Program Book

Master Brewers Association of the Americas
123rd Anniversary Convention

June 18–20, 2010
Rhode Island Convention Center
Providence, RI, U.S.A.

Part of Brewing Summit 2010

Courtesy of the Providence Warwick CVB.

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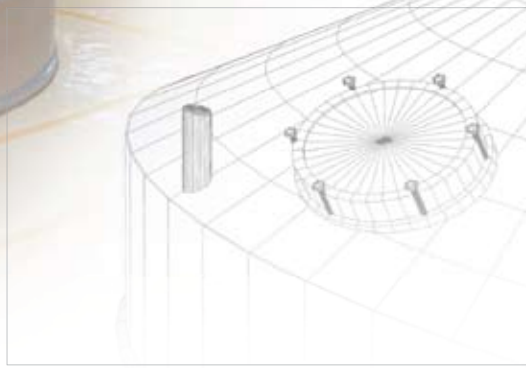

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Governing Committees

Some say that 2020 vision is a very good thing. We would agree.

We continually strive for an understanding of the things that matter to our clients. The World is a rapidly changing place - different challenges are emerging every day, new thinking is required. Process Engineers like us, need to help clients be ready for the challenges not just of today, but ten years hence.

The International Brewing Convention returns to Manchester, UK between 18th and 20th October, 2010. a Platinum sponsor for this very prestigious event. A number of incredibly strong speakers have already committed their support, including some of the most powerful voices in our industry.

Visitors will be able to attend for all three days of the conference, or select one or two days from the programme to fit busy schedules. **The conference theme is 'Ahead of the Curve' - shorthand for an exploration of our industry's vision for the year 2020.**

What's more, we have chosen to sponsor the sample room - so come and share a beer and a few thoughts with us.

Ahead of the Curve
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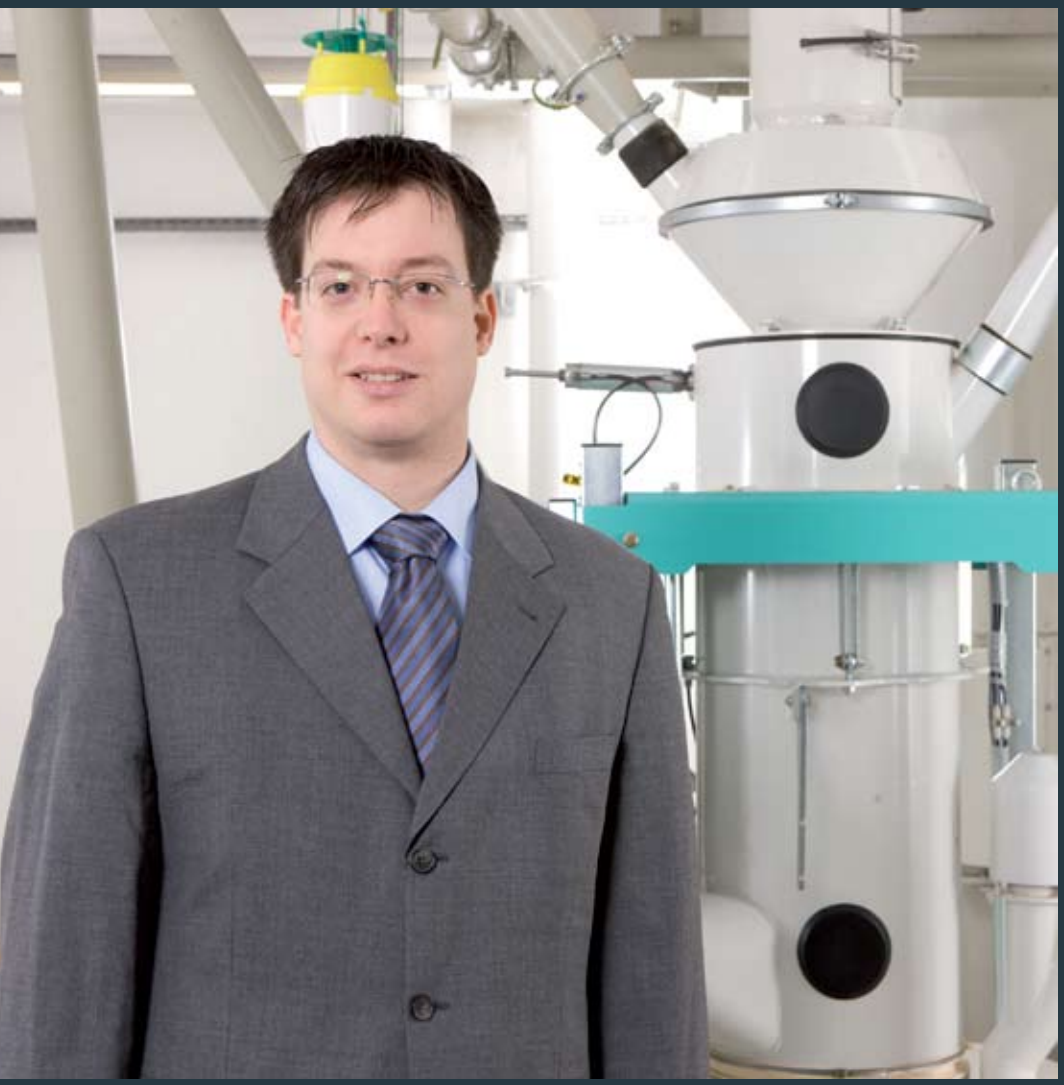

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MBAA Program Overview

Sessions and events all take place at the Rhode Island Convention Center unless otherwise indicated.

Thursday, June 17		
8:00 a.m. – 1:30 p.m.	MBAA Executive Committee Meeting • *550 B*	
2:00 – 5:00 p.m.	MBAA Board of Governors Meeting • *557*	
5:00 – 6:00 p.m.	MBAA District Officers' Forum • *557*	MBAA Technical Committee • *550 B*
6:00 – 6:30 p.m.	MBAA Convention Orientation • *554 A/B*	

Friday, June 18: *Shared Day of Programming with ASBC*			
8:30 – 9:30 a.m.	ASBC Technical Subcommittee Meeting – New and Alternate Methods of Analysis • *550 A*		
8:30 – 10:00 a.m.	Exhibits • *Ballroom/Exhibit Area*		
8:30 – 10:00 a.m.	ASBC and MBAA Poster Viewing • *West & East Pre-functions*		
10:15 – 11:30 a.m.	**ASBC–MBAA Workshop:** In-line/ On-line Measurement • *555/556*	**ASBC Technical Session:** Packaging • *551 A/B*	**MBAA Technical Session:** Nutrition & Enzymes • *552 A/B*
11:30 a.m. – 12:30 p.m.	ASBC Technical Subcommittees • *See program for details*		
11:30 a.m. – 2:00 p.m.	Exhibits and Lunch • *Ballroom/Exhibit Area*		
11:30 a.m. – 2:00 p.m.	ASBC and MBAA Posters (a*uthors present 1:00 – 2:00 p.m.)* • *East & West Pre-functions*		
2:15 – 3:30 p.m.	**ASBC–MBAA Workshop:** Critical Quality Review: Culture, Communications, and Customers • *555/556*	**ASBC Technical Session:** Innovation • *551 A/B*	**MBAA Technical Session:** Yeast • *552 A/B*
3:45 – 5:00 p.m.	**MBAA Workshop:** Practical Malt Quality • *551 A/B*	**ASBC Closing Session:** What's the Buzz? • *555/556*	**MBAA Technical Session:** Stability • *552 A/B*
7:00 – 10:00 p.m.	Brewing Summit Social • *Offsite: Squantum Association*		
10:00 p.m.	After Glow Party • *Rotunda*		

Saturday, June 19			
8:00 – 9:45 a.m.	**Technical Session:** Sustainability • *552 A/B*	**Technical Session:** Fermentation • *555/556*	**Workshop:** Evaluating Quality of Hop Pellets • *551 A/B*
10:00 – 11:40 a.m.	**Technical Session:** Brewhouse/Sensory • *555/556*		**Technical Session:** Packaging and Cleaning • *552 A/B*
11:30 a.m. – 2:00 p.m.	Exhibits and Lunch • *Ballroom/Exhibit Area*		
11:30 a.m. – 2:00 p.m.	MBAA Posters (a*uthors present 1:00 – 2:00 p.m.)* • *East Pre-function*		
2:15 – 3:30 p.m.	**Technical Session:** Malt • *555/556*	**Workshop:** Technical Packaging: How It's Made • *551 A/B*	**Workshop:** Practical Aging in Wood • *552 A/B*
3:45 – 5:00 p.m.	**Technical Session:** Finishing • *555/556*		**Workshop:** Old and New World Wheat Beer Styles: Raw Materials, Technology, and Flavor Profiles • *551 A/B*
7:00 p.m. – 9:30 p.m.	President's Closing Celebration • *Rotunda*		

Sunday, June 20			
7:30 – 8:45 a.m.	General Session and Award of Merit • *555/556*		
9:00 – 10:45 a.m.	**Workshop:** Money Down the Drain: Water Conservation Strategies • *552 A/B*	**Workshop:** Brewhouse Optimization • *555/556*	**Workshop:** Running Powerslam: Wrestling Your Maintenance Program into Shape • *551 A/B*
11:00 a.m. – 12:45 p.m.	**Technical Session:** Engineering/WCM • *552 A/B*		**Technical Session:** Hops • *551 A/B*

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MBAA Program

Thursday, June 17

7:30 a.m. – 6:00 p.m.	Registration	5th Level Lobby
8:00 a.m. – 1:30 p.m.	Executive Committee Meeting	550 B
2:00 – 5:00 p.m.	Board of Governors Meeting	557
2:00 – 5:00 p.m.	Poster Set Up	East Pre-function
4:00 – 11:00 p.m.	Bierstube/Hospitality	Westin: Waterplace Ballroom
5:00 – 6:00 p.m.	District Officers' Forum	557
5:00 – 6:00 p.m.	Technical Committee Meeting	550 B
6:00 – 6:30 p.m.	Convention Orientation	554 A/B

District Officers' Forum
5:00 – 6:00 p.m. • 557
All District officers are invited to attend this forum. Learn about the priorities of MBAA, discuss challenges facing your District, and brainstorm with other District officers on what works and what doesn't. You will also receive a handout with information about how headquarters can assist you.

Convention Orientation
6:00 – 6:30 p.m. • 554 A/B
Discover how to take advantage of the wealth of activities offered at the MBAA Convention. This is a great opportunity to meet members who can answer your questions and help you make the most of your convention experience.

Friday, June 18

Shared Day of Programming with ASBC

7:00 – 8:00 a.m.	MBAA Presenter Breakfast (orals 1–9, posters 38–60, Friday Workshops)	Rotunda
8:00 – 8:30 a.m.	MBAA Poster Set Up	East Pre-function
8:00 – 9:00 a.m.	MBAA Global Emerging Issues Committee Meeting	553 A
8:00 a.m. – 4:00 p.m.	Registration	5th Level Lobby
8:30 – 9:30 a.m.	ASBC Technical Subcommittee Meeting – New and Alternate Methods of Analysis	550 A
8:30 – 10:00 a.m.	Exhibits	Ballroom/Exhibit Area
8:30 – 10:00 a.m.	MBAA and ASBC Poster Viewing	East and West Pre-functions
10:15 – 11:30 a.m.	MBAA Technical Session: Nutrition & Enzymes *Moderator: Jens Voigt, Technical Univ Munich Weihenstephan* 10:15 a.m. O-1 Innovative concepts for the production of non-alcoholic malt-based beverages. MORITZ KRAHL, Thomas Becker 10:40 a.m. O-2 Mindfulness: What happened? CHARLES BAMFORTH 11:05 a.m. O-3 A comparison of beer quality attributes between 100% barley malt and barley adjunct beer, with a focus on changes in the protein composition. ELISABETH STEINER, Andrea Auer, Martina Gastl, Stefan Kreisz	552 A/B
10:15 – 11:30 a.m.	ASBC Technical Session: Packaging *Moderator: Kathy Kinton, MillerCoors* *Abstracts found in the ASBC section.* 10:15 a.m. O-37 Microbiological QA—Classification perplexity with modern packaging. ROLAND FOLZ 10:40 a.m. O-38 Technologies, tools, and challenges for packaging beer in PET. LORINDA (LORI) Y. YODER 11:05 a.m. O-39 Beverage and package quality—Two inseparable key parameters in the modern quality control of bottled beverages. JOHANN ANGRES	551 A/B
10:15 – 11:30 a.m.	ASBC–MBAA Workshop: In-line/On-line Measurement	555/556
11:30 a.m. – 12:30 p.m.	ASBC Technical Subcommittees • MOA Wort Review • Craft Brewers	 551 A/B 553 B
11:30 a.m. – 2:00 p.m.	Exhibits and Lunch	Ballroom/Exhibit Area
11:30 a.m. – 2:00 p.m.	MBAA and ASBC Poster Viewing (authors present 1:00 – 2:00 p.m.)	East and West Pre-functions

2:15 – 3:30 p.m.	MBAA Technical Session: Yeast *Moderator: Roland Folz, VLB Berlin* 2:15 p.m. O-4 Profiling a lager fermentation completed using active dried yeast. CHRIS POWELL, David Jenkins, Tobias Fishbourn, Katherine Smart 2:40 p.m. O-5 Yeast activity monitoring. MICHAEL BRADLEY 3:05 p.m. O-6 Possible roles of the mitochondria in sulfur dioxide production by lager yeast. ERIC SAMP, Patricia Pratt	552 A/B
2:15 – 3:30 p.m.	ASBC Technical Session: Innovation *Moderator: Fred Strachan, Sierra Nevada Brewing Co.* *Abstracts found in the ASBC section.* 2:15 p.m. O-40 A novel approach to brew alcohol-free beer. ZHUMAO JIANG, Zongcui Yue, Guangtian Zhou, Mengmeng Huang 2:40 p.m. O-41 Ingredients and energy from brewer's spent grain. ANNIKA WILHELMSON, Piritta Niemi, Juhani Sibakov, Pekka Lehtinen, Laura Flander, Raija-Liisa Heiniö, Kaarina Viljanen, Veli-Pekka Heiskanen, Niklas Von Weymarn, Johanna Buchert 3:05 p.m. O-42 Recycling and refining of alcohol from waste beer. ZHUMAO JIANG, Mengmeng Huang, Xiaolei Dong, Guangtian Zhou	551 A/B
2:15 – 3:30 p.m.	ASBC–MBAA Workshop: Critical Quality Review: Culture, Communications, and Customers	555/556
3:45 – 5:00 p.m.	MBAA Technical Session: Stability *Moderator: Daniel Carey, New Glarus Brewing Co.* 3:45 p.m. O-7 A fresh look at beer flavor stability. ALASTAIR PRINGLE 4:10 p.m. O-8 The influence of unmalted barley on the oxidative stability of wort and the final beer. THOMAS KUNZ, David Mato Gonzalez, Frank-Jürgen Methner 4:35 p.m. O-9 The role of polyphenols in beer haze and astringency. KARL SIEBERT	552 A/B
3:45 – 5:00 p.m.	MBAA Workshop: Practical Malt Quality	551 A/B
3:45 – 5:00 p.m.	ASBC Closing Session: What's the Buzz?	555/556
4:00 – 7:00 p.m.	Bierstube/Hospitality	Westin: Waterplace Ballroom
7:00 – 10:00 p.m.	Brewing Summit Social	Offsite: Squantum Association
10:00 p.m.	After Glow Party	Rotunda
10:00 – 11:30 p.m.	Bierstube/Hospitality	Westin: Waterplace Ballroom

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ASBC Technical Subcommittee Meetings
See the program for details

Each meeting is specific to an ASBC Technical Subcommittee run from 2009 to 2010 and will provide an overview of the results and recommendations. The meetings are open to all meeting attendees, and your feedback and participation in these meetings are essential to ensuring the quality of the methods being tested or reviewed.

ASBC–MBAA Workshop: In-line/On-line Measurement
10:15 – 11:30 a.m. • 555/556

Presenters include Al Worley, optek-Danulat, Inc., and Jeff DeVoy, Heuft U.S.A.
Moderators: Jeff Cornell, MillerCoors; Horace Cunningham, Terrapin Beer Co.

This workshop consists of three speakers covering in-line measurement technologies across a wide range of brewing and packaging applications. The focus will be placed on the theory and principles of the various technologies as well as the advantages and potential pitfalls in real-world applications. Attendees should come away with a good sense of the measurement science and how these various technologies are best applied to process measurements enabling improved quality and/or throughput. Specific topics include applied photometry for brewing applications, in-line package inspection, and applied technologies for dissolved oxygen measurement. The workshop will conclude with questions from the audience and an interactive discussion.

ASBC–MBAA Workshop: Critical Quality Review: Culture, Communications, and Customers
2:15 – 3:30 p.m. • 555/556

Presenters: Stu Oliver, MillerCoors; Dan Carey, New Glarus Brewing Co.; Jason Perkins, Allagash Brewing Co.; Paul Pettinger, New Belgium Brewing Co.
Moderators: Rebecca Newman, Consultant; Mary Pellettieri, MillerCoors

This workshop targets growing breweries that are seeking to understand and grow the maturity of their quality efforts. Representatives from micro-breweries to macro-breweries will be present to speak about the quality journey. The objective is to provide context and direction around creating culture of quality that fosters internal and external customer relationships.

MBAA Workshop: Practical Malt Quality
3:45 – 5:00 p.m. • 551 A/B

Presenters: Nigel Davies, Muntons PLC; Bob Hansen, Briess Malt
Moderator: Susan Welch, Malteurop North America Inc.

This workshop will include a panel of international brewers and maltsters who will present overviews and lead discussions on topics related to malt color and beer, such as: a comparison of how brewers and maltsters view color as a quality parameter, how malt formula is determined from beer color and how beer color is predicted by malt formula, variability in base malt color, variability in the analysis of base malt color, and a brewer's perspective on color specifications and beer.

ASBC Closing Session: What's the Buzz?
3:45 – 5:00 p.m. • 555/556

The Closing Session is an excellent capstone to the ASBC Annual Meeting. This interactive session will provide you with a recap of the entire ASBC Annual Meeting. The floor will then be opened for you to voice your thoughts about ASBC and discuss your experiences from the past three days. This session was new in 2009 and the feedback was outstanding. Make plans to join us for a great end-of-the-meeting synopsis.

Brewing Summit Social
7:00 – 10:00 p.m. • Offsite: Squantum Association

Join your colleagues as ASBC brings their Annual Meeting to a close and MBAA kicks off its Convention. The social will take place at Squantum Association where we will mix and mingle in the historic Main Club House as well as the Bakehouse that is built out over the rocky coastline. Attendees will also enjoy the beautiful manicured gardens and dramatic views of the Providence River and Narragansett Bay. A wide selection of appetizers, dinner fare, desserts, and drinks along with the ambiance of the waterfront and the historic surroundings will make the evening complete. Shuttle service will be available from the Westin to the Squantum Association. Shuttles to the social will run from the Westin Providence from 6:00 – 7:00 p.m. and return service will be available from 9:00 – 10:30 p.m.

After Glow Party
10:00 p.m. • Rotunda

After the Brewing Summit Social, join us for a relaxing night of Irish coffee, cocktails, and networking. The After Glow Party is sponsored by Malteurop North America, Inc.

Saturday, June 19

7:00 – 8:00 a.m.	MBAA Presenter Breakfast (orals 10–29, posters 61–75, Saturday Workshops)	Rotunda
7:45 a.m. – 4:00 p.m.	Registration	5th Level Lobby
8:00 – 9:15 a.m.	Technical Session: Fermentation *Moderator: Kathy Kinton, MillerCoors* 8:00 a.m. O-10 Impact of fermentation on yeast quality and assessment of fitness to ferment. KATHERINE SMART 8:25 a.m. O-11 Influence of accelerated fermentation on yeast physiology and beer quality. KOJI ONODA, Thomas Kunz, Frank-Jürgen Methner 8:50 a.m. O-12 The nature and fermentability of last runnings. GRAHAM STEWART, John Andrews, Michaela Miedl, Richard Taylor	555/556
8:00 – 9:45 a.m.	Technical Session: Sustainability *Moderator: Ruth Martin, Sierra Nevada Brewing Co.* 8:00 a.m. O-13 Establishment of energy conservation management system at Asahi Beer. TOSHIHIKO NAGAOKA, Taro Kondo, Yuichi Kiwaki 8:25 a.m. O-14 Product improvement, cost reduction, and more sustainability with total O_2 management. ARJEN VAN ZEIJST 8:50 a.m. O-15 Sustainability metrics and better practices in the BevBrew sector: Carbon, water, and energy footprints associated with water, waste, and co-product management. RAJ RAJAN 9:15 a.m. O-15a Integration of solar process heat. JOHANNES PREISS	552 A/B
8:00 – 9:45 a.m.	Workshop: Evaluating Quality of Hop Pellets	551 A/B
10:00 – 11:40 a.m.	Technical Session: Brewhouse/Sensory *Moderator: John Mallet, Bell's Brewery Inc.* 10:00 a.m. O-17 The origin of pilsner brewing technology. JENS VOIGT, Andreas Richter 10:25 a.m. O-18 New investigations on the process technology of mashing and lautering. JOHANNES TIPPMANN, Jens Voigt, Karl Sommer, Simon Henke 10:50 a.m. O-19 The influence of different malting and mashing methods on beer characteristics. TAICHI MARUHASHI, Martina Gastl, Thomas Becker, Ludwig Narziss 11:15 a.m. O-20 Impact of different hop compounds on the overfoaming volume of beer caused by primary gushing. MICHAEL MÜLLER, Thomas Becker, Martina Gastl	555/556

10:00 – 11:15 a.m.	Technical Session: Packaging and Cleaning *Moderator: Jim Diamantis, Wayne Chemical, Inc.* 10:00 a.m. O-21 Practical sustainable initiatives during cleaning and packaging operations. GEORGE AGIUS, Doug Funnell 10:25 a.m. O-22 Use and misuse of adenosine triphosphate (ATP) in the brewing industry. CHAD THOMPSON 10:50 a.m. O-23 Water conservation/reuse in the modern brewery: Advantages and pitfalls to avoid. JACK BLAND, Tom Soukup, Jaclynn Peterson	552 A/B
11:30 a.m. – 2:00 p.m.	Exhibits and Lunch	Ballroom/Exhibit Area
11:30 a.m. – 2:00 p.m.	MBAA Poster Viewing (authors present 1:00 – 2:00 p.m.)	East Pre-function
2:00 – 4:00 p.m.	MBAA Poster Take Down	East Pre-function
2:00 – 5:00 p.m.	Exhibit Take Down	Ballroom/Exhibit Area
2:15 – 3:30 p.m.	Technical Session: Malt *Moderator: Robert Hansen, Briess Malting Co.* 2:15 p.m. O-24 Impact of different malting parameters on the protein composition of malt, wort, and finished beer. ELISABETH STEINER, Elke Arendt, Thomas Becker, Martina Gastl 2:40 p.m. O-25 New application areas for micromalting systems. MARTINA GASTL, Florian Schüll, Thomas Becker 3:05 p.m. O-16 Cutting the carbon footprint of malting by 75%—Achievable or just hot air? NIGEL DAVIES	555/556
2:15 – 3:30 p.m.	Workshop: Practical Aging in Wood	552 A/B
2:15 – 3:30 p.m.	Workshop: Technical Packaging: How It's Made	551 A/B
3:00 – 7:00 p.m.	Bierstube	Westin: Waterplace Ballroom
3:45 – 5:00 p.m.	Technical Session: Finishing *Moderator: Horace Cunningham, Terrapin Beer Co.* 3:45 p.m. O-27 Increasing brewery production yield and minimizing waste to reduce operating costs using advanced separation techniques. DIRK WEBER, Jonathan Pratt 4:10 p.m. O-28 Crosspure: Regenerable DE-free filtration for existing beer filters. ANDREW FRATIANNI 4:35 p.m. O-29 Ultraviolet control—Disinfection of air, surface, and water through quantifiable controls. TROY SMITH	555/556
3:45 – 5:00 p.m.	Workshop: Old and New World Wheat Beer Styles: Raw Materials, Technology, and Flavor Profiles	551 A/B
7:00 – 9:30 p.m.	President's Closing Celebration	Rotunda
9:30 – 11:30 p.m.	Bierstube	Westin: Waterplace Ballroom

Workshop: Evaluating Quality of Hop Pellets
8:00 – 9:45 a.m. • 551 A/B

Presenters include Val Peacock, Hop Solutions, Inc.
Moderator: Tim Kostelecky, John I Haas, Inc.

Hop pellets are a major form of hops used by brewers worldwide. In this workshop you will learn how hop pellets are made and what quality parameters are important to the brewer. Topics include bale moisture, cleaning of hops, milling of cones to powder, blending the powder, and formation of the pellets in the die, as well as alpha acids yield, process and product temperature control, pellet blending, and packaging issues.

Workshop: Practical Aging in Wood
2:15 – 3:30 p.m. • 552 A/B

Presenters: Vinnie Cirluzo, Russian River Brewing; Lauren Salazar, New Belgium Brewing Co.; Jason Perkins, Allagash Brewing Co.
Moderator: Matt Brynildson, Firestone Walker Brewing Co.

A panel of expert brewers who utilize wood barrels to create high-end beers will share their experience with the audience. Panel members will discuss barrels that they utilize, care and maintenance of barrels, the kinds of beers that are suited for barrel aging programs, and much more information on why barrel aging continues to grow in popularity in brewing today.

Workshop: Technical Packaging: How It's Made
2:15 – 3:30 p.m. • 551 A/B

Presenters: Tony Grandinetti, Ball Corp.; David Piccioli, Graham Packaging, Co.; Jeff Slaught, O-I; Doug Wynalda, Wynalda Litho
Moderator: Gary Dick, New Belgium Brewing Co.

A panel of packaging suppliers will share with the audience how their materials are made. Audience is welcome to ask questions throughout the presentations.

Workshop: Old and New World Wheat Beer Styles: Raw Materials, Technology, and Flavor Profiles
3:45 – 5:00 p.m. • 551 A/B

Presenters: Joe Casey, Craft Brewers Alliance; Roland Folz, VLB Berlin; Phil Leinhart, Brewery Ommegnang; Cem Schwarz, TU Muenchen – Weihenstephan; Jens Voigt, TU Muenchen – Weihenstephan; Martin Zarnkow, TU Muenchen – Weihenstephan
Moderator: Florian Kuplent, Anheuser-Busch InBev

Wheat beers are one of the fastest growing segments in the U.S. beer market. Despite their common ingredient, wheat beers are quite diverse in how they are brewed and their sensory qualities. This workshop features presentations on the production technology and flavor profiles of the four major wheat beer styles: Bavarian Hefeweissbier, Berliner Weisse, Belgian Wit, and American Wheat.

President's Closing Celebration
7:00 – 9:30 p.m. • Rotunda
The Closing Celebration is your place to mingle with friends and wind down at the MBAA Convention. Food stations will feature an assortment of appetizers, main courses, desserts, and, of course, cold beer.

Sunday, June 20

6:30 – 7:15 a.m.	MBAA Presenter Breakfast (orals 30 – 37, Sunday Workshops)		550 A/B
7:15 – 11:30 a.m.	Registration		5th Level Lobby
7:30 – 8:45 a.m.	General Session and Award of Merit		555/556
9:00 – 10:45 a.m.	Workshop: Brewhouse Optimization		555/556
9:00 – 10:45 a.m.	Workshop: Money Down the Drain: Water Conservation Strategies		552 A/B
9:00 – 10:45 a.m.	Workshop: Running Powerslam: Wrestling Your Maintenance Program into Shape		551 A/B
11:00 a.m. – 12:45 p.m.	Technical Session: Engineering/WCM		552 A/B
	Moderator: Vince Coonce, MillerCoors		
	10:00 a.m.	O-30 Flexibility beats restrictions—Brewing control at its best. MARTIN LUTZ	
	10:25 a.m.	O-31 Inline measurement for process validation—New comprehensive process control tools for milling, mashing, lautering, and boiling. JENS VOIGT, Hans-Joerg Menger, Heinz Dauth, Johannes Tippmann	
	10:50 a.m.	O-32 Line right up! An examination of process quality issues related to pipe stress and poor connections. DARREN MOSER	
	11:15 a.m.	O-33 Using six sigma to optimize brewhouse performance. GRADY HULL	
11:00 a.m. – 12:45 p.m.	Technical Session: Hops		551 A/B
	Moderator: Matthew Brynildson, Firestone Walker Brewing Co.		
	10:00 a.m.	O-34 Influence of hopping on beer quality. ADRIAN FORSTER	
	10:25 a.m.	O-35 Influence of various degradation products of isohumulones on resulting beer quality. SEBASTIAN KAPPLER, Udo Kattein, Thomas Becker, Martin Krottenthaler	
	10:50 a.m.	O-36 Possibilities to influence the hoppy flavor of beer. STEFAN HANKE, Thomas Becker, Werner Back, Martin Krottenthaler	
	11:15 a.m.	O-37 The usefulness of linalool models in predicting hop aroma. VAL PEACOCK	

General Session and Awards
7:30 – 8:45 a.m. • 555/556

This is an interactive session not to be missed. Attendees will be encouraged to provide feedback about the convention and the Brewing Summit as a whole. Then, stay put as the Inge Russell Best Paper Award is presented and Award of Merit recipient Graham Stewart addresses the assembly.

Workshop: Brewhouse Optimization
9:00 – 10:45 a.m. • 555/556

Presenters: Fred Havel, Molson Coors Brewing Co.; Jeroen Vandenbussche, Meura; and Peter Gattermeyer, Krones AG
Moderator: Dan Carey, New Glarus Brewing Co.

The key to success in brewing is not only to make a great beer but also to make it efficiently so brewers can gain a competitive edge by optimizing their process. This panel of experts will offer insights into what it takes to operate a modern brewhouse.

Workshop: Money Down the Drain: Water Conservation Strategies
9:00 – 10:45 a.m. • 552 A/B

Presenters: Eckehard Adrian, Krones; Jeff Edgerton, BridgePort Brewing Co.; Michael Eumann, EUWA H. H. Eumann GmbH; Udo Funk, GEA Brewery Systems
Moderator: Karl Ockert, Bridgeport Brewing Co.

Breweries typically use anywhere from two to ten times the amount of water per unit of beer they produce. As fresh water becomes more highly valued and the costs of disposing dirty water increases, brewers need to focus on methods of optimizing water use in order to get the most out of every gallon coming into their plant. Water down the sewer is literally money down the drain. This workshop will feature practical brewery case studies, cost implications, and a discussion of water conservation strategies. Suggested conservation projects, along with actual data points, will be presented for all facets of brewery operations from brewhouse through packaging. Audience members will be encouraged to share their own experiences and findings.

Workshop: Running Powerslam: Wrestling Your Maintenance Program into Shape
9:00 – 10:45 a.m. • 551 A/B

Presenters: "The Crusher" Eric Allstott, New Belgium Brewing Co.; Scott "Mad Dog" Dietrich, Victory Brewing Co.; John "El Gigante" Haggerty, New Holland Brewing Co.; "Insanity" Greg Harris, MillerCoors
Moderators: Vince Coonce, MillerCoors; John Mallett, Bell's Brewery, Inc.

Are you feeling like brewery maintenance has you in a Reverse Cobra Clutch? Are you ready to turn the tables and unleash a Double Corkscrew Leg Drop? Then join our discussion focusing on opportunities and pitfalls in developing effective maintenance programs in new facilities, installing new maintenance programs in old facilities, dealing with equipment breakdowns, and operating an effective maintenance process. Although the panelists have significant brewery operational experience spanning 500 to 8,000,000 bbls/year, your voice and insight into developing, operating, and improving effective brewery maintenance is critical. Approximately an hour and a half will be available to address specific questions from the audience. Please note: This will not be staged in a "cage match" format.

Abstracts

MBAA Convention Oral Presentations

O-1
Innovative concepts for the production of non-alcoholic malt-based beverages
Presenter: Moritz Krahl, TU München, Freising, Germany
Coauthor(s): Thomas Becker, TU München, Freising, Germany

In recent years a number of novel innovative beverages have been launched. Due to growing consumer awareness of the negative impact of malnutrition in Western countries novel drinks based on natural raw materials have attracted growing interest. Specially malted grains and natural fruit juices are suitable for the production of such beverages as they are generally considered positive and healthy food ingredients. At the same time stricter limits concerning drinking and driving have led to a growing interest in non-alcoholic beers. This paper shows a concept to create a novel malt-based beverage using lactic acid fermentation. Wort is produced using existing brewing equipment and is subsequently fermented by selected strains. The resulting fermentation products are mixed with different fruit juices and carbonated, resulting in well-balanced, refreshing drinks. A new way to create a non-alcoholic beer is the use of stopped fermentation coupled with controlled lactic acid fermentation. Hops is added after fermentation, and thus the microbiological stability is improved. Sensory evaluation of both beverages was done by a trained tasting panel to investigate flavor stability. Fresh and forced-aged samples were analyzed. Stale flavor compounds were measured using GC-FID and GC-MS. The results obtained for these two new beverages were compared to a range of commercially available malt-based beverages and non-alcoholic beers.

Moritz Krahl was born in 1980 in Schwetzingen, Germany. In 2000 he started his education in brewing and beverage science at the Technische Universität München in Germany. In 2004 he graduated with a B.S. degree and in 2005 with a Dipl. Ing. degree. Since 2005 he has been working as a Ph.D. student at the Institute for Brewing and Beverage Technology in Weihenstephan.

O-2
Mindfulness: What happened?
Presenter: Charles Bamforth, University of California, Davis

In the spring quarter of 2010, a new freshman seminar class was introduced at UC Davis, titled "Mindfulness and Alcohol." The class description said "The class will address mindful consideration of alcoholic beverages. It is intended primarily for those who are not yet of legal drinking age. It will address worldwide societal and religious attitudes to alcohol, the risk-benefit balance of alcoholic beverages and implications for student life and beyond." This presentation will summarize what the author discovered from teaching the class, reviewing it in the context of the worldwide brewing scene in 2010, and the perception of beer.

Charlie Bamforth is the Anheuser-Busch Endowed Professor of Malting & Brewing Sciences at UCD. He has been part of the brewing industry for more than 31 years. He is the former deputy director-general of Brewing Research International and research manager and quality assurance manager of Bass Brewers. He is a special professor in the School of Biosciences at the University of Nottingham, England, and was previously visiting professor of brewing at Heriot-Watt University in Scotland. Charlie is a Fellow of the Institute of Brewing & Distilling, Society of Biology, and International Academy of Food Science and Technology. Charlie is editor in chief of the Journal of the American Society of Brewing Chemists*, is on the editorial boards of several other journals (including the MBAA* Technical Quarterly*), and has published innumerable papers, articles, and books on beer and brewing, as well as written prolifically on soccer. His personal interest in people and matters spiritual presaged the current study.*

O-3
A comparison of beer quality attributes between 100% barley malt and barley adjunct beer, with a focus on changes in the protein composition
Presenter: Elisabeth Steiner, TU München, Freising, Germany
Coauthor(s): Andrea Auer, TU München, Freising, Germany; Martina Gastl and Stefan Kreisz, Novozymes A/S, Bagsvaerd, Denmark

The present work provides an overview of the applicability of barley raw material in the brewing process and its influence on beer quality parameters. Beer was brewed with barley malt and with barley adjunct and exogenous enzymes. Barley raw material, malt, kettle-full wort, cold wort, unfiltered beer, and filtered beer were analyzed to investigate changes during the brewing process, the applicability of barley adjunct, and its influence on beer quality attributes (e.g., filterability, flavor stability, foam stability, etc.). We also studied changes in protein composition during the brewing process and how exogenous enzymes influence this composition. All analyses were based on methods described in ASBC, EBC, or MEBAK. To monitor protein changes during the brewing process 2D-PAGE was used. According to the results differences in the chemical composition of the finished beer could be observed. Not only changes in the protein composition, with the help of 2D-PAGE, could be shown, but also differences in the β-glucan content, viscosity, foam stability, and filterability. Although differences could be seen the taste of an adjunct beer was not significantly different than that of 100% malt beer.

Elisabeth Steiner was born in 1981 in Austria. She graduated with a Dipl. Ing. degree at the Universität für Bodenkultur, Vienna, in 2005. In 2006 she worked as a trainee in the Brau Union Österreich AG. Since then she has been working as a Ph.D. student at the Institute of Brewing and Beverage Technology in the field of proteins and their influence on the brewing process with regard to haze formation and filterability.

O-4
Profiling a lager fermentation completed using active dried yeast
Presenter: Chris Powell, University of Nottingham, Loughborough, UK
Coauthor(s): David Jenkins, University of Nottingham, Loughborough, UK; Tobias Fischborn, Lallemand Inc., Montreal, Canada; Katherine Smart University of Nottingham, Loughborough, UK

In the brewing industry it is standard practice to propagate a pure yeast culture before inoculating (pitching) the fermentation vessel. Due to the capacity of yeast to be serially repitched, a culture can often suffice for several fermentations. However, yeast is not reused indefinitely, and propagation is required at regular intervals. Propagation requires additional equipment, energy, and water inputs, must be initiated several days before the yeast is required, and typically requires that the yeast to be inoculated soon after it is produced. Active dried yeast offers an alternative method of yeast supply to propagation, but extensive use has often been prohibited in larger breweries by a perception of modified fermentation performance. In this investigation small-scale fermentations were performed using the lager yeast LAL1, in both "wet" (laboratory propagated) and active dried yeast (ADY) form. Both fermentations were compared for lag phase, time to attenuation, yeast cell viability, and budding indices. At pivotal time points throughout each fermentation the assimilation of amino acids and the uptake of fructose, sucrose, maltose, maltotriose, and glucose were monitored. Using these data we discuss the

effects of employing dried yeast for beer fermentations and describe some of the simple precautions to ensure ADY fermentation performance.

Chris Powell obtained a B.S. degree in biology and environmental biology and subsequently moved to Bass Brewers (now Coors UK) in 1997 to work as part of the R&D team. The following year Chris began his Ph.D. studies at Oxford Brookes University, in conjunction with Bass, and received his doctorate in 2001 on the subject of yeast cellular aging and fermentation performance. Subsequently, Chris became involved in a project funded by the European Commission, exploring mechanisms for the rapid detection of microbial contaminants within breweries. Chris moved to Lallemand Inc. in Montreal, Canada, in 2004 and was responsible for the R&D laboratory for the molecular identification and characterization of microorganisms utilized within the food and beverage industries, in addition to continuing research focused on brewing yeast. In February 2010 Chris returned to the United Kingdom to take his current position as lecturer in yeast and fermentation at the University of Nottingham. Chris is also a faculty member of the Siebel Institute of Technology and serves on the ASBC Technical Committee.

O-5

Yeast activity monitoring

Presenter: Michael Bradley, Nalco, Naperville, IL

Yeast is generally recognized to be one of the most difficult elements of the brewing process to correctly manage. Inconsistent yeast management practices can negatively impact the consistency of fermentation and the quality of beer produced. The standard method of yeast analysis by light microscopy and viability staining, however, presents assorted difficulties and limitations in a production setting. As a result, many brewers are forced to operate their process without true information regarding the physiological state of their yeast. Over the years, numerous methods have been developed for measuring brewing yeast activity, but few have found commercial success due to a variety of reasons. A successful yeast activity measurement should be non-subjective, fast, easy, quantitative, and automated, and the resulting data should be relevant to the brewing process. A new laboratory instrument for automated yeast activity measurements is now offered by Nalco Company that meets all of these qualifications. The fundamental basis of the technology is a fast, fluorescence-generating reaction that targets native yeast enzymes. The instrument's interactive touch-screen computer guides the user through the sample preparation steps, which are performed on a digital balance connected to the instrument and require about 30 seconds of hands-on time. After inserting a rugged, triple-sensor probe directly into the prepared sample an automated series of measurements lasting about 2 minutes follows. Several key features differentiate this new technology from the industry standard practices of microscopic cell counting and viability staining. The sample preparation and reaction monitoring procedures employed are completely non-subjective and automated, meaning that anyone can perform the measurement without introducing operator-to-operator variability. The results are automatically logged by the instrument and made immediately available over a network for integration into reports, databases, and control systems. Finally, the activity levels measured with the system depend on the number of viable cells in the sample, as well as the metabolic activity (vitality) of the population. Examples will be presented of successful application of this technology for optimizing propagation, yeast pitching from a slurry, and fermentation monitoring in the brewing industry.

Michael Bradley lives in the suburbs of Chicago and works as an R&D scientist at Nalco Company, where he develops microbial detection, control, and optimization technologies. Prior to working at Nalco, Mike trained at the University of Chicago and the University of Florida, where his research combined elements of bioinformatics, evolutionary theory, and wet-lab approaches to explore biomolecular structures and functions. Mike received his Ph.D. degree at the University of Illinois – Chicago for his thesis on yeast prion proteins.

O-6

Possible roles of the mitochondria in sulfur dioxide production by lager yeast

Presenter: Eric Samp, MillerCoors

Coauthor(s): Patricia Pratt, MillerCoors

Sulfur dioxide is one of the key lager yeast metabolites that brewers seek to control, as it has multiple effects on the quality of lager beers. It has been widely reported that yeast cells, when fermented in high-glucose worts, are susceptible to producing elevated sulfur dioxide, yet the exact mechanisms may not be fully understood. It is known that utilizing glucose as a primary carbon source to fuel yeast growth negatively affects mitochondrial development, specifically its unique membrane lipid, cardiolipin. In this study, we show the results of incubation experiments aimed at altering cardiolipin formation and mitochondrial development with a stimulator of cardiolipin synthesis (L-thyroxine and glycerol) and an inhibitor (inositol). These results demonstrated significantly lower sulfite levels ($P < 0.05$), adjusted for ethanol production, under conditions promoting cardiolipin formation. In addition, fermentations with respiratory-deficient mutants also revealed significantly lower efficiency in the conversion of sulfate, as measured by the ratio of the amount of sulfite produced to the amount of sulfate taken up, as compared to the parental strain ($P < 0.05$). These findings suggest that this overlooked organelle may have a vital role in sulfite production, which we speculate is related to a key prosthetic group in the enzyme complex, sulfite reductase. This group, namely the [4Fe-4S] iron-sulfur cluster, provides the catalytic site in sulfite reductase electrons to reduce sulfur dioxide to sulfide. We postulate either limitations in mitochondrial ATP availability or export of this cluster to the cytosol is involved. Additional roles for the mitochondria will also be suggested.

Eric Samp is a quality engineer for MillerCoors working in the Manufacturing Quality Organization and focusing on packaging quality issues. He holds a Ph.D. degree in applied statistics from the University of Northern Colorado and CQE and CQM certifications from ASQ and a Dipl. Brewer degree from the IBD. He is also a certified 6σ master black belt.

O-7

A fresh look at beer flavor stability

Presenter: Alastair Pringle, Pringle-Scott LLc, St. Louis, MO

Brewers strive to not only manufacture a product that is as close to brewery taste as possible, but also as consistent as is practical. The flavor of packaged beer, as perceived by customers, is the result of many processes in the brewery. Research on beer freshness and the mechanisms by which stale flavors are produced will be reviewed. By applying the principle of Ockham's razor, the key points will be summarized into a new model of beer staling. The model shows that the mechanisms of staling are complex and distributed throughout the beer production, so they cannot be controlled by focusing on a single action. Therefore, freshness can only be improved through a holistic approach where the critical factors are controlled throughout the supply chain from the brewhouse to packaging and into distribution. Examples of practical tools, such as check lists and critical control point measurements, will be discussed that can be applied throughout the brewing process and lead to real improvements in freshness. In addition, a practical means to monitor improvements through specialized panels will be discussed.

Alastair Pringle began his career in the brewing industry in England when he started working in a pub at the age of 18. His interest in brewing motivated him to obtain undergraduate and graduate degrees in microbiology. Alastair joined Anheuser-Busch Inc. in 1984 after five years of postdoctoral experience in the United States and two years as a visiting professor at UCLA. At Anheuser-Busch he held a number of technical management positions, including director of brewing research, in both corporate R&D and brewing technical services. He has worked on all

aspects of brewing, including malting, mashing, fermentation, finishing, and new product development. He is currently principal at Pringle-Scott LLC, a science-based consulting company that serves alcohol-based industries. Alastair is also a visiting professor at DeVry University.

O-8

The influence of unmalted barley on the oxidative stability of wort and the final beer

Presenter: Thomas Kunz, Technische Universität Berlin, Germany
Coauthor(s): David Mato Gonzalez and Frank-Jürgen Methner, Technische Universität Berlin, Germany

The aim of this study was to investigate the influence of unmalted barley on the brewing process and the quality of the resulting beer-like beverages, with the main focus on oxidative stability, using EPR-spectroscopy (EAP value, T400 value). The use of barley instead of malt is interesting with respect to costs. However, in the cost calculation it is important to consider that barley has a considerable enzyme deficit and requires the addition of technically produced enzymes during the brewing process. Two series of five different brews containing 0, 25, 50, 75, and 90% barley were produced. Based on laboratory pretrials, a combination of technical enzymes (α-amylase, protease, pullulanase, glucanase, xylanase), depending on the barley content, was used. In general it can be said that beers with a proportion of up to 75% barley in the grain will achieve comparable or lower remaining extract and, thus, higher attenuation of the final beer. Only beer with a proportion of barley of 90% showed a significant reduction of this value. Furthermore, a significant reduction of the colors of wort could be observed with increasing barley proportions. In comparison to pilsner malt, which contains more Maillard products and melanoidins caused by the kilning process, barley has fewer coloring compounds. The missing heat exposure of barley and lower oxidative stress resulted in lower values of TBA in wort with increasing amounts of barley. Furthermore, it was observed that an increase of the barley content in the grist leads to a higher oxidative stability (EAP value) and a lower ESR signal intensity (T400 value) as indicators of radical generation in the wort and final beverage. In both series, the beers brewed with a proportion of 50% barley were preferred significantly better for flavor and taste than beer produced with 100% of malt. Only the brews with a barley proportion of 75% or more scored lower in the tasting results than all-malt beer. Although all analytical values were within the normal range according to MEBAK, the slight decrease in total polyphenol content and FAN and an increase in β-glucan caused by the high proportion of barley is unfavorable. In the assessment criteria like mouth-feel, fizziness, and quality of bitterness did not show significant differences. Notably, the beers with a proportion of 50% barley showed superior results in the brewing process and beverage parameters with the same extract yield. This is the case, in particular, for the TBA, stability of foam, EAP value, and ESR signal intensity (T600 value). Further improvement can be achieved by optimizing the concentration of enzyme addition.

After qualifying as a certified technician in preservation engineering (1991–1993), Thomas Kunz completed his basic studies in chemistry at Isny University of Applied Sciences (1994–1995) and his basic studies in food chemistry at Wuppertal University (1995–1998) before studying food technology at Trier University of Applied Sciences (1998–2002). After graduating, he worked as a chartered engineer (Dipl. Ing.) in the field of ESR spectroscopy at the Institute of Biophysics at Saarland University (2002–2004). Since 2005, he has been employed as a Ph.D. student at the Research Institute of Brewing Sciences at Berlin Technical University Berlin. His main research focus lies in analyzing radical reaction mechanisms in beer and other beverages using ESR spectroscopy.

O-9

The role of polyphenols in beer haze and astringency

Presenter: Karl Siebert, Cornell University, Geneva, NY

Polyphenol interactions with proline-rich proteins (PRPs) are involved in both the formation of protein–polyphenol haze and the perception of astringency. The nature of polyphenol interactions with proteins in these phenomena will be reviewed. A polyphenol attachment site has two or more hydroxyl groups on an aromatic ring. When the hydroxyls are adjacent, the binding is stronger. Some polyphenols bind to proteins but do not cross-link two protein molecules together; this does not result in haze or astringency. Cross-linking occurs when a polyphenol has two or more attachment sites and can bridge proteins together; this complex formation can lead to insoluble particles that scatter light, resulting in haze. In the case of the salivary PRPs, polyphenol cross-linking removes the lubrication of oral surfaces that PRPs normally provide, resulting in the sensation of astringency. Larger polyphenol molecules and those with more hydroxyl groups bind more strongly to proteins but are more readily lost during the brewing process. Protein–polyphenol interaction is known to involve both hydrogen bonding and hydrophobic bonding. There is some evidence that the face of a polyphenol ring stacks against the face of a proline ring in the protein and that the adjacent amino acid in the peptide is also involved. This may be related to the finding that glutamine is frequently located adjacent to proline in both barley hordeins and human salivary PRPs; binding to polyphenols appears to be an important function of both these proteins. The adsorbent polyvinylpolypyrrolidone (PVPP) also binds to polyphenols and can be used both to chillproof beer and to reduce its astringency.

Karl Siebert received a Ph.D. degree in biochemistry from Penn State in 1970. He then spent 18 years at the Stroh Brewery Company in Detroit, where he held positions from research associate to director of research. In 1990, Karl joined Cornell University as professor of biochemistry in the Department of Food Science and Technology. He served five years as department chair and now has a predominantly research commitment. Karl is active as a consultant in beverage technology and chemometrics. He twice received MBAA Presidential Awards for papers he presented, and he and his colleague Penny Lynn have received the ASBC Eric Kneen Memorial Award (for the best paper published in the Journal of the American Society of Brewing Chemists *in the prior year) three times. Karl received the ASBC Award of Distinction in 1999. He is a member of the ASBC Journal Editorial Board and the ASBC Foundation Board. Karl's research interests involve foam and haze in beverages, astringency and other flavor perceptions, the application of chemometric methods in food science, and assessment of microbiological risk.*

O-10

Impact of fermentation on yeast quality and assessment of fitness to ferment

Presenter: Katherine Smart, University of Nottingham, Loughborough, UK

Optimization and consistency of large-scale fermentations from pitching and dispersal of yeast to product recovery is of critical economic and industrial importance. Efficient fermentation requires conditions appropriate for ensuring high productivity while maintaining yeast viability, vitality, and genetic stability. However, optimal conditions for rapid fermentations can be suboptimal for maintaining yeast quality, leading to inconsistent and even "stuck" fermentations. During industrial fermentation yeast is exposed to fluctuations in oxygen concentration, carbon dioxide, osmotic potential, pH, ethanol concentration, nutrient availability, and temperature. Individually and collectively these stresses can adversely affect yeast potential to perform over time. Over the years a series of methods has been developed in an attempt to assess yeast quality, and while some have clearly provided benefit, others have not been adopted. In part this might be due to the plethora of assays that have been launched in the industry, each with their own merits, but perhaps not

suited to the rigors of a brewing quality assurance laboratory. Although there is no single test for the illusive characteristic of fermentation potential, many methods have merits. This paper will attempt to identify a toolkit of assays that are "fit for purpose." Some of the key methods will be mapped to attributes of yeast quality and fermentation performance. This paper will consider the gaps in our knowledge, as well as the real opportunities for innovation.

Katherine Smart completed a B.S. (honors) degree in biological sciences at Nottingham University in 1987 and was awarded the Rainbow Research Scholarship to complete a Ph.D. degree in brewing yeast and fermentation at Bass Brewers, Burton-on-Trent. She then moved to Cambridge University to take up an appointment as research fellow in the Department of Plant Sciences, where she worked on bioactive surfaces, biofouling, and bacterial contamination of beverages in collaboration with the beverage packaging company Elopak. In 1992, Katherine became a lecturer in microbiology and fermentation at Oxford Brookes University. By 2000, she had been appointed to Scottish Courage Reader in Brewing Science and became the youngest Fellow of the Institute and Guild of Brewing. In 2005 Katherine moved to the University of Nottingham, where she became the SABMiller Professor in Brewing Science. Katherine has received several awards for her research, including the Institute of Brewing and Distilling Cambridge Prize (1999), the prestigious Royal Society Industrial Fellowship (2001–2003), an Enterprise Fellowship (2002), and the Save British Science Award at the Houses of Parliament in the United Kingdom (2003). She has also recently commenced patent filing for a novel PCR technology. Her core research interests are yeast cell biology, fermentation, and stress responses in yeast.

O-11

Influence of accelerated fermentation on yeast physiology and beer quality

Presenter: Koji Onoda, Kirin Brewery Company, Limited, Yokohama, Japan
Coauthor(s): Thomas Kunz and Frank-Jürgen Methner, TU Berlin, Berlin, Germany

Fermentation and maturation are the most time-consuming steps in the production of lager-type beers. There has been extensive research done on decreasing production time; however, it remains difficult to control yeast physiology and beer quality in accelerated fermentation and/or maturation methods. Such methods often cause the deterioration of yeast viability and vitality, so that beer quality tends to be high in fatty acids, low in foam stability, and have insufficient flavor stability. Brewing trials were carried out at the 40-L scale using cylindroconical fermenters. Pressure fermentation (14°C fermentation/14°C maturation with 1 bar of counter pressure), cold fermentation with programmed maturation (9°C/20°C without pressure), cold fermentation–warm maturation (9°C/12°C without pressure), and cold fermentation with forced maturation (9°C/9°C without pressure) were performed, aiming to achieve similar beer parameters. To avoid deterioration of beer quality from the autolyzed yeast, deposited yeast was removed from the tank every 2 to 3 days during forced and programmed maturation, every 2 days during warm maturation, and every day during pressure fermentation during maturation. The level of maturing indicator compounds and aroma compounds in the final beer were determined using gas chromatography (GC). EPR determination of the endogenous anti-oxidative potential (EAP) was carried out. Taste testing was carried out according to the DLG scheme in fresh and forced-aged states. Forced maturation, programmed maturation, and warm maturation showed similar analytical characteristics, including esters, higher alcohols, fatty acids, and foam stability. Although pressure fermentation showed relatively higher acetaldehyde, sulfite, and phenyl ethyl alcohol and lower attenuation, it showed almost similar analytical characteristics in the other parameters. EAP was the best in pressure fermentation. The vitality of deposited yeast using the intracellular pH and flow cytometric methods showed few differences in the first cropping yeast. The outcome of tasting trials in fresh and forced-aged beers showed no significant differences. These findings show that the use of accelerated fermentation and maturation methods in beer production, with proper yeast handling and the right fermentation and maturation conditions, has the potential to allow the brewing of sufficiently high-quality beer without problematic deterioration in beer quality.

Koji Onoda is a researcher at the Research Laboratories for Brewing, Kirin Brewery Company, Limited. He graduated from Tokyo Institute of Technology in 1998 with a M.Eng. degree in biotechnology and joined Kirin Brewery. He worked at the Kobe brewery (1998–2003), Kirin distillery (2003–2005), and Marketing Department (2005–2007). From 2007 to 2009 he worked on brewing technology as a guest researcher under the direction of F.-J. Methner, chair of Brewing Science at the Berlin Institute of Technology (TU Berlin).

O-12

The nature and fermentability of last runnings

Presenter: Graham Stewart, ICBD, Edinburgh, Scotland
Coauthor(s): John Andrews, Briggs of Burton plc, Burton on Trent, England; Michaela Miedl, ICBD, Edinburgh, Scotland; Richard Taylor, Wells and Young's Brewing Company Ltd., Bedford, England

Last runnings are traditionally regarded as the final liquid at mash-off flowing into the kettle following the separation of sweet wort from spent grains. As the gravity decreases in the last runnings the major portion of the extract is fermentable sugars. Potentially detrimental substances, such as proteins and polyphenols, have been diluted such that they are not detrimental if added to the kettle. If this material is discharged into the sewer, not into the kettle, the effluent costs because of high COD and BOD concentrations could be high. Wort collection can probably continue as long as the brewer does not mind diluting the wort in the kettle for the sake of a small amount of additional fermentable extract compared to the discharge costs. Although full-scale trials are required, the volume of last runnings from the lauter tun was higher than from the mash filter. However, the composition of the last runnings from the two wort separation systems was similar. This study did not address the question of the organoleptic characteristics of beer under controlled taste panel conditions. However, preliminary taste panel assessment indicates little difference in the beers produced with added last runnings compared with no added last runnings.

Graham Stewart, emeritus professor in brewing and distilling at Heriot-Watt University in Edinburgh, Scotland, was the director and professor of the International Centre for Brewing and Distilling, Heriot-Watt University, from 1994 to 2007. He received his B.S. (honors) degrees in microbiology and biochemistry from the University of Wales, Cardiff, and Ph.D. and D.S. degrees from Bath University. He was a lecturer in biochemistry in the School of Pharmacy at Portsmouth College of Technology (now Portsmouth University) from 1967 until 1969. From 1969 to 1994 he held a number of technical positions with Labatt Brewing Company in Canada and from 1986 to 1994 was its brewing technical director. He was the president of the Institute of Brewing (now the Institute of Brewing and Distilling) in 1999 and 2000. He is a member of ASBC and MBAA. He holds fellowships in the IBD, the Institute of Biology, and the American Academy of Microbiology. He has more than 250 publications (books, patents, review papers, articles, and peer-reviewed papers) to his name. On retiring he established a consulting company—GGStewart Associates, with an office in Caerphilly, Wales. As well as being awarded the Horace Brown Medal of the IBD (2008), he has been presented with the ASBC Award of Excellence (2008), the MBAA Presidential Award (1983 and 1998), and the Charles Thom Award of the Society of Industrial Microbiology (1988).

O-13

Establishment of energy conservation management system at Asahi Beer

Presenter: Toshihiko Nagaoka, Asahi Breweries, Ltd., Ibaraki, Japan
Coauthor(s): Taro Kondo and Yuichi Kiwaki, Asahi Breweries, Ltd., Nishinomiya, Japan

Implementing continuous energy conservation initiatives and achieving targets for carbon dioxide emissions requires day-to-day management of utility usage data for processes and facilities. Verifying differences based on process and facility data and implementing improvements to reduce disparities between plants is also necessary. Asahi Breweries deployed a utility management system at all of its plants in order to continuously implement such energy conservation initiatives. Prior to deploying the system, Asahi Breweries conducted energy management between plants based on their overall energy intensity. Due to differences in facility configurations, process-specific management was not implemented between the plants, and energy management was left up to individual plants. This type of organization, however, prevented further energy conservation. The deployment of the energy management system enabled comparison of process-specific data between plants and the implementation of a continuous "plan, do, check, act" (PDCA) cycle. By comparing process-specific data between plants, Asahi Breweries was able to clarify differences compared with plants having low energy intensity, calculate optimum theoretical values, and identify energy conservation strategies to achieve these values (plan). Asahi Breweries then implemented the identified strategies (do) and subsequently, verified the benefits of the executed strategies (check). This process made it possible to establish and then apply (act) a manufacturing configuration for efficiently using energy conservation measures. The energy management system enabled the continuous implementation of energy conservation initiatives while running a PDCA cycle. Energy conservation requires both the implementation of energy conservation strategies and steady, day-to-day management. The energy management system implemented at Asahi Breweries became an optimum tool for running a PDCA cycle. By deploying the system at all of its plants, Asahi Breweries was able to make great strides in improving energy conservation.

Toshihiko Nagaoka joined Asahi Breweries as a plant engineer in 1987. From 1987 to 1991 Toshihiko was involved in the design of beer tanks and piping and managed the construction and organized the initial testing for the renewal and upgrade of the Hakata brewery. From 1991 to 1994 Toshihiko worked as a staff member in the packaging section at the Hokkaido brewery, focusing on quality management and operation efficiency. From 1994 to 1996 Toshihiko was involved in equipment maintenance and operation efficiency and managed the repair and improvement of facilities to save energy and increase productivity as a technical chief at the Ibaraki brewery. From 1996 to 1997 Toshihiko studied packaging in the United States at the School of Packaging at Michigan State University as a visiting scholar. From 1997 to 2000 Toshihiko worked in the packaging section at the Tokyo brewery as a line manager. From 2000 to 2002 Toshihiko worked in the Production Technology Center at the Suita brewery, specializing in energy conservation. From 2002 to 2009 Toshihiko worked in the production section at the Hokkaido brewery as the environmental management representative and significantly contributed to the Hokkaido brewery's winning of the Minister of Economy, Trade and Industry Award for Factory Energy Management Excellence. Currently, Toshihiko is the chief project engineer for promotion of the 3Rs (reduce, reuse, recycle) at the Production Technology Center.

O-14

Product improvement, cost reduction, and more sustainability with total O_2 management

Presenter: Arjen van Zeijst, Norit Haffmans, Venlo, The Netherlands

Oxygen's negative influence on the quality and shelf life of the product is common knowledge in the brewing industry. Many process controls in a brewery are based on oxygen values. Performing total oxygen management throughout the entire process leads to improved product quality, cost reduction, and a more sustainable production process. By improving quality with more accurate and frequent monitoring you are able to increase reaction time in the process controls. Costs are reduced due to decreased downtime, rework, and product losses, including the labor involved. To be more sustainable is in many cases directly linked to cost reduction. Less re-work and fewer product losses lead directly to decreased energy use and waste of raw materials. All together, total oxygen management will increase efficiency and product quality in the brewery.

Arjen van Zeijst studied electrical engineering at HTS Venlo and finished in 1996. Arjen worked for a PVD coating machine manufacturer until 2008. Arjen started at this company as a process control engineer and later worked as a project engineer, was responsible for the Process Control Department, and was an international sales manager. Arjen began at Norit Haffmans BV in 2008 as the product/area manager responsible for quality control equipment in the Americas.

O-15

Sustainability metrics and better practices in the BevBrew sector: Carbon, water, and energy footprints associated with water, waste, and co-product management

Presenter: Raj Rajan, Ecolab, Victor, NY

Factors affecting the costs of energy and environmental management within the BevBrew sector continue to pose significant challenges to profitability. Fossil fuel prices continue to rise, environmental regulations governing off-site disposal of wastes and co-products continue to become more stringent, and the pressure on the animal feed market has increased (from the rapid growth of the fuel ethanol industry and the increasing abundance of distiller's grain). Water use impacts in stressed areas and withdrawal from long-term stored water sources impose local challenges beyond those that apply to global carbon footprint concerns that are currently being tackled by the industry. The link between water and energy within plants (thermal load to heat or cool aqueous products) is often trumped by the inextricable link between the two in the broader community (embedded water in energy used and embedded energy in water used). Innovative cleaning and sanitation solutions from Ecolab's Food and Beverage group have had a positive impact on reducing energy and water use within production facilities. Off-the-shelf waste-management solutions, when combined creatively, have helped reduce both carbon and water footprints of BevBrew products. Such solutions include production of a renewable bio-fuel energy source from by-product and waste streams and reuse of treated wastewater to reduce freshwater use within the facility. Case studies of efficient anaerobic waste-to-energy processes implemented in full scale at several food and beverage facilities across the United States by Ecolab's Water, Energy and Waste Solutions group are illustrated. Benchmark practices and sustainability metrics from the global brewing industry are summarized.

Raj Rajan is vice president, engineering, in Ecolab's Water, Energy and Waste Solutions group. Raj holds a Ph.D. degree in environmental engineering from the University of Massachusetts. His current focus within the food and beverage industries is waste minimization, bioprocess engineering, control systems, renewable energy integration, and facility-specific documentation and portfolio-wide roll-ups of sustainability metrics. His team provides process support to outsourced industrial waste management and wastewater treatment facilities for major multinational

food and beverage clients. Raj has extensive experience delivering environmental process solutions to the chemical, petroleum, food, paper, utility, and transportation industries. His technical background is in physical, chemical, and biological processing of potable water sources, industrial wastewaters, and impacted groundwaters. Over the past 26 years, Raj has designed, engineered, and executed a variety of wastewater treatment and remediation projects across the United States. He has authored dozens of peer-reviewed publications, several trade journal articles, and technical presentations at national and international conferences. He is active in several professional engineering organizations and is a registered professional engineer in Michigan and Ohio.

O-15a
Integration of solar process heat
Presenter: Johannes Preiß, Krones AG, Neutraubling, Germany

"Just by telling the local media that we are planning to build a solar power plant, there was a perceptible increase of sales" are the first comments of Benno Emslander, the owner of the Hofmühl Brewery, Bavaria, if you ask him about his new solar power plant. The rising environmental consciousness of consumers, even if it's not predictable, is one result of the integration of a solar power plant. The imminent increase in the price of fossil energy and CO_2 taxation are more or less fixed figures, which we are forced to calculate over the next years. Krones has introduced solar process heat into a brewery as an alternative energy supply. The whole process of this and further projects could be divided into the following steps: concept, analysis, design, and implementation. Each of these steps has to be regarded individually for different applications to provide a reasonable and, in the end, efficient alternative energy supply for breweries or beverage plants. Therefore, Krones developed tools for a consumption data and solar yield forecast to provide a reliable database for the investment calculation. Finally, there should be lower energy costs for the producer in addition to a notable reduction in CO_2 emissions.

Since 2008 Johannes Preiß has worked as a project manager in the Department for Conceptual Engineering of Process Technology at Krones AG. He started his career during his studies of brewing and drinking technologies at the Technical University of Munich in Weihenstephan, Germany, when he worked at the Steinecker plant in the Department of Technology. After Johannes graduated as an engineer, he moved to Krones headquarters in Neutraubling, where he managed several projects in the field of beverage technology. One current project on which he is heading the new lautering technology Pegasus PX. He is also involved in activities at Krones AG regarding the integration of renewable energies into the beverage industry.

O-16
Cutting the carbon footprint of malting by 75%—Achievable or just hot air?
Presenter: Nigel Davies, Muntons plc, UK

Targets for preventing global warming suggest that we need to reduce at least 75% of our carbon emissions by 2050. On a global scale this appears an impossible target, but analyzing the supply chain from barley to malt shows that there are some reasonably straightforward initiatives that could indeed save that amount of carbon. This paper examines the impact of cereal production on the carbon footprint and looks at opportunities to save carbon in the growing of barley and production of malt. The combined effects of legislative pressure, agricultural practice, use of process water, improvements in malting process conditions, and changes in malt specification are shown in concert to make a 75% reduction within our grasp.

Nigel Davies is the manufacturing and technical director of Muntons plc, a U.K.-based malting company and the largest producer of malted ingredients in the world. His remit is directing the manufacture and technical support of malt and malted ingredients at the main board level. After earning his doctorate, he lectured in biological sciences at London University before joining Brewing Research International (BRi). During a 10-year stint in brewing research, he specialized in cereal physiology and pioneered the use of freezing-stage electron microscopy to study many different foods, becoming manager for confidential international malting and brewing projects. He is also experienced in flavor analysis of malts, beers, and wines. He regularly acts as an expert witness in cases where food safety of cereals is at issue.

O-17
The origin of pilsner brewing technology
Presenter: Jens Voigt, Technische Universität München, Freising-Weihenstephan, Germany
Coauthor(s): Andreas Richter, Weyermann Specialty Malt, Bamberg, Germany

Original pilsner brewing technology demands specific processes with regard to water, hops, and especially malt. Historically the bohemian style of pilsner beer differs in color, flavor, and overall character. The process of producing the required higher color malt is very specific and traditionally done in floor malting. Moisturization and germination conditions are controlled by special treatment and turning operations. The malting process is highly sophisticated and requires experience and specific know-how. This malting technology is compared with the modern pneumatic malting system. In brewing typically a triple-decoction program is used, requiring individual brewhouse facilities. This paper describes the malting and brewing process, comparing pale pilsner type malt from modern malting facilities and darker Bohemian style pilsner malt. The resulting beers are both typical pilsner-style beers, but quite different in taste, color, and other properties. The paper shows analytical parameters during production of malt and beer, as well as the analytical values and sensorial analytics of the final beer.

Jens Voigt received a Dipl. Eng. (M.S.) degree in brewing and beverage technology from TU München Weihenstephan, Germany, in 1985. He started his career with A. Steinecker GmbH, Freising, as a technical engineer in brewhouse and fermentation and filtration equipment. He held sales and product manager positions with Steinecker until 1995. From 1988 until 1992 he worked on his doctorate in brewing technology on beer foam from Weihenstephan (under Professor Narziß). In 1996 he joined Doemens Brewing School in Munich, Germany, as managing director. In late 1997 he joined Heinrich Huppmann GmbH, Kitzingen, Germany, as key account manager for brewery equipment and was managing director of brewmaxx, a supplier of software solutions for the brewing industry. Since early 2004 he has been a research associate with Professor Karl Sommer (Chair for Mechanical Engineering and Process Technology) at the WZW (Wissenschaftszentrum Weihenstephan), Center of Life Science, Technische Universität München Weihenstephan, working on brewing and beverage process technology issues. He is a member of MBAA and IBD and of the editorial board of the Journal of the Institute of Brewing, London *(*JIB*).*

O-18
New investigations on the process technology of mashing and lautering
Presenter: Johannes Tippmann, Technische Universität München Weihenstephan, Freising, Germany
Coauthor(s): Jens Voigt, Karl Sommer, and Simon Henke, Technische Universität München Weihenstephan, Freising, Germany

Technological impacts on the mashing process have been well investigated and the influences of the raw material quality, fineness of the ground malt, and temperature programs explored. New aspects of the mashing process, from the procedural point of view, show that alternative methods can provide a lot of new opportunities for faster and better lautering. Concerning this, a lot of research has been done at the institute.

Especially the behavior of fine particles was investigated very intensively during the last months. The first tests were done with laser diffraction. A method developed at the institute provided the ability to follow the behavior of particle size distribution during the mashing process. Subsequent, trials were done in a microscopic mash tun to define the form factor of these particles. This provided the opportunity to observe in reality what happens to the particles depending on temperature, enzyme input, and others. Additionally there was done a lot of research done on the lautering process. In this step of beer production, it is also possible to use procedural analysis to solve a series of problems. The unknown flow behavior of the wort through the filter cake depends on many influencing factors. This presentation will show which factors are responsible for that. Flow reduction and blocking of the filter cake are just two examples that have to be optimized with a procedural look at the process.

Johannes Tippmann graduated from university in 2004 with a Dipl. Eng. degree in brewing sciences and beverage technology. In 2005 he started work on his Ph.D. thesis with Professor Sommer on solids handling in the brewhouse. He collected many experiences in procedural knowledge of beer production during his studies, performing student research projects and his diploma thesis on this topic. Since 2000 he has worked as a student research assistant in dispensing systems and collected lots of experiences in this subject area. Since 2006 he has been responsible for research issues in dispense systems at the institute. He is also a member of the "Dispensing Systems" Technical Committees of the Government Association for the Food and Catering Industry (BGN) and of the DIN German Institute for Standardization. In addition, he is working for the MEBAK Dispense Work Group and has published a number of papers.

O-19

The influence of different malting and mashing methods on beer characteristics

Presenter: Taichi Maruhashi, Suntory, Osaka, Japan
Coauthor(s): Martina Gastl and Thomas Becker, Lehrstuhl für Brau- und Getränketechnologie, Freising, Germany; Ludwig Narziss, TU München-Weihenstephan, Freising, Germany

High molecular proteins contribute not only to beer taste, especially fullness and aftertaste, but also to the foam quality of the finished beer. However, if the proportion of high molecular proteins is too high, unpleasant turbidity can occur. For this reason, control of protein modification in malting and mashing is very important for the brewing process and beer quality. Because it is both easy and economical, it has become popular to use malts with relatively high protein modification. However, this may cause low fullness or an unpleasant aftertaste if the mashing method is not well considered. In this study, different malting and mashing methods were investigated in order to confirm the influence of nitrogen compounds on fullness and aftertaste. Other characteristics, i.e., foam, filterability, haze stability, and flavor stability, were evaluated at the same time. Barley (Marthe, harvest 2008) was germinated in a micro-malting apparatus to obtain three protein modifications at 44.9%, 40.3%, and 37.4%. The degree of cytolysis was nearly equal. These malts were brewed after three different mashing methods with mashing-in temperatures of 40°C, 50°C, and 62°C. It was found that the fullness and aftertaste of the final beer were improved by a combination of low Kolbach index and low mashing-in temperature. By analysis of nitrogen compounds, it was found that the amounts of high and low molecular nitrogen compounds had an influence on fullness and aftertaste. A comparison between the infusion method and decoction method revealed that the former produces better foam quality, filterability, and haze stability. A sensory test, however, showed that the quality of the decoction beer was superior for both fresh and aged beer. Better flavor stability of decoction beer came from fewer heat-derived compounds, 2-furfural, and gamma-nonalacton, in the aged beer.

Taichi Maruhashi graduated with a M.S. degree from the Tokyo University of Science in 2001. After joining Suntory, he worked for six years in the position of second brewmaster at the Suntory Tonegawa brewery in Gumma, Japan. He then went to Technische Universität München, Weihenstephan, Germany, as an international student and studied there for three years. He currently works in the Beer Development Department of Suntory Liquors Limited.

O-20

Impact of different hop compounds on the overfoaming volume of beer caused by primary gushing

Presenter: Michael Müller, TU München–Wissenschaftszentrum Weihenstephan, Freising, Germany
Coauthor(s): Thomas Becker and Martina Gastl, TU München–Wissenschaftszentrum Weihenstephan, Freising, Germany

When weather conditions favor the growth of molds on barley, beers brewed from the resulting malts often tend to gush. Certain *Fusarium* species (e.g., *F. graminearum*, *F. culmorum*) especially may cause this problem. This phenomenon is brought to the attention of maltsters and brewers every few years. Supersaturated with CO_2, a primary gushing beer contains an overcritical concentration of microbubbles that are supposed to be stabilized by *Fusarium*-derived hydrophobins. A lot of research with varying brewhouse parameters has been done to investigate the influenceable factors of primary gushing. As hops are known to contribute a wide range of both gushing-positive and -negative substances to beer, hopping regime emerged as an important aspect. This paper presents the impact of different hop varieties and products on gushing. Hop oils and unsaturated fatty acids are understood to be gushing suppressors. However, compounds like dehydrated humulinic acid can intensify it. The aim of the project is to identify the impact of the hop products used by the application of common hop pellets with a prevalent range of conductometric values (4–1% alpha-acid), as well as pre-isomerized downstream products with differing oil contents. By working with the same "gushing malt," the spectrum of compounds in the finished beer only differ through the hop product used. The overfoaming volumes of different samples were determined according to the MEBAK guidelines. They were compared with the respective hop oil and fatty acid concentrations (GC method) and isohumulone contents (HPLC method). Also, a chronological sequence of the changing percentages of beer loss is shown.

Michael P. Müller studied brewing and beverage technology at TU München – Wissenschaftszentrum Weihenstephan until 2007. After obtaining his diploma, he started his career as head of the laboratory (10 L) and pilot-scale (60 L) brewery at the Chair for Brewing Technology. Since 2008 he has focused on his Ph.D. thesis "Influence of Brewhouse Parameters on the Overfoaming Volume of Primary Gushing Beer."

O-21

Practical sustainable initiatives during cleaning and packaging operations

Presenter: George Agius, Diversey Inc., Oakville, ON, Canada
Coauthor(s): Doug Funnell, Diversey Inc., Oakville, ON, Canada

Concern for the environment and the escalating costs of energy, water, and materials are forcing brewers to move toward more sustainable practices for every stage of the beer-making process. Clean-in-place of process tanks and lines, package lubrication, and bottle washing can use up to 36% of the total water and 25% of the heat energy consumed by the brewery. Bottle washing and CIP between them use the lion's share of the water and energy and, therefore, present several opportunities for reductions. This paper explores several proven initiatives implemented in various breweries that are known to reduce the water, energy, and other materials in these areas. Some of the practices reviewed include CIP interface management, rinsing, detergent selection to reduce CIP steps, temperature reduction, substitution of heat sanitation by cold chemical

sanitizers, and bottle-washer rinsing operations. These reductions can amount to between 10% and 50% of the water and energy used and therefore, can lead to a significant effect on a brewery total operational cost. More importantly, these initiatives have been selected because they can be realized without involving major capital investment in new equipment to implement.

George Agius received his M.S. degree in chemistry at the Royal University of Malta and was a lecturer in organic and physical chemistry at the Royal University of Malta between 1971 and 1981. In 1982 he joined Diversey (Canada) as senior chemist in their R&D Department, leading to the position of technical director (1990) with JohnsonDiversey, where he was responsible for new product development, engineering systems, and customer technical support for the North America, Latin America, and Asia-Pacific regions. During that time, George directed the development of synthetic conveyor lubricants, new sanitizers, bottle scuff maskants, low environmental-impact and acidic CIP cleaners, bottle-washing programs, new pasteurizer treatments, flocculant process for the recovery of caustic, and associated engineering systems. George is currently working on ways to improve sustainability during cleaning applications and the development of dry conveyor lubricants for use in the brewing industry. He has contributed a number of papers on various topics to brewing and educational journals. He is a professional member of the Master Brewers Association of the Americas and a member of the Technical Committee for District Ontario. George currently holds the position of global application expert at Diversey Inc. George is married to Joyce and has two daughters, Suzanne and Louise. He enjoys canoeing, photography, astronomy, and reading on the history of science.

O-22

Use and misuse of adenosine triphosphate (ATP) in the brewing industry

Presenter: Chad Thompson, Ecolab, Inc., St. Paul, MN

Are you getting your equipment clean? How do you know? Adenosine triphosphate (ATP) has been used as a troubleshooting tool by brewers for some time to determine the effectiveness of their manual and automated cleaning programs. This presentation will discuss what ATP is, what it is not, and how to use ATP as a tool to evaluate your cleaning program. It will also outline how not to use ATP and common mistakes when implementing a program. The presentation will include "real-world" examples, allowing a variety of brewers to relate to the content.

Chad Thompson has more than 18 years of experience and in 2007 joined the Brewery Group in the Food & Beverage Division of Ecolab, Inc. as their lead scientist. His responsibilities include the development and commercialization of new cleaning, sanitizing, and lubrication products for the brewing industry. He has been brewing for 13 years and has been with Ecolab for 6 years. During his time at Ecolab he has contributed to numerous business segments within the corporation. Chad is a contributing member to the Master Brewers Association of the Americas and received an honorable mention for Best Paper in 2009. He received a degree from Michigan State University in packaging engineering and has been granted three patents for his work.

O-23

Water conservation/reuse in the modern brewery: Advantages and pitfalls to avoid

Presenter: Jack Bland, ChemTreat, Richmond, VA
Coauthor(s): Tom Soukup and Jaclynn Peterson, ChemTreat, Richmond, VA

Global consolidation in the international brewing industry, coupled with recent and sustained high energy costs have spawned renewed efforts at energy and water conservation/reuse in the quest to minimize operating costs while maximizing efficiency in all areas of brewery operation. While these water conservation and reuse initiatives have produced considerable savings, compared to previous operations, there are new potential pitfalls that, if not properly addressed, may lead to consequences not envisioned as part of the effort to deliver water and energy savings. This paper will highlight the successes of the most common water conservation/reuse initiatives in the packaging, utilities, and brewing areas and explain potential pitfalls that may offset any savings from conservation programs. In addition, the paper will highlight potential product quality issues that may arise as a result of misguided reuse of certain process water streams. Specific data gathered from more than 20 U.S. and international breweries will be summarized in order to document the findings listed in the paper. Finally, recommendations will be presented, listing "best practices" to avoid "water and energy conservation pitfalls," while maximizing savings associated with these programs.

Jack Bland is the director of corporate technical support, Brewery Services Division, of ChemTreat, which is headquartered in Richmond, VA. He has more than 30 years experience in water-treatment programs related to packaging and utilities systems in the brewing industry, and he has authored numerous MBAA papers related to brewery water treatment. Jack has been a member of MBAA District Mid-Atlantic since 1982, and he is responsible for primary technical support for 24 U.S. and Caribbean breweries. In addition to his extensive involvement in the brewing industry, he has also served on the Board of Directors and as past president of the Cooling Technology Institute.

O-24

Impact of different malting parameters on the protein composition of malt, wort, and finished beer

Presenter: Elisabeth Steiner, TU-München, Freising, Germany
Coauthor(s): Elke Arendt, University College Cork, Ireland; Thomas Becker and Martina Gastl, TU-München, Freising, Germany

Beer is a complex mixture of over 450 constituents, and in addition, it contains macromolecules such as proteins, nucleic acids, polysaccharides, and lipids (Briggs, 2004). Out of these constituents, beer contains approx. 500 mg/L of proteinaceous material, including a variety of polypeptides with molecular masses ranging from 100 kDa (Curioni, 1995). These polypeptides, which mainly originate from barley proteins, are the product of the proteolytic and chemical modifications that occur during brewing. Depending on the complexity, problems emerge during the brewing process, hence those problems are as varied as the constituents. Response surface methodology was used to investigate the influence of three malting parameters (germination time, degree of steeping, and germination temperature) on the protein content and composition of malt, wort, and finished beer. All analyses were based on methods described in EBC or MEBAK. To evaluate the protein changes during the malting and brewing process, lab-on-a-chip capillary electrophoresis and 2D-PAGE were used. In this work we want to give insights into the influence of different malting parameters on protein content and composition in wort and finished beer. We monitored the protein size changes through the brewing process to find out which proteins (size ranges) influence the brewing process. With the combination of lab-on-a-chip capillary electrophoresis and 2D-PAGE, protein changes through the brewing process could be followed, and interesting correlations between protein composition and haze formation were established.

Elisabeth Steiner was born in 1981 in Austria. She graduated with a Dipl. Ing. degree at the Universität für Bodenkultur, Vienna, in 2005. In 2006 she worked as a trainee in the Brau Union Österreich AG. Since then she has been working as a Ph.D. student at the Institute of Brewing and Beverage Technology in the field of proteins and their influence on the brewing process with regard to haze formation and filterability.

O-25

New application areas for micromalting systems

Presenter: Martina Gastl, Technische Universität München
Coauthor(s): Florian Schüll and Thomas Becker, Technische Universität München

Micromalting systems are often used to assess barley quality for malting and brewing purposes. Commonly they are applied to evaluate the breeding progress by new varieties and the influence of variety or provenance on quality characteristics and to estimate as soon as possible the quality characteristics, as well as the processability, of barley from a new crop. Pilot-scale malting systems were mostly used for scale-up trials to calculate the processing properties of barley variety and to get helpful information for malting at a technical scale. Malting trials have been performed in micro-scale (1 kg) and pilot-scale equipment (200-kg pilot-drum malting system) to point out the difference in malt quality caused by scale-up. The use of statistical software to design scientific trials, with the opportunity to calculate a model and forecast the behavior of a variety under different conditions (humidity, germination time, temperature), provides an instrument to get maximum information with a manageable number of trials. Response surface methodology was used to find an optimal malting regime for the variety on the one hand and to evaluate the impact of processing parameters on the resulting malt quality on the other hand. To determine the scale-up effect, selected malting programs of the RSM (1-kg scale) were repeated in the 200-kg pilot scale. The malt was analyzed using MEBAK methods. The results provide an informative basis for variety and plant characteristics and include 1) evaluation of the informative value of mircomalting systems used as instruments to forecast the processability of a variety in large industrial production scale; 2) system limits of micromalting; 3) drawbacks and opportunities for the use of micromalting systems by selection of barley sample and varieties; 4) instructions for the practical application (performance of industrial malting systems). The results offer breeders, trade, maltsters, and brewers an opportunity to get preliminary information from micro- and pilot-malting in terms of quality characteristics (e.g., barley variety) and malting performance in industrial scale.

Martina Gastl apprenticed as a brewer and maltster from 1994 to 1996 in Klosterbrauerei Andechs, Germany. She studied brewing and beverage technology at the Technische Universität München-Weihenstephan, Germany. She graduated as an engineer in 2002. From 2002 to 2006 she completed her Ph.D. degree on the "Technological Influence on Lipid Degradation in Terms of Improvement of Beer Flavour Stability." After graduation in 2002 she worked as a scientific employee and head of the GC/HPLC laboratory at Lehrstuhl für Technologie der Brauerei I (TU München-Weihenstephan) for two years, following the head of the malt laboratory. She is currently assistant professor and head of the raw material research group at the Lehrstuhl für Brau- und Getränketechnologie in Weihenstephan. Since 2008 she has been working on her postdoctoral lecture qualification; her research interest involves "Characterization and Interaction of Flavour Active Taste Compounds in Cereal based Beverages Influencing Beverage Harmony."

O-27

Increasing brewery production yield and minimizing waste to reduce operating costs using advanced separation techniques

Presenter: Dirk Weber, Pall Corporation, Frankfurt, Germany
Coauthor(s): Jonathan Pratt, Pall Corporation, Port Washington, NY

Maximizing the yield of the brewery and, hence, minimizing waste is a major source of cost reduction and competitive advantage. In an increasingly challenging market it becomes a critical focus. Whilst the subject is considered by all breweries, the best practices and full process implementation of the latest separations techniques can produce significant yield improvements of up to 5%, depending on the size and operating procedure of the brewery. This presentation looks at individual unit operations of the brewery, including primary clarification, beer recovery from fermentation bottom yeast, and finishing, and considers the optimization possibilities and their impact on yield, waste reduction, and cost. Having considered the unit operations, the full improvement possibilities and yield increases are discussed in the context of the entire brewery. Considerations for craft breweries, regional operations, and large (over 1 million hL) breweries are given. Yield improvement options are identified for any brewery. Separation technologies and methodology developed in the last five years are discussed, including options introduced as recently as late 2009.

Dirk Weber studied technology and biotechnology of foods at the Technical University of Munich – Weihenstephan from 1993 to 1999. From 1999 to 2002 he worked on a research project financed by the Federal Ministry of Agriculture in Germany and achieved his doctorate on this from the Technical University of Munich. From 2003 to 2006 he worked as a product manager for cross-flow filtration and depth filter sheets and modules at Sartorius Food & Beverage. From 2007 to 2008 Dirk worked for Festo as segment manager for food and beverage processing. In 2009 he joined Pall, working here as global marketing manager of beer.

O-28

Crosspure: Regenerable DE-free filtration for existing beer filters

Presenter: Andrew Fratianni, BASF Corp.

Crosspure polymer, developed by BASF, is a new filter aid that is used for the simultaneous filtration and stabilization of beer. It is an alternative to diatomaceous earth or membrane filtration and has the capability to stabilize beer through the removal of polyphenols and flavanoids. Unlike diatomaceous earth, and other single-use stabilization aids, Crosspure polymer is designed to be regenerated and can be reused repeatedly, which helps to significantly reduce storage, handling, and disposal costs associated with single use filter aids. In addition, Crosspure polymer can be used on existing diatomaceous earth filter lines. Minor modification of the filter line is required to use this eco-friendly product. The product is cost-effective and has the additional benefit of not introducing iron into the finished beer.

Andrew Fratianni began brewing beer at home at the age of 14. His newfound popularity in school led him to become a brewer. After graduating with a master's degree in German Literature from New York University in 1992, he headed to Portland, OR, where he started working in the craft brewing industry. He passed the Institute of Brewing AME exams in 1997 while at the University of California, Davis. He has worked for Stroh and has been brewmaster for Pabst Brewing in China and DG Yuengling and Son. Andrew has worked as a product manager at A. Steinecker Maschinenfabrik, and since 2008, he has been with BASF as senior technical sales representative for PVPP applications in the beer, wine, and beverage industries. He is a member of MBAA and IBD.

O-29

Ultraviolet control—Disinfection of air, surface, and water through quantifiable controls

Presenter: Troy Smith, Radiant Industrial Solutions, Houston, TX

In today's market(s) we see a wider array of ultraviolet options than we have ever seen in the past. It has become quite clear that the ultraviolet industry has matured. We are seeing new players enter the industry and mature manufacturers merge, as well as new methods to deliver ultraviolet. In all we have watched the technology of ultraviolet change from the category "other disinfection methods" to a main disinfection method. UV light is used to combat disinfection by-products (DBP), as well as organisms resistant to chlorination, such as *Cryptosporidium*. Ultraviolet as a means of disinfecting water has been around since 1955 and became a main means of disinfection throughout the 1980s and 1990s, with the number of users increasing annually. We have learned over many years that the best ultraviolet system is a system

well maintained. From the EPA, International Ultra-Violet Association (IUVA), and other associations, we now have standards of engineering design. The EPA has provided documentation that gives standards from design to suggested service. However, it is still in the hands of the equipment owners to maintain a working system that will meet application specific requirements. Third-party service groups such as Radiant Industrial Solutions, Nalco, and Siemens work with end-users to establish working standards that are site-specific. The focus on-site is to understand the environment conditions and, more specifically, the water quality coming into the ultraviolet vessel from the feed source. Based on this information, a UVT measurement is typically taken on-site to understand the ability or challenges of the ultraviolet system. Each ultraviolet system is designed to a UVT (ultraviolet transmittance) level that is determined by the application process. Further definition of water quality or "what is in the water" will tell us how to maintain the system. As you look at a UV system it is common to ask the question, "How do I know it is working correctly?" The answer is through proper measurement, equipment operation signals, and mechanical inspections. Each of these factors can be measured and used to better understand your system but more importantly to control the system performance. Metering is the one item within a UV system that is always discussed. This is the tattle tale of the system. With a good metering device in a UV system we will have the ability to log data that may affect the performance of UV disinfection. With a logging meter, we can measure and record all of the variables of the system. There are only a few manufacturers that actually record this data, thus leaving the end-user to record the data by hand. Advancements in the field are changing this and providing metering that can record these points within a given UV system. The key to a properly working system is to understand the measurements available per installation.

Troy Smith is the president and owner of Radiant Industrial Solutions, Inc. based in Houston, TX. Troy has been in the ultraviolet water and air markets for more than 20 years. Prior to Radiant Industrial, Troy worked with Trojan Technologies, Aquafine, Technical Connections, and Ultraviolet Systems and Equipment. Troy has been involved with regulatory compliance, as well as organizations that include IBWA, ISBT, Ashrae, SGIA, Radtech, and other technical committees. Over the past 10 years Troy has been involved in product patents, as well as providing training seminars and educational training on the topics surrounding ultraviolet technologies throughout various industries and tradeshows.

O-30

Flexibility beats restrictions—Brewing control at its best

Presenter: Martin Lutz, ProLeiT International GmbH & Co. KG, Herzogenaurach, Germany

Brewers need automation solutions that support them in the best possible way within the specifics of their business—flexible, module-based systems that guarantee production safety, product versatility, and easy enlargement with the growth of the brewery. The lecture will address the following topics: benefits of process automation in general; possibilities within state-of-the-art automation and data management systems for brewers; difference of mere SCADA systems to real process control systems; how easily a system can "grow" with the success of the brewery; advantages of "off-the-shelf" brewery-specific modules compared to applications with nonspecific automation products; examples of realized applications. The intention is to give an overview of what is, with a realistic effort, possible and, therefore, reasonable with today's automation and data management systems for breweries of different sizes and needs. The audience shall be able to judge what makes sense for them in the current stage of their business and what can be the development for them as a final goal. We focus on the benefits of process automation systems with respect to product safety and quality; the flexibility to support a brewmaster's creativity in finding new tastes or following-up their production with automatic supply of the figures for raw materials consumed and produced amounts of wort and beer; tracking and tracing of production; defining the key performance indicators; and quality statistics, historical analysis, or energy consumption data.

Martin Lutz graduated with a brewmaster degree from Weihenstephan University, Germany. After several years of working in medium- and small-sized breweries, he joined ProLeiT in its business field of brewery automation and manufacturing data management. He has gained profound knowledge of the various aspects of brewery automation and is connecting the requirements of the brewmaster with the possibilities and structures of modern process control systems.

O-31

Inline measurement for process validation—New comprehensive process control tools for milling, mashing, lautering, and boiling

Presenter: Jens Voigt, Technische Universität München Weihenstephan, Freising, Germany

Coauthor(s): Hans-Joerg Menger, Ziemann, Ludwigsburg, Germany; Heinz Dauth and Johannes Tippmann, Technische Universität München Weihenstephan, Freising, Germany

Technical and technological complexity and interdependence between the brewing process steps of milling, mashing, lautering, and boiling, as well as the knowledge of their technical/technological influence on the product quality and plant economy form the basis for research and development of an in-line process validation. The target of the described development is to implement different types of in-line measurements, e.g., particle size measurement during mashing, viscosity measurement during mashing and lautering, conductivity measurement during mashing, particle size measurement during wort boiling, etc., in a complete network unit and to use the collected process data in order to create a self-optimizing process control system. For example, a combination of the data measurement of viscosity and particle size distribution during the mashing process can be used in order to optimize the rest times and temperatures during the mashing process. The grist structure reached during milling, which is responsible for an effective and fast mash filtration—particularly for lautering with lauter tuns—can be used to adapt the particle size of the grist or the amount of added water during conditioning of the malt or the rest time after conditioning if the whole grain-conditioning milling system or a traditional conditioning system is used. This in-line adaptation of the mechanical effect during milling can be used to increase the permeability of endosperm cell walls, as well as the active surface of substrates, which improves the amylolysis, proteolysis, and cytolysis for the mashing process and the husk structure for the lautering process. Another example is the in-line measurement of the particle size-distribution changes during wort boiling. These figures give the possibility to influence the protein size structure or to identify and fix protein size distribution during boiling. All described issues were tested and developed as part of the process chain analysis at TUM Weihenstephan and tested both in the lab and in a 10-hL pilot brewery plant of Ziemann Ludwigsburg GmbH.

Jens Voigt received a Dipl. Eng. (M.S.) degree in brewing and beverage technology from TU München Weihenstephan, Germany, in 1985. He started his career with A. Steinecker GmbH, Freising, as a technical engineer in brewhouse and fermentation and filtration equipment. He held sales and product manager positions with Steinecker until 1995. From 1988 until 1992 he worked on his doctorate in brewing technology on beer foam from Weihenstephan (under Professor Narziß). In 1996 he joined Doemens Brewing School in Munich, Germany, as managing director. In late 1997 he joined Heinrich Huppmann GmbH, Kitzingen, Germany, as key account manager for brewery equipment and was managing director of brewmaxx, a supplier of software solutions for the brewing industry. Since early 2004 he has been a research associate with Professor Karl Sommer (Chair for Mechanical Engineering and Process Technology) at the WZW (Wissenschaftszentrum Weihenstephan), Center of Life Science, Technische Universität München Weihenstephan, working on brewing and beverage process technology issues. He is a

member of MBAA and IBD and of the editorial board of the Journal of the Institute of Brewing, London *(*JIB*).*

O-32

Line right up! An examination of process quality issues related to pipe stress and poor connections

Presenter: Darren Moser, Trumer Brauerei, Berkeley, CA

Proper movement of fluid is one of the principle requirements in any brewery. Depending on plant scale, size can be established by a variety of equipment designs. Plant layout and fluid flow are related to overall process quality and also protection of mechanical equipment and safe operation. Small- to mid-size breweries undoubtedly depend on a combination of pipe arrangements that can include hard piping, flow panels, hoses, and vessels of varying sizes. The quality of the connections between the beer pathways are critical to the quality of the process flow and directly influence the product. Flanges, clamp connections, and threaded connections that are poorly made due to improper installation or pipe stress can inhibit proper cleaning during normal CIP procedures, as biofilms and solids can easily collect in and around gaskets and their shadows. The associated pipe stress can also impede the proper operation of valves. Direct beer quality issues associated with poor connections consist of dissolved oxygen inclusion, microbiological vulnerability, and product loss. Inadequately joined lines can also pose a serious safety hazard within brewery operations when steam and CIP fluids are considered. A necessary part of brewery operations is to monitor and audit these connections and understand the relationship they have with process quality.

Darren Moser received his B.S. degree in natural history from Juniata College in Huntingdon, PA, in 2004. In 2005 he completed the Master Brewers Program in the University of California Davis Extension. Darren began work at the Trumer Brauerei Berkeley in June 2005 and is currently the production manager. Darren has been an active member of the MBAA since March 2005.

O-33

Using six sigma to optimize brewhouse performance

Presenter: Grady Hull, New Belgium Brewing Company

In the craft brewing industry it's common for efficiencies to be less than optimal. Substantial variations in recipes, temperatures, batch sizes, etc. make it difficult to maintain optimum capacity in the brewhouse. Our main brewhouse was not performing at optimal capacity. By improving the efficiency of the brewhouse we could produce more beer in less time, saving operational costs and postponing the need to operate a second brewhouse. After a few failed attempts to improve brewhouse performance we decided to use a six sigma approach. At the start of the project the brewhouse was producing an average of 1,441 kg of extract per hour. A goal was set to increase this amount to 1,700 kg of extract per hour without doing anything which would negatively affect cost or quality. The root cause of the problem was that the lauter tun was not performing optimally. The other vessels in the brewhouse were spending too much time sitting idle, waiting for the lauter tun. There are many factors that can affect lauter tun performance, and many of the interactions are not intuitive, so six sigma design of experiment was an extremely helpful tool in this project. In total 30 different adjustments were made to the lauter tun parameters and other vessel parameters affecting the lauter tun. This paper reports the findings of a six sigma project that increased our average kilograms of extract per hour from 1,441 to 1,716, effectively improving from 10 brews a day to 12 brews a day.

Grady Hull graduated from Colorado State University in 1994 with a B.S. degree in food science and technology. After an internship with Coors Brewing Company, he worked as a brewer for CooperSmith's and Fleetside brewpubs. In 1996 he began working at New Belgium Brewing Company, where he is currently the assistant brewmaster. While working at New Belgium he received his M.S. degree in brewing and distilling from Heriot-Watt University.

O-34

Influence of hopping on beer quality

Presenter: Adrian Forster, German Hop Growers Association, Wolnzach, Germany

Although the influence of hopping on beer quality has been documented intensively, there exist still controversial results. Therefore a simple and concise test series is presented as follows: to 5 beers with low bittering units (approx. 15 mg iso-alpha acids/L) and little specific character ever-increasing amounts of aroma hops were added. The effects on analysis values, sensory results, and costs will be discussed. During the first German Hop Day in Tettnang in 2009, the beers were tested by the participants of the workshop. By using aroma hops, the corresponding clean beer bittered only with isomerized extract could be improved considerably regarding body, palatefulness, hop aroma, and harmony of bitterness; this was achieved by moderate additional costs of up to 0.10€/hL beer. As a result, it becomes obvious that even beers with little specific character and low bittering units can be enhanced sensorially by the use of aroma hops.

Adrian Forster attended the Technical University Munich Weihenstephan and obtained a Ph.D. degree in brewing science in 1972. Until 2003, Adrian was the managing director of one of the world's leading hop extraction and hop pellet plant, with responsibilities also in research. Adrian has published extensively on hop-related topics and currently works as a hop consultant.

O-35

Influence of various degradation products of isohumulones on resulting beer quality

Presenter: Sebastian Kappler, Technische Universitaet Muenchen, Freising-Weihenstephan, Germany

Coauthor(s): Udo Kattein, Thomas Becker, and Martin Krottenthaler, Technische Universitaet Muenchen, Freising-Weihenstephan, Germany

Iso-alpha-acids are the major contributor to the perception of bitterness in beer. They contribute to over 85% to the overall bitterness of traditional beers. In the brewing process, however, only about 30% of the alpha-acids present in hops are isomerized and transferred into the finished beer. On the one hand losses occur due to alpha-acids that are not isomerized and on the other hand due to iso-alpha-acids that are degraded during the wort boiling process. The problem of degradation is even more pronounced if pre-isomerized kettle extract is used. Degradation products of iso-alpha-acids contribute to the perception of bitterness as well, but to a lesser extent. Previous work showed factors affecting the rate of degradation. It could be shown that about 20% of dosed isohumulones to wort are degraded within 90 minutes of boiling. By varying wort composition and boiling parameters the losses could be reduced. In this work the influence of degradation products on overall beer quality is shown. Pilot-scale trials were done to evaluate the influence of various degradation products on sensorial and analytical attributes, as well as their behavior during aging of beer. Particular attention is paid to the bitterness profiles of fresh and forced-aged beers. Also, trials with reduced amounts of degradation products were done. The results presented in this paper provide a better understanding of the conversions occurring during the brewing process and their influence on beer quality. Suitable approaches toward an improved yield of bitter acids and improved bitter quality are shown!

Sebastian Kappler received a Dipl.-Ing. degree in brewing and beverage technology from Technische Universitaet Muenchen in 2008. He began his employment with the Augustiner-Wagner brewery in Munich as an apprentice to a brewer and maltster in 2000. After achieving the position of assistant, he started his studies on brewing science at the Technische

Universitaet Muenchen. Since May 2008 he has been working as a scientific employee at the Chair for Brewing and Beverage Technology in Weihenstephan. The topic for his doctoral thesis is the evaluation of the factors affecting the yield of isohumulones during preparation of wort.

O-36

Possibilities to influence the hoppy flavor of beer

Presenter: Stefan Hanke, Lehrstuhl fuer Brau- und Getraenketechnologie, Freising, Germany

Coauthor(s): Thomas Becker, Werner Back, and Martin Krottenthaler, Lehrstuhl fuer Brau- und Getraenketechnologie, Freising, Germany

A pleasant hoppy flavor of beer is a fashionable way to distinguish a brand from competitors in the market. In order to achieve a perceivable hoppy flavor in beer different methods can be used. Most common are late hop additions at the end of wort boiling or in the whirlpool. From several hundred aroma compounds found in hops only a few are known to have an impact on the hop aroma of kettle-hopped beers. Another method, mainly applied in the craft brewers segment, is hop addition after the main fermentation. This so-called "dry-hopping" imparts flavor impressions that are different from the late kettle hop flavor. It is well known that the content of bitter acids in hops is subject to seasonal variations. In general, the hop dosage in the brewery is determined according to the alpha-acid content, which of course can lead to totally different contents of hop aroma substances in the finished beer. This results in different aroma intensities, which can be detected by the consumer. To create a seasonally independent hop aroma, transfer rates of different hop aroma compounds were calculated and verified for the different hopping technologies (late hopping vs. dry-hopping). It can be shown that linalool is a suitable indicator of hoppy flavor when hop addition is done at late stages of wort boiling. Linalool showed very good correlation with the intensity of the hoppy flavor. Other aroma compounds behaved differently. In this study variety depending on transfer rates of aroma compounds will be presented. It is also shown that the concentration of hop volatiles is influenced by fermentation temperature. Additionally the perception of hop aroma is influenced by fermentation by-products. This proves that hops can enhance beer quality, and a dosage according to oil and/or linalool content is the best approach to create hoppy beers.

Stefan Hanke was born in 1980. From November 1999 to July 2004, he studied brewing science and beverage technology at Munich Technical University (Weihenstephan), graduating as an engineer with a Dipl.-Ing. degree. In 2010 he finished his Ph.D. degree, which dealt with the influence of hopping technology on the harmony of beer. During his studies, he worked for and received practical training at several German brewing and malting companies. Since September 2004 he has been a scientific employee at the Lehrstuhl fuer Technologie der Brauerei I, Freising-Weihenstephan, Germany (Professor Back). From December 2006 until May 2007 he headed the institute's Small Scale and Pilot Scale Brewery Department. Since May 2007 he has been responsible for the GC/HPLC Laboratory of the institute. His main research topics are the influence of hops on beer drinkability and the influence of beer matrix on bitter taste. Since May 2009 he has been the head of the GC/HPLC Laboratory of the Chair for Brewing and Beverage Technology (Professor Becker).

O-37

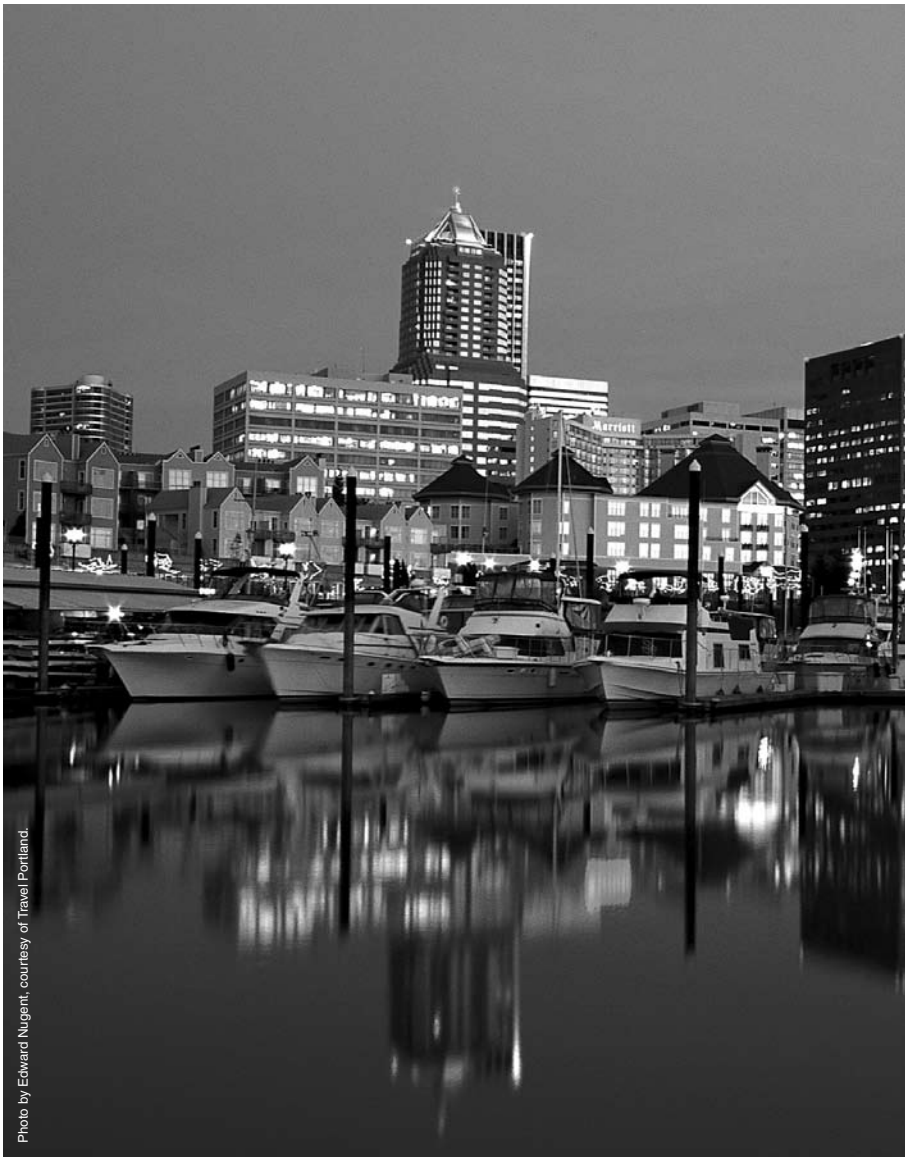
The usefulness of linalool models in predicting hop aroma

Presenter: Val Peacock, Hop Solutions Inc., Edwardsville, IL

Linalool is one of the few hop-derived aroma compounds found in beer that is accepted as being flavor active. Recent efforts to model the aroma potential of hops based on the linalool content of the oil have become more sophisticated than earlier models (Van Engel, 1992; Peacock, 1981), but they still suffer from some of the same problems. For one, the essence oil is not the only source of linalool in beer, as non-volatile glycoside-bound linalool in hops is also a source. In addition, geraniol (also found in hops) is known to convert to linalool in wine and likely does so in beer. Linalool does contribute strongly to late-hopped beer aroma but is only a minor contributor, at most, to the more refined and delicate kettle-hop aroma. The chemistry of dry-hopping is greatly different from kettle- or late-hopping, because there is no steam distillation of the oil from the kettle and only minimal contact with yeast. Flavor-active methyl esters in hop oil are converted to ethyl esters in a vigorous fermentation, and methyl ketones found in raw hop oil are reduced to much less flavor-active secondary alcohols. This is why dry-hopped beer smells of hops but, when the hop oil is subjected to fermentation, the beer smells only vaguely like hops. The aroma of linalool in a dry-hopped beer is often overpowered by the hop esters and ketones normally transformed during brewing. In conclusion, linalool is important to late-hop flavor, but it is not the only contributor to this and is much less important in kettle-hop and dry-hop aroma/flavor. Linalool seems to be a target in many hop-breeding programs these days, perhaps because of a lack of a better target, but the brewing world seems content with Cascade and some other varieties for this flavor, and the real demand is for a hop with an interesting aroma, but distinctly different from linalool.

Val Peacock holds a B.S. degree in chemistry from Iowa State University (1973) and a Ph.D. degree in organic chemistry from the University of Wisconsin (1978). Val was a research associate at Oregon State University from 1978 to 1981, working on the chemistry of hop flavor in beer. From 1981 to 1986, Val was a research scientist with the Philip Morris beverage Research Lab & Seven-Up Company. From 1978 to 1988, Val was a research associate at Oregon State University (hop flavor). From 1988 to 1989, Val was a research chemist for Redd Citrus Flavors (Safety Harbor, FL). From 1989 to 2008, Val was the manager of hop technology for Anheuser-Busch. Currently, Val is the sole proprietor of Hop Solutions Inc. (HSI), a consulting firm serving the brewing and ethanol industries.

WBC



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P-38

Comparisons between the requirements of electrical and thermal energies of different wort-boiling systems with regard to the wort aroma profiles

Presenter: Udo Kattein, TU München, Freising, Germany
Coauthor(s): Sebastian Kappler, TU München, Freising, Germany

Besides the mainstream modern wort boiling systems with internal and external heat exchangers, in the last decade a new generation of vacuum plants was established in the brewhouses. As these devices perform evaporation during wort treatment only partly by feeding thermal energy but predominantly by vacuum application, a high saving of energy was promised by the manufacturers. Otherwise an additional amount of electrical energy must be considered to energize the vacuum devices. Furthermore a lower amount of thermal energy can get reclaimed, as these plants have lower evaporation rates and temperatures in the vapors. So it would be of interest to look at these figures in comparable test arrangements. As our research brewery installed all these plants, it was possible to compare the different systems and to monitor the energy inputs under otherwise identical conditions with regard to similar wort qualities. We made the decision to test four different wort boiling systems: internal heater with circulation pump, external heater with circulation pump, "Vario Boil" and "SchoKo." All brews were performed with identical raw materials and with the normal parameter settings of the particular systems. The complete energy uptakes were monitored and recorded, including the electrical energy requirements of all circulation and vacuum pumps and agitators completed by the thermal inputs of live steam. In former trials it could be proved that the fundamental quality parameters such as coagulable nitrogene, TBN, and free DMS were achieved by all these systems. In these investigations, therefore, we looked mainly at the aroma profiles of the finished worts. They were analyzed to these special needs and concentrations of strecker aldehydes, 2-furfural, and DMS were determined. The paper shows the additional installations and parameter settings of the different systems and gives an overview of the first results of the finished worts.

Udo Kattein received a diploma engineer degree from the Technical University of Munich – Weihenstephan in 1972; afterword, he performed an economic study at the University of Munich, finishing a diploma merchandiser degree in 1976. At that time he started work on his doctoral thesis and employment at the TU Munich. He was in charge of the technical leadership of the Trial and Research Brewery Weihenstephan. He served as head brewer and was responsible for production of commercially sold malts and top-fermented beers. In addition to theses, tasks he was involved in the development of new beer types and training students. In 1984 he received a Ph.D. degree in engineering sciences, with a thesis on investigations of sulfur compounds in malt, wort, and beer. Since 2002 he has been responsible for the construction of the new malting ad brewing facilities of the research brewery, which began in 2005.

P-39

The new Research Brewery Weihenstephan—A universal platform for scientific research, training courses, and technology

Presenter: Udo Kattein, TU München, Freising, Germany
Coauthor(s): Martin Krottenthaler, TU München, Freising, Germany

Scientific research as well as the training of students demand the most modern technical equipment, which must be suitable for the production of high-quality malts and beers at semi-industrial scale. Furthermore the equipment should be able to perform all process engineering that is common in commercial breweries worldwide. To achieve these goals, the new Research Brewery Weihenstephan was constructed and has proved its capabilities. All kinds of plants for processing 200 kg of barley to malt and 150 kg of malt to beer were installed and run without problems. The best facilities are now available for widespread research with regard to malt and beer production through to finished and bottled beers. The malting device has one steeping tub, two germination units, and one kiln dryer. The brewhouse equipment comprises dry and wet malt-milling devices, one mashing vessel that permits hyperbaric boiling of adjuncts as well, a lauter tub, a mash filter, and a wort kettle that is suitable for hyperbaric processing. Two different heating systems and two kinds of vacuum plants complete these highly sophisticated processing facilities. Hot-break separation and further treatment of the wort during fermentation and maturation is built up in a classical shape. Beer filtration can be performed with kieselguhr and sheet filter or via membranes as well; small fully automated devices for filling kegs or bottles complete the brewery equipment. This poster gives an overview of the construction progress during the last few years and the final installation details of the malting and brewing facilities. The whole pattern of available process engineering is described and illustrated. An overview of the practical courses offered to students completes this poster.

Udo Kattein received a diploma engineer degree from the Technical University of Munich – Weihenstephan in 1972; afterword, he performed an economic study at the University of Munich, finishing a diploma merchandiser degree in 1976. At that time he started work on his doctoral thesis and employment at the TU Munich. He was in charge of the technical leadership of the Trial and Research Brewery Weihenstephan. He served as head brewer and was responsible for production of commercially sold malts and top-fermented beers. In addition to theses, tasks he was involved in the development of new beer types and training students. In 1984 he received a Ph.D. degree in engineering sciences, with a thesis on investigations of sulfur compounds in malt, wort, and beer. Since 2002 he has been responsible for the construction of the new malting ad brewing facilities of the research brewery, which began in 2005.

P-40

Cleaning in place (CIP) in breweries using an acid formulation that is phosphorus-free and respects the environment

Presenter: Vijay Srinivas, Arkema Inc., King of Prussia, PA
Coauthor(s): Jean-Alex Laffitte and Bernard Monguillon, Arkema, Lacq, France

The various tanks employed in breweries need frequent cleaning to remove scale and beerstone. Cleaning in place (CIP) systems using caustic formulations have predominated in the industry for some time. While it is efficient to dissolve organic impurities, there are inherent disadvantages, such as the need to vent carbon dioxide from these tanks prior to introducing caustic detergents, extensive rinsing needed to remove caustic detergents, and significant risks of inefficient scale elimination. Acid-only cleaning has been gaining some ground based on comparable efficiency, with essentially no setbacks. Acid-only cleaning formulations currently used are mainly based on a combination of phosphoric and nitric acids. While these acid cleaning solutions bring several advantages, they increase the phosphate and nitrate content in the effluent water. Scaleva solution, developed by Arkema, is a strong acid that is very efficient and has better scale-removal efficiency than phosphoric acid and beerstone removal efficiency equivalent to the currently used mixtures of phosphoric acid and nitric acid. Plant-growth nutrients such as phosphorous in effluent waters need to be reduced now. Eutrophication of lakes and rivers all around the world caused by phosphates and nitrates present in treated wastewater has been recognized as a serious problem. Algal blooms have created "dead zones" in water bodies, where aquatic life is not sustainable due to severely depleted oxygen levels, a condition known as "hypoxia." One source of aqueous

effluent phosphorus is phosphoric acid-based detergents used to clean tanks in breweries. This puts significant pressure on water-treatment facilities to treat these effluents to reduce the phosphorus content to regulated levels for the specific region. As we know the EPA has set nutrient water quality criteria by ecoregions for lakes and rivers. Nearly half of all U.S. states have enacted phosphate restriction laws. It has also established a National Pollutant Discharge Elimination System (NPDES) permit for discharging pollutants to surface waters. A total maximum daily load (TDML) has been established by various states, which supports a specific section of the Clean Water Act, allowing the EPA to restore water quality by identifying bodies of water that do not meet these standards as "impaired." Effluent wastewater generated from the use of Scaleva solution is free of any phosphorus and does not need any special treatment in water-treatment facilities. We will present some comparative data on the efficiency of Scaleva solution for the removal of scale and beerstone and highlight some synergies that could be observed with specially formulated Scaleva solutions. We will also present some data on the stability of Scaleva solution in the presence of commonly used emulsion systems in detergents for the brewing industry.

Vijay R. Srinivas is currently a principal scientist in the Thiochemicals Department of Arkema Inc. He has been involved for more than 25 years in the technical promotion of several thiochemicals in refinery, petrochemical, and polymer markets. Prior to this he was an R&D manager, in charge of new process and product development. Vijay's graduate work in the United States and at the Indian Institute of Technology was in organic chemistry, with a particular emphasis in heterogeneous catalysis. After completing his post-doctoral training at the University of Chicago, Vijay joined the Thiochemicals Department of Pennwalt Corporation in 1984 (now Arkema Inc.). Early in his career, he worked on the development of new catalysts and processes for the manufacture of various thiochemicals. Several of these are currently in commercial use. In 1997 he was one of the recipients of the Elf Innovation Award for the development and commercialization of a catalyst to make mercaptans, which he shared with a colleague. He is a member of the MBAA, MBAA District Philadelphia, and the American Chemical Society.

P-42
Stainless steel passivation and its importance for the brewery with respect to equipment maintenance and sanitation
Presenter: Dirk Loeffler, Loeffler Chemical Corporation, Atlanta, GA

Stainless-steel equipment requires periodic maintenance, just like any other piece of equipment in the brewery. The importance of stainless steel passivation and its physics are still a mystery for most breweries and sometimes even for equipment manufacturers. This paper discusses the different grades of stainless steel and why only certain grades are suitable for use in equipment that is in contact with beer. It will explain the process of passivation, how it plays a vital role in both maintaining the stainless-steel equipment in a brewery, and how it is often directly related to cleaning problems. The paper also addresses how poorly manufactured equipment can impact the flavor of beer and discusses chemical remedies.

Dirk Loeffler is the technical director for Loeffler Chemical Corporation, a chemical company specializing in cleaning products and technologies for breweries. In his capacity as technical director, he is continuously involved in developing new cleaning technologies and products for breweries. A native of Cologne, Germany, Dirk graduated with a business degree in Cologne, Germany, and started working for Chemische Fabrik Kalk GmbH. In 1990, he joined the family business of Karl Loeffler GmbH and Co. KG as the third generation. In 1992, he came to Atlanta, GA, to lay the groundwork for the start of the U.S. operation of Loeffler Chemical Corporation. He has been a member of MBAA since 1993, and he is also a member of BA and ASBC.

P-43
Use of on-site generated disinfectants in three-step clean-in-place operations
Presenter: Andrew Boal, MIOX Corporation

Clean-in-place (CIP) operations are a critical step in beverage manufacturing, providing necessary cleaning and sanitization of lines that allow for high-quality products to result from the manufacturing process. Traditional CIP cleaning methodologies utilize a five-step process in which a line is rinsed with water, hot detergent, water, a sanitizer solution, and a final water rinse. While highly effective, these five-step processes take up time that could otherwise be utilized for increased production. Recently, MIOX has been investigating the application of on-site generated mixed oxidant solution (MOS) to CIP. In these studies, we have found that MOS can be used as part of a three-step CIP process: water rinse, MOS rinse, and a final water rinse. This three-step process has been found to provide comparable cleaning and disinfection of production lines, but the length of the CIP process could be decreased by as much as 40% compared to traditional five-step processes. In this presentation, we discuss some of the details, challenges, and outcomes resulting from various pilot studies of applying on-site–generated MOS to CIP processes.

Andrew Boal received his doctorate in organic chemistry from the University of Massachusetts in 2002. Since then, he has worked as a post-doctoral researcher at Sandia National Labs, fellow at the NASA Astrobiology Institute at the University of Hawaii, and senior member of the technical staff at Sandia National Labs, accumulating more than 50 peer-reviewed and other technical publications over the years. In 2008, Andrew joined MIOX Corporation in Albuquerque, NM. At MIOX, Andrew's research is centered on a broad spectrum of topics of interest to the municipal and industrial water sectors. In addition to leading applied research initiatives at MIOX, such as the recently awarded National Science Foundation grant to study chlorine-based advanced oxidation processes, Andrew also leads MIOX's scientific efforts in the applications of on-site generated disinfectants for the beverage industry.

P-44
Using antifoams in fermentation
Presenter: Dana Johnson, BIRKO Corporation

Brewers are facing ever-increasing economic obstacles and demands that impact the bottom line. Raw materials, energy, packaging, and chemical prices have all increased dramatically in recent years. Maintaining a comfortable profit margin has become a real struggle for brewers, regardless of size. Successful brewers are finding ways to reduce costs, cut down on waste, and improve efficiency. One of the ways brewers are accomplishing this and improving the quality of their beer at the same time is with the use of antifoam. For the purpose of this talk, I will focus on using antifoam in fermentation to reduce loss, improve head retention, and optimize efficiency.

After attending Mesa College in Grand Junction, CO, Dana Johnson joined BIRKO Corporation's research and development staff in 1979. During his 30 years working in the lab at BIRKO, Dana has been in charge of quality assurance on finished products, managed the Con-Tact-It bacteria detection system, and formulated products for the food processing and brewing industries. A home brewer since 1989, Dana began calling on the brewing industry for BIRKO in 1995. Dana is currently the membership chair for MBAA District Rocky Mountain and MBAA membership co-chair for the Western United States of America.

P-45

Achieving a higher than 99.998% vol. CO_2 purity through removal of non-condensables in a CO_2 recovery system

Presenter: Heiko Grimm, Norit Haffmans, Venlo, The Netherlands

CO_2 recovery systems allow today's brewers to ensure a high-quality product through the recovery, purification, and liquefaction of raw fermentation CO_2 gas. Using state-of-the-art equipment in the brewery results in knowing the source of the CO_2 gas, lower CO_2 costs, a reduction in CO_2 emissions, and, of course, the highest in final liquid CO_2 quality. By recovering and supplying your own liquefied CO_2 from your by-product source, you ensure that it is of the highest quality and purity that will improve the overall shelf life of your products. The reduction of the non-condensable gases in the liquefied CO_2 from fermentation to an extremely low amount of less than 0.002% vol is achievable using a liquid CO_2-stripping system, a part of the liquefaction system in a CO_2 recovery plant. This system takes advantage of the fact that condensed CO_2 gas from fermentation passes through a stripping column counter flow to high pure evaporated liquid CO_2 from the reboiler. Due to the lower partial pressure of the non-condensable gases in the CO_2 gas, the non-condensables present in the liquid CO_2 will vent from this liquid phase, resulting in a final liquid CO_2 purity of better than 99.998% vol (less than 5 ppm O_2).

Heiko Grimm graduated in 2007 from Technische Universität München – Weihenstephan with a master's degree in brewing and beverage technology. Immediately after finishing his, master's thesis on new beer stabilization methods, Heiko began working for Norit Haffmans BV in June 2007 as CO_2 units product manager. In this position he was responsible for the units and inline business worldwide. In 2010, he transferred to the position of CO_2 systems product manager. He is currently responsible for the U.S., Canada, Mexico, and Caribbean regions for all CO_2 systems sales.

P-46

Design of a utility monitoring system using the example of a brewery

Presenter: Hans-Joerg Menger, Ziemann Ludwigsburg GmbH, Ludwigsburg, Germany
Coauthor(s): Theo de Groen and Tobias Becher, Ziemann Ludwigsburg GmbH, Ludwigsburg, Germany

Thinking about enterprise resource planning, such as a manufacturing execution system (MES), the first step demands steady, compact, and complete data records, which leads to a manufacturing information system (MIS) in the second step. This paper serves as a description of a basic building block for the development of an MIS for a brewery. It contains specific evaluation toward the overall goal of a consistent monitoring system and proposes a systematic way of looking at measuring utilities. Breweries can be segmented in a "utility block," "hot block," "cold block," and "packaging block." This paper concentrates on these blocks and ignores further logistic and administrative segments. The utility block (UB) can be defined as a functional block where the inputs are the primary utilities and the outputs are primary and secondary utilities. The remaining blocks, hot, cold, and packaging, are then solely users of the utilities provided by the UB. Utilities in the context of this paper consist of energy, water, and other utilities. Energy is delivered to the brewery as electrical or thermal energy, mostly in the form of fossil fuels. Water is either sourced from a municipal source or can come from brewery-owned wells. Other utilities in this context are not energy or water. Utilities can be divided into those sourced from outside the brewery perimeter and those made "in house." The ones sourced from outside are referred to as primary utilities, e.g., municipal water, natural gas, and electricity. Secondary utilities would be steam, de-aerated water, compressed air, etc. They are all made by converting and combining primary utilities. Where to locate the actual metering devices will be different from brewery to brewery. It depends on many factors, such as the actual utility distribution schematics, device specifications, maintenance considerations, and local safety regulations, just to name a few. So, more important then the physical location is how to go about determining the locations that can be adapted to most breweries. The utility monitoring system introduces a thought pattern that can be easily adapted for this purpose.

Hans-Joerg Menger was awarded a doctor of science degree by the University of Stuttgart-Hohenheim (Germany) in 2003. He started an apprenticeship as a brewer and maltster in 1985 and, in 1990, began studying food technology at the University of Stuttgart-Hohenheim, with a special focus on brewing science. In 1998 he started his professional career at Ziemann Ludwigsburg GmbH (Germany) in the Engineering/ Technology Department. Since 2000 he has been in charge of patents at the Ziemann Group. In 2003 Hans-Joerg was appointed manager of the Engineering/Technology, Research and Development, and Patents Departments.

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Traditional and novel tools for sizing and specification of beer tanks

Presenter: Jaime Jurado, The Gambrinus Company Breweries, San Antonio, TX

Brewers' proven rules-of-thumb are reviewed for sizing fermenters, unitanks, aging tanks, and bright beer tanks, because they are a good start to the process of identifying the required right size tank(s). A design methodology is presented, where a driving parameter is defined; the driver could be incremental expansion, minimization of tank surface/volume ratio, optimizing utilization of an available footprint, staging of new tanks for an existing brewhouse while anticipating a newer, larger brewhouse, sizing new tanks while anticipating other later processing area changes, or maximizing tank size in constrained physical boundaries or to process new and novel products. Examples are presented of traditional sizing decisions versus contrasting ones that feature some form of quantifiable plant optimization. Some basic underpinning calculus is presented to illuminate optimality quantification. A brief review of customer tank specifications is included.

For13 years, Jaime Jurado has served as director of brewing operations for The Gambrinus Company, which brews and packages beer in Texas, Oregon, and California, as well as contracted beer in New York. He has an undergraduate degree in chemical engineering and a master's degree in electrical engineering (evening courses taken during his tenure as master brewer). He also undertook further postgraduate study and research in medical engineering during three years at Oxford University, and he has worked at large breweries in the United States, as well as in England and Ireland, and a startup in Rajasthan, India. He has served as chair of the MBAA Technical Quarterly *Editorial Board. He has been in breweries since 1982. He was president of MBAA in 2005. Jaime is a senior member of the AIChE and ACS, where he has served as a program chair and is currently chair of the San Antonio Section. He has authored a number of publications, including technical papers and an MBAA book chapter. He delivers graduate seminars and undergraduate lectures in chemical engineering departments and in 2009 and 2010 has been busy with invitations and chemical engineering seminars at Columbia, Bucknell, Georgia Tech, UC-Berkeley, UC-Davis Engineering, Drexel, Melbourne School of Engineering, Kansas State, Colorado, Texas, Rice, Minnesota, Cambridge, Oxford University, and others, as well as the AIChE Western Regional Meeting and ACS Southwest Regional Meetings.*

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Yeast propagation manager – YPM

Presenter: Helmut Kühnl, Esau & Hueber, Schrobenhausen, Germany
Coauthor(s): Stephan Birle, Munich Technical University, Germany; Markus Fellner, Gimbio mbH, Adelschlag, Germany; Jorg Lehmann and Harald Wening, Germany Spaten-Franziskaner-Löwenbräu GmbH, Munich, Germany; Ernst Potzl, Esau & Hueber, Schrobenhausen, Germany; Thomas Becker, Munich Technical University, Germany

Intensive yet flexible yeast propagation is the basic requirement for successful yeast management. Short propagation cycles and high cell counts with maximum quality and production safety constitute stringent requirements for such a process and its control. This paper presents a highly flexible and user-friendly software solution for the targeted control and optimization of yeast propagation. The product was developed by Gimbio in cooperation with Esau & Hueber and is based on a virtual system manager, the so-called "yeast propagation manager" (YPM). It is already being successfully used at the AB-InBev site in Munich (Franziskaner Wessbier, Löwenbräu, and Spaten). Under normal circumstances, yeast supply is a static, recipe-driven process with isothermal management and continuous or intermittent ventilation. The settings are mostly statically selected or based on values obtained by experience. The process settings, therefore, do not take the current yeast requirements into account. Operating interruptions or changing process conditions, therefore, can be eliminated only by manual sample taking and lab analyses and, therefore, are a time-delayed response of the system operator. Pure yeast culture is a product of a static, recipe-driven process, isothermal management, continuous/intermittent ventilation, and time-delayed response and manual intervention by the system operator. The YPM used at the Esau & Hueber pure culture plant in Munich is based on the virtual expert system developed by Gimbio and the Institute for Brewing and Beverage Technology of TU-Munich in Weihenstephan. It is a software solution that takes over the tasks of a system operator, thus assisting the latter in this task. Unlike previous, rigidly recipe-controlled management systems, the virtual expert is designed for situation-related process management. It constantly and simultaneously monitors all process-related parameters and carries out adjustments in the event of a deviation from the ideal state. The virtual expert does not respond like a conventional control system, i.e., to individual deviations; it optimizes the process after carrying out a linguistic evaluation of the overall process. The required decisions are not taken on the basis of mathematical equations or models but rather on the basis of expert knowledge. The software simply plugs into the current brewery control system and can be linked to all systems. It is installed on a standard PC, which has an interface to the control system. The virtual expert system uses this interface to read all the information available about the process and makes use of the control and setting parameters that influence the process.

Helmut Kühnl, born in 1957, was working his way up from the bottom when he started in 1974 as an apprentice brewer and maltster at Spaten Franziskaner Bräu in Munich. In 1977 he started his studies in brewing technology at the Technische Universität Weihenstephan and received his brewmaster diploma in 1980. Three years later he completed his degree in business economics. After working as a key account/sales manager in the German market for Alfa Laval and APV, he 1998 joined Esau & Hueber as sales director. Under Helmut's procurement and responsibility Esau & Hueber perfected its yeast management processes during the last decade and has become one of the world's leading suppliers in this segment. In particular, he was significantly involved in the development of the successful yeast management system Flexi Prop, which allows pure culture propagation and crop yeast revitalization, both in one plant.

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Flavor and taste of beers made with 100% barley brewing technology

Presenter: Stefan Kreisz, Novozymes A/S, Copenhagen, Denmark
Coauthor(s): Niels Elvig and Hans-Peter Heldt-Hansen, Novozymes A/S, Copenhagen, Denmark

Since significant improvements in enzyme technology have been introduced to the brewing industry, the full replacement of malt with barley as a brewing raw material has become an option. Barley has the advantage of providing the same basic composition as malt, and if hydrolyzed with a suitable enzyme blend, it can deliver nearly the same wort and beer quality. Barley can supply not only fermentable sugars, like other starch sources, but in combination with exogenous enzymes, sufficient free amino nitrogen and comparable aroma and taste profiles, even if 100% of malt is replaced. This concept has been challenged by brewers worldwide in pilot, as well as in industrial, scale, resulting in different beer types and aroma profiles. The paper presents results from six different industrial brewing trials and several pilot trials with a focus on the taste panel of the bottled beers. The industrial trials were conducted in breweries in Europe, India, and China. The pilot brews were executed mainly at the Ziemann pilot plant (16–20 hL scale) in Ludwigsburg, Germany. All wort and beer analysis where made according to Analytica EBC or MEBAK, respectively. The taste panels were done by the Centre for Malting and Brewing Science at K.U.Leuven in Belgium and at VLB Berlin. The results show that the 100% barley technology can be used mainly in all common brewhouse systems maintaining the specifications for yield and throughput. An infusion mashing system developed for brewing with 100% barley with a total mashing time below 2 h can provide a good lauter performance in mash filters, as well as with lauter tun technology. The remaining wort matches all-malt specifications regarding viscosity and final attenuation based on maltose wort with over 55% of maltose. The total nitrogen content of barley worts is lower than worts from all-malt brews, but detailed analysis showed that barley wort can be fermented with less amino acid because of a favorable amino acid composition. This is mainly caused by significantly lower levels of proline and leads to a significantly lower amount of amino acids and strecker aldehydes in beer. The taste panels showed that all 100% barley beers were rated with average or higher scores within their category. The individual flavor evaluation showed no significant off-flavor and good flavor stability. The different beer types (from Indian pale ale to a Danish pilsner) proved the flexibility of the concept.

Stefan Kreisz studied brewing and beverage technology at the Technische Universität München – Weihenstephan, Germany (1991–1997). He graduated as an engineer in 1997. From 1997 to 2002, he completed his doctoral thesis on the filterability of wort and beer at the Institute for Brewing Technology I in Weihenstephan. From 2000 to 2002, he worked as a scientific employee and assistant at the malt laboratory at the Institute for Brewing technology I. From 2002 to 2007, he was an assistant professor and head of the malt laboratory. His main research interest has been cereals and malting technology and beer filtration. He also worked as a consultant for malt houses and breweries and has presented several papers at brewing congresses (WBC and EBC). Since May 2007 he has been working as a science manager for Novozymes A/S in the Department for Brewing and Alcoholic Beverages in Copenhagen, Denmark.

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Proper storage and shelf life of concentrated brewing worts and syrups

Presenter: Elizabeth Walston, Briess Malt and Ingredients
Coauthor(s): Robert Hansen, Briess Malt and Ingredients

In today's flexible manufacturing environment concentrated worts and specialty brewing syrups are finding increased application. These brewing syrups have potential quality and spoilage concerns if stored improperly. Bulk tank, mini bulk totes, drums, pails, and other packaging each have unique storage condition-related problems. The root causes of these problems are the same. These concentrated products are preserved from spoilage by virtue of their low water activities. Fluctuating temperature conditions or refrigeration during storage can cause condensation to form inside the package and allow spoilage to occur. Storing the products at elevated temperatures causes color development and quality problems. The fundamental basis for these problems is examined and their effects quantified. From this analysis best storage practices are recommended.

Elizabeth Walston received a B.S. degree in food science and biochemistry from the University of Wisconsin-Madison. She began her career as a malting intern with Anheuser-Busch and also worked for the USDA Cereal Crops Research Unit in its Malt and Barley Division. Elizabeth

worked in the food industry for the J.M. Smucker Company as a quality supervisor. She is currently a quality assurance chemist with Briess Industries, focusing on malt and ingredient testing, as well as food and brewing applications. Elizabeth is an active member of MBAA and ASBC.

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Evaluation of diseased and damaged hops in finished beer

Presenter: Andreas Gahr, Hopfenveredlung St. Johann, Germany
Coauthor(s): Laura Hansen, MillerCoors LLC, Golden, CO

The purpose of this work is to evaluate if defective, poor quality hops have an effect on the final quality of beer. To evaluate the outcome, one lot of raw hops that was damaged due to disease, vermin, weather, and mishandling was selected, photographed, and analyzed in comparison to premium quality hops of the same variety. Comparing the analytical data of the two lots no differences could be found when applying the standard analyses regarding bitter substances content, as measured by HPLC or hop storage index (ASBC method), which does not meet the expectations from the significant difference in appearance and sensory evaluation of the raw hops. Lager beers were brewed using the two comparative lots in a 2-hL pilot brewery, applying the hops in an early and late addition. The beers were analyzed, and several sensory tests, including triangular and descriptive taste tests, were conducted in order to describe the sensory impact of the spoiled hops on final beer quality, especially the quality of the bitterness and aroma composition.

Andreas Gahr was trained for two years on the job as a brewer and maltster at the Augustiner Brewery in Munich, Germany. He received a brewmaster degree from the Technical University Munich-Weihenstephan in 1994 and worked for another four years at the university for the Chair of Brewing Technology. Since 1998 Andreas has been the head of the Research Brewery St. Johann, which belongs to the hop processing company of Hopfenveredlung St. Johann GmbH & Co. KG and deals with all kinds of hop-related trials and product developments, as well as technological and raw material trials for suppliers and the whole brewing industry.

P-53

Disposable kegs—A review on current systems and latest German DIN standards

Presenter: Johannes Tippmann, Technische Universität München Weihenstephan, Freising, Germany
Coauthor(s): Ulrich Schober, Deutsches Institut für Normung e. V., Berlin, Germany; Klaus Doersam, Berufsgenossenschaft Nahrungsmittel und Gaststätten, Mannheim, Germany; Jens Voigt, Technische Universität München Weihenstephan, Freising, Germany

With the growing export of beer to countries all over the world, breweries have a series of problems that cause high costs. As an alternative cask, disposable kegs have been established in the past years. With this new type of package, new standards were necessary. The German Institute of Standardization (DIN) published a first version in the first years of 2000. With the production and testing of such casks, started in the last few years, the real necessity has been identified. Therefore, the standard DIN 6647-4 has been revised. The institute has collected many experiences on this topic in the past few years. A test method was established and conducted on different types of disposable kegs. Furthermore, a calculation model was created that can be used as a tool to calculate CO_2 emissions, as well as the financial benefit when using disposable kegs. Besides a short overview on the current systems, figures and facts on the subject will be presented.

Johannes Tippmann graduated from university in 2004 with a Dipl. Eng. degree in brewing sciences and beverage technology. In 2005 he started work on his Ph.D. thesis with Professor Sommer on solids handling in the brewhouse. He collected many experiences in procedural knowledge of beer production during his studies, performing student research projects and his diploma thesis on this topic. Since 2000 he has worked as a student research assistant in dispensing systems and collected lots of experiences in this subject area. Since 2006 he has been responsible for research issues in dispense systems at the institute. He is also a member of the "Dispensing Systems" Technical Committees of the Government Association for the Food and Catering Industry (BGN) and of the DIN German Institute for Standardization. In addition, he is working for the MEBAK Dispense Work Group and has published a number of papers.

P-54

Learning from food technology—Future development for draught beer equipment

Presenter: Heinz Dauth, TU München, Freising, Germany

A lot of investigations show that draught beer quality is not only dependent on cleaning intervals and detergents used, but also on the applied equipment. Besides the used material, the design and installation of the process equipment (e.g., surface roughness; drainability; avoidance of crevices, shadow zones, and dead areas; misalignment), as well as the ability to dismantle a component, has a huge effect on cleanability. There is a connection between the hygienic design of the equipment used and the contamination of the system. Food technology has made progress during the last 20 to 25 years in its product quality by considering the specifications of hygienic design guidelines. To ensure safe cleaning it is essential to have easy-to-clean equipment. Particularly, the design should consider requirements for cleanability to avoid all areas where soil can accumulate and, therefore, be a hazard to the product (e.g., beer). Equipment that is designed hygienically has three key advantages: 1) it ensures that the product is not held up within the equipment, where it could deteriorate (quality); 2) it prevents from substances that could adversely affect the health of the consumer (safety); and 3) it reduces the time required for equipment to be cleaned (cost reduction). Based on the experience and parts used over the past 20 years in draught equipment and system configurations, it is time to make a step forward in this field.

Heinz Dauth graduated as an engineer for food technology and biotechnology from TU München – Weihenstephan in 1993. Afterward he was appointed as a scientific researcher at the Chair of Process Engineering (Professor Sommer) in Weihenstephan. His doctoral thesis was completed in 1999 in the field of mechanical process engineering. Since 2003, he has been a scientific assistant and university lecturer at the Chair of Process Engineering, TU München. His main research interests are bulk solids technology, dispensing technology and hygiene, and process engineering for specific problems in the food and beverage industries. He is also responsible for the institute's industrial cooperation program. He is also working as an assistant professor at the Weihenstephan University of Applied Sciences, lecturing on mechanical and thermal process engineering.

P-56

Determining malt formula from beer color and predicting beer color from malt formula

Presenter: Daniel Bies, Briess Malt and Ingredients
Coauthor(s): Robert Hansen, Briess Malt and Ingredients

Different malt types (dark roasted, caramel roasted, or kilned) affect the visible spectrum transmittance of beer in distinctly different ways. These effects were studied and quantified for each type of malt. The resulting spectrums have several useful applications. By examining the color spectrum of an individual beer, the percentage of each type of malt in a formula can be determined. Conversely, the percentage and amount of each type of malt in a formula can be used to predict what the final full visible spectrum beer color will be. This spectrum can be input into color generators to show actual visual beer color that will be perceived in a finished beer.

Daniel Bies received his B.S. degree in biology from the University of Wisconsin-Stevens Point. He has worked in manufacturing and environmental laboratories, performing both microbiological and chemical analyses. He is currently a quality assurance chemist for Briess Industries, primarily focusing on ingredient testing and brewing applications. Dan is an active member of MBAA.

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High-resolution QTL mapping of malting quality traits in 'Mikamo Golden' × 'Harrington' cross

Presenter: Zhou Tian-su, Sr., Sapporo Breweries Ltd., Ota, Japan
Coauthor(s): Hirota Naohiko, Kihara Makoto, Iimure Takashi, Hoki Takehiro, and Ichikawa Seiichiro, Sapporo Breweries Ltd., Ota, Japan; Sato Kazuhiro, Okayama University, Kurashiki, Japan

'Mikamo Golden' and 'Harrington' are barley cultivars traditionally grown in Japan and North America, respectively. The former has a lower Kolbach index and a higher pre-harvest sprouting tolerance than the latter. Variations with respect to characteristics of both agronomic performance and beer quality profile by manufacture were observed in progenies from the cross between these two cultivars. In the present study, a high-resolution linkage map consisting of 556 markers was constructed based on the segregation data on 95 doubled-haploid lines (DHLs). The majority of the markers were single nucleotide polymorphisms from an oligonucleotide pooled assay (Illumina Co.). Other markers included 120 restriction fragment length polymorphisms from our earlier study, and eight expressed sequence tags developed by Okayama University. Genetic factors controlling malt extract, total nitrogen, soluble nitrogen, Kolbach index, and wort β-glucan were detected as quantitative trait loci (QTL), using linkage with markers on the map. A QTL controlling both Kolbach index and soluble nitrogen was particularly interesting and detected significantly ($P < 0.05\%$) on the interval of 45 cM from the terminal of the long arm of chromosome 5H, with high log-likelihood score (24.7) and accounted variance explained (33.1%). Comparisons of the Kolbach index and marker haplotypes around the QTL region among the 95 DHLs indicated that Kolbach index QTL might map in a 4 cM region from the terminal of the long arm of the 5H chromosome. Significant QTL of malt extract, total nitrogen, and β-glucan were also detected on chromosomes 4H, 5H, and 6H, respectively. Surveys of the QTL-related EST markers with their annotation on the databases of HarvEST (www.harvest-web.org/) and Barley DB (www.shigen.nig.ac.jp/barley/) suggested several candidate genes for the QTL. One of these candidates might control Kolbach index and soluble nitrogen and possibly be useful for marker-assisted selection in breeding. High-resolution mapping and map-based cloning are on the way to determine the function of the locus controlling Kolbach index.

Tian-su Zhou completed his doctorate in botanical science from the University of Tokyo in 1989. He has worked as a scientific researcher for Sapporo Breweries Ltd. since 1990 and began his studies on molecular biology of barley in 2005 as a senior researcher in the Barley R&D Center, Bioresources R&D Department. He is a native of China and has lived in Japan since 1983.

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Microstructural changes in wheat grain (*Triticum aestivum* L.) during the malting process by using confocal laser scanning microscopy and scanning electron microscopy

Presenter: Andrea Faltermaier, University College Cork, Ireland
Coauthor(s): Martin Zarnkow, University College Cork, Ireland; Martina Gastl and Thomas Becker, Technische Universitat München, Germany; Elke Arendt, University College Cork, Ireland

Wheat has a long tradition as a raw material used for the production of malt and beer. Nevertheless it has been studied to a much lesser extent than barley. To gain a fundamental understanding of the changes taking place during the malting of wheat, CLSM and SEM were used to investigate microstructural changes in the wheat kernel. With the help of these powerful optical tools, the organization of starch, proteins, and β-glucan of wheat could be investigated separately in projections, and the microstructure was visualized with an imaging software. Both microscopes are necessary for the investigation and evaluation of the changes taking place, since SEM and CLSM use different optical tools. With CLSM single compounds can be stained with specific fluorescence dyes. On the other hand SEM has a higher magnification, which allows a deeper insight into the grain structure. It is possible to visualize even small changes in the starch granule during malting when SEM is applied. Various grain regions, like the aleurone layer, starchy endosperm, and germ, were analyzed with CLSM, and differences in single fractions were clearly visible. The starch in unmalted wheat showed that it is embedded in a compact protein network, which consists of protein bodies, and is degraded during malting. In conclusion, it was possible to visualize the degradation of proteins, starch, and β-glucan and obtain a deeper insight into the ultrastructural changes during malting of wheat using two different microscope systems.

Andrea Faltermaier studied food technology from 2003 to 2009 at the Technische Universität München, Weihenstephan. She carried out her bachelor and diploma theses at the Lehrstuhl für Brau- und Getränketechnologie (Institute of Brewing and Beverage Technology, Technische Universität München, Weihenstephan). Her diploma thesis was a cooperative project hosted by Professor Werner Back (formerly Lehrstuhl für Technologie der Brauerei I, Technische Universität München, Weihenstephan) and Professor Elke Arendt (Department of Food and Nutritional Science, University College Cork, Ireland). Since 2009 Andrea has been a Ph.D. student at the University Collage Cork, Ireland, and she has received the InBev-Baillet Latour Scholarship in Brewing and Malting. The topic of her Ph.D. project is "Fundamental Studies on the Application of Wheat in Malting, Brewing and Functional Beverages." This Ph.D. thesis is a cooperative project hosted by the Department of Food and Nutritional Science, University College Cork, Ireland (Professor Elke Arendt) and the Institute of Brewing and Beverage Technology, Technische Universität München, Weihenstephan (Professor Thomas Becker).

P-60

Optimization of the malt quality, nutritional compounds, and protein changes taking place during the malting of wheat (*Triticum aestivum* L.) monitored with RSM-based designs

Presenter: Andrea Faltermaier, University College Cork, Ireland
Coauthor(s): Thomas Becker, Technische Universitat München, Germany; Elke Arendt, University College Cork, Ireland; Martina Gastl, Technische Universitat München, Germany

Wheat has a long tradition as a raw material used for the production of malt and beer. Nevertheless it has been studied to a much lesser extent than barley. It has been established for a very long time that for the production of good quality malt the variety used, as well as the malting conditions, have an important influence on the malt and beer quality. This experience is especially based on barley. Due to this fact a statistical experimental design was used to vary the malting regime of wheat. To track the differences in the degradation products (e.g., proteins, sugars, nutritional compounds, etc.) and the produced malt quality, these malts were evaluated based on MEBAK and EBC methods. In particular a closer look was taken at the proteins of the wheat kernel. To gain a detailed understanding on the enzyme–protein interactions, they were analyzed using 2D-gel electrophoresis, RP-HPLC, and a bioanalyzer. The bioanalyzer, also referred to as lab-on-a-chip, allows identification of the protein changes, as well as semi-quantitative analysis. The principle behind the bioanalyzer is the use of capillary electrophoresis on a microchip. Diverse malts were compared with each other to achieve an optimized malting process.

Andrea Faltermaier studied food technology from 2003 to 2009 at the Technische Universität München, Weihenstephan. She carried out her bachelor and diploma theses at the Lehrstuhl für Brau- und Getränketechnologie (Institute of Brewing and Beverage Technology, Technische Universität München, Weihenstephan). Her diploma thesis was a cooperative project hosted by Professor Werner Back (formerly Lehrstuhl für Technologie der Brauerei I, Technische Universität München, Weihenstephan) and Professor Elke Arendt (Department of Food and Nutritional Science, University College Cork, Ireland). Since 2009 Andrea has been a Ph.D. student at the University Collage Cork, Ireland, and she has received the InBev-Baillet Latour Scholarship in Brewing and Malting. The topic of her Ph.D. project is "Fundamental Studies on the Application of Wheat in Malting, Brewing and Functional Beverages." This Ph.D. thesis is a cooperative project hosted by the Department of Food and Nutritional Science, University College Cork, Ireland (Professor Elke Arendt) and the Institute of Brewing and Beverage Technology, Technische Universität München, Weihenstephan (Professor Thomas Becker).

P-61
"A flush a day" as an improvement for tap hygiene and draught beer quality!
Presenter: Heinz Dauth, TU München, Freising, Germany
Coauthor(s): Johannes Tippmann and Jens Voigt, TU München, Freising, Germany

The understanding of the necessity of cleaning but lack of practice is a quite common game in the selling of draft beer. Without a doubt, hygiene is a crucial parameter for sales success in the draft-beer segment. The obvious question is, how much care is actually needed, and furthermore, which kind of care leads to a sufficient level of quality? Instead of an unverified assumption, scientific investigations are needed to answer these questions. This presentation discusses the impact of tap cleaning on the microbiological situation for the tap itself and for the whole dispensing system. In other words—is tap care worth the effort? Practical investigations have been carried out with a test rig consisting of five beer lines identical in length, diameter, construction, and mountings. With regard to tap care, five different parameters were determined. As a result it was shown that in comparison to the standard weekly cleaning procedure a daily tap-cleaning treatment could dramatically reduce the microbiological load by as early as three weeks. Daily cleaning of the tap just with water showed a significant reduction in the microbiological load at the tap and, which is very interesting, also in the beer line behind the tap. In summary it has to be concluded that tap care improves the whole microbiological situation of a beer-dispensing system considerably and gives outlets with a high quality standard a competitive advantage in selling draft beer.

Heinz Dauth graduated as an engineer for food technology and biotechnology from TU München – Weihenstephan in 1993. Afterward he was appointed as a scientific researcher at the Chair of Process Engineering (Professor Sommer) in Weihenstephan. His doctoral thesis was completed in 1999 in the field of mechanical process engineering. Since 2003, he has been a scientific assistant and university lecturer at the Chair of Process Engineering, TU München. His main research interests are bulk solids technology, dispensing technology and hygiene, and process engineering for specific problems in the food and beverage industries. He is also responsible for the institute's industrial cooperation program. He is also working as an assistant professor at the Weihenstephan University of Applied Sciences, lecturing on mechanical and thermal process engineering.

P-66
Flash pasteurization—A significant influence on the long-term stability of beer
Presenter: Jean Titze, Deloitte Consulting GmbH, Munich, Germany
Coauthor(s): Vladimir Ilberg, University of Applied Science Weihenstephan-Triesdorf, Freising, Germany; Harun Parlar and Fritz Jacob, Technical University of Munich, Freising, Germany

Due to increased globalization, distribution paths become longer, which requires a guarantee of a good stability regarding microbiological, physico-chemical, and flavor stability within the shelf life of a product. One of the most important quality criteria of beer is its long-term stability, referring to filtered beer being free of haze on the one hand and the preservation of wheat beer hazing on the other hand. The premature hazing of a filtered beer, as well as the clearing of wheat beer results, in a loss of marketability. In this work the influence of a flash pasteurizer on the colloidal stability of different beers (wheat beers and bottom-fermented pale ales) was investigated. For the first time, a complete particle analysis (a particle charge and particle potential analyzing system, as well as particle size measurement) was used to characterize particle behavior in beer. Particle size distribution, particle surface charge, and particle surface potential were specifically analyzed. For this investigation, flash pasteurizer simulation trials, as well as real time tests with a flash pasteurizer in a brewery, were conducted. During the simulation trials the beer was heated up to 60°C, 70°C, and 80°C. In praxis tests the beer was heated up to 80°C, and the pasteurization unit intensity was varied from 400 PU to 600 PU and to 900 PU by adjusting the flow rate. It could be shown that flash pasteurization leads to a significant change in the surface potential of the particles, which means, for example, that particles in a thermally untreated wheat beer with a negative surface potential are shifted to a positive potential. In the simulation trial it was observed that with the increase in pasteurization temperature from 60°C to 70°C to 80°C the surface potential increased as well. The simulated trials and real time tests showed similar results. Also for the bottom-fermented pale ales a significant change in surface potential could be measured. Generally, the physical stability of beer increases with the level of potential (high potential = high stability). With the help of particle size measurement the agglomeration of particles could be analyzed. Due to the particle size distribution it could be shown that the agglomeration rate was dependent on the pasteurization temperature. This was proven by analyzing the agglomeration process using the surface charge titration method. Using particle analysis it could be explained for the first time that the flash pasteurizer has a positive effect on the physico-chemical stability of beer.

Jean Titze studied the technology and biotechnology of food at the Technical University of Munich until 2004. From 2005 to 2008, he worked as a brewery consultant and a scientist at the Research Center Weihenstephan for Brewing and Food Quality. In 2006, he took courses at the Academy of Food Law (Philipps-University, Marburg) specializing in national and European food law. Under the supervision of Professor Harun Parlar (chair for Chemical Technical Analysis and Chemical Food Technology), he is currently completing his Ph.D. degree in the area of beer analysis at the Technical University of Munich. He is focusing his research, together with his partner Vladimír Ilberg (University of Applied Science Weihenstephan-Triesdorf), on physical chemistry and particle analysis, especially with regard to beer and beverages. Since January 2009 he has been working as a senior consultant for Deloitte at the Food and Beverage Center of Expertise in Weihenstephan.

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Next generation depth filter modules—For improved process economics and environmental protection

Presenter: Dirk Weber, Pall GmbH, Bad Kreuznach, Germany

Depth filtration for fine filtration of beer with filter sheet material in general is still going strong, although the market share of membrane technologies is increasing. Depth filtration with filter sheet material can be done either with flat filter sheets or in closed systems with lenticular filter modules. The use of a closed system offers several advantages. The product is no longer exposed to environment, which means higher product safety. Drip losses are a thing of the past and with this also the sticking and molder of flat filter sheets in the filter holder. Pall recently introduced with the SUPRApak filter modules the next generation of depth filter modules using a revolutionary filtration principle—"edge flow" technology. The intention for this new development was a further improvement of the depth filter module technology used for particle and fine filtration of beer downstream of a DE filter. Due to having a higher packaging density, CAPEX, as well as OPEX, should be improved compared with flat filter installations. The flexibility in terms of different flow rate requirements is provided by the modular design of the complete system. This is also relevant for fast filter change out and reduction of service and maintenance costs by reducing the number of sealings to be changed. The SUPRApak modules consist of an inner plastic core with depth filter material wrapped around it. The filter material contains separated feed and filtrate channels punched into it. This enables the revolutionary edge flow of the fluid. The use of this new technology results in a higher filtration area incorporated in one module. Due to this, systems can be sized smaller and require a smaller footprint. This ensures a reduction in CAPEX. Due to the modular design, the filters can be changed out quickly and easily. One filter housing contains up to six filter modules that can be installed and uninstalled with a special tool in one step. This reduces the handling time between filtration runs, minimizes labor costs for filter change outs, extends the processing time, and, due to this, reduces OPEX. Reduced system volumes compared to flat filter installations minimize the water and cleaning agent consumption, as well as the energy and time needed for heating up and cooling down the system. The closed system with a low hold-up volume and the possibility of pushing the liquid out of the filter with gas guaranties a dramatic reduction in product losses. Additionally the costs for the filter housings are only a part of the comparable CAPEX of a sheet filter. The advantages of this new technology were proven in a field test in France, where the OPEX was reduced by 37.5% compared with the previously used flat filter sheet installation. Additionally, the environment is disburdened.

Dirk Weber studied the technology and biotechnology of foods at the Technical University of Munich – Weihenstephan from 1993 to 1999. From 1999 to 2002 he worked on a research project financed by the Federal Ministry of Agriculture in Germany and achieved his doctorate from the Technical University of Munich. From 2003 to 2006 he worked as a product manager for cross-flow filtration and depth filter sheets and modules at Sartorius Food & Beverage. From 2007 to 2008 Dirk worked for Festo as segment manager, food and beverage processing. In 2009 he joined Pall, working as the global marketing manager, beer.

P-68

Energy savings of up to 60% through simultaneity in liquefaction and vaporization

Presenter: Heiko Grimm, Norit Haffmans BV, Venlo, The Netherlands

With increased environmental awareness and a desire to further reduce costs, breweries are focusing on more compact possibilities to reduce energy consumption when they decide to invest in their current or new CO_2 system operations. The main consumers of energy in a CO_2 recovery plant are the liquefaction and vaporization units. Norit Haffmans LiquiVap takes advantage of the simultaneous application of both processes in one piece of equipment in a brewery. The LiquiVap simultaneously liquefies purified gas entering the system from the fermenters and re-vaporizes liquid CO_2 coming from the liquid CO_2 storage tanks. LiquiVap systems can be fitted into existing systems, as well as be part of new installations, which will instantly provide energy savings of up to 60%, thereby reducing the total operating costs of the CO_2 gas recovery system. In addition to the abovementioned savings, collection efficiency is increased by the colder operating temperatures. Due to the reduced number of hours the cooling plant and vaporizers operate, maintenance is reduced, resulting in significant cost savings. Last but not least, a LiquiVap system enables the brewery to invest in a more highly energy efficient and less costly cooling and vaporization system, due to the fact that the LiquiVap system takes over some of the work load.

Heiko Grimm graduated in 2007 from Technische Universität München – Weihenstephan with a master's degree in brewing and beverage technology. Immediately after finishing his, master's thesis on new beer stabilization methods, Heiko began working for Norit Haffmans BV in June 2007 as CO_2 units product manager. In this position he was responsible for the units and inline business worldwide. In 2010, he transferred to the position of CO_2 systems product manager. He is currently responsible for the U.S., Canada, Mexico, and Caribbean regions for all CO_2 systems sales.

P-69

Reducing the environmental impact of beer production with a proline-specific endo-protease (PSEP) demonstrated by comparative life cycle analysis (LCA) screening

Presenter: Jeroen Van Roon, DSM Food Specialties, Delft, The Netherlands

Coauthor(s): Justin Juengel, DSM Food Specialties USA, Inc., Parsippany, NJ

Previous studies have demonstrated that the use of a proline-specific endo-protease (PSEP, commercial name Brewers Clarex) enables shorter cold maturation at elevated temperature, while ensuring efficient colloidal stability and maintaining beer quality. This paper presents the results of the first life cycle analysis (LCA) screening done for a PSEP compared with current synthetic products for beer stabilization in beer production. The LCA study showed that PSEP enables brewers to significantly lessen their CO_2 footprint by reducing energy costs, water consumption, and raw materials usage in beer production. In an LCA all emissions released into the environment and resources consumed along the whole life cycle of beer are added up to produce an inventory list of substances. This inventory is translated with the help of an impact assessment methodology into environmental impacts. This study used two widely used methods, Eco-indicator 99 and IPCC 2001, for calculating all the impacts and performing sensitivity analysis, respectively. The results showed that the environmental impact for the production of the beer stabilizer needed to stabilize a set beer volume is about 10 times lower for PSEP compared with current synthetic stabilizers. In a second step the environmental costs of producing PSEP were compared to the savings in environmental impact due to the change in beer process. The study showed that the total environmental impact of the brewer's beer manufacturing stage is reduced by 5–8% when PSEP is used. In a third step, the environmental impact of the use of PSEP was assessed in the total beer value chain, i.e., from the crops on the land to the recycling of the beer bottle. To this end, the total beer value chain was divided into four main stages: suppliers, beer manufacturing, distribution, and use/disposal. The first two stages account for over 65% of the total environmental impact. This study clearly demonstrates that the use of PSEP lessens significantly the environmental impact of the suppliers and beer manufacturing stages, hence the total environmental impact of the beer value chain. The use of PSEP compared to current synthetic stabilizers reduces by 2% the total environmental impact of the total beer value chain.

After finishing an M.S. degree in bioprocess engineering, Jeroen van Roon received his Ph.D. degree (with honors) for research in the field of biocatalysis at Wageningen University, The Netherlands. In January 2005, he joined DSM Food Specialties in Delft, The Netherlands, where he worked as a scientist, biochemistry and application for brewing enzymes. He has played a major role in the development of DSM's innovative concept for beer stabilization, Brewers Clarex. He continued his work as the product and application development manager for brewing enzymes, involved in the further development of DSM's brewing enzyme portfolio and application knowledge in the field of brewing. Currently, Jeroen holds the position of industry manager, beer, and is co-responsible for the DSM brewing business worldwide.

P-71

Development of production technology utilizing a mini-brewery

Presenter: Wataru Hatsumi, Asahi Breweries, Ltd., Ibaraki, Japan
Coauthor(s): Jun Kawai and Yoshinori Ito, Asahi Breweries, Ltd., Ibaraki, Japan

We report on Asahi's mini-brewery, which lies adjacent to the Asahi Breweries Ibaragi brewery, and its utilization. The mini-brewery has a production capacity of 5 kL of beer and is equipped with the same brewhouse vessels, 29 cylindroconical fermentation and storage tanks, filtration equipment, and bottling equipment. The features of the mini-brewery facilities are as follows: 1) automatic control is normally used for each process, but interlock is avoided as much as possible for flexible adaptation to various tests; 2) advanced control, such as raw material bottom-loading and pressure control of fermentation storage tanks in 0.01-MPa units, is possible; and 3) yearly precision gains are achieved through '*kaizen*' activities in the workplace, such as achieving uniformity of temperature distribution inside fermentation tanks and devising calculation formulas for precise control of the temperature at the start of fermentation. Due to these features, the mini-brewery facilities are capable of reproducing behaviors found within the main brewery and predicting risk points during actual production. The main missions of the mini- brewery are 1) development of brewing technology; and 2) development of new products. For the development of brewing technology, the mini- brewery conducts extreme experiments that cannot be conducted at the main brewery and is used to evaluate the feasibility of deploying new equipment at the main brewery. For the development of new products, the mini-brewery is used to finalize recipes by determining the risk points for production at the main brewery. We describes examples of experiments conducted using the mini-brewery, for both development of brewing technology and development of new products.

Wataru Hatsumi is a deputy manager of the Production Technology Center, Asahi Breweries, Ltd., and he is currently responsible for management of the mini-brewery. He received an M.S. degree in agricultural chemistry from Tokyo University of Agriculture and Technology. He began employment with Asahi Breweries, Ltd. in 1995. He worked in Asahi's Fukushima, Shikoku, and Nagoya breweries as a technician in the brewing section. He also has three years of experience in the laboratory and two years of experience at the Sumidagawa Brewing Company, a craft brewery in downtown Tokyo. In 2009 he transferred to his present section.

P-73

Manufacturing execution systems in the brewing industry

Presenter: Michael James, MESA Europe, Haarlem, The Netherlands

A manufacturing execution system (MES) is a dynamic information system that drives effective execution of manufacturing operations. Using current and accurate data, MES guides, triggers, and reports on plant activities as events occur. MES is a set of functions that manages production operations from the point of order release into manufacturing to the point of product delivery of finished goods. This paper describes how Carlsberg Breweries in Europe arrived at the decision to implement MES and the impact it had on the organization. The MES has now been implemented at four breweries and is said to be improving response to market demand. This report has been reviewed, and permission has been granted by Carlsberg Breweries to present a live demonstration of the system. The system includes at-line quality checks, environmental reporting such as CO_2 and energy use, as well as traceability to meet regulatory requirements.

Mike James gained his first international experience with Allen-Bradley's Controls Division and then moved to The Netherlands to lead Allen-Bradley's expansion into Europe. ATS was founded in 1986. As a co-founder, Mike has been instrumental in growing ATS into a global independent solution provider and has worked across a wide range of industries at major breweries such as Heineken, but also at small, specialized breweries. Mike is a board member of MESA EMEA, a non-profit organization developing technical standards for manufacturing execution systems (MES) and development of MES awareness. Mike is a member of the MES governance boards at Rolls-Royce Aerospace and Carlsberg Breweries. In 2002 he became the first person to receive the Entrepreneur of the Year Award in two countries simultaneously.

P-74

Application of the novel rotary jet mixing technology in breweries: Experience and potential

Presenter: Olav Nielsen, Alfa Laval, Soborg, Denmark
Coauthor(s): Mikkel Nordkvist, Alfa Laval, Ishoj, Denmark; Chris Boulton, University of Nottingham, Loughborough, UK

Mixing is needed in a number of brewery applications for gas dispersion and/or to ensure homogeneity, e.g., in yeast storage vessels to produce a homogenous yeast slurry for pitching and in yeast propagation for efficient dispersion of air; recently the beneficial effects of employing forced convection during fermentation has also been demonstrated. The patented rotary jet mixing technology is a new technology that has already demonstrated its capabilities in a number of brewery applications. The technology is based on mixing by rotating liquid jets. In this system, liquid is withdrawn from the bottom of a tank, circulated through an external loop, and re-injected into the bulk liquid in the tank through the two or four nozzles of a rotary jet mixer, thereby ensuring more efficient mixing than in simple pump loop systems known from both propagation and storage vessels. Liquid, particulate solids, or gas feed can be added to the recirculation loop, and heat exchange can be performed in a heat exchanger installed in the loop. The rotary jet mixer is also ideal for CIP between batches since it was developed for mixing from that original area of application. Results from full-scale installations show that the application of the mixing process during fermentation leads to a faster fermentation process, thus offering a very cost-effective solution for increasing capacity. In addition a more consistent fermentation both in terms of process time and residual extract level is realized. Furthermore, trials have shown that the system offers potential advantages for homogenizing harvest yeast and aerating propagation vessels.

Olav Nielsen was born in 1951 and graduated from the Technical University of Denmark with an M.S. degree in biochemical engineering. Olav worked for many years in other bioengineering fields before joining Scandi Brew in 1996. At Alfa Laval Scandi Brew, Olav holds a position as application engineering manager for yeast, which is a core product of the company. Olav's work has concentrated on developing aeration aggregates for yeast propagation plants and mixers for yeast storage plants, with a focus on efficiency and low-stress conditions. Olav's earlier work involved propagation tests verifying the influence of the Crabtree effect on yeast propagation and investigating measurable stress as a result of mechanical impact on propagated yeast caused by agitation and aeration. Olav's previous work was published at IGB 2003, EBC 2003, 4th BYFPC 2003, WBC 2004, WBC 2008, and MBAA 2009. Olav's planned work involves optimal oxygen supply, use of the fed-batch process during propagation, and further research into minimizing vitality and viability loss during storage.

P-75

The use of dry yeast for bottle conditioning

Presenter: Sylvie Van Zandycke, Lallemand Brewing, Milwaukee, WI
Coauthor(s): Tobias Fischborn, Lallemand R&D, Montreal, QC, Canada

The popularity of dry yeast in brewing applications is increasing due to the high quality and consistency of the product. This is the result of implementation of extensive quality control and plant sanitation for dry beer-yeast production. It is believed that the quality of dry yeast is equivalent to liquid yeast, with all the advantages of a dry product: flexibility, consistency, extended shelf life, and non-refrigerated shipping. Bottle conditioning is one of the applications that generated recent interest because of the large selection of yeast strains available in dry form (brewing, wine, distilling yeast), easy dosage, and yeast performance. In order to be able to sustain the stresses occurring in beer, with sometimes a large amount of alcohol present, the quality of the yeast culture is important. The requirements for refermentation would be a healthy culture in terms of viability and vitality and cell membranes conditioned in unsaturated acids and sterols to assimilate sugars rapidly and efficiently. These two parameters and many more make dry yeast an ideal choice for a process that has been used for many centuries as a method of carbonation. The practical use of dry yeast in a brewery to achieve adequate and consistent results in bottle conditioning will be demonstrated, and the differences in beer characteristics that can be achieved by using different strains will also be highlighted.

Sylvie Van Zandycke studied biochemical engineering and fermentation at the Institute Meurice (Brussels, Belgium); she completed her degree in September 1996. During that time, she obtained an Erasmus Studentship for a 6-month project on brewing yeast cell aging at Oxford Brookes University. She obtained her Ph.D. degree on oxidative stress and aging in Saccharomyces cerevisiae *in July 2000 at Oxford Brookes University. From March 2000, Sylvie was employed as project manager for SMART Brewing Services. She was involved in contract research, microbiological analysis, and development of methods and kits for the brewing industry. She also took part in organizing international courses, symposia, and congresses for the brewing industry. In 2004 Sylvie left the United Kingdom for Canada and accepted a post at Lallemand Inc. as project manager for their Genetic Identification Laboratory. She was involved with both yeast and bacteria QC and R&D, and her main focus in research was developing new methods for microorganism identification and characterization, as well as detection of contaminants in alcohol production processes. Since February 2007, Sylvie has occupied the position of brewing fermentation manager and, more recently, technical sales manager for Lallemand to service and support the brewing industry worldwide with dry yeast and nutrition products.*

MBAA Author Index

The number following an author's last name refers to the number of the author's abstract and indicates the order of that presentation in the program and in the printed abstracts. The "O" preceding the number refers to an oral presentation. The "P" preceding the number refers to a poster presentation.

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June 15–20, 2010

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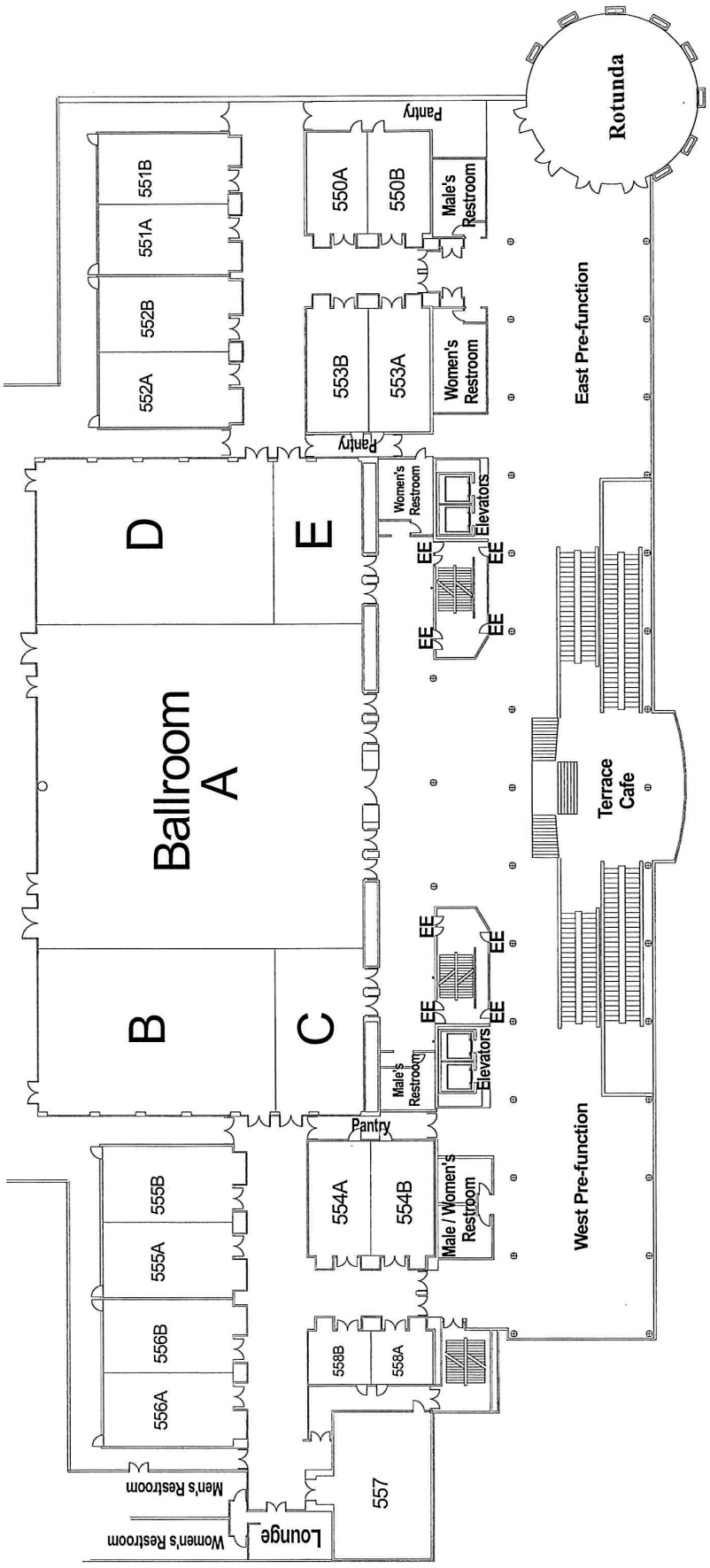

General Summit Information

Registration Desk

5th Level Lobby

Tuesday, June 15	3:30 – 6:45 p.m.
Wednesday, June 16	7:30 a.m. – 5:00 p.m.
Thursday, June 17	7:30 a.m. – 6:00 p.m.
Friday, June 18	8:00 a.m. – 4:00 p.m.
Saturday, June 19	7:45 a.m. – 4:00 p.m.
Sunday, June 20	7:15 – 11:30 a.m.

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Take home the research presentations from the ASBC Annual Meeting and the MBAA Convention! Your copy is available at the registration desk for the discounted price of $65.

Summit Attire

Business casual dress is encouraged for all summit events.

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ASBC and MBAA staff will take photos throughout the summit for use in promotional materials. By virtue of your attendance, you agree to ASBC's and MBAA's use of your likeness in promotional materials.

Open Meeting Room

There is a small meeting room available for use throughout the summit. Stop by the Registration Desk to check availability and room location and to reserve a meeting time.

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The Rhode Island Convention Center, Westin Providence, and Hilton Providence are fully prepared to handle different types of situations to assist guests. The following is information on their emergency procedures.

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Program Changes

Poster Presentations

Additions

ASBC P-70a
FT-NIR Analysis of Czech Republic Beer: A Qualitative and Quantitative Approach

G. Budinova (1), I. Dominak (1), T. Strother (1)
(1) Thermo Fisher Scientific, Madison, WI

Analysis of beer is required for proper reproducible production and labeling. Conventionally, a separate instrument is required for the analysis for each component in beer. Fourier transform near infrared (FT-NIR) spectroscopy is a much more rapid technique and was performed on beer samples from Czech Republic breweries to demonstrate it's capacity to rapidly and accurately measure and predict multiple components simultaneously. An Antaris FT-NIR analyzer was used for the analysis of beer samples using a transmission cell module. Qualitative measurements successfully classified the beer samples as 10°, 11°, or 12°. Quantitative analysis reported highly predictive measurements for original gravity, real extract, apparent extract, and alcohol content.

Presenter Changes

MBAA P-67
Now presented by Ronald Johnson, Pall Corp., Chapel Hill, NC

Withdrawals

ASBC P-48

Workshop and Technical Sessions

Presenter Changes

MBAA Workshop: Practical Malt Quality
Friday, June 18 3:50–5:00 p.m. 551 A/B
Updated Presenters: Dan Bies, Briess Malt & Ingredients; Nigel Davies, Muntons PLC; Mary-Jane Maurice, Malteurop North America, Inc.
Updated Moderator: Matt Brynildson, Firestone Walker Brewing Co.

ASBC O-19
Now presented by Trevor Cowley, University of Nottingham, United Kingdom

MBAA O-4
Now presented by David Jenkins, University of Nottingham, United Kingdom

MBAA O-10
Now presented by Chris Powell, University of Nottingham, United Kingdom
New title and abstract to be announced

Posters

Poster Hours

ASBC: West Pre-function
MBAA: East Pre-function

Wednesday, June 16

2:00 – 5:00 p.m.	ASBC Poster Set Up

Thursday, June 17

8:00 – 9:00 a.m.	ASBC Poster Set Up
9:00 a.m. – 6:00 p.m.	ASBC Poster Viewing
1:00 – 2:00 p.m.	ASBC Poster Authors Present
2:00 – 5:00 p.m.	MBAA Poster Set Up

Friday, June 18

8:00 – 8:30 a.m.	MBAA Poster Set Up
8:30 – 4:00 p.m.	ASBC and MBAA Poster Viewing
1:00 – 2:00 p.m.	ASBC and MBAA Poster Authors Present
2:00 – 5:30 p.m.	ASBC Poster Take Down

Saturday, June 19

7:45 a.m. – 2:00 p.m.	MBAA Posters Viewing
1:00 – 2:00 p.m.	MBAA Poster Authors Present
2:00 – 4:00 p.m.	MBAA Poster Take Down

Speaker Ready Kiosk

Speakers may review their presentations the day before their scheduled talk at the Speaker Ready Kiosk located at the Registration Desk. Presentations will not be available for review on the day the presentation is scheduled. The kiosk will be open during registration hours.

ASBC Poster Presentations

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P-45 Mark Libardoni. Analysis of volatile components in beer using automated solid-phase microextraction (SPME) and high-speed GC×GC-TOFMS.
P-46 Aaron MacLeod. Application of ultra performance liquid chromatography for the determination of amino acids in wort and beer.
P-47 Sylvie M. Deckers. Are magnetic fields a technical opportunity to influence the structure of CO_2 nanobubbles responsible for primary gushing in beer?
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P-49 Jason Bennett. Bioethanol from brewer's spent grains: Novel pre-treatment and hydrolysis approaches.
P-50 Tobias Fischborn. Characterization of dry Nottingham ale yeast under different fermentation conditions.
P-51 Leif A. Garbe. Determination of bisphenol-A (BPA) in polycarbonate plastic bottles by SIDA.
P-52 Femke L. Sterckx. Determination of volatile monophenols in beer using solid-phase microextraction combined with GC-MS.
P-53 Setsuzo Tada. Development of an auto-cuvette machine to measure semiautomatically premature yeast flocculation activity in malt.
P-54 Cynthia A. Henson. Differential RNA expression of Bmy1 during late seed development in wild and cultivated barley and the association with βamylase activity.
P-55 Takuya Hatanaka. Effect of lauter turbidity on the brewing process and beer quality.
P-56 Dave Barr. EPR-detected free-radical formation following photoactivation of a commercial hop oil product.
P-57 Barry Ziola. Ethanol tolerance of lactic acid bacteria.
P-58 Urs Wellhoener. Experiences with a special circulation system in a rectangular nonpressurized fermenter.
P-59 Marcia A. Browers. Factors influencing free-radical development in malt, as measured by EPR.
P-60 Florian A. Schuell. High gelatinization temperatures of barley starch—Effects on malt and beer quality.
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P-62 Caroline Scholtes. Innovative yeast extract as nutrient and natural antioxidant during propagation.
P-63 Philip Wietstock. Iron-chelating properties and hydroxyl-scavenging activities of hop acids.
P-64 Makoto Kanauchi. Levels of βglucan and pentosan and their degradation products in beer.
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P-66 Joyce E. Carr. Reduction of hazardous solvent usage in the hops laboratory.
P-67 Mark R. Schmitt. Simplified mashing methods for initial prediction of malting quality.
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ASBC New Products and Services Poster Sessions

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MBAA Poster Presentations

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P-50 Proper storage and shelf life of concentrated brewing worts and syrups. ELIZABETH WALSTON, Robert Hansen

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P-54 Learning from food technology—Future development for draught beer equipment. HEINZ DAUTH

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P-71 Development of production technology utilizing a mini-brewery. WATARU HATSUMI, Jun Kawai, Yoshinori Ito

P-73 Manufacturing execution systems in the brewing industry. MICHAEL JAMES

P-74 Application of the novel rotary jet mixing technology in breweries: Experience and potential. OLAV NIELSEN, Mikkel Nordkvist, Chris Boulton

P-75 The use of dry yeast for bottle conditioning. SYLVIE VAN ZANDYCKE, Tobias Fischborn

Exhibits

Exhibit Hours

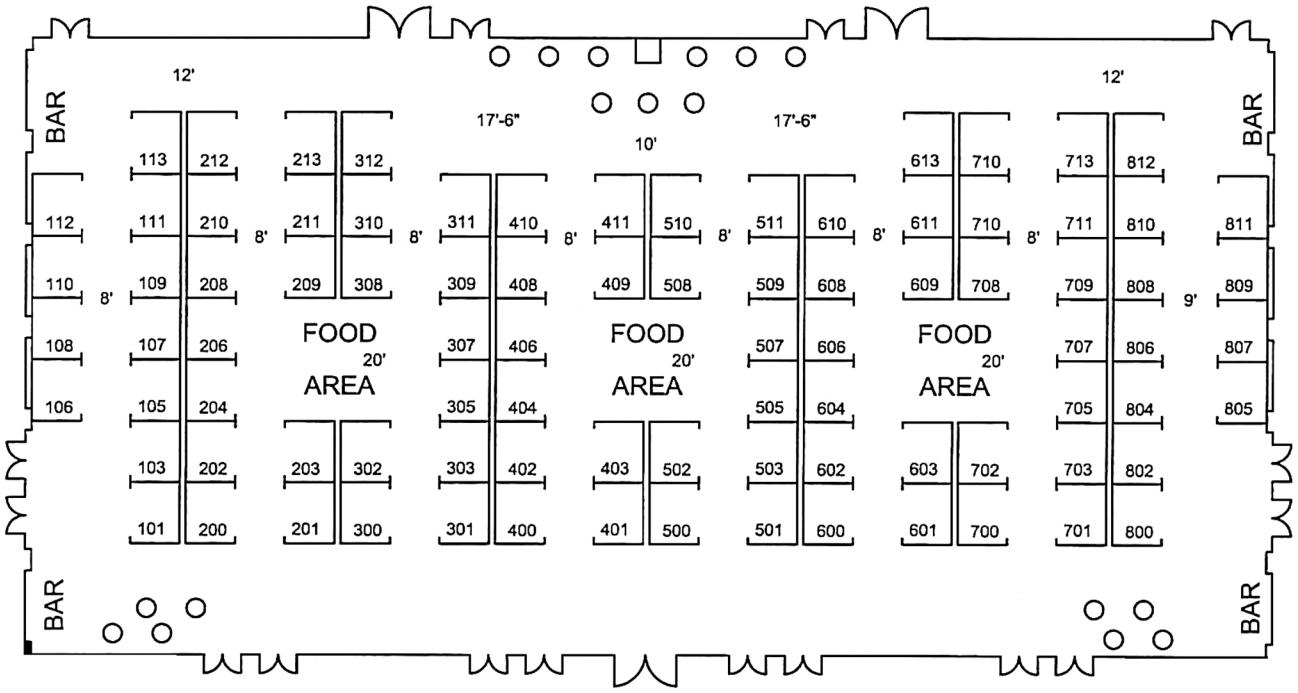
Ballroom/Exhibit Area

Wednesday, June 16
2:00 – 6:00 p.m. Exhibit Set Up

Thursday, June 17
7:30 – 9:00 a.m. Exhibit Set Up
11:30 a.m. – 2:00 p.m. Exhibits and Lunch

Friday, June 18
8:30 – 10:00 a.m. Exhibits and European Continental Breakfast
11:30 a.m. – 2:00 p.m. Exhibits and Lunch

Saturday, June 19
11:30 a.m. – 2:00 p.m. Exhibits and Lunch
2:00 – 5:00 p.m. Exhibit Take Down



Brewing Summit 2010 Exhibitor Listing

101	Skalar, Inc.
103	MIOX Corporation
105	AFTEK, Inc.
106	PerkinElmer
107	Lallemand Brewing/Ethanol Technology
108	Wayne Chemical Inc.
109	GKD-USA Inc.
110	EMD Chemicals
111	Endress+Hauser Inc.
113	Munktell Inc.
200 & 202	Siemens Industry, Inc.
201 & 203	Briggs of Burton
204	Norit Haffmans
206	Weyermann Specialty Malts
208	The University of Nottingham-Brewing Science
209	Nexcelom Bioscience
210	Brau Welt (Fachrenlac Hanscarl)
211	VitalSensors Technologies
212	EMG International
213	Pursuit Dynamics, Inc.
300 & 302	Airborne Labs International
301	optek-Danulat, Inc.
303	GF Piping
305 & 307	Gusmer Enterprises
308	Steinfurth, Inc.
309	IBD Trading
310	Rochester Midland Corp.
311	ProLeiT AG
312	INVISTA
400	SPX Flow Technology, Waukesha Cherry-Burrell, and APV brands
401	DSM Food Specialties USA, Inc.
402	Anton Paar USA
403	Krones
404 & 406	Ziemann Ludwigsburg GmbH
408	PureMalt Products
409	VLB Berlin
410	Ecolab
411	EUWA Water Treatment Plants
500	Pall Corporation
501	Albert Handtmann Armaturenfabrik GmbH & Co. KG
502	S.S. Steiner, Inc.
503	Esau & Hueber GmbH
505	LECO Corporation
507	Buhler Inc.
508	Symbiont
509	Tyco Flow Control
510	Cargill
511	Butterworth, Inc.
600	GEA Tuchenhagen North America
601	Kagetec
602	GEA Brewery Systems
603	VTT Technical Research Centre of Finland
604	GEA Westfalia Separator
606	PQ Corporation
608	Astoria-Pacific International
609	American Tartaric Products, Inc.
610	Nalco
611	Profamo Inc.
613	Newlands Systems, Inc.
700	Anderson Instrument Company, Inc.
701	3M Purification Inc.
702	Mettler-Toledo Ingold Inc.
703	Ashland Hercules Water Technologies
705	Siebel Institute/World Brewing Academy
707	White Lab/Frings America
708	Parker domnick hunter
709	Enzyme Development Corp.
710	Filtrox North America
711	Hach Company
712	Radiant Industrial Solutions, Inc.
713	Beckman Coulter, Inc.
800	Flottweg Separation Technology, Inc.
802	Diversey Inc.
804	Can Lines Engineering
805	Advanced Chromatography Systems
806	Tig-Pro Inc.
807	ChemTreat Inc.
808 & 810	Centec LLC
809	Wyeast Laboratories Inc.
811	Briess Malt & Ingredients Co.
812	Loeffler Chemical Corporation

Brewing Summit 2010 Exhibitor Descriptions

701 **3M Purification Inc.,** 400 Research Pkwy., Meriden, CT 06450; Telephone: +1.203.237.5541, Website: www.3Mpurification.com. 3M Purification Inc. (formerly CUNO) provides a wide range of filtration products for the brewing industry. Brewers rely on 3M Purification for clarification, sterile filtration, DE trap filtration, water filtration, and air and gas filtration. Featured products include Zeta Plus(TM) depth filter cartridge systems for clarification and significant reduction of spoilage yeast and bacteria.

805 **Advanced Chromatography Systems,** 1941 Savage Rd., Ste. 500 E&F, Charleston, SC 29407; Telephone: +1.843.559.4889, Fax: +1.843.559.4881, Website: www.advancedlcgcs.com. ACS is a manufacturer of specialty scientific instruments focusing on Fast Chromatography and High Sensitivity Detection. We provide one-of-a-kind liquid chromatography (LC) and gas chromatography (GC) systems. Our feature products are the 800 Series TEA Organic Nitrogen Detector for analysis of NDMA in malt, the 300 Series Fast GC with Automatic Column Installation, and the LC/FID which mixes LC and GC technologies creating a brand new detection technique. Other products include the EZ Flash II Fast GC Accessory and the 200 Series Compact GC which targets system customization for problem application areas that in the past did not have a solution. All products are manufactured at our locations in the United States and the United Kingdom.

501 **Albert Handtmann Armaturenfabrik GmbH & Co. KG,** Arthur-Handtmann-Strasse, 11, 88400 Biberach/Riss, Germany; Telephone: +49.7351.342.4542, Fax: +49.7351.342.4465, Website: www.handtmann.de. Handtmann Armaturenfabrik is a leading supplier of valves, fittings, and complete process equipment for the beverage industry. The deep-bed filter MultiMicroSystem for secure and economical sterile filtration of beer and the Combined Stabilizing System CSS for beer stabilization demonstrate Handtmann's innovative expertise in realizing new ideas for the benefit of the brewer.

105 **AFTEK, Inc.,** 710 Driving Park Ave., Ste. H, Rochester, NY 14613; Telephone: +1.585.458.7550, Fax: +1.585.458.7476, Website: www.aftekfilters.com. AFTEK is the leader in providing beer, CO_2, and water filtration solutions, while servicing the brewing industry. AFTEK represents the highest standards of products including Begerow (BECOPAD, the world's only mineral and DE free filter sheet), Alfa-LAVAL centrifuges, yeast propagation systems, heat transfer equipment, domnick hunter CO_2 polishers and chillers.

300 & 302 **Airborne Labs International,** 22C World's Fair Dr., Somerset, NJ 08873; Telephone: +1.732.302.1950, Fax: +1.732.302.3035, Website: www.airbornelabs.com. We provide certified CO_2 purity lab-testing services, rugged, turn-key CO_2 purity monitoring systems, technical training, R&M support, discount supplies and quality solutions to the international brewing industry. Our services and products allow brewers to quickly check the quality of a CO_2 delivery, identify odors and determine the purity of captured/re-purified CO_2 intended for in-house use or outside ISBT-grade sale. We offer convenient No-Haz sampling kits for easy shipping and rapid testing of your gaseous samples. Our versatile analyzer systems are used at both large and small brewing facilities and are designed to meet your specific requirements and budget.

609 **American Tartaric Products, Inc.,** 1865 Palmer Ave., Larchmont, NY 10538; Telephone: +1.914.834.1881 or +1.815.357.1778, Fax: +1.815.357.6221, Website: www.americantartaric.com. ATP is the largest supplier to the wine industry and is proud to present a range of products to the brewing industry. Our product range includes brewing process aids, anti-foams, clarifiers, filtration aids, stabilizers, filter sheets, cartridges, filtration equipment, pasteurizers, packaging equipment, and analytical equipment. ATP represents well respected and established companies such as Alfatek, Begerow, Birko, EP Minerals, Hanna, ISP, Nirva-MecSens, and Padovan and Seital.

700 **Anderson Instrument Company, Inc.,** 156 Avriesville Rd., Fultonville, NY 08873; Telephone: 1.800.803.0081, Fax: +1.518.922.8907, Website: www.andinst.com. The Anderson Instrument Company operates in the U.S. market as Anderson Instrument and in Europe as Negele Messtechnik. Together the companies offer a full line of sanitary process instrumentation. Negele maintains an excellent reputation in the brewery market in Europe and has created a presence in the U.S. by way of importation of brewing equipment. Together these companies have a portfolio including temperature, level, pressure, flow, conductivity, and turbidity sensors. Both branches of this company grew up in the sanitary market and play true to their roots offering products designed to survive in the demanding food, beverage, and pharmaceutical industries.

402 **Anton Paar USA,** 10215 Timber Ridge Dr., Ashland, VA 23005; Telephone: +1.804.550.1051, Fax: +1.804.550.1057, Website: www.anton-paar.com. Ensuring the highest quality in production is the number one priority of beer manufacturers around the world. This can be achieved by combining laboratory testing and monitoring the beer directly in the production line. Visit booth #402 to learn about comprehensive solutions for beer analysis in the laboratory and for direct monitoring of beer in the main line offered by Anton Paar. All systems are designed and built with an emphasis on high precision and ease of use. For more information, visit the Anton Paar website: www.anton-paar.com.

703 **Ashland Hercules Water Technologies,** 1313 N. Market St., Wilmington, DE 19894; Telephone: +1.302.594.5000, Fax: +1.302.594.6890, Website: www.ashland.com. Ashland Hercules Water Technologies, a commercial unit of Ashland Inc., is a leading specialty chemical supplier to a number of the world's most essential industries. The chemistries offered are used by customers to improve their operational efficiencies, to enhance the quality of their products, to protect their plant assets, and to minimize their impact on the environment. For the brewing industry, Ashland offers a variety of technologies for influent, boiler water, cooling water, wastewater, and pasteurization applications. These technologies include biocides, coagulants, corrosion inhibitors, defoamers, deposit control agents, flocculants, membrane treatments, metal passivators, odor inhibitors, oxygen scavengers, scale inhibitors, and sludge dewatering polymers.

608 **Astoria-Pacific International,** PO Box 930, Clackamas, OK 97015; Telephone: 1.800.536.3111, Fax: +1.503.655.7367, Website: www.astoria-pacific.com. Astoria Pacific was established in 1990 with the purpose of maximizing laboratory

and production efficiency by offering automated analysis solutions. We are an American company that designs, produces, markets and services analytical instrumentation and reagents to automate analytical chemistries. Our Astoria® and Astoria®2 flow analyzers and Astoria® Discrete analyzer rapidly and accurately measure alpha amylase, beta glucans, bitterness, diastatic power, diacetyl, free amino nitrogen, polyphenols, proteins (e.g., BSA) and more in beer and malt production processes.

713 **Beckman Coulter, Inc.,** 250 S. Kraemer Blvd., Brea, CA 92821; Telephone: +1.714.961.3270, Fax: +1.714.961.3111, Website: www.beckmancoulter.com. Beckman Coulter develops, manufactures and markets products that simplify, automate and innovate complex biomedical testing. Scientists use our life science research instruments to study complex biological problems including causes of disease and potential new therapies or drugs.

210 **Brau Welt (Fachrenlac Hanscarl),** Ander Nacher Str. 33.9, Germany, 90411; Telephone: +49 0 911 952 85 0, Website: www.brauwelt.de & www.hanscarl.com. The specialist publisher Hans Carl has been working in and for the beverage and brewing industry since 1861 with a total of seven trade journals, customer publications and a range of specialist books. The trade periodicals *Brauwelt* and *Brauwelt International* belong to the world's leading journals in this sector. The online archives provide information about everything concerning beer production, non-alcoholic beverages and the development of the international market. The scientific journal *BrewingScience* provides an insight into the latest trends of research completing at highest level the publisher's portfolio. More detailed information is available under: www.brauweltinternational.com, www.brauwelt.de and www.brewingscience.de.

811 **Briess Malt & Ingredients Co.,** 625 S. Irish Rd., PO Box 229, Chilton, WI 53014; Telephone: +1.920.849.7711, Fax: +1.920.849.4277, Website, www.brewingwithbriess.com. Brew consistently great beer with consistently high quality malts from Briess. Made fresh in the U.S.A., Briess malts are carefully handcrafted using specialized equipment to develop exceptional flavors and aromas. And because Briess produces more styles of malts than any malting company in the world, you can streamline ordering and receiving by purchasing all of your malt, malt extracts, and brewers flakes from Briess. Staffed by veteran maltsters, brewers, microbiologists, and agronomists, Briess offers unparalleled support and service to help you brew more efficiently and solve malt handling and brewhouse challenges that may arise. Certified organic since 1990. Family owned since 1876.

201 & 203 **Briggs of Burton,** 400 Airpark Dr., Ste. 40, Rochester, NY 14624; Telephone: +1.585.426.2460, Fax: +1.585.426.0250, Website: briggsplc.com.uk. Briggs are experienced process engineers, operating in the brewing and distilling sector since 1732 and responsible for some of the most high-profile work of the last decade. This includes the most recent large-scale brewhouse in North America, a near doubling of capacity at Diageo's largest grain spirit distillery, the world's first demonstration-scale lignocellulosic ethanol facility and a brewhouse for Carlton United in Brisbane, Australia, where CUB still claim the world benchmark for water efficiency. Briggs now have eyes set firmly on the future, with a highly developed suite of process engineering tools in the Briggs A Frame toolbox.

507 **Buhler Inc.,** 13105 12th Ave N., Plymouth, MN 55441; Telephone: +1.763.847.9900, Fax: +1.763.847.9911; Website: buhlergroup.com. As the world's leading provider of technology to the grain processing industry, Buhler is able to offer customized solutions for optimal raw material processing and to support you with every step of grist production. We offer solutions from malt and grain intake, grain storage, transport, cleaning and classification, through to preparation of grain by peeling and color sorting, right up to individual grinding of malt and other grain-based raw materials. The proven quality of Buhler's roller and hammer mills ensures that the product is ground evenly and to precisely the correct size for the specific type of grain.

511 **Butterworth, Inc.,** 16737 W. Hardy Rd., Houston, TX 77060; Telephone: +1.281.821.7300, Fax: +1.281.821.5550, Website: www.butterworth.com. For over 85 years, Butterworth has engineered and manufactured automated tank cleaning devices for all types of tanks and process vessels in a variety of industries with one goal in mind, remove workers from the inside of the tank. Today, we sell, rent and lease machines and complete systems for any application in vessels from 5 gallons up to 10,000,000 gallons. Please visit www.butterworth.com.

804 **Can Lines Engineering,** N922 Tower View Dr., Ste. 100, Greenville, WI 54942; Telephone: +1.920.757.6795, Fax: +1.920.757.8817, Website: www.canlines.com. Can Lines Engineering (CLE™) specializes in designing and modifying brewery lines since 1960. We manufacture custom-designed bottle and can conveyors to run any can size at any line speed along with case-and-palletize conveyors. We work with customers like MillerCoors, Anheuser-Busch, and Genesee Brewery, along with many craft breweries throughout North America. We also locate new and used packaging equipment to assist our customers in line completion. We carry a line of pasteurizers, coolers and warmers that are competitively priced and are built extremely robust to last for decades. We look forward to seeing you at the show.

510 **Cargill,** 15407 McGinty Rd. W., Wayzata, MN 55391; Sweeteners - Telephone: +1.937.237.1236, Fax: +1.937.237.2529; Malt - Telephone: +1.742.742.4066, Fax: +1.952.742.5050; Flavor Systems – Telephone: 1.800.234.2539, Fax: +1.513.771.8748; Website: www.cargill.com. Let Cargill help you create great beverages for your customers. As the leading provider of quality ingredients, services, and innovative solutions to the worldwide brewing industry, Cargill's team can help you drive product innovation and optimize costs to support your growth goals for business success. Count on us to bring you the world's most complete line of brewing ingredients including: adjuncts, sorghum syrup, organic glucose syrup, pale and specialty malts, and flavors. To learn more about how Cargill can help you succeed, we invite you to call us or stop our booth at Brewing Summit 2010.

808 & 810 **Centec LLC,** PO Box 820, Germantown, WI 53022; Telephone: +1.262.251.8209, Fax: +1.262.251.8376, Website: www.centec-usa.com.

807 **ChemTreat, Inc.,** 4301 Dominion Blvd., Glen Allen, VA 23060; Telephone: +1.804.935.2000, Fax: +1.804.965.6974, Website: www.chemtreat.com. ChemTreat, Inc., a specialty chemical company, manufactures industrial water treatment products that include influent clarification products and waste treatment polymers. The company offers cooling water and

boiler water products, as well as pretreatment services, boiler water services, cooling water services, influent/effluent water services, odor control services, air stripper treatment, customer service laboratory, automation control and monitoring, and automation programs. It also provides services for pretreatment equipment selection and sizing calculations; boiler and cooling system operations and equipment troubleshooting; chemical treatment product selection and product feed calculations; chemical control, product feed, and control system instrumentation; regulatory and environmental issues; and field training and operator seminars on various aspects of water treatment. The company offers its services for industries including automotive, cogeneration, brewery, food, electronics, glass, utility, textile, chemical, and primary metals. It has operations in North America, South America, the Caribbean, and the Asia/Pacific. The company was founded in 1968 and is headquartered in Glen Allen, Virginia. As of July 2, 2007, ChemTreat, Inc. is a subsidiary of Danaher Corp.

802 **Diversey Inc.,** 8310 16th Street, Sturtevant, WI 53177-0902; Telephone: +1.262.631.4001, Website: www.diversey.com. Diversey Inc. is a global cleaning and sanitation company with over 20,000 associates in more than 60 countries serving the brewing industry. Diversey Inc. is involved with technology and engineering expertise that meets and exceeds the hygiene standards of today's brewing business. This results in a better looking and better tasting product, while reducing water, energy, and environmental impact.

401 **DSM Food Specialties USA, Inc.,** 45 Waterview Blvd., Parsippany, NJ 07054; Telephone: +1.973.257.8372, Fax: +1.973.257.3248, Website: www.dsm.com. DSM supplies breakthrough concepts that create value for the brewing industry. These innovative solutions endow brewers around the world with efficient, simple, and cost-effective processes for beer stabilization with Brewers Clarex™; optimized brewing processes providing substantial cost-reduction opportunities; enhanced beer quality (consistency) while processing raw materials of variable quality; increased brewhouse efficiency; and higher productivity. DSM's R&D Department works closely with leading brewing institutes, innovative equipment suppliers, and R&D departments of major international brewing groups to shape the future beer industry.

410 **Ecolab,** 370 Wabasha St. N., St. Paul, MN 55102; Telephone: 1.800.392.3392, Fax: +1.651.293.2260, Website: www.ecolab.com. As the leading global provider of sanitation products and systems to the brewing industry, the Ecolab team helps implement and maintain practical solutions to aid customers in producing safer, high-quality products, continuously improving operational efficiency, and enhancing environmental stewardship through best-in-class sustainability programs, including proprietary cleaners and sanitizers, conveyor lubrication programs that include dry lubrication, custom-engineered CIP systems and controls, water and energy management systems and services, effluent management, water reclamation, renewable energy production, and pest-elimination services.

110 **EMD Chemicals Inc.,** 480 S. Democrat Road, Gibbstown, NJ 08027; Telephone: +1.856.599.6694, Fax: 1.800.599.6763, Website: www.emdchemicals.com. EMD Chemicals represents the North American chemical sector of Merck KGaA, Darmstadt, Germany. EMD Chemicals is featuring Real Time PCR (RT PCR) based rapid pathogen detection kits in addition to their impressive line of microbiology products. All Foodproof® pathogen detection kits are probe-based molecular tests that are designed to amplify sequence specific DNA targets allowing both real time visualization and confirmation of presence or absence of target organism within 60–90 minutes. Foodproof® pathogen detection kits offer a clear advantage of both specificity and speed when it comes to detection of beer spoilage organisms.

212 **EMG International,** PO Box 1600, Media, PA 19053-1600; Telephone: +1.484.444.0400, Fax: +1.610.565.6465, Website: emgint.com. EMG International and Pizzagalli Construction have partnered to provide clients with efficient waste stream treatment and renewable energy. Together, they provide an integrated, full-service engineering and construction solution. EMG's innovative technology, combined with Pizzagalli's extensive construction experience in the industrial market, provide the knowledge, technology, and tools to meet the waste stream treatment needs of the brewing industry. The efficient, compact, cost-effective system reduces costs and produces energy while ensuring compliance with environmental permits and regulations.

111 **Endress+Hauser Inc.,** 2350 Endress Place, Greenwood, IN 46143; Telephone: +1.317.535.2134, Website: www.us.endress.com/foodinfo. Endress+Hauser is a privately owned manufacturer of instrumentation and automation solutions. See us for support on energy conservation, beer loss reduction and calibration services. Our products include flow level, pressure temperature, Plato, liquid analysis and optical transition monitoring.

709 **Enzyme Development Corp.,** 360 W. 31st St., Ste. 1102, New York, NY 10001-2727; Telephone: +1.212.736.1580, Fax: +1.212.279.0056, Website: www.enzymedevelopment.com. Enzyme Development Corporation has been serving the needs of enzyme users since 1953. Team members are stationed across the country with the head office in New York City and primary production in Scranton, PA. Our people provide technical analysis to help you select the best options. Whether you need multiple truckloads or only a few kilograms, the care, the attention and the commitment are the same. We offer a full range of enzyme solutions for enhanced brewing performance.

503 **Esau & Hueber GmbH,** Kapellenweg 10, Schobenhausen, Germany 86529; Telephone: +49 8252 898533, Fax: +49 8252 898515, Website: esau-hueber.de. ESAU & HUEBER supplies a large range of special systems and services to the brewing industry. TURBO AIR JETS are accepted as best practice installations exceeding 800 units worldwide either for wort aeration and oxygenation, carbonation or nitrification. FLEXIPROP yeast management systems combine the benefits of yeast propagation and revitalization in one plant layout. The TURBO AIR yeast aerator within the external circulation loop is the key to more cells in a shorter time than any other system.

411 **EUWA Water Treatment Plants,** Daimlestrasse 2-10, Gartringeo, Germany 71116; Telephone: +49 7034 27539, Fax: +49 7034 27590; Website: www.euwa.com. EUWA is the leading specialist in the field of brew water treatment and looks back to more than 40 years of experience. We offer our customer tailor-made solutions around water treatment, which include all modern membrane applications like reverse osmosis, ultrafiltration and membrane deaeration systems as well as the classical treatment methods such as lime

precipitation, ion exchange, sand and activated carbon filters and disinfection. High emphasis is put on the development of in-house technology in water saving, consulting and water recycling, which are often protected by patents. EUWA plants are used in more than 90 countries on 5 continents.

710 **Filtrox North America,** 9805 NE 116th St., A-200, Kirkland, WA 98034; Telephone: +1.425.820.4850, Fax: +1.425.820.2816, Website: www.filtrox.com. Stop by our booth and talk to a filtration expert! FILTROX—a leading manufacturer of depth filter media and equipment; a tradition of more than 70 years! We provide solutions for your challenges in filtration. Our product range comprises FIBRAFIX® filter pads, FILTRODISC® lenticular modules, as well as the appropriate sheet filters (NOVOX®), and housings (DISCSTAR®) in all dimensions.

800 **Flottweg Separation Technology, Inc.,** 10700 Toebben Dr., Independence, KY 41051; Telephone: +1.859.448.2300, Fax: +1.859.448.2333, Website: www.flottweg.com. Headquartered in Vilsbiburg, Germany, near Munich, Flottweg specializes in manufacturing a wide range of separation equipment. As a Bavarian company, Flottweg strives to deliver its very best quality products to the brewing industry to ensure high quality beer production. Its portfolio includes sedicanters for beer recovery from spent yeast, high-speed separators for green beer clarification and beer pre-Kieselghur clarification, decanters for hot wort separation from trub and belt presses for spent grain dewatering for combustion. Flottweg has subsidiaries and branch offices worldwide. Its North American headquarters are located in the greater Cincinnati metro area.

602 **GEA Brewery Systems,** 1600 O'Keefe Rd., Hudson, WI 54016; Telephone: +1.715.386.9371, Fax: +1.715.386.9376, Website: www.gea-brewery.com. GEA Brewery Systems provides brewery technology from a single source. We develop innovative solutions that are specifically tailored to your specific requirements. We supply individual process units, complete brew houses and cellars, process automation and utilities, training and consulting as well as complete turnkey plants. For many years, many international brewing groups, large breweries and also many medium-sized breweries have been relying on our know-how and comprehensive service. Now we have expanded our scope of supply to include complete craft brewing solutions. The competence and technology of GEA Brewery Systems have always been the basis for the production of great beers.

600 **GEA Tuchenhagen North America,** 90 Evergreen Dr., Portland, ME 04103; Telephone: +1.207.797.9500, Website: www.tuchenhagen.us. GEA Tuchenhagen is a global leader in the manufacture of a wide range of sanitary flow components, including mixproof, single-seat, divert, modulating, butterfly, pressure relief and sample valves, valve control technology, inline instrumentation, cleaning devices, vessel protection and cleaning systems, and the innovative and cost-effective ECO-MATRIX® piping system. We also offer services for manifold design and application concept development, after-sales service and support. For our customers' convenience, in partnership with our nationwide distribution network, spare parts are available overnight or same day to any location in the U.S. and Canada.

604 **GEA Westfalia Separator,** 100 Fairway Court, Northvale, NJ 07647; Telephone: +1.201.767.3900, Fax: +1.201.767.3416, Website: www.wsus.com. GEA Westfalia Separator is a leading manufacturer and distributor of high-quality centrifuges and ceramic membranes for a wide variety of applications within the beverage industry. The company also offers PROFI®, a DE-free technology that combines centrifugal separation with membrane filtration for use in beer production. With full-service repair facilities on the East and West Coasts, GEA Westfalia Separator offers a complete maintenance, testing, engineering, training, repair and spare parts capability. The company has been manufacturing centrifuges since 1893.

303 **GF Piping,** 2882 Dow Ave., Tustin, CA 92780-7258; Telephone: +1.714. 368.4112, Fax: +1.714.368.4113, Website: www.gfpiping.com. COOL-FIT® ABS Plus is a complete pre-insulated plastic piping system for glycol and secondary cooling piping systems. The system is based on GF Piping Systems' COOL-FIT ABS piping system, which contains pipe, fittings, valves, and transition fittings. It is UV resistant, vapor-tight and 100% water-tight. The top-quality energy-efficient system requires minimum installation time. This piping system is maintenance-free with a life span of 25+ years. It is also very environmentally friendly; a TEWI report is available on request. Installation training is provided free of charge. COOL-FIT® comes with a full range of actuated valves, measurement and instrumentation.

109 **GKD-USA Inc.,** 825 Chesapeake Dr., Cambridge, MD 21613; Telephone: +1.410.221.0542, Fax: +1.221.0544, Website: www.gkdusa.com. For over 75 years, GKD has enjoyed a reputation for precision weaving and extensive knowledge of industrial filtration processes. Our filter media, woven on our innovative looms, allows us to produce the highest quality filter cloth available on the market. These same quality and superior standards apply to the design and fabrication of our NeverLeak® filter leaf, developed to clearly out-perform ordinary filter leaves. The NeverLeak pressure filter leaves provide dependable filtration for industrial process of beer/malt beverage, juice, and wine/spirits; edible oils and other foods; and chemicals and pharmaceuticals.

305 & 307 **Gusmer Enterprises,** 1165 Globe Ave., Mountainside, NJ 07092-2903; Telephone: +1.715.258.5525, Fax: +1.715.258.8488, Website: www.gusmerbeer.com. For 86 years, Gusmer has taken a revolutionary approach to serving the brewer's vision. It's why we have developed our extensive R&D and Application Support Labs, offer the most advanced products, and provide a ready resource for problem-solving. Gusmer manufactured goods are skillfully developed, made in the U.S., and created from the highest quality raw materials. We also distribute a variety of carefully selected, high-quality products from superior suppliers. Gusmer team members possess actual brewing experience and can match specific products to the needs of your brewery. Gusmer has what you need for your brewery.

711 **Hach Company,** PO Box 389, Loveland, CO 80539-0389; Telephone: 1.800.227.4224, Fax: +1.970.609.2932; Website: www.hach.com. Hach Company provides the most comprehensive portfolio of analytical solutions to ensure water and product quality. We design, manufacture, and distribute reagents, test kits, and instrumentation for testing water and product quality in a variety of brewery applications including incoming water, fermentation, maturation, packaging, and

effluent water treatment. Our products cover a wide variety of parameters including dissolved oxygen, carbon dioxide, nitrogen, chlorine, turbidity, organics, and microbiology. They can be used in-line or in the lab, from spectrophotometry to complete package analysis. Convenient on-site service contracts available.

309 **IBD Trading,** 33 Clarges St., London, United Kingdom, W1J7EE; Telephone: +44 0 20 7499 8144, Fax: +44 0 20 7499 1156, Website: www.ibd.org.uk. The Institute of Brewing & Distilling (IBD) is a members' organisation and registered educational charity. The IBD's Vision Statement is: "The advancement of education and professional development in the science and technology of brewing, distilling and related industries." The IBD is a leading global provider of professional qualifications. It also produces two highly respected publications—*Journal of the Institute of Brewing* and *The Brewer & Distiller International.*

312 **INVISTA,** One Lake Point Plaza, 4th Fl., 4235 S. Stream Blvd., Charlotte, NC 28217; Telephone: 1.888-6INVISTA, Fax: +1.704.586.7564, Website: www.INVISTA.com & polyshield@INVISTA.com. PolyShield® resin monolayer PET barrier technology was designed for shelf life and barrier requirements of oxygen-sensitive food and beverages, including beer. PolyShield® resin prevents oxidation of the product, which can affect taste, and provides more than one year of shelf life. This resin features oxygen scavenging and passive carbonation barrier when combined with MXD6 and provides outstanding clarity for tinted bottles. PolyShield® resin-MXD6 blends can be processed on standard PET manufacturing equipment with only minor changes and minimal investment. INVISTA is one of the world's largest integrated producers of polymers and fibers, primarily for nylon, spandex and polyester applications.

601 **Kagetec,** 309 Elm Ave. SW, Montgomery, MN 56069-1233; Telephone: +1.612.298.8838, Fax: +1.612.435.7643, Website: www.kagetecusa.com. Kagetec is the world leader in chemical-resistant, hygienic, industrial flooring systems consisting of slip-resistant tile and integrated stainless steel drains. We have more than 20 years of experience in the brewing industry and take pride in maintaining the highest quality floors by performing the installation ourselves.

403 **Krones,** 9600 S. 58th St., Franklin, WI 53132; Telephone: +1.414.409.4000, Fax: +1.414.409.4100, Website:www.krones.com. Krones will feature its brewing process systems technology, which covers all aspects of brewing, from malt intake to filtered beer, including brewhouse and filter plants, as well as fermentation and storage cellars. ShakesBeer, Pegasus, Stromboli, Merlin, Whirlpool Calypso, Twin Flow System filters, and beer flash pasteurization rank among their best-known brewing innovations.

107 **Lallemand Brewing/Ethanol Technology,** 6120 W. Douglas Ave., Milwaukee, WI 53218; Telephone: +1.702.481.8735, Website: lallemandbrewing.com. Lallemand Brewing specializes in dry yeast and nutrients. Dry yeast represents an alternative to liquid yeast not only for primary fermentation but also for bottle conditioning. Four strains are available in dry form: Nottingham Ale Yeast, Windsor British Type Beer Yeast, Munich Wheat Beer Yeast and Diamond Lager Yeast. All can be reused and/or propagated. Dry yeast offers the advantage of flexibility, long shelf-life and easy storage/shipping. Nutrition products include complete nutrients mix and the zinc-enriched yeast Servomyces recommended for propagation, high-gravity brews and serially repitched yeast.

505 **LECO Corporation,** 3000 Lakeview Ave., St. Joseph, MI 49085; Telephone: 1.800.292.6141 or +1.269.983.5531, Website: www.leco.com. For over 70 years, industries around the world have trusted LECO to deliver technologically advanced products and solutions for analytical science. Today's technologies for separation science resolve complex samples and pioneer high sample throughput using GCxGC, GCxGC-TOFMS, and GC-TOFMS. A unique combination of easy-to-use software and advanced instrumentation provides an innovative solution for today's most demanding applications, including food and beverage quality, and flavor/fragrance, environmental, and metabolomics.

812 **Loeffler Chemical Corporation,** 5700 Busknell Dr., Atlanta, GA 30336; Telephone: +1.404.629.0999, Fax: +1.404.629.0650, Website: www.loefflerchemical.com. The Loeffler Chemical Corporation offers a complete line of cleaning and sanitizing products for all brewery applications, including caustic and acid CIP and foam cleaners, line lubricants, specialty products as well as sanitizers and disinfectants. We manufacture customized industrial-grade chemical automation equipment for a wide variety of applications including, but not limited to, chemical dosing and monitoring, CIP, water treatment and bottle washing. Loeffler also offers a line of specialty enzymes for brewing applications and the only chemical/mechanical beerline cleaning system currently available in the United States.

702 **Mettler-Toledo Ingold Inc.,** 36 Middlesex Turnpike, Bedford, MA 01730; Telephone: +1.781.301.8802, Fax: +1.781.271.0681, Website: www.mt.com. Mettler-Toledo Ingold, Inc. is the leading producer of in-line process analytics worldwide. We offer innovative and unique solutions in pH, dissolved oxygen, gaseous oxygen, conductivity, and turbidity measurements. Please join us to learn more about our "whole loop ownership" concept, long-life electrodes, and fully automated cleaning and calibration systems.

103 **MIOX Corporation,** 5601 Balloon Fiesta Pkwy. NE, Albuquerque, NM 87113; Telephone: +1.505.343.0090, Fax: +1.505.343.0093, Website: www.miox.com. The Vault™ uses an efficient and cost-effective clean-in-place (CIP) technology for cleaning the interior surfaces of beverage production equipment without disassembly, reducing production downtime and increasing plant efficiency. The self-cleaning Vault uses only salt, water, and power to safely generate a dilute chlorine-based solution on-site, on demand. The environmentally benign and single component solution replaces 4- and 5-step CIP processes with a rapid, non-thermal, 3-step process consisting of rinse, treatment, and final rinse.

113 **Munktell Inc.,** 7517 Precision Dr., Ste. 112, Raleigh, NC 27617; Telephone: +1.919.226.0752, Fax: +1.919.226.0758, Website: www.munktell. Munktell was founded in 1815 as the first company ever to manufacture analytical filter paper and today we are one of the world-leading companies within macro filtration. Headquartered in Falun, Sweden, we have a global presence with subsidiaries in Germany and the USA. We offer pleated/flat filter papers, membranes, syringe filters, and other types of specialized filtration products for the brewery industry. Munktell is ISO 9000 certified and our products are manufactured according to MEBAK and EBC standards.

610 **Nalco,** 1601 W. Diehl Rd., Naperville, IL 60563; Telephone: +1.630.305.2947 or +1.630.305.1239, Fax: +1.630.305.1239 or +1.603.305.2947, Website: www.nalco.com. Nalco is the world's leading water treatment and process improvement company, delivering significant environmental, social and economic performance benefits to our customers. Our brewing team is the leader in water and energy management. Only Nalco brings you the technologies that will DETECT system conditions, automatically DETERMINE appropriate response and DELIVER unprecedented water and energy savings while protecting your equipment assets: 3D TRASAR® technology for cooling water, 3D TRASAR technology for boilers, 3D TRASAR technology for reverse osmosis, 3D TRASAR technology for pasteurizers. Ask us about our process programs for breweries: the Nalco yeast activity monitor consistently measures metabolic activity rates in under 3 minutes.

613 **Newlands Systems, Inc.,** 602 - 30731 Simpson Rd., Abbotsford, British Columbia, Canada, V2T 6Y7; Telephone: 1.877.855.4890, Fax: +1.604.850.7909, Website: www.nsibrew.com. Over the last 23 years, Newlands has distinguished itself as being the premiere brewing equipment supplier in North America. Through the use of state-of-the-art technologies in design, engineering, and fabrication, Newlands creates highly innovative and expertly crafted products. Providing a comprehensive array of products and services, including everything from project conception through installation and commissioning, Newlands is your single source for brewing expertise. A true world-class manufacturer, utilizing an ISO:9001 and ASME certified facility, Newlands produces complete systems ranging in size from 2-barrel pilot breweries up to large-scale regional breweries.

209 **Nexcelom Bioscience,** 360 Merrimack St., #9, Lawrence, MA 01843; Telephone: +1.978.327.5340, Fax: +1.978.327.5341, Website: www.nexcelom.com. Nexcelom is a leading manufacturer of automated cell counting and analysis equipment. Their Cellometer line of simple-to-use cell counters is designed to automate manual cell counting and analysis by obtaining accurate concentration, viability, and cell sizes of yeast. The system also automates sample tracking and data capture. Cellometer easily integrates into existing manual counting work flows, with the potential to increase sample throughput and leading to more consistent fermentation. Please stop by our booth to learn more or visit www.nexcelom.com.

204 **Norit Haffmans,** 1330 Anvil Dr., Rockford, IL 61115; Telephone: +1.815.639.0322, Website: www.haffmans.nl. Norit Haffmans is a leading supplier of total CO_2 and O_2 management systems, offering a wide range of quality control equipment, water deaeration systems, and blending and carbonation units. Norit Haffmans' quality control equipment measures CO_2, O_2, foam, and turbidity and monitors pasteurization. As your O_2 management measuring specialist, Norit Haffmans measures O_2 from wort production through filling, allowing you to track this important measuring point through the process. Norit Haffmans' CO_2 recovery technology, including brewery-type CO_2 recovery plants, liquid CO_2-stripping systems, and LiquiVap, the energy-efficient heat recovery system, allows you to recover CO_2 from fermentation sources.

301 **optek-Danulat, Inc.,** N118 W 18748 Brusen Dr, Germantown, WI 53022; Telephone: 1.800.371.4288, Fax: +1.262.437.3682, Website: www.optek.com. Optek's process control instrumentation provides advanced and precise inline analysis of product color, turbidity, haze, and constituent concentration for real-time results. Our inline UV-VIS-NIR absorption-based photometers, insertion probes, and scattered-light turbidity meters monitor and control fermentation, filtration, separation, yeast pitching, wort color and clarity, DE and PVPP dosing, sanitizer concentrations and more. In addition, optek recently introduced the Haze Control series of dual-angle lab and process turbidity meters for QA/QC, as well as NIST calibration solution standards. Optek helps brewers achieve uninterrupted processing for the best possible product with reduced product loss, improved profitability, and greater efficiency—from line to lab.

500 **Pall Corporation,** 25 Harbor Park Dr., Port Washington, NY 11050; Telephone: +1.516.484.3600 or 1.866.905.7255, Fax +1.516.801.9711, Website: www.pall.com. For the food and beverage industries, Pall Corporation has developed filtration and advanced filtration systems that meet market needs for reliability and cost effectiveness. Easy to install and simple to use, the space-saving systems satisfy a wide variety of filtration requirements. Pall filters remove particulate contamination, ensure the absence of spoilage microorganisms and provide high-quality air and gases. Membrane processes can additionally concentrate products without heat, purify and clarify, selectively remove components, and deal with process effluent.

708 **Parker domnick hunter,** 5900 Northwoods Pkwy., Ste. B, Charlotte, NC 28269-3738; Telephone: +1.704.921.9303, Fax: +1.704.921.1960, Website: www.domnickhunter.com. Parker domnick hunter & Parker's Process Advanced Filtration Division are supported by innovative products, state-of-the-art technical facilities and a specialized international team. Our capability is based on understanding the specific needs of your business and providing total system solutions. We offer CO_2 polishers for both plant-scale and retail dispense applications, nitrogen gas generators, process water chillers, compressed air treatment plus a full line of filtration products which assist beverage processors in achieving the characteristics consumers demand—clear, sparkling products free of spoilage organisms and other contaminants.

106 **PerkinElmer,** 710 Bridgeport Ave., Shelton, CT 06484; Telephone: 1.800.762.4000, Website: www.perkinelmer.com. PerkinElmer is a global scientific leader providing an extensive range of technology solutions and services to address the most critical issues facing humanity. From critical research and prenatal screening to environmental testing and industrial monitoring, we're actively engaged in improving health and enhancing quality of life all around the world. PerkinElmer's proud history dates back to the 1930s. Our legacy of scientific advancement, operational excellence and continual expansion, from Boston to Beijing, is the foundation of our mission to improve human and environmental health. Collaborating with customers to identify risks, discover and monitor the things that matter most—from safer drinking water to cleaner air, faster research to healthier babies—is imperative to executing our mission. Encouraging ingenuity and exploration, integrity and generosity, and teamwork and employee development is essential to living our mission, every day.

606 **PQ Corporation,** PO Box 840, Valley Forge, PA 19482-0840; Telephone: +1.610.651.4200 or 1.800.944.7411, Fax: +1.610.251.5249, Website: www.pqcorp.com. PQ's BRITESORB® silica gels meet the needs of brewers the world

over and provide selective chillproofing performance with excellent filtration characteristics. The gels remove only the proteins that cause chill-haze, not those that stabilize foam. BRITESORB® beer stabilizers are manufactured in PQ's state-of-the-art production facilities to meet all regulatory requirements for food-grade silica and maintain consistent high quality and performance batch after batch, order after order. PQ BRITESORB® beer stabilizers: the clear choice for world-class beer.

611 **Profamo Inc.,** 7506 Albert Tillinghast Dr., Sarasota, FL 34240-8688; Telephone: +1.941.379.8155, Fax: +1.941.379.8699, Website: www.profamo.com. Profamo Inc. is pleased to present at Brewing Summit 2010 the (Nirva) MecSens line of equipment, which includes their package analyzer for true TPO and CO_2 measurement as well as their wireless, in-line and portable DO meters. The MecSens units can be used in conjunction with the Headmaster dissolved oxygen and CO_2 calibrator which will also be displayed. Also on the booth will be the Advanced Instrument's CO_2 purity analyzer; Rotech's keg racker monitoring system and Pfeuffer Sortimat and Tannometer.

311 **ProLeiT AG,** Einsteinstr. 8, 91074 Herzogenaurach, Germany, Telephone: +49 9132 777 100, Fax: +49 9132 777 150, Website: www.proleit.com. ProLeiT provides process control engineering and MES solutions for the process industry. Based on well-founded, industrial process know-how for breweries the complete range of the automation and information engineering from the field level through to the enterprise management level is covered. The preparation of design and functional specifications, the development of user software, including the commissioning, training, service and support belongs to our delivery spectrum for turn-key automation solutions. The technical basis is the in-house developed technology-oriented Plant iT process control system. Plant iT is marketed under the trade name brewmaxx for use in breweries.

408 **PureMalt Products,** Victoria Bridge, Haddington, East Lothian, United Kingdom, EH41 4BD; Telephone: +44 162082 4696, Fax: +44 1620828 667, Website: www.puremalt.com. PureMalt Products Limited is the world leader in new specialty malt ingredients for the brewing industry. PureMalt Products Limited produces refined malt extracts of pale malt, crystal malt and roasted malt suitable for late addition to beer. The ZAB range offers solutions for blending of non-alcoholic and low-alcohol beers and malt beverages. A new product is aimed at increasing the drinkability of reduced-alcohol or reduced-calorie beers and beverages.

213 **Pursuit Dynamics, Inc.,** 101 Merritt 7, Norwalk, CT 06851; Telephone: +1.203.286.0608, Fax: +1203.286.0601, Website: www.pdx.biz. The PDX® wort heater represents the latest in energy-saving technology being introduced to the brewing market. Key PDX® wort heater benefits include: quality profiles maintained—quality profiles such as SMM, DMS, hop isomerization and flavor are easily maintained; up to 50% reduction in energy use—energy savings during the wort heat up and boiling cycle; reduced cleaning times—no hot spots or no burn on, resulting in significantly reduced cleaning times; accelerated cycle times—no hot spots or burn on, thus no insulating layer of wort build up resulting in a more efficient thermal transfer.

712 **Radiant Industrial Solutions, Inc.,** 10801 Kempwood Dr., Ste. 1, Houston, TX 77043; Telephone: +1.713.972.0196, Fax: +1.832.248.4229, www.radiantuv.com. Radiant Industrial is the premier food and beverage disinfection provider specializing in air, surface, and water applications. Radiant provides contamination control through disinfection products specific to the F&B environment. Radiant products are designed to provide safety process controls and contamination removal that are measured, controlled, and reported. Products range from standard to custom equipment. Disinfection levels range from 1 to 9 log reduction. Radiant provides ultraviolet water systems meeting current and forthcoming regulations, as well as ultraviolet air treatment for product safety, consumer confidence, and documented contamination control. Surface disinfection provided by Radiant is specific to each application ranging from standard bottle caps to product surface disinfection. Radiant offers equipment for harsh environments including extreme temperatures from sub-zero to high heat; high volatility, to standard F&B wash down environments. From application design to process/product service, Radiant is your partner in the beverage industry for disinfection solutions.

310 **Rochester Midland Corp.,** 333 Hollenbeck St,, Rochester, NY 14621; Telephone: +1.585.336.2200, Website: www.rochestermidland.com. Rochester Midland Corporation provides a HAACP-based food safety program that offers sanitation solutions to food and beverage manufacturers across all aspects of brewing from fermenters to fillers. Our BrandGuard Program® is made up of 7 steps which are all critical components of a consultative and effective food safety program. Built into each step are the environmental, social and financial legs of sustainability. With our 120+ years of experience, we have formed long-term partnerships with our customers to provide them with the integrated solutions that will protect their business financially.

705 **Siebel Institute/World Brewing Academy,** 1777 N. Clybourn Ave., Chicago, IL 60614-5519; Telephone: 1.847.284.2337, Fax: +1.312.255.1312, Website: www.siebelinstitute.com. The Siebel Institute of Technology and World Brewing Academy (a partnership between Doemens Academy and Siebel Institute) are proud to offer more brewing-related courses than any other school, including our web-based Concise Course in Brewing and our new 20-week English-language Master Brewer Program. Our campus-based and web-based programs cover the full range of brewing-related subjects, offering world-class training that ranges from the fundamentals of brewing to advanced-level programs designed and presented by the most talented instructors in brewing education. We also offer consulting, yeast management and production, lab services and laboratory media for your QC/QA applications.

200 & 202 **Siemens Industry, Inc.,** 11601 Lilburn Park Rd., St. Louis, MO 63146; Telephone: +1.423.747.5850, Fax: +1.678.297.8120, Website: www.siemens.com. Siemens supplies automation solutions and brewing know-how to help craft breweries increase capacity, improve productivity and increase the repeatability/quality of their beer. With a full line of instrumentation, motors and drives and the Braumat Compact control system, we cover your brewhouse, cellars, utilities, grain handling, and CIP operations. Siemens also provides a complete line of water and wastewater treatment solutions and services for the brewing industry. Processes and technologies include membrane filtration, pretreatment, water reuse processes, and biological wastewater treatment to assist

you in meeting compliance issues, minimize waste, and reduce BOD levels.

101 **Skalar, Inc.,** 5012 Bristol Industrial Pkwy., Bedford, GA 30518; Telephone: 1.800.782.4994, Fax: +1.770.416.6718, Website: www.skalar.com. Skalar is a Dutch instrument manufacturer established in 1965. The Skalar analyzers meet the highest quality standards and have proven to be the most reliable and economical choice in today's modern routine laboratory. Skalar has developed many applications specifically designed for the brewing and malting industries over the years allowing not only quicker turn-around time for results, but also with great precision. Such analytes include, but are not limited to: IBU, total SO_2, alpha amylase, beta-glucan, free amino nitrogen, diastatic power. Their automated total SO_2 method is an approved ASBC/EBC method on their unit and can be coupled with any listed above.

400 **SPX Flow Technology, Waukesha Cherry-Burrell and APV brands,** 611 Sugar Creek Rd., Delavan, WI 53115; Telephone: +1.800.252.5200 or +1.262.728.1900, Fax: +1.800.252.5012 or +1.262.728.4904, Website: www.gowcb.com and www.apv.com. Waukesha Cherry-Burrell brand manufactures sanitary equipment for brewery processes. WCB's new features in brewery mix proof technology include: minimal CIP loss; superior mechanical strength; chemically inert, press-on PTFE seats; free-draining, horizontally mounted valves; reliability and various control top options with networking technology. APV has been a leading supplier to the brewing industry for over 80 years and has developed a network for working closely with customers all over the world. Our international pool of brewing experts and their expertise within design and project management makes APV a specialist in the design and execution of customized beer processing lines.

502 **S.S. Steiner, Inc.,** 655 Madison Ave., New York, NY 10021; Telephone: +1.212.838.8900, Fax: +1.212.593.4238, Website: www.hopsteiner.com. S.S. Steiner is a full-service worldwide grower, processor, and dealer of hops and hop products. Additional information regarding the purchase of whole leaf, pellets (90 and 45), CO_2 extract, and other modified hop products in a variety of package sizes is available on our website at www.hopsteiner.com.

308 **Steinfurth Inc.,** 5148 Kennedy Rd., Ste. 600, Forest Park, GA 30297-2051; Telephone: +1.678.500.7035, Fax: +1.678.500.7036, Website: www.steinfurth.com. Steinfurth, leading specialist for quality control instruments, will be presenting its automatic foam stability tester and the SF-PastControl System (pasteurization logger). The newest Steinfurth products, the compact package analyzer for combined CO_2, torque fill level & density measurement and Automatic Multiple Sampler AS380C is rounding up the family of instruments for quality control on beverages and beverage packages. Steinfurth's range of products for the beverages industry includes CO_2 measuring systems; devices for calibrating pressure and temperature; torque tester; logger for pressure, temperature and pasteurization; packaging testing devices, measuring for foam stability and turbidity in beer; laboratory carbonization systems and sampling devices.

508 **Symbiont,** 6737 W. Washington St., Ste. 3440, West Allis, WI, 53214; Telephone: +1.414.291.8840, Fax: +1.414.291-8841, Website: www.symbiontonline.com. Symbiont, Science, Engineering and Construction is an engineer-led design-build company specializing in the beverage industry. Symbiont provides full service engineering services in house with single point accountability. Brewing services include material handling, brewing process, cold services, fermenting, conditioning, packaging, and process piping controls. Industrial services include facilities and site engineering, process design, plant utilities, process instrumentation and control, design-build project delivery, energy optimization, water/wastewater treatment, investigation remediation, air and waste management, and environmental management.

806 **Tig-Pro Inc.,** 21 Tee Dr., Portland, ME 04103; Telephone: +1.207.878.1190, Fax: +1.207.871.1898, Website: www.tigpro.com. TigPro has been servicing the food and beverage industries since January 2000. We offer complete lines of sanitary process equipment from some of the industry's leading manufacturers including pumps, valves, heat exchangers, tanks, flow components, and instrumentation. Our engineering services include sanitary process and control, prototypes, equipment sizing/selection, piping system design, fabrication, installation, and system start up. Our shop fabrication services include custom modular skidded systems, manifolds, valve clusters, transfer panels, catwalks, platforms, railings, tables, and countertops. Our welders are certified to ASME section IX standards and are also certified for tank entry to repair cracks and replace components.

509 **Tyco Flow Control,** 10707 Clay Rd., Houston, TX 77041; Telephone: +1.713.986.4665, Fax: +1.713.986.8575, Website: tycoflowcontrol.com. Tyco Flow Control is the world's largest manufacturer of valve products that move, control, and sample liquids, gases, powders, and other substances. We together are the world's premier manufacturers of flow control products. With over 90 valve brands, we offer a level of expertise that is second-to-none in providing innovative solutions to the most challenging flow control applications. Tyco has an extensive track record of meeting the demands of the food and beverage industries. Combining advanced technology with outstanding engineering expertise, we have a series of valve, actuation and control products designed to solve your toughest problems.

208 **The University of Nottingham-Brewing Science,** Sutton Bonington Campus, Loughborough, United Kingdom, L312 6RD; Telephone: +44 1159 516214, Fax: +44 1159 516162; Website: www.nottingham.ac.uk. The University of Nottingham offers a choice of postgraduate brewing science qualifications and individual modules designed for professionals working in the brewing and allied industries. These pioneering programs are delivered through the latest innovations in e-learning, coupled with intensive residential-taught courses. We are engaged in a range of research programs in support of and in collaboration with the worldwide brewing industry. Areas of current research interest include brewing yeast genetics and metabolomics, brewing yeast physiology and handling, flocculation, fermentation technology and biofuels, malting science, crop science and beer flavor technology.

211 **VitalSensors Technologies,** 3 Post Office Square, Acton, MA 01720; Telephone: +1.978.635.0450, Fax: +1.978.635.0590, Website: www.vitalsensorstech.com. VitalSensors Technologies is the world leader in real-time, infrared quality control sensors for beverage and food manufacturers. Our sensors are not affected by pressure spikes or extreme working conditions. All VitalSensors products operate in place during cleaning and sterilizing and contain no moving parts. The VS-3000 Beer and

Wine Monitor directly measures three of the most important quality control concentrations used by beer and wine producers: CO_2, alcohol, Brix/extract and calculates original gravity. The VS-3000 measures the concentration and temperature of fluids in a process stream or tank in real-time. VitalSensors also offers industry-leading single concentration sensors with our VS-1000 family.

409 **VLB Berlin,** Seestrasse 13, 13353 Berlin, Germany; Telephone: +49 (30) 4 50 80-0, Fax: +49 (30) 45 36 069, Website: www.vlb-berlin.org. The Versuchs-und Lehranstalt für Brauerei in Berlin, VLB (Research and Teaching Institute for Brewing in Berlin) is a German institute and service provider with a focus on all brewing related topics. It was founded in 1883. Today around 120 people work in the fields of research, teaching, service and information for the brewing, malting, beverage and their supply industries. The VLB has its roots in the German brewing industry but also works internationally. Customers all around the world take advantage of our training courses and of our broad experience in the fields of analyses and consulting. For further information please visit our website at www.vlb-berlin.org.

603 **VTT Technical Research Centre of Finland,** PO Box 1000, Espoo, Finland, 02044; Telephone: +358.20.722.7113, Fax: +358.20.722.7071, Website: www.vtt.fi. VTT Technical Research Centre of Finland is a globally networked multitechnological contract research organization. Our expertise covers the entire barley-malt-beer chain. We can help when you want to improve the performance of your yeast strain, manage microbes in malting, create new applications for side-streams, develop functional beverages, identify microbial contaminants, develop environmentally friendly packages, improve the energy efficiency of your process and buildings, or assess the sustainability of your value chain. Our special strength is creating competitive technologies and innovations by combining knowledge and expertise in different fields.

108 **Wayne Chemical Inc.,** 7114 Homestead Rd., Fort Wayne, IN 46804; Telephone: 1.888.432.1120, Fax: +1.260.432.1473, Website: www.waynechemical.com. Wayne Chemical provides sanitation and production chemicals, equipment and consulting to the brewing, beverage and food processing industries. Wayne Chemical addresses the needs of individual facilities with programs and solutions for sanitation and production utilizing The Perfect Mix® of specialty chemicals, customized dispensing equipment, account services and consulting since 1969. Wayne Chemical has developed a reputation for quality in the industry and is proud to be a long-term partner of its customers, helping them continually improve. Wayne Chemical offers a unique binary system of patent-pending alkaline hydrogen peroxide products that eliminate the need for the use of chlorine in the sanitation process.

206 **Weyermann® Specialty Malts,** Brennerstrasse 17-19, 96052 Bamberg, Germany; Telephone: +49 (0)951-93220-12, Fax: +49 (0)951-93220-912, Website: www.weyermannmalt.com. The widest range of malts on earth. Meet the Weyermann® malsters at the Brewing Summit 2010 for a chat! Experience the family tradition and competence and inform yourselves about the widest range of malt on earth! Distributing more than 80 different malts to 113 countries on each continent, the Weyermann® family business became a global player in the brewing industry–serving the smallest to the biggest breweries and bringing color and flavor to more than 9,000 beers all over the world!

707 **White Lab/Frings America,** 7564 Trade St., San Diego, CA 92121; Telephone: 1.888.593.2785 or +1.303.530.0469, Fax: 1.888.693.1026, Website: www.whitelabs.com. White Labs, Inc. cultures pure liquid yeast for brewers, distillers, and wine makers. Our full-service laboratory provides beer and microbial analysis, analytical testing, and proprietary yeast banking and is the home of Siebel Analytical Lab Services. White Labs offers quality fermentation enzymes, Siebel lab media, laboratory supplies, quality control test kits and brewing lab equipment. Our expert staff provides on-site or telephone laboratory consulting. White Labs partners with Frings America to provide high-performance yeast propagation systems in sizes from 14L to 350 bbl. Our mission is to provide the highest quality product at a fair price with unparalleled service.

809 **Wyeast Laboratories Inc.,** 3760 Eagle Loop, Hood River, OR 97031; Telephone: +1.541.354.1335, Fax: +1.541.354.3449, Website: www.wyeastlab.com. Wyeast Laboratories, Inc. has manufactured 100% pure liquid yeast since 1986. Our collection includes ale, lager, wheat, Belgian and lambic strains. Specialty strains from our Private Collection are offered quarterly, along with custom strain banking and propagation services. Our professional staff of microbiologists and brewers is available to assist with strain selection, customized cell counts, yeast management and product usage. We also distribute natural haze stabilizers, anti-oxidants and Wyeast nutrient blend.

404 & 406 **Ziemann Ludwigsburg GmbH,** Industriestra 6, Burgstadt, Germany, 63327; Telephone: +49 7141 408200, Website: www.ziemann.com. Ziemanns—Taking care of brewing and bottling. Everything from one source! For ZIEMANN this is not just a slogan. ZIEMANN is committed to providing complete turn-key breweries of the highest quality using state-of-the-art technology and offering reliability without compromise. And ZIEMANN doesn't stop in the production area either. The full integration of complete tailor-made bottling and packaging plants are familiar tasks for ZIEMANN. As a global team player, ZIEMANN works hand-in-hand with its customers and takes their visions seriously. This stands for extensive competence, smooth interfaces, fast communication and flexible decisions.