is lots to enjoy. We wish you a very successful Symposium and hope you will decide to visit Poland again.

Danuta Gut

Director General
Polish Brewers
# TABLE OF CONTENTS

**EBC Symposium 2016**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>WELCOME</td>
<td>1</td>
</tr>
<tr>
<td>PROGRAMME</td>
<td>4</td>
</tr>
<tr>
<td>ABSTRACTS AND AUTHORS</td>
<td>7</td>
</tr>
<tr>
<td>PRACTICAL INFORMATION</td>
<td>20</td>
</tr>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>20</td>
</tr>
</tbody>
</table>
PROGRAMME

SUNDAY, 18 September 2016

15h00 Opening of the registration desk at Sofitel Old Town Hotel.

17h00 Gathering at the lobby of the Sofitel Old Town Hotel. Departure for guided tour of Wrocław’s Old Town at 17.30

19h00 Departure of the boat from the Hala Targowa harbour. Beer and barbecue dinner served on board.

21h15 Arrival of the boat at the Hala Targowa harbour. Return by bus to Sofitel Old Town hotel and Ibis Styles hotel.

MONDAY, 19 September 2016

From 08h00 Opening of the registration desk at Sofitel Old Town Hotel.

08h30 to 08h45 Welcome speech by EBC President

Tiago Brandão, Unicer bebidas, PT

KEY-NOTE SESSION

Chairman: EBC President Tiago Brandão (Unicer bebidas)

08h45 to 09h15 Former brewhouses and their evolution to modern brewing systems

Ludwig Narziss, TUM Weihenstephan, DE

09h15 to 09h45 Reflections on 40 years in brewhouse development

Theo Vervloet, Belgian Brewers, BE

09h45 to 10h15 An overview of the Polish beer market and recent trends

Jan Lichota, UNED, ES

COFFEE / TEA / BEER BREAK
### TECHNICAL SESSION I: BREWHOUSE MACHINERY AND INSTALLATIONS

**Chairman:** Carsten Zufall (Cervecerias Polar)

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>10h30-11h00</td>
<td>Gentle and smart - final wort treatment by means of a dynamic coolship</td>
<td>Tobias Becher, Ziemann Holvrieka GmbH, DE</td>
<td>L4</td>
</tr>
<tr>
<td>11h00-11h30</td>
<td>Brewhouse challenges caused by craft beer production</td>
<td>Konrad Müller-Auffermann, Krones AG, DE</td>
<td>L5</td>
</tr>
<tr>
<td>11h30-12h00</td>
<td>The Browar Stu Mostów project: Planning and commissioning a craft brewery project in Poland</td>
<td>Grzegorz Ziemian, Browar Stu Mostów, PL</td>
<td>L6</td>
</tr>
</tbody>
</table>

**LUNCH**

### TECHNICAL SESSION II: BREWHOUSE INSTRUMENTATION

**Chairman:** Jean Titze (Hochschule Anhalt)

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>13h30-14h00</td>
<td>Combining inline instrumentation and data monitoring to improve brewhouse and brewery efficiency</td>
<td>Alfred Baumegger, Anton Paar GmbH, AT</td>
<td>L7</td>
</tr>
<tr>
<td>14h00-14h30</td>
<td>Online monitoring of mash processes using Specshell SIBA IR spectroscopy</td>
<td>Andreas Kunov-Kruse, Specshell ApS, DK</td>
<td>L8</td>
</tr>
<tr>
<td>14h30-15h00</td>
<td>Improving extract yield and wort viscosity: Automated measurement of hydrolytic enzymes in the production of fermentable sugars</td>
<td>Claudio Cornaggia, Megazyme international, IE</td>
<td>L9</td>
</tr>
</tbody>
</table>

**COFFEE / TEA / BEER BREAK**

### TECHNICAL SESSION III: RAW MATERIALS AND ANALYSIS

**Chairman:** August Bekkers (Heineken)

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>15h30-16h00</td>
<td>Hard resins: New insights into a long-known hop fraction</td>
<td>Martin Biendl, Hopsteiner, DE</td>
<td>L10</td>
</tr>
<tr>
<td>16h00-16h30</td>
<td>Basic beer style parameters - Quality control by basic means</td>
<td>Axel G. Kristiansen, Danmarks Tekniske Universitet, DK</td>
<td>L11</td>
</tr>
<tr>
<td>16h30-17h00</td>
<td>Five years of increased hop utilisation by using a pre-isomerisation plant in practice - a review</td>
<td>Stefan Meyna, Bitburger Braugruppe, DE</td>
<td>L12</td>
</tr>
</tbody>
</table>

**19h00**  
**Evening reception at Browar Mieszczanński**  
*Bus departure at 18h00 from Sofitel Old Town Hotel*  
*Return buses at 22h30 and 23h15 to Ibis Styles and Sofitel Old Town hotels*
TUESDAY, 20 September 2016

TECHNICAL SESSION IV : NEW TECHNOLOGIES
Chairman: Sandra Stelm (Diageo)

09h00 to 09h30  The brewery of the future: Manufacturing intelligence and mobile devices
Jaap Both, Actemium, NL  L13

09h30 to 10h00  A generic modelling and simulation platform for assessing novel malting and
brewing technologies
Eemeli Hytönen, VTT Technical Centre of Finland, FI  L14

10h00 to 10h30  Fundamental study on the application of lactic acid bacteria in oat wort based
beverages
Eric Steffen, University College Cork, IE  L15

COFFEE / TEA / BEER BREAK

TECHNICAL SESSION V : ENERGY EFFICIENCY IN THE BREWHOUSE
Chairman: Tobias Becher (Ziemann-Holvrieka)

10h45 to 11h15  Energy Storage 2.0 - Advantages of an open system and impact on the water
balance of a Brewhouse
Peter Sterk, GEA Brewery Systems GmbH, DE  L16

11h15 to 11h45  The green brewery - Biogas from spent grains BDI
Elmar Offenbacher, BioEnergy, AT  L17

11h45 to 12h15  A complete energy management solution for breweries
Simon Durrant, eSight Energy Ltd, UK  L18

LUNCH

TECHNICAL SESSION VI : WRAP-UP
Chairman: EBC President Tiago Brandão (Unicer Bebidas)

13h15 to 13h45  Beer production with wort concentrate - potential for craft beer breweries?
Jean Titze, Hochschule Anhalt, DE  L19

13h45 to 14h15  Innovative brewing process for non-alcoholic beer production
Alberto Sun, Anheuser-Busch Inbev, BE  L20

14h15 to 15h00  Summary and conclusions with reference to future European Brewery
Convention and The Brewers of Europe events
John Brauer / Tiago Brandão / Carsten Zufall

15h00  Shuttle service from Sofitel Old Town Hotel to WRO Airport
15h30 to 17h30  EBC Executive Committee meeting (members only)

19h00  Evening reception at Browar Stu Mostów with launch of the “Schöps” beer
Bus departure at 18h30 from Sofitel Old Town Hotel
Return buses at 22h30 and 23h15 to Ibis Styles and Sofitel Old Town hotels
ABSTRACTS AND AUTHORS

L1

Former brewhouses and their evolution to modern brewing systems
Ludwig Narziss, TUM Weihenstephan, DE

Born 1925, after apprenticeship as a brewer and maltster 1945-1947, one year more as an operator, 1948-1951 studies at the Faculty of Brewing, Weihenstephan, Scientific worker and consultant at the Research- and Consulting Institutes in Nuremberg and Weihenstphan, 1956 Dr. agr. 1958-1964 Head Brewmaster of Loewenbraeu Munich, 1964 Professor of Brewing Technology at the Technical University of Munich, Faculty of Brewing Weihenstephan. Research interests range from raw materials to technology of malting and brewing, as well as beer properties, more than 600 publications as an author or co-author, three textbooks in several editions. Since Autumn 1992 emeritus, but still active in various fields of former work.

Abstract
Copper or black steel brewhouses of an age of 40-80 years had been “reconstructed” several times, but nevertheless the processes took their time from mashing-in to cold wort. There was a lot of air uptake, transferring mash or wort from one vessel to another, the heating times were longer and prior to the energy crisis, wort boiling happened with open doors. Wort treatment was not effective, the cooling times long, thus causing thermal reactions. However, the colour of the beers was “golden”, the foam good, the taste full-bodied and the bitterness (supposing more aroma hops) smoother and rounding-off. The brewers knew, how to handle their equipment, although the flavor stability was limited.

Modern brewhouses, made of stainless steel, comprising no air uptake, bright worts, “effective” wort boiling bring about beers of lighter colour, less foam, less body and less balance but a better flavor stability. It is demonstrated by analytical data, how the situation could be improved within several steps: Controlled modification of the malt, shorter enzyme rests, higher mashing-in temperatures, and biological acidification of mash and wort. Furthermore the boiling regime was re-adjusted, as an example, by an internal boiler of extended heating surface, allowing lower temperatures of the heating medium, nevertheless ensuring a good homogeneity. The protein precipitation was reduced and more foam positive nitrogen saved. Along with this, the evaporation rate fell from 8 to 4%, a positive effect for energy reasons. There remains the question of colour which is solved individually, preferably without the use of black malt. Additionally, it should be emphasized, that yeast and yeast management in modern fermentation plants require special attention.

L2

Reflections on 40 years in brewhouse development
Theo Vervloet, Belgian Brewers, BE

Born in Ghent in 1946. Has obtained the degree of Bio-engineer at Kaho Sint Lieven in Ghent (now KULeuven Campus Gent) and in Marketing and Distribution at Hogeschool Gent. His professional career has evolved in different capacities (administrative, marketing and sales, management) in breweries such as Brouwerij Van Honsebrouck in Ingelmunster, Brouwerijen Lamot (owned by Bass Charrington Burton) in Mechelen, Brouwerij Mort Subite in Kobbegem, and finally from 1984 until 2010 in Brouwerij De Smedt Opwijk (later changed to Affligem Brouwerij Opwijk). Served as President of Belgian Brewers between 2004 and 2014.
Abstract
In 45 years we do a trip through brewhouses, constructions (some more than 100 years), and with personal experience. While seeking for a good job, with up and downs the speaker tells the story of a quest in his professional life driven by the differences between theory and practice, knowledge and experience.

Brewing in cast iron, copper and all kind of stainless steel brewhouses and struggling with raw materials trying to brew good beer as there are: all kind of lager beers, lambics, red sour, cloudy white beers and strong ales – even the original Indian pale ale in the seventies of last century.

Discovering the German maischverfahren (drei-zwei- eins) and infusion method and all other kind of systems. A dream became reality, when in 2005, was bought a new brewhouse of 200 hl flexible and modular. The 220,000 hl capacity will be doubled in 2016 to 440,000 hl.

The active career ended finally to find out that in spite of all the R&D, modern engineering and the IT revolution, the whole industry of brewing could be forced to think again about beer and perhaps re-invent it...

An overview of the Polish beer market and recent trends
Jan Lichota, Universidad Nacional de Educación a Distancia, ES

Abstract
The long tradition of beer in Poland has witnessed various changes throughout the history for political and societal reasons. In recent years Poland has undergone major structural reforms in its economy and the beer market has responded in a very dynamic way. The presentation aims at showing the evolution towards the current situation of the Polish market in an international context.

Gentle and smart - final wort treatment by means of a dynamic coolship
Axel Hoffmann, Christopher Biechl, Tobias Becher, Klaus Wasmuht

Presenting author: Tobias Becher, Ziemann Holvrieka Gmbh, DE

Tobias Becher graduated as diploma engineer of brewing science and beverage technology in 2001 at the Technical University of Munich in Freising-Weihenstephan (Germany). He made an apprenticeship as a brewer and maltster before and worked afterwards as a process engineer for beer filtration systems. Later he worked as a technical consultant especially for environmental issues in the German brewing sector. Since 2005 he has been employed by Ziemann as an expert for process engineering and brewing technology. Today he is the head of research and development within the Process Technology Division at Ziemann Holvrieka GmbH in Ludwigsburg (Germany).
Abstract
Evaporation is an important process step for the wort production. The purposes of evaporation are concentration of the wort and to expel undesirable, volatile aroma components. Among all respective solutions there is still more development to finalize the wort quality accurately. Reflecting the old tradition of a coolship a new, smart and gentle wort treatment process is introduced to achieve all quality requirements by use of atmospheric conditions. Hence, without additional energy and continuously, which explains that the process equipment is called “dynamic coolship”. Positive influence on wort quality parameters like dimethyl sulfide (DMS) and linalool has been proven. Already during first pilot scale trials the reduction of free DMS by up to 30 % could be measured. With an industrial scale prototype of the dynamic coolship these values could be confirmed. The atmospheric evaporation during this process step is about 0,1 %. Linalool is not substantially influenced by this treatment. Hence, further prospects are given to the respective beer quality.

Conclusion
A new, smart and gentle way to finalize the wort quality accurately is introduced. Positive influence on wort quality parameters has been proven. The dynamic coolship allows flexible treatment of the wort, especially to react to changing raw material conditions.

Brewhouse challenges caused by craft beer production
Konrad Müller-Auffermann, Krones AG, DE

Konrad Müller-Auffermann had already two years of international experience, before he studied Brewing and Beverage Technology at the Technical University of Munich (“TUM”). During his studies he worked for several major construction companies, partly in foreign countries.

In 2009 Konrad was employed by the Research Center Weihenstephan for Brewing and Food Quality (TUM) as a consulting engineer specialized in international brewing, fermentation, and filling technologies. One year later he became head of the Research and Development- and Hygienic Design department at the institute. The focus of his PhD thesis was continuous main fermentation methods and includes alternative plant and process designs.

In 2015 Konrad became head of Breweries Product Development of the KRONES AG.

Abstract
Topic A:

Brewhouse challenges caused by craft beer production
Craft brewers can be characterized by their individuality. They think outside the box and implement processes which are not foreseen traditionally. The usage of different ingredients and increments thereby lead to new challenges which have to be tackled by operators and suppliers. The presentation will focus on problems and solutions for the usage of high hop amounts as well as flowered hops.
Topic B:

**Alternative concepts for energy reductions in breweries**

The global warming has led to international agreements in order to reduce emissions. Furthermore, experts foresee an increase in the prices for fossil energies. Therefore, the reduction of energy, used for manufacturing goods, will be a topic of increasing interest.

In this presentation the advantages of using hot water instead of steam will be discussed and also the highly efficient integration of a combined heat and power plant will be shown.

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**L6**

The Browar Stu Mostów project: Planning and commissioning a craft brewery project in Poland  
Grzegorz Ziemian, Browar Stu Mostów, PL

Grzegorz Ziemian, President of Browar Stu Mostów, ESADE Business School MBA Class of 2012, previously worked in a financial industry in the United States and private equity in Poland. Upon return to Europe in 2010 earned an MBA degree and together with Arletta Ziemian and business partners began working on a craft brewery project in Poland, one of the biggest beer markets in the world. Planning phase completed at the end of 2013 and Browar Stu Mostów offered first products in December 2014.

**Abstract**

Browar Stu Mostów is the first industrial craft brewery in Wroclaw, a city that has 800 years of beer traditions and is often called the “Good Beer Capital” of Poland. The opening of Browar Stu Mostów was a turning point in the history of brewing in Wrocław and brought one of the most innovative brewing technologies to Poland, the first fully automatic, turn-key BrauKon brewery, by many considered a milestone of a young Polish craft beer market. Located in a historic building, Browar Stu Mostów project has become a case study for brewing technology, beer marketing as well as planning and implementation.

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**L7**

Combining inline instrumentation and data monitoring to improve brewhouse and brewery efficiency  
Alfred Baumegger, Anton Paar GmbH, AT

Degree in Chemistry from Graz University of Technology, Austria  
Started with Anton Paar in 1993 as application specialist for density and concentration measurement  
Key account manager for beverages EMEA since 2015

**Abstract**

Live monitoring of lauter tun and kettle wort extract as well as beer extract and alcohol is a useful method of monitoring overall brewhouse and brewery efficiency. Currently, only Statistical Process Control (SPC) software or programmers with the knowledge to do it themselves have the means to make this possible. By combining inline extract and/or alcohol measurement with often existing flow meters, the total mass of extract and/or alcohol is measured. Monitoring the total mass of extract and/or alcohol provides the user more information to actively compare batches, investigate process fluctuations, identify and monitor critical control points (CCP) and make adjustments.
This presentation will describe in detail a method of combining existing process sensors to measure the total mass of extract and alcohol and demonstrate how it can be used to identify process shortcomings, reduce production loss and improve brewhouse and brewery efficiency.

**Online monitoring of mash processes using Specshell SIBA IR spectroscopy**

Andreas Kunov-Kruse, August Bekkers, Jens Piltoft, Christian Petersen, Nanna Møller, Jan-Maarten Geertman, Erik Hoffmann-Petersen  
*Presenting author: Andreas Kunov-Kruse, Specshell ApS, DK*

Andreas Kunov-Kruse holds a PhD degree from the Technical University of Denmark in spectroscopy and chemical engineering. Andreas co-founded the company Specshell while finishing his postdoctoral research at Massachusetts Institute of Technology. Specshell is a Danish company specializing in in-line analysis of carbohydrates in industrial processes. Currently Andreas continues his research in spectroscopic investigations of carbohydrates, while maintaining an active role in the development of Specshell’s in-line technology.

**Abstract**

SIBA (Specshell In-line Brew Analyzer) is a new mid-infrared based technology allowing for fully automated continuous inline monitoring of industrial mashing. The technology registers the amount of dissolved carbohydrates, average degree of polymerization, as well as individual carbohydrate profile, to be determined in real time with accuracy.

The presentation will show results from initial testing of the SIBA system at the HEINEKEN pilot brewery in Zoeterwoude, the Netherlands. It will be demonstrated how the method can provide simultaneously insight in both gelatinization behavior and amylase activity during the mashing, by time-resolved analysis of the starch derived sugars and their degree of polymerization.

The SIBA technology empowers the brewer to conveniently collect and utilize data from each mash, thus aiding the brewer to tackle variations in raw materials. With SIBA-technology, the brewer obtains a valuable set of completely new tools for data driven process optimization, e.g. raw material utilization and shortening of processing time, with potential for further product improvements.

**Improving extract yield and wort viscosity: Automated measurement of hydrolytic enzymes in the production of fermentable sugars**

*Presenting author: Claudio Cornaggia, Megazyme international, IE*

Dr. Claudio Cornaggia attended the University of Pavia, Italy where he earned his BSc and MSc in Chemistry following a research period at the Technical University of Munich, Germany. After a short spell as a Research Assistant at his Alma Mater, he moved to Trinity College, Dublin, Ireland where he earned a PhD degree in Organic Chemistry. He is the author of a number of publications in the areas of polymer chemistry, organocatalysis and carbohydrate chemistry and is currently involved in the development of novel colorimetric substrates for the assay of carbohydrate hydrolases.
He is employed as Senior R&D Organic Chemist with Megazyme International under CEO Professor Barry Mc Cleary who developed the Ceralpha method recognised by AOAC, AACC, ICC, RACI and CCFRA along with a wide range of assays and CODEX approved methods for the measurement of resistant starch (AOAC 2002.02), total starch (AOAC 996.11) and β-glucan (AOAC 995.16).

Abstract
The combined action of a range of carbohydrate hydrolases endogenous to barley is responsible for starch mobilisation and hydrolysis into fermentable sugars during the mashing stage.1 endo-(1,3;1,4)-β-Glucanase, (EC 3.2.1.73) and endo-1,4-β-xylanase (EC 3.2.1.8) are the two major hydrolytic enzymes involved in the breakdown of the endosperm cell wall which is composed by approximately 75% (w/w) β-glucan and 25% (w/w) arabinoxylan.2 The extent of cell wall hydrolysis by these two enzymes is crucial because it affects wort viscosity and filterability and in addition it allows the amylolytic enzymes α-amylase (EC 3.2.1.1), β-amylase (EC 3.2.1.2) and limit-dextrinase (EC 3.2.1.142) to hydrolyse the starch within the endosperm into fermentable sugars. The relevant parameters commonly measured for a given malt sample are diastatic power3 and β-glucan content4 which indirectly quantify the overall amylolytic activity and β-glucanase activity respectively. Novel assay formats have been developed for the direct and specific measurement of endo-(1,3:1,4)-β-glucanase,5 endo-1,4-β-xylanase, α-amylase,6 β-amylase7 and limit-dextrinase.8 Crucially each of these assays can be readily automated which facilitates high-throughput analysis.

L10

Hard resins: New insights into a long-known hop fraction
Martin Biendl, Hopsteiner, DE

Martin Biendl is a chemist and R&D manager at the German site of the global Hopsteiner group, a hop trading and hop processing company. He is the representative of the International Hop Industry Cooperation (IHIC) in various analysis committees of the international hop and brewing industry and he is board member of the German Hop Trade Association.

Abstract
The commercial value of hops is particularly influenced by the content of alpha-acids, the main source of bitter taste in beer. Recently could the additional positive contribution of hard resins to beer bitterness be clearly demonstrated after isolation of more than 30 single constituents from this fraction with subsequent determination of their bitter sensory profile (thesis of Michael Dresel, 2013). The practical impact of these findings was verified in brewing trials (6 hl). Single hopped lager beers were produced in duplicate using pellets, ethanol-extract or a special product, enriched in hard resins, all from the hop variety Hallertau Taurus. The beers were evaluated by chemical and sensorial analysis. Single constituents like xanthohumol, isoxanthohumol or co-multifidol glucoside, which are typical for the hard resin fraction, were present in all the different beers. Their concentrations were almost identical in the case of pellets and ethanol-extract but consistently higher in the case of the hard resin-enriched product. However, the taste panels detected no significant differences between the various beers. The fact, that the variant of using the special product also resulted in comparable quality confirms hard resins to have no negative impact at all.
**Basic beer style parameters - Quality control by basic means**

Axel G. Kristiansen, Danmarks Tekniske Universitet, DK

Axel G. Kristiansen (AGK) holds a M.Sc. in Food Science and Technology from Copenhagen University and a Diploma Master Brewer exam from Scandinavian School of Brewing in Copenhagen.

AGK has worked in the international brewing industry since 1984 and his experience comprises technical management positions working for Carlsberg 1984 till 2004. In this period AGK was assigned tasks as Deputy head of maltings, Process Manager, Packaging line manager, Brewhouse Manager and Technical Director for two Italian Carlsberg breweries. In the years 2004 – 2014 AGK was Director of Scandinavian School of Brewing in Copenhagen managing teaching, recruitment, creation of new courses and company finance.

Since December 2014 AGK is currently Deputy Director for the Danish Technical University Bachelor of Engineering Studies Institute with 17 different study lines and 2500 students in Copenhagen.

AGK has since 1985 published 21 technical papers comprising maltings technology, brewhouse technology, brewhouse adjuncts, review of the Balling Formula, Lean in Breweries, Future Brewery 2020 etc.

**Abstract**

The chemical characteristics determining beer styles and the perceived beer quality can be defined by only 7 basic chemical parameters. The present study shows, that with 7 basic Quality Control (QC) documents and with measurements of only 7 chemical parameters Quality and Beer style can be controlled.

The 7 documents are sample plans, a recipe, process descriptions, specifications, a production log. The 7 chemical analysis recommended are measurements of Original Gravity (OG), Real Extract (ER), Real Degree of Fermentation (RDF), Color, pH, Alcohol and CO₂. When the brewer pays these documents and analysis into account, he is well positioned to ensure the wished quality and that each new brew follows the defined process.

Furthermore, necessary chemical instruments to achieve this QC are suggested – they are few and not costly. A review of the necessary suggested QC documents is also required to achieve the objective. Finally, a discussion on the wanted and necessary accuracies for each type of instrument used is offered.

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**Five years of increased hop utilisation by using a pre-isomerisation plant in practice - a review**

Stefan Meyna, Bitburger Braugruppe, DE

1999 graduate engineer from TU Berlin/ VLB Berlin, faculty of brewing science. PhD in biotechnology/brewing science at Prof. Wackerbauer’s Institute for malting and brewing in 2005. At that time head of the research labs, trainer of the brewing science students, and lecturer about beer flavor stability at several EBC and WBC congresses/symposia. Two years head of quality management in the fruit juice industry, after that head of quality department at Bitburger Brewery Group, plant König-Brauerei, from 2007 to 2012.
Change to the headquarters of Bitburger Brewery Group as head of beer production in 2012. Still working in this position in Bitburg. Additional skills as six sigma black belt since 2012.

Abstract
Five years ago Hertel et al. presented a new device for the pre-isomerization of hop products and we started some trials with them in our 1.1 Mio. hl plant, König-Brauerei in Duisburg, for the first time.

The working principle is very simple: a part of the total hop dosage is pre-boiled in a special pressure vessel at high temperatures (> 100 °C) for a defined time. By this procedure the isomerization yield is much higher in comparison to the regular wort boiling step. The pre-boiled hops are then added to the regular wort kettle. Due to the better isomerization yield hop utilization is more efficient and the total hop dosage in the brew house can be reduced without changing the level of bitterness in wort and final beer.

We made several trials with different temperatures and pre-isomerization times to obtain the best yield. As we did not want to change the hop aroma profile of the final beer, the reduction was only done for the bitter hop dosage, the aroma hop portion was not affected. However, our main focus was on quality of the final beer which must not be influenced negatively in any way, even concerning beer flavor stability, sensory impression, hop degradation products (e. g. tricyclocohumol), and the ratio of cis- and trans-iso-alpha-acids. All these factors were analyzed in detail during the experiments. In the end we were able to reduce the total alpha-acid dosage by 15% reliably, without changing any of the mentioned quality factors and also having no change in bitterness (i.e. same level of BU) certainly. This corresponds to savings of round about €60,000 p. a., depending on the current alpha-acid price.

The brewery of the future: Manufacturing intelligence and mobile devices
Jaap Both, Actemium, NL

Jaap Both (1966) graduated from the Delft University of Technology on process control. After a few years being an engineer of process equipment and gaining experience in PLC, SCADA and DCS projects, he specialized in the field of Manufacturing Operations Management (MOM).

Now Jaap is a business consultant for over 15 years helping production facilities on specifying requirements, software selection, system design, project management and quality control. He has been active in a wide range of projects in feed, food and beverages, in manufacturing like automotive, semiconductors and metals, and in public facilities like water and energy. He has been member of the MESA Technical Committee and wrote some articles on MOM and MOM project management. Also he did research on a MOM design methodology to describe system functionality in a SMART way.

Abstract
The brewery of the future is like a brewery now, producing quality beer for its customers. The difference is that in future the same output is produced more efficiently. Gradual increase of automation will reduce the amount of energy needed per hl, reduce waste and rejected product, and reduce the manpower needed to operate the process.
The presentation will highlight two aspects of a brewery of the future: manufacturing intelligence and mobile devices. Software and smart devices can assist operators to do things right the first time by presenting accurate information and preventing mistakes. Statistical analysis of production data can reveal unknown process characteristics to be taken into account. Advanced in-line measurements can give feedback for direct quality control. It is demonstrated how combining data collected from various sources can enhance the information for operators, providing manufacturing intelligence. Examples of using mobile devices like tablets and smart glasses in other industries and experimental situations show the potential they can have in a brewery.

A generic modelling and simulation platform for assessing novel malting and brewing technologies

Mr. Eemeli Hytönen (PhD), Ms. Lotta Sorsamäki and Ms. Marja Nappa
Presenting author: Eemeli Hytönen, VTT Technical Centre of Finland, FI

Mr. Eemeli Hytönen (PhD) is Research Team Leader at VTT Technical Research Centre of Finland. His team is focusing on process design, modelling and simulation, and sustainability assessment in process and manufacturing industrial contexts. Eemeli has M.Sc. degree in applied physics from University of Jyväskylä (2005), and PhD in Chemical Engineering from Ecole Polytechnique de Montreal (2011). He has a broad technological expertise in forest, bio-based and food industrial processing. He also has strong methodological expertise in steady-state process simulation and modelling, early stage process design, cost accounting, and risk assessment and decision analysis under uncertainty. He has been involved in development of a commercial process simulation software (Balas®), authored or co-authored 6 peer-reviewed articles and 22 other publications, and he has been teaching process simulation and modelling for conceptual power plant design at Aalto University since 2012.

Abstract
A generic modelling and simulation platform has been developed for investigating impacts of technological choices and implementation of novel technologies on malting and brewing processes. The key performance measures evaluated using the platform are plant wide and departmental energy and water consumption and equipment utilisation degree. The platform enables system configuration to represent many different breweries and malt houses, including the possibility to select main process equipment types, cooling and heating media, and the inclusion of utility systems such as boilers and water treatment. For platform control Microsoft Excel based user interface has been developed. A superstructure -type steady-state process simulation model for simulating mass and energy balances is built using commercial process simulation software Balas®. The simulation model is linked to the user interface for model parameterization, efficient parameter fitting and result comparisons; also further economic assessments are possible. In this presentation, the modelling platform is illustrated using two case studies. The main features of the linked modelling platform and specifically the simulation model are discussed. The case studies are: assessment of the impacts of very high gravity brewing on a brewing process, and evaluation of the impacts of malt moisture on a malt house and brewery integate.
L15  
**Fundamental study on the application of lactic acid bacteria in oat wort based beverages**
Eric J. Steffen, Kieran M. Lynch, Alan Lucid, Claudia Axel, Elke K. Arendt
*Presenting author: Eric Steffen, University College Cork, IE*

Eric Steffen studied Beverage Technology at Hochschule Geisenheim University (B.Sc.) and Justus-Liebig-University Giessen in corporation with Hochschule Geisenheim University (M.Sc.). His research extended over wine fermentation with non-saccharomyces yeasts and polysaccharides of coffee colloids. After an industrial project, he is now doing his PhD in the group of Prof. Elke Arendt at University College Cork.

**Abstract**

Lactic acid bacteria (LAB) fermentation of oat-derived wort was investigated as a means of producing beverages with novel properties. Therefore, raw hulled oat, *Avena sativa*, was processed using an optimized malting regime and brewed in a pilot plant to produce a 100% oat wort. Subsequently, this wort was fermented with two LAB strains that were able to produce either exopolysaccharide (EPS) or antifungal compounds. Dextran EPS production was evident in the *Weisella cibaria* MG1 fermented wort. This improved the rheological properties due to the increase in viscosity. *Lactobacillus reuteri* R29 was able to produce antifungal compounds in oat wort, including lactic, acetic and phenyllactic acids. These compounds are known to suppress the growth of fungi such as *Fusarium culmorum*, *Aspergillus niger* and *Penicillium expansum*. LAB strains negative for the particular trait under investigation and barley wort were used as controls.

In conclusion, oat is a suitable substitute for barley, to design novel non-alcoholic beverages. Fermentation with LAB positively influences the properties of this substrate, such as prolonging its shelf-life stability and enabling modulation of parameters such as sensory and organoleptic properties.

L16  
**Energy Storage 2.0 - Advantages of an open system and impact on the water balance of a brewhouse**
Peter Sterk, GEA Brewery Systems GmbH, DE

Peter Sterk finalized an apprenticeship as a technical draftsman at Huppmann in Kitzingen working with the CAD-System ME10. In the following years he studied mechanical engineering at the University of Applied Science in Schweinfurt and graduated as engineer in 2006.

In January 2007 he returned to GEA Brewery Systems, the former Huppmann GmbH, which was taken over by the GEA Group AG. He was the responsible team leader for the product engineering department.

Since August 2015 he has a new role as a product manager being responsible for typical brewhouse equipment. In this function he has to care about continuous improvement and progress in design and function.

**Abstract**

The classical energy storage system was introduced in 1988 into the brewing industry. It was designed as a closed system (one energy storage tank) being only able to manage the energy transfer between wort boiling and wort heating.
The paper will explain the potentials of an open energy storage system consisting of two water tanks with different temperature levels using project examples from Europe, Asia and a brewery located at the equator. Main focus is the management of the hot water balance of a brewhouse considering the temperature of the ambient water and its seasonal fluctuation as well as the possibilities to reduce a hot water surplus during a production week. In another project example, the influence of the pitching temperature (brand mix) on the water balance is also discussed.

An open system allows, within physical limitations, a moderate reduction of the evaporation rate below the “balanced” figure of approx. 4.2 %. This opens a playground to reduce the total energy consumption of a brewhouse.

L17

The green brewery - Biogas from spent grains BDI
Elmar Offenbacher, BioEnergy, AT

Elmar is Director Sales BioGas of BDI-BioEnergy International and has been working in the field of Waste to Energy for almost 20 years. Before he joined BDI in 2011, Elmar began his career as a process engineer with Austrian Energy & Environment for fluidised bed combustion technologies; from there he progressed to sales management and was also based at the Sydney office for several years to introduce sustainable technologies for the thermal treatment of waste materials. Elmar is Master of Science and holds a degree in Chemical and Process Engineering of the Graz University of Technology in Austria.

Abstract
Beer is a distinctive product of our nature, and so the brewing process itself is demanding for maximum sustainability, reducing the CO₂ emissions to a minimum. One significant step towards a Green Brewery is making use of all waste products arising from the brewing process, hence generating valuable BioGas that can cover about half of the total energy demand of the brewery.

The patented multistage BDI BioGas Technology is the only proven solution for processing spent grain and yeast to produce valuable BioGas and fertilizer. In the first step of hydrolysis, the long chain organic compounds such as protein and fats step are broken down to acids, while carbon and hydrogen will be converted into methane in the main fermenter and final post-fermenter.

This paper will present the design features and operation experience of the world’s first BioGas plant processing spent grain and yeast, implemented in the Green Brewery at Göss (Austria). Capable to treat about 20,000 tons of brewery residues per year, more than 15 GWh of biogas energy can be produced that is used for the steam boiler and for producing electricity in a CHP.

L18

A complete energy management solution for breweries
Simon Durrant, eSight Energy Ltd, UK

Simon is the CEO and founder of the eSight Energy Group. eSight Energy provides solutions and services for the management of energy, emissions and cost reduction. Simon has overseen the introduction of the highly successful eSight product range, which is now in use in over 30 countries.

With a background in building automation systems, Simon previously worked for Schlumberger, the world leading meter manufacturer which is now part of Itron. As part of the metering systems division, he worked on electricity metering and building control solutions.
Simon has taken the eSight product suite from an initial concept in 2003 to widespread use across Europe, US and Asia. The eSight Energy Group has operating companies spanning each of these regions. eSight is in use across the built environment, healthcare, education, pharmaceutical and the food & drinks industry.

Abstract
The importance of effective energy management is rightly high on the agenda of breweries of all sizes in every sector. It is generally accepted that in order to achieve effective energy management, a tool that offers clear visibility and analysis of energy data is key. But with so many products and services on the market claiming to relate to ‘energy management’ in the brewing sector, how do you choose the best solution?
This presentation will help you to consider the features and functionality you need to successfully manage and ultimately reduce energy use in breweries. Factors such as compatibility with existing systems, accessibility, scalability, future proofing and global capability will be discussed in order to helped attendees understand their energy management requirements. Focusing on the brewery sector, the presentation will be relevant to those looking to source or upgrade an energy management system.

Beer production with wort concentrate - potential for craft beer breweries?
Jean Titze, Hochschule Anhalt, DE

Jean Titze had studied at the Technical University of Munich and did his PhD at the Department for Chemical-Technical Analysis and Chemical Food Technology in brewing science. For several years, he worked as a Brewery Consultant for the Research Center Weihenstephan and later on as a Senior Consultant for Deloitte & Touche focusing on the food and beverage industry. After that, he lived in Ireland for two years working as a Senior Research Scientist and Brewery Manager for the National University of Ireland at University College Cork. During the last three years, he has been working as Head R&D Cereal Ingredients at Doehler focusing on the production of cereal and malt extracts. He is now Professor at the Anhalt University of Applied Sciences for Food Technology of Plant-based Products.

Abstract
The hype of craft beer worldwide is still unbroken. In the last few years, the number of craft breweries has exploded. The innovative nature of these craft brewers has driven this market. Subsequently, more and more brewers want to take advantage of this trend. Looking at traditional brewing, the investment of the brewhouse (from milling to wort cooling) is still the major cost factor. To cut down these costs, one solution is the use of wort concentrates. Using a special brewhouse technology, brewers can produce fresh beer onsite by starting the brewing process with the main fermentation.
The presentation will discuss the main quality parameters of cold wort and final beer which show significant differences between the use of standard wort and wort from wort concentrate. Furthermore, a comprehensive cost analysis for the use of wort concentrate compared with the traditional wort production process will be done.
The results show that it is possible to produce a premium beer with a high quality wort concentrate. Additionally, the use of wort concentrate provides an opportunity for craft brewery entrepreneurs which have to keep down their investment costs even with a brewhouse size of cast out volumes up to 30 hL.

L20  
Innovative brewing process for non-alcoholic beer production
Alberto Sun, Anheuser-Busch Inbev, BE

Brazilian citizen, holds a MS Degree in Malting and Brewing from the University of California Davis. Started his brewing career in 2005 with AB-Inbev and since then has taken increasing responsibility roles within the organization in the areas of brewing and brewing raw materials in both USA and Brazil. He is now currently the Global Director for Product Technology & Material Development Group at AB-Inbev, located in the Global R&D Headquarters in Leuven, BE. His main responsibilities include the development of new raw materials, process and technologies for the development of new products.

Abstract
The challenges related to harmful drinking of alcohol have led to foster a culture of smart drinking goals. The development of non-alcoholic and low alcohol beers on the market maybe an element to contribute to them. The presentation will focus on the technical challenges encountered with the process of non-alcoholic beer production and some solutions found for obtaining the best sensory results with the combination of different existing techniques.
PRACTICAL INFORMATION

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“Beer and Health: Moderate consumption as part of a healthy lifestyle” presents the results of an extensive review of scientific literature on moderate beer, and alcohol, consumption and its impact on health. It describes both the overall health effects of moderate beer consumption and the links with specific diseases or health conditions. It also takes into account and considers the impacts amongst different adult groups. The booklet is available to download on the beerandhealth.eu website, which also features regular news and publications on the matter.

Read more on www.beerandhealth.eu
Brewing future:
Science for better beers

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Cankarjev Dom
Ljubljana, Slovenia

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