

*120th Anniversary Convention of the*  
**Master Brewers Association  
of the Americas**

**Where Brewers Come Together**



Photo by Barry M. Winkler, courtesy of the Nashville CVB.



**Program Book**

**October 26-28, 2007  
Gaylord Opryland Resort &  
Convention Center  
Nashville, Tennessee**



# experience

## experience

\ik-sper'-ē-əns\ n:  
the accumulation  
of knowledge or  
skill from direct  
participation in  
events or activities

**Experience** is invaluable. It is easy to recognize yet difficult to quantify. The experience of your suppliers can be critical to your process. With the right supplier the value of experience and advice can far exceed the material cost.



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# 120th Anniversary Convention of the Master Brewers Association of the Americas

## ▼ 17 Industry-related Topics

Page 10

Automation	Finishing
Barley	Flavor
Brewhouse	Historical
Craft Management	Malting
Craft Technical	New Products
Crop Reports	Packaging
Environmental	Quality Control
Facility Management	Utilities
Fermentation	



## ▼ Award of Merit Lecture

Page 17

### Abstract O-29

Supply chain vulnerability: Is it really God's fault?



Frank Kirner  
Anheuser-Busch (retired)  
Director Brewing Materials

Sunday, October 28, 9:00 – 9:35 a.m.  
Tennessee Ballroom C



## ▼ Three Outstanding Preconvention Workshops

Page 12

Advanced Yeast Workshop  
Automation: Brewing Process  
Control Systems  
Getting the Most Out of the New  
MBAA Master Brewers' Toolbox  
CD-Rom



## ▼ NEW! Craft Brewing Track Featured

Page 19

More than 50 oral papers are scheduled to be presented at this year's convention. Compare that to an average of 30 oral papers in past years. Craft brewers, be sure to check out the presentations prepared with you in mind!

Craft Technical I: Orals 11-14  
Craft Management: Orals 23-26  
Craft Technical II: Orals 38-41

## ▼ The Exhibit Hall

Page 56

Learn about the latest products, services, and research from exhibitors and technical posters.



## ▼ Nashville, Tennessee

Page 63

Out and about in Music City U.S.A.



Belmont Mansion by Bob Schatz, courtesy of the Nashville CVB.

## Acknowledgments

### Technical Committee Chair

William J. Ladish  
Cargill Malt (retired)

### Technical Committee Vice Chair

Karl F. Ockert  
BridgePort Brewing Co.

### Committee Members

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Miller Brewing Co.

Horace G. Cunningham  
Summit Brewing Co.

Ramon L. Garcia Tatis  
Cerveceria Nacional Dominicana

Frederik Y. Havel  
Molson Coors Brewing Company

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Carlton and United Breweries (retired)

Florian Kuplent  
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John A. Mallett  
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Yutaka Ogawa  
Kirin Brewery Co., Ltd.

Mary B. Pellettieri  
Goose Island Beer Co.

J. Antolin Sierra-Benavides  
FEMSA

Jeffrey Tito  
Miller Brewing Co.

### Ex-officio

Raymond J. Klimovitz  
Klimovitz Brewing Consultants Inc.



## Table of Contents

General Meeting Information .....	4
Safety Tips .....	6
Gaylord Opryland Floor Plans .....	7
Schedule-at-a-Glance .....	10
Thursday/Friday Schedule .....	12
Friday Highlights .....	12
Saturday Schedule .....	14
Saturday Highlights .....	15
Sunday Schedule .....	17
Sunday Highlight .....	18
Abstracts—Oral Presentations .....	19
Abstracts—Poster Presentations .....	45
Exhibits .....	56
Author Index .....	62
Music City U.S.A.—Nashville, Tennessee .....	63

## Advertisers Index

A. Ziemann GmbH .....	13
Barry-Wehmiller Company .....	44
Briggs of Burton Inc. ....	3
Buhler Inc. ....	Cover III
E. Begerow GmbH & Co. ....	5
Norit-Sudmo-Haffmans .....	Cover IV
Pall Corp. ....	Cover II
Siemens Energy & Automation .....	11

## Governing Committees

### Executive Committee

**President:** Larry L. Sidor; **1st Vice President:** Gil W. Sanchez; **2nd Vice President:** George F. Reisch; **Treasurer:** Mark P. Sammartino; **Past President:** Jaime Jurado; **Technical Director:** Raymond J. Klimovitz

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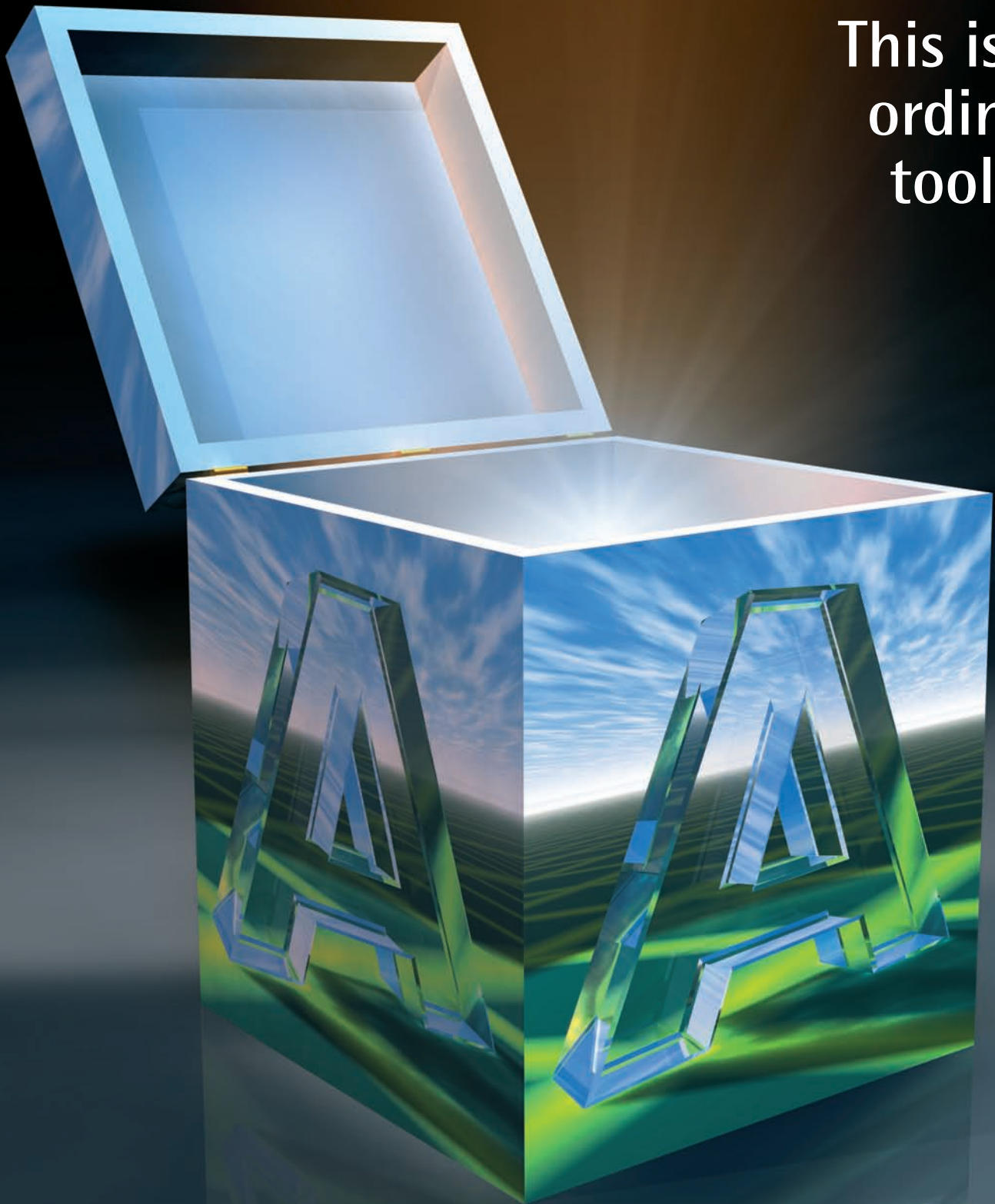
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# General Meeting Information

## Registration Desk

Registration will be in Tennessee Lobby A, located on Level Two of the Gaylord Opryland.

### Hours:

Thursday, October 25 3:00 – 6:00 p.m.  
Friday, October 26 7:00 a.m. – 4:00 p.m.  
Saturday, October 27 7:45 a.m. – 4:00 p.m.  
Sunday, October 28 7:45 a.m. – 4:00 p.m.

## Exhibits

Don't miss the latest products and services offered by industry suppliers! Representatives from over 60 leading industry suppliers will be available to answer questions and share information.

### Exhibition Hours

Friday, October 26	2:00 – 5:00 p.m.	Setup
Saturday, October 27	8:50 – 9:50 a.m.	Exhibit & Poster Viewing
	12:00 – 2:00 p.m.	Exhibits, Posters, & Lunch <i>Lunch served until 1:00 p.m.</i>
Sunday, October 28	12:00 – 2:00 p.m.	Exhibits, Posters, & Lunch <i>Lunch served until 1:00 p.m.</i>
	2:00 – 5:00 p.m.	Takedown



## Women in Brewing Networking Social

Connect with other women  
in the industry at this informal  
networking event.

Saturday, October 27  
5:30 – 6:30 p.m.  
Belmont A

## Member Services

Need to renew your membership? Not sure what your MBAA login is? Interested in joining MBAA? Staff will be available to answer your membership-related question at the Registration Desk.

## Open Meeting Room

MBAA has a small meeting room available for use throughout the meeting. To check availability and room location and to reserve a meeting time, stop by the Registration Desk.

## Media

Members of the media seeking news releases or other MBAA information should contact headquarters staff at the Registration Desk.

## Photo Release

Photographs will be taken at the MBAA Convention. By registering for this meeting, you agree to allow MBAA to use your photo in any MBAA publications or websites.

## Convention Facility

Gaylord Opryland Resort and Convention Center  
2800 Opryland Drive  
Nashville, TN 37214  
Tel: +1.615.883.2211

## Emergency Information

Medical emergencies should be communicated to either an MBAA staff member at the Registration Desk or a hotel employee. From your room dial 0 for the hotel operator or 1700 for hotel security. Give your name, location of the incident, and a description of what is happening. The hospital and clinics located closest to the Gaylord Opryland Resort and Convention Center are (MBAA does not endorse these facilities):

### Skyline Medical Center

3441 Dickerson Pike  
Nashville, TN  
Tel: +1.615.769.2000

### Tennessee Urgent Care

1616 Gallatin Pike North  
Nashville, TN  
Tel: +1.615.865.8500

### Minute Clinic

1200 Gallatin Pike South  
Nashville, TN  
Tel: +1.866.389.2727

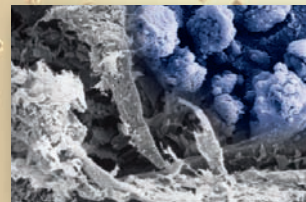


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with video contributions by Nicholas Ricketts

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during the  
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& Processing Parameters and Brewing  
Process & Product Specifications

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**during the meeting.**  
(near registration)



AD #1

## Safety Tips

- Do not travel alone – stay in groups and travel in well-lit areas.
- Remove name badges when outside the hotel unless you are participating in an MBAA event.
- Do not give your room number out to anyone you do not know and avoid giving out your room number in conversations where strangers may hear you talking.
- Bolt your hotel room door and only open when you know who is on the other side. (Note: Hotel personnel wear uniforms and have an identification badge. If in doubt, call hotel security to verify an employee's identity.)
- Do not leave your door ajar if you are going down the hall for ice. Someone may enter when you are not looking.
- Know where the stairs are located in case of fire (do not use elevators). Also count the number of doors to the nearest exit in case you cannot see in a smoke-filled hallway.
- Valuables, airline tickets, and money should be kept in a hotel safety deposit box or in a room safe, if available.

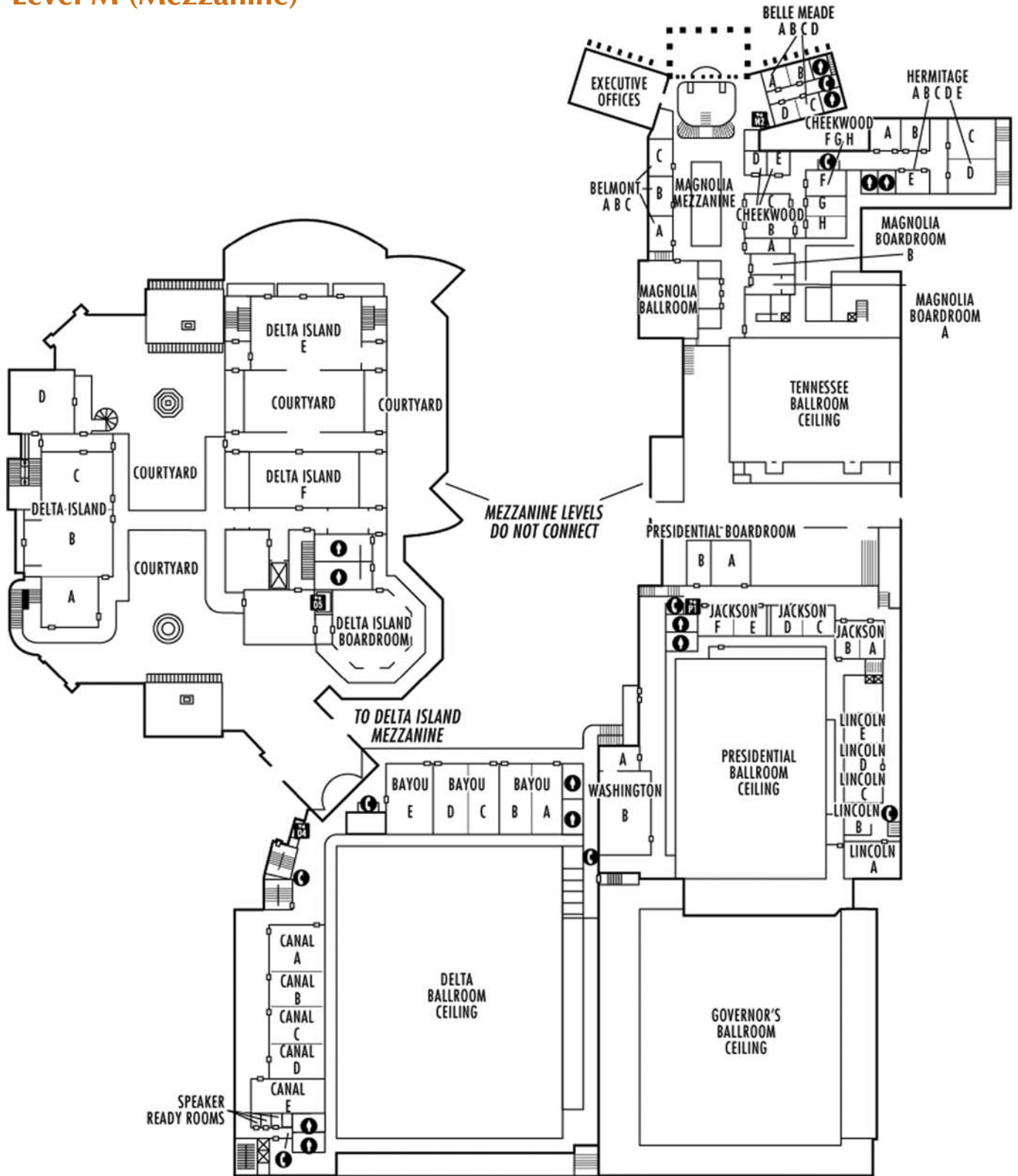
### Procedures In Case of Fire

- Try to leave the hotel/center as quickly as possible. If you cannot, stay in your room and call the operator or security to let them know you are in your room.
- Put your hand on the room door to see if it is hot before opening it. If it is, do not open quickly. Open it just a crack to see what is on the other side and be prepared to slam it quickly if necessary.
- If you leave your room, take your room key with you! Shut your room door to keep smoke out. You may have to return if the exit is blocked. Remember the way back to your room as you go to the exit in case you need to return.
- If necessary, drop to your knees to avoid smoke. Tie a wet towel around your nose and mouth to act as a smoke filter. Fold it into a triangle and put the corner in your mouth.
- Do not take the elevator when you smell smoke or if you know that there is a fire in the building.

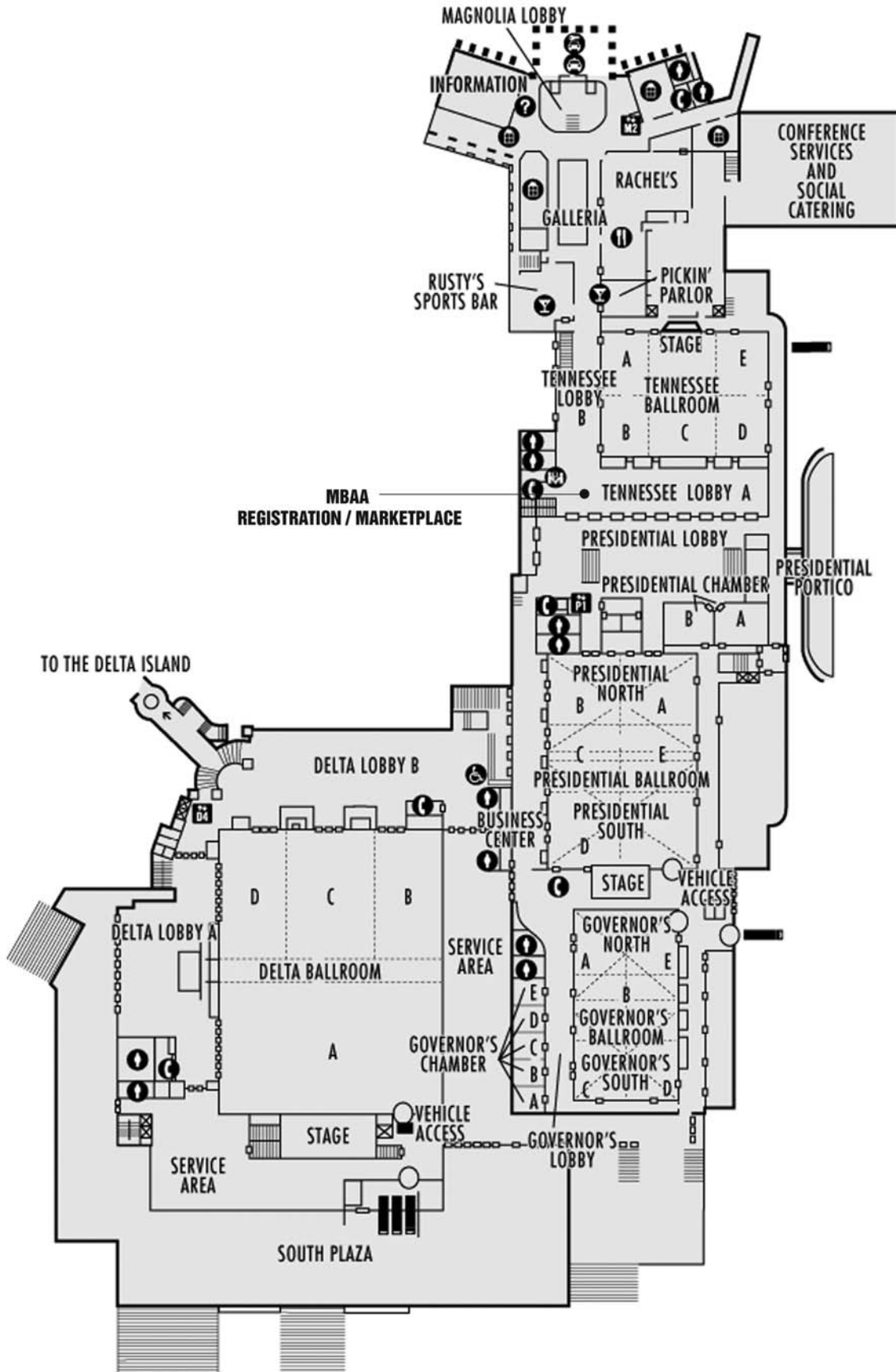


# Gaylord Opryland Floor Plans

## Level M (Mezzanine)

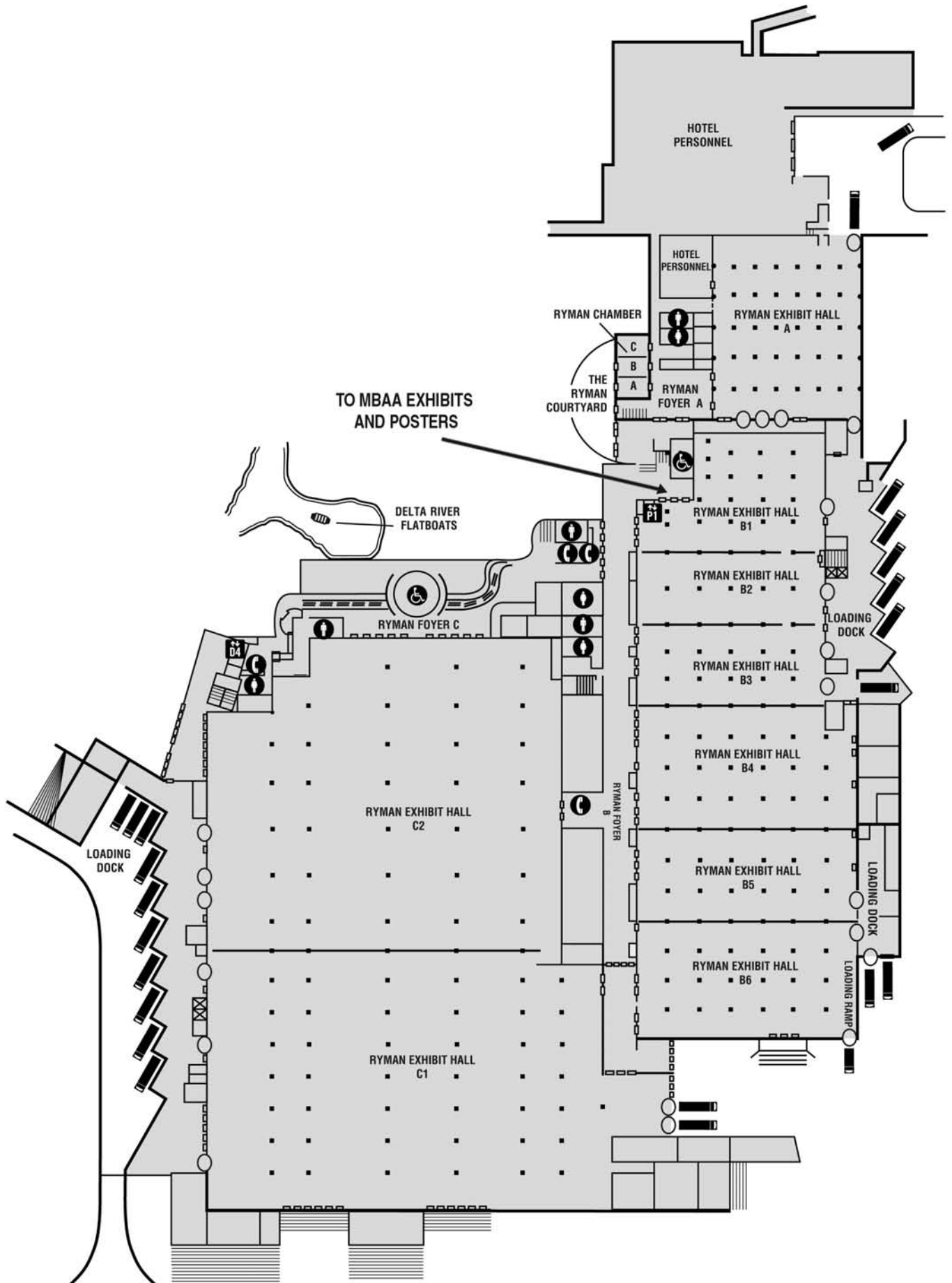


# Level Two





# Level Zero



## Schedule-at-a-Glance

Friday, October 26	Saturday, October 27	Sunday, October 28
<p><b>Automation: Brewing Process Control Systems Workshop</b> 8:00 a.m. – 12:00 p.m. • Hermitage A</p> <p><b>Technical Committee Meeting</b> 9:00 – 11:00 a.m. • Belle Meade A</p> <p><b>Board of Governors Meeting</b> 11:00 a.m. – 4:00 p.m. • Cheekwood G / H</p> <p><b>Advanced Yeast Workshop</b> 1:00 – 5:00 p.m. • Hermitage A</p> <p><b>Getting the Most Out of the New MBAA Master Brewers' Toolbox CD-Rom Workshop</b> 1:00 – 5:00 p.m. • Hermitage B</p> <p><b>Exhibit and Poster Set Up</b> 2:00 – 5:00 p.m. • Ryman Exhibit Halls B1 / B2</p> <p><b>Meeting Orientation</b> 4:30 – 5:00 p.m. • Cheekwood F</p> <p><b>District Officers' Orientation</b> 5:00 – 6:00 p.m. • Belmont B</p> <p><b>President's Night Reception, <i>entertainment sponsored by Novozymes</i></b> 7:00 – 10:00 p.m. • Tennessee Ballroom D / E</p>	<p><b>Presenters' Breakfast</b> 6:45 – 7:30 a.m. • Belmont B</p> <p><b>Opening Remarks &amp; Plenary Session</b> 7:50 – 8:50 a.m. • Tennessee Ballroom C</p> <p><b>Spouse/Guest Breakfast</b> 8:00 – 10:00 a.m. • Belmont A</p> <p><b>Exhibit and Poster Viewing, <i>coffee sponsored by Briess Malt &amp; Ingredients Co.</i></b> 8:50 – 9:50 a.m. • Ryman Exhibit Halls B1 / B2</p> <p><b>Technical Session — Brewhouse</b> 9:50 a.m. – 12:00 p.m. • Tennessee Ballroom D</p> <p><b>Technical Session — Barley and Malting</b> 9:50 a.m. – 12:00 p.m. • Tennessee Ballroom A</p> <p><b>Technical Session — Craft Technical I</b> 9:50 a.m. – 12:00 p.m. • Tennessee Ballroom B</p> <p><b>Exhibits, Posters, and Lunch, <i>lunch served until 1:00 p.m.</i></b> 12:00 – 2:00 p.m. • Ryman Exhibit Halls B1 / B2</p> <p><b>Poster Authors Present</b> 1:00 – 2:00 p.m. • Ryman Exhibit Halls B1 / B2</p> <p><b>Technical Session — Fermentation</b> 2:00 – 4:25 p.m. • Tennessee Ballroom D</p> <p><b>Technical Session — Utilities and Automation</b> 2:00 – 4:25 p.m. • Tennessee Ballroom B</p> <p><b>Technical Session — Craft Management</b> 2:00 – 4:25 p.m. • Tennessee Ballroom A</p> <p><b>Break, <i>coffee sponsored by domnick hunter</i></b> 2:55 – 3:15 p.m.</p> <p><b>Technical Committee Meeting</b> 4:30 – 5:30 p.m. • Belle Meade A</p> <p><b>TQ Editorial Board Meeting</b> 4:30 – 5:30 p.m. • Hermitage E</p> <p><b>Women in Brewing Networking Social</b> 5:30 – 6:30 p.m. • Belmont A</p> <p><b>Pub Crawl, <i>sponsored in part by Pall Corporation</i></b> 7:00 p.m. • Buses depart from the Magnolia Lobby</p>	<p><b>Presenters' Breakfast</b> 6:45 – 7:30 a.m. • Belmont B</p> <p><b>Opening Remarks &amp; Plenary Session</b> 7:50 – 9:00 a.m. • Tennessee Ballroom C</p> <p><b>Spouse/Guest Hospitality</b> 8:00 – 10:30 a.m. • Belmont A</p> <p><b>Award of Merit Lecture</b> 9:00 – 9:35 a.m. • Tennessee Ballroom C</p> <p><b>Break, <i>coffee sponsored by Briess Malt &amp; Ingredients Co.</i></b> 9:35 – 9:50 a.m.</p> <p><b>Technical Session — Fermentation and Finishing</b> 9:50 a.m. – 12:00 p.m. • Tennessee Ballroom D</p> <p><b>Technical Session — Packaging I</b> 9:50 a.m. – 12:00 p.m. • Tennessee Ballroom A</p> <p><b>Technical Session — Craft Technical II</b> 9:50 a.m. – 12:00 p.m. • Tennessee Ballroom B</p> <p><b>Exhibits, Posters, and Lunch, <i>lunch served until 1:00 p.m.</i></b> 12:00 – 2:00 p.m. • Ryman Exhibit Halls B1 / B2</p> <p><b>Spouse/Guest Hospitality</b> 12:00 – 2:00 p.m. • Belmont A</p> <p><b>Poster Authors Present</b> 1:00 – 2:00 p.m. • Ryman Exhibit Halls B1 / B2</p> <p><b>Poster Take Down</b> 2:00 – 3:00 p.m. • Ryman Exhibit Halls B1 / B2</p> <p><b>Exhibit Take Down</b> 2:00 – 5:00 p.m. • Ryman Exhibit Halls B1 / B2</p> <p><b>Break</b> 2:55 – 3:15 p.m.</p> <p><b>Technical Session — Flavor</b> 2:00 – 4:25 p.m. • Tennessee Ballroom D</p> <p><b>Technical Session — Packaging II</b> 2:00 – 4:25 p.m. • Tennessee Ballroom B</p> <p><b>Technical Session — Potpourri</b> 2:00 – 4:25 p.m. • Tennessee Ballroom A</p> <p><b>Exhibit Take Down</b> 2:00 – 5:00 p.m. • Ryman Exhibit Halls B1 / B2</p> <p><b>Technical Committee Meeting</b> 4:30 – 5:30 p.m. • Belle Meade A</p> <p><b>Installation of Officers and Awards Social</b> 6:30 – 7:00 p.m. • Tennessee Lobby A</p> <p><b>Installation of Officers and Awards Dinner</b> 7:00 – 9:00 p.m. • Tennessee Ballroom C</p> <p><b>After Glow, <i>sponsored in part by ADM Malting Company</i></b> 9:00 – 11:00 p.m. • Magnolia Ballroom</p>



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# Program

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## Thursday, October 25

12:00 p.m. – TBA	Executive Committee Meeting	Magnolia Boardroom A
3:00 – 6:00 p.m.	Registration	Tennessee Lobby A
4:00 – 10:00 p.m.	Bierstube	Hermitage C

## Friday, October 26

7:00 a.m. – 4:00 p.m.	Registration	Tennessee Lobby A
8:00 a.m. – 12:00 p.m.	Automation: Brewing Process Control Systems Workshop	Hermitage A
9:00 – 11:00 a.m.	Technical Committee Meeting	Belle Meade A
11:00 a.m. – 4:00 p.m.	Board of Governors Meeting	Cheekwood G / H
11:00 a.m. – 7:00 p.m.	Bierstube	Hermitage C
1:00 – 5:00 p.m.	Advanced Yeast Workshop	Hermitage A
1:00 – 5:00 p.m.	Getting the Most Out of the New MBAA <i>Master Brewers'</i> <i>Toolbox</i> CD-Rom Workshop	Hermitage B
2:00 – 5:00 p.m.	Exhibit and Poster Set Up	Ryman Exhibit Halls B1 / B2
4:30 – 5:00 p.m.	Meeting Orientation	Cheekwood F
5:00 – 6:00 p.m.	District Officers' Orientation	Belmont B
7:00 – 10:00 p.m.	President's Night Reception, <i>entertainment sponsored by Novozymes</i>	Tennessee Ballroom D / E

## Friday Highlights

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### Automation: Brewing Process Control Systems

8:00 a.m. – 12:00 p.m. • Hermitage A

**Presenter:** Don Lovell, RAH Consulting

Good information is a key factor in controlling any process and producing a quality beer. In this workshop, attendees will be introduced to every aspect of process control—from architecture hardware to software and on to calibration and statistical process control. The workshop will also highlight basic measurements, appropriate devices, HMI, critical control points, information systems, manufacturing execution systems, and modular process batch systems.

### Getting the Most Out of the New MBAA *Master Brewers'* *Toolbox* CD-Rom

1:00 – 5:00 p.m. • Hermitage B

**Presenter:** James Hackbarth, The Gambrinus Company

The *Master Brewers' Toolbox* is an easy-to-use program developed by master brewer James Hackbarth. The toolbox does the work, so you can be creative and quickly experiment with new formulations, analyze their costs, and bring new brews to market faster. This dynamic database application will give you the power without the headaches of other applications. Learn how to use this powerful brewing formulation and processing program. During this hands-on workshop, you will get the training you need to get the most out of the *Master Brewers' Toolbox* to help you improve your existing beer formulations and design creative new brews. Remember, you'll need your own fully charged PC laptop loaded with MS Access 2000 or higher at this workshop. You will receive a copy of the CD-Rom with your registration to this workshop.

### Advanced Yeast Workshop

1:00 – 5:00 p.m. • Hermitage A

**Presenters:** Charlie Bamforth, University of California; David Kapral, Anheuser-Busch (retired); Inge Russell, Alltech Inc.; Alex Speers, Dalhousie University; Graham Stewart, Heriot Watt University

Yeast is at the heart of the fermentation process and has been intensely studied for years. Yet, there are many aspects of yeast fermentation that we still do not understand. This workshop will not cover yeast basics. It is an advanced workshop and will focus on the latest yeast research (published and unpublished) and how these findings offer insights into why fermentation and beer stability problems occur, as well as discussing practical solutions. The workshop will include short lectures by leading experts, and a large portion of the session will be devoted to interaction and discussion among the participants.

### Meeting Orientation

4:30 – 5:00 p.m. • Cheekwood F

All first-time meeting attendees are welcome to join us in discovering how to take advantage of the wealth of meeting activities offered at the MBAA Annual Convention. It is a great opportunity to meet members who can answer your questions and help you make the most of your meeting experience.

### District Officers' Orientation

5:00 – 6:00 p.m. • Belmont B

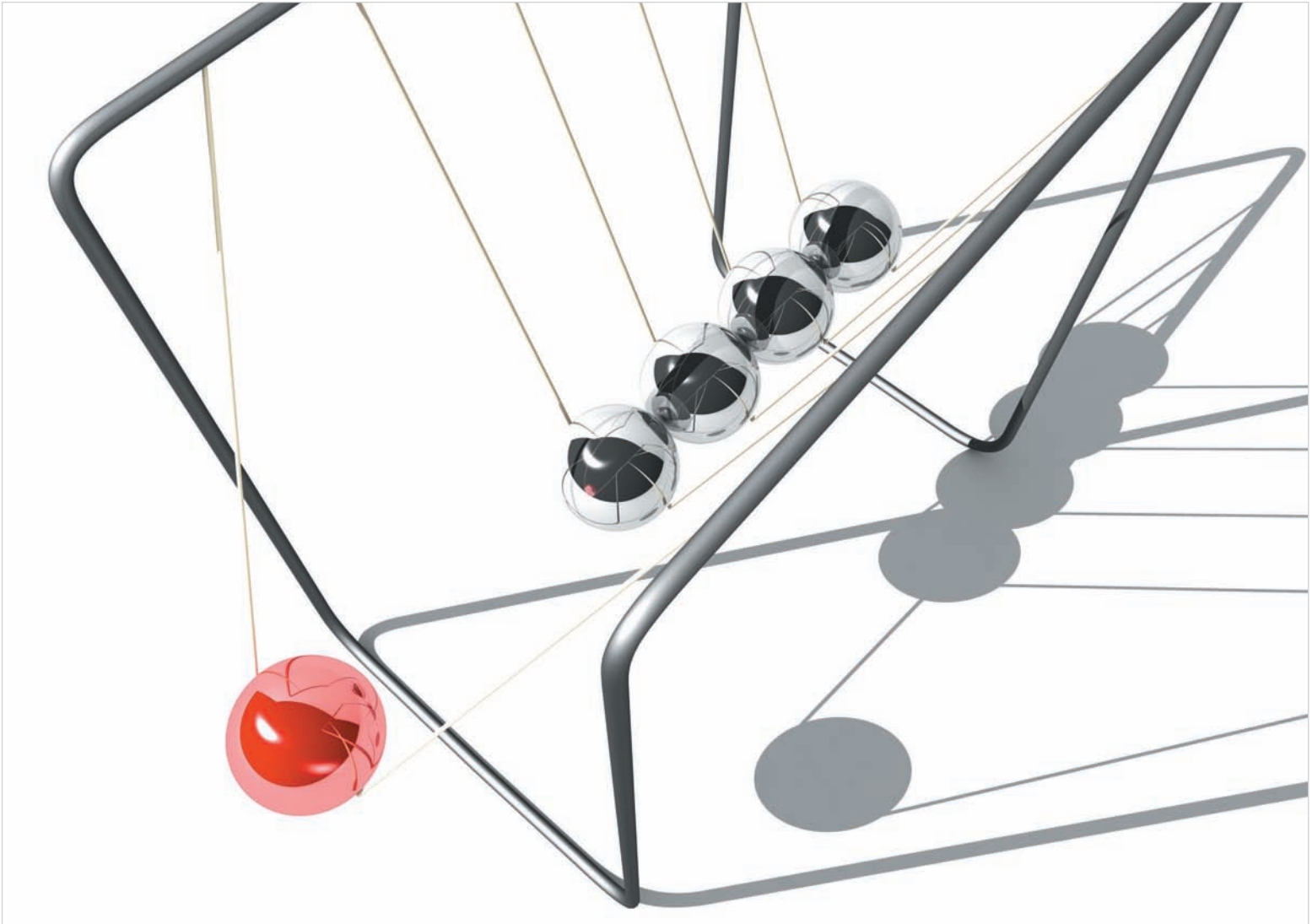
All District Officers are invited to attend this orientation session to learn more about the priorities of MBAA and discuss what challenges your district is facing and how headquarters can assist in your operation.

### President's Night Reception • *entertainment sponsored by Novozymes*

7:00 – 10:00 p.m. • Tennessee Ballroom D / E

Kick start your convention experience at the President's Night Reception. Mix and mingle with colleagues while enjoying light hors d'oeuvres and beverages.





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## Saturday, October 27

6:45 – 7:30 a.m. 7:45 a.m. – 4:00 p.m.	Presenters' Breakfast (orals 1–26, posters 54–64) Registration	Belmont B Tennessee Lobby A
7:50 – 8:00 a.m.	Opening Remarks Larry Sidor, MBAA President, and Bill Ladish, Technical Committee Chair	Tennessee Ballroom C
8:00 – 8:50 a.m.	Opening Plenary Session Moderator: Bill Ladish, Brookfield, WI O-1. World hop crop and market report. LOUIS GIMBEL O-2. Report on 2007 worldwide barley crop situation and outlook. GONZALO PETSCHEN	Tennessee Ballroom C
8:00 – 10:00 a.m. 8:50 – 9:50 a.m.	Spouse/Guest Breakfast Exhibit and Poster Viewing, <i>coffee sponsored by Briess Malt Ingredients Co.</i>	Belmont A Ryman Exhibit Halls B1 / B2
9:50 a.m. – 12:00 p.m.	Technical Session — Brewhouse Moderator: Ramon Garcia, Cerveceria Nacional Dominicana, Miami, FL O-3. Efficient use of energy in the brewhouse. UDO FUNK O-4. Heat markers for the brewing process. STEPHEN MCCARTHY, Alastair Pringle O-5. "FreeFlow" deep tube, wort boiling system. JOHN MALLETT O-6. Comparison of on-line viscosity measurement in mash with laboratory results—New measuring of mash variables. JENS VOIGT, Johannes Tippmann, Karl Sommer, Hans-Jörg Menger	Tennessee Ballroom D
9:50 a.m. – 12:00 p.m.	Technical Session — Barley and Malting Moderator: Vince Coonce, Miller Brewing Co., Milwaukee, WI O-7. Strategic barley breeding design at Molson Coors Brewing Company. JIM HETTINGER, Eric Samp, Alan Foster O-8. Use of fluorogenic proteinase assays to examine protein mobilization in barley varieties and across populations. MARK SCHMITT, Allen Budde O-9. 2006 Survey of Idaho, Montana, and North Dakota barley growers. PAUL SCHWARZ O-10. Latent variable modeling of malt quality data. ERIC SAMP	Tennessee Ballroom A
9:50 a.m. – 12:00 p.m.	Technical Session — Craft Technical I Moderator: Horace Cunningham, Summit Brewing Co., St. Paul, MN O-11. Navigating through a better wort filtration. CHRISTIAN ARTZNER O-12. Preventing solids flow problems at breweries. ROGER BARNUM O-13. Novel options for stabilization of beer. MUSTAFA REHMANJI, Andrew Mola O-14. Go with the flow: Pumps, pipes, and paranoia. MICHAEL LEWIS	Tennessee Ballroom B
10:00 a.m. – 10:00 p.m. 12:00 – 2:00 p.m. 1:00 – 2:00 p.m.	Bierstube Exhibits, Posters, and Lunch, <i>lunch is served until 1:00 p.m.</i> Poster Authors Present	Hermitage C Ryman Exhibit Halls B1 / B2 Ryman Exhibit Halls B1 / B2
2:00 – 4:25 p.m.	Technical Session — Fermentation Moderator: Mary Pellettieri, Goose Island Beer Co., Chicago, IL O-15. Olive oil addition to yeast as an alternative to wort aeration. GRADY HULL O-16. Improvement of yeast propagation in malt (barley)-free Japanese new genre beer. YUICHI NAKAMURA O-17. Influence of yeast physiology on beer quality. MAO SUGIHARA O-18. The impact of yeast nutrients on fermentation performance and beer quality. S. M. VAN ZANDYCKE, T. Fischborn	Tennessee Ballroom D
2:00 – 4:25 p.m.	Technical Session — Utilities and Automation Moderator: Florian Kuplent, Anheuser-Busch Inc., University City, MO O-19. Removal technology of unpleasant odor compounds in beer brewing water. HIDEKI MATSUDA	Tennessee Ballroom B

- O-20. Reduction/replacement of cleaning and disinfectant solutions in brewhouse and cellar plants by developing and using a new cleaning and disinfection technology. HANS-JÖRG MENGER
- O-21. Alternative materials of construction to 304 stainless steel for fabrication of brewery tanks. BRIAN UHLENKAMP
- O-22. Process analytical technology—A tool for brewing? ERIC SAMP, Chris McCready

2:00 – 4:25 p.m.	Technical Session — Craft Management Moderator: Karl Ockert, BridgePort Brewing Co., Portland, OR O-23. On hiring, training and motivating employees. CARRIE ALDEN O-24. Practical brewery project management. TOM THOMASSER O-25. Safety in the brewery—A novel approach. DAVID RADZANOWSKI O-26. Supply chain planning for regional brewers. NATHAN TURNER	Tennessee Ballroom A
3:00 – 3:15 p.m.	Break, <i>coffee sponsored by domnick hunter</i>	Tennessee Lobby A
4:30 – 5:30 p.m.	Technical Committee Meeting	Belle Meade A
4:30 – 5:30 p.m.	TQ Editorial Board Meeting	Hermitage E
5:30 – 6:30 p.m.	Women in Brewing Networking Social	Belmont A
7:00 p.m.	Pub Crawl, <i>sponsored in part by Pall Corporation</i>	Buses depart from the Magnolia Lobby

## Saturday Highlights

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### **Women in Brewing Networking Social**

*5:30 – 6:30 p.m. • Belmont A*

Over the past 30 years the number of women in the brewing industry has grown substantially. Women working in the industry are invited to join us for this informal networking session.

### **Pub Crawl • Transportation sponsored by Pall Corporation**

*7:00 – 10:00 p.m. • Buses depart from, and return to, the Magnolia Lobby*

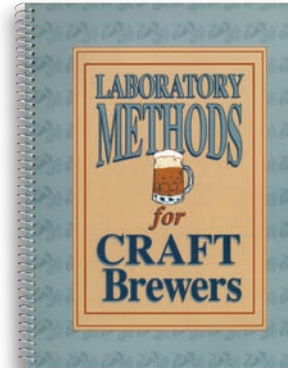
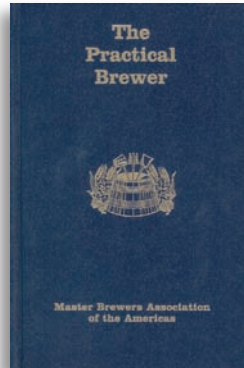
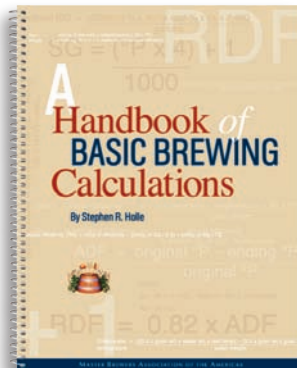
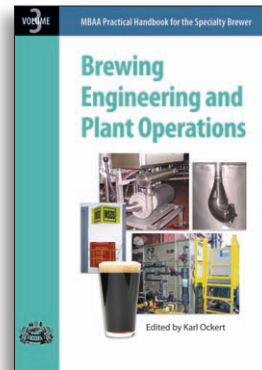
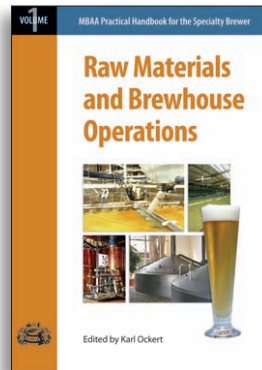
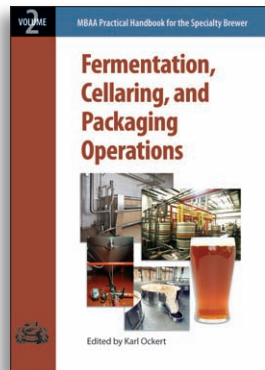
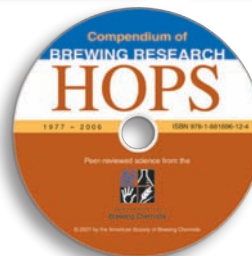
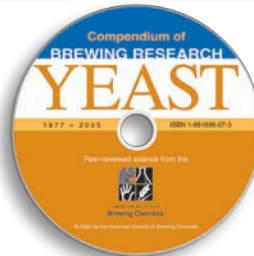
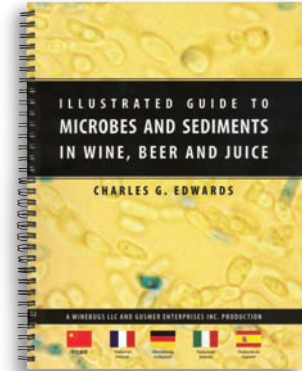
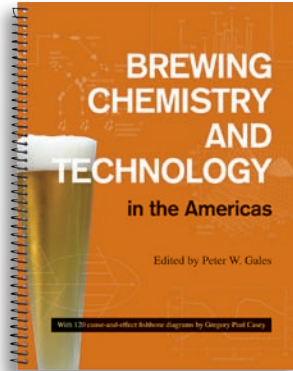
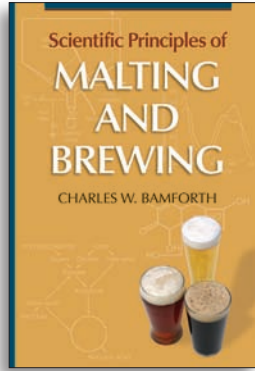
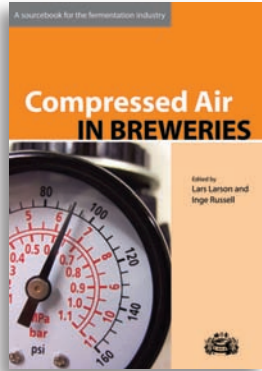
Dust off your cowboy boots and hat and join your friends for a fun night out on the town in the heart of Nashville. The Pub Crawl is a favorite of MBAA Annual Convention attendees. Pall Corporation is providing roundtrip transportation from the Gaylord Opryland Resort to some of Nashville's top brewpubs. Buses depart promptly at 7:00 p.m. from the Magnolia Lobby. Tickets for this event are available at the MBAA Registration Desk.



# SAVE on the BEST in Brewing Science

## ON SALE during the Convention

(located near registration)



## Sunday, October 28

6:45 – 7:30 a.m. 7:45 a.m. – 4:00 p.m.	Presenters' Breakfast (orals 27–53, posters 65–74) Registration	Belmont B Tennessee Lobby A
7:50 – 8:00 a.m.	Opening Remarks Larry Sidor, MBAA President, and Bill Ladish, Technical Committee Chair	Tennessee Ballroom C
8:00 – 10:30 a.m.	Spouse/Guest Hospitality	Belmont A
8:00 – 9:00 a.m.	Plenary Session Moderator: Bill Ladish, Brookfield, WI O-27. World class manufacturing—A balancing act. ROD MCLEOD O-28. The influence of mashing conditions on the fermentation characteristics of all-malt wort to produce beer or whisky. GRAHAM STEWART, Takeshi Yonezawa, Stephen Martin	Tennessee Ballroom C
9:00 – 9:35 a.m.	Award of Merit Lecture O-29. Award of Merit Lecture – Supply chain vulnerability: Is it really God's fault? FRANK KIRNER, Anheuser-Busch (retired)	
9:35 – 9:50	Break, <i>coffee sponsored by Briess Malt &amp; Ingredients Co.</i>	
9:50 a.m. – 12:00 p.m.	Technical Session — Fermentation and Finishing Moderator: Horace Cunningham, Summit Brewing Co., St. Paul, MN O-30. Improvement in design and delivery of green beer movement into maturation and the start up and installation of state-of-the-art centrifuges. RAYMOND KANZLEITER O-31. An assessment of the physiological status of yeast during high and low gravity wort fermentations determined by flow cytometry. PAUL CHLUP, Graham Stewart O-32. Visual versus instrumental perception of haze. KARL SIEBERT, Christine Fleet O-33. The recovery of polyphenols from PVPP and their antioxidant capacity. CHARLES BAMFORTH, Cale May	Tennessee Ballroom D
9:50 a.m. – 12:00 p.m.	Technical Session — Packaging I Moderator: Jeff Tito, Miller Brewing Co., Albany, GA O-34. Dry lubricant technology for the brewery industry. CHAD THOMPSON, Leanne Adkins O-35. Reducing potential quality problems in the modern brewery while simultaneously improving pasteurizer service life. JACK BLAND, Jeff Tito, Ken James, Bruce Johnston, Tom Soukup, Tom Szabo O-36. Energy-saving technology that enhances pasteurization control in tunnel pasteurizers. J. DAVID DUFF O-37. Fine adjustment of amount of beer filling according to can size and improvement of accuracy in filling with a mechanical can filler. YASUO KAWAI, Masatake Taguchi	Tennessee Ballroom A
9:50 a.m. – 12:00 p.m.	Technical Session — Craft Technical II Moderator: John Mallett, Bell's Brewery Inc., Kalamazoo, MI O-38. Streamlining data flow through M.E.S. JEAN TOUMI O-39. Shipping wort as an innovative approach to maximizing brewpub efficiencies. LARRY CHASE, Bob McKenzie O-40. Zen and the art of brewery maintenance. JAMES OTTOLINI O-41. A discussion of wastewater opportunities for the craft brewer. JOHN MERCER	Tennessee Ballroom B
10:00 a.m. – 6:00 p.m. 12:00 – 2:00 p.m. 12:00 – 2:00 p.m. 1:00 – 2:00 p.m. 2:00 – 3:00 p.m.	Bierstube Exhibits, Posters, and Lunch, <i>lunch is served until 1:00 p.m.</i> Spouse/Guest Hospitality Poster Authors Present Poster Take Down	Hermitage C Ryman Exhibit Halls B1 / B2 Belmont A Ryman Exhibit Halls B1 / B2 Ryman Exhibit Halls B1 / B2
2:00 – 4:25 p.m.	Technical Session — Flavor Moderator: Florian Kuplent, Anheuser-Busch Inc., University City, MO O-42. Sensory characterization of hop oil fractions in classical beer styles. RAY MARRIOTT, Christina Schoenberger	Tennessee Ballroom D

	O-43. The impact of a new heavy metal-adsorbing filter aid on flavor stability. MARCUS HERRMANN, Martina Gastl, Nikolaj Schmid, Spika Gero, Werner Back	
	O-44. Influence of beer matrix composition on bitter sensation. MARTINA GASTL, Stefan Hanke, Werner Back	
	O-45. The effect of acids on the perception of astringency. KARL SIEBERT, Claire Euzen, Atsushi Maekawa	
2:00 – 4:25 p.m.	Technical Session — Packaging II Moderator: Jeff Tito, Miller Brewing Co., Albany, GA O-46. Reducing beer loss on the racking line: A practical case study. DARREN MOSER O-47. Development of a system to reduce residual beer in keg filling. MASA AKI SHINONAGA, Masatake Taguchi, Takaya Nagafune, Satoshi Kusano O-48. Quality control of barrier-enhanced bottles. ROLAND FOLZ O-49. Solar energy collector to heat bottle washer water. CORNELIA STUMPE	Tennessee Ballroom B
2:00 – 4:25 p.m.	Technical Session — Potpourri Moderator: Bill Ladish, Brookfield, WI O-50. Gluten-free beer from proso millet malt ( <i>Panicum miliaceum</i> ). MARTIN ZARNKOW, Elke Arendt, Werner Back, Felix Burberg, Matthias Keßler, Stefan Kreis O-51. Emmer ( <i>Triticum dicoccum</i> ): Ancient grain for highly aromatic malts and beers—Technology and process in modern brewing. JENS VOIGT, Martin Zarnkow, Werner Back, Elke Arendt, Andreas Richter O-52. “Koda Energy”—Biomass to energy for economic survival. PAUL KRAMER O-53. Brewed in Dixie—Nashville brewing from the Civil War to the modern day. SCOTT MERTIE	Tennessee Ballroom A
2:00 – 5:00 p.m.	Exhibit Take Down	Ryman Exhibit Halls B1 / B2
3:00 – 3:15 p.m.	Refreshment Break	Tennessee Lobby A
4:30 – 5:30 p.m.	Technical Committee Meeting	Belle Meade A
6:30 – 7:00 p.m.	Installation of Officers and Awards Social	Tennessee Lobby A
7:00 – 9:00 p.m.	Installation of Officers and Awards Dinner	Tennessee Ballroom C
9:00 – 11:00 p.m.	After Glow, <i>sponsored in part by ADM Malting Company</i>	Magnolia Ballroom

## Sunday Highlights

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**Installation of Officers and Awards Social, Dinner, and After Glow Party • Sponsored in part by ADM Malting Company**  
6:30 – 11:00 p.m. • Tennessee Lobby A / Tennessee Ballroom C / Magnolia Ballroom

Join us at the end of an exciting MBAA Convention to celebrate the awardees and officers of MBAA at this sit-down dinner. Following dinner, join us at the After Glow party for a relaxing night of Irish coffee, cocktails, and networking.



# Abstracts

## Oral Presentations

### O-1

#### World hop crop and market report

Presenter: Louis Gimbel, S.S. Steiner, New York, NY

Hop demand is unprecedented after several years of oversupply. We will review the issues surrounding these market developments and also provide an update on the results of the world's 2007 hop crop.

*Louis Gimbel is president and COO of S.S. Steiner, Inc. and managing director of S.H. Steiner, GmbH. He has been with Steiner since 1990 and is a member of the family that founded the Hopsteiner Group in 1845. He is a native of New York and holds a B.S. degree in industrial relations from Cornell University. He is a graduate of Harvard Business School's PMD, and he attended the Siebel Institute's short course, The Doemens Schule's "Konzentrierte Action," and VLB's Brewing Technology on the Spot. He is married and has two children.*

### O-2

#### Report on 2007 worldwide barley crop situation and outlook

Presenter: Gonzalo Petschen, Cargill Inc., Wayzata, MN

The worldwide barley supply is the tightest it has been in years, with continued pressure on supply coming from growth in biofuels, growth in beer demand and strong global economic growth. The 2007 worldwide barley crop has potential to correct some of the shortages the current market is facing. Of specific production interest are the major production areas of the world; those include North and South America, Europe, Australia and China. The barley crop supply for each of these major producing areas will have significant implications for markets worldwide.

*Gonzalo Petschen is the worldwide commercial manager for Cargill Malt and the general manager for Cargill Malt in the Americas. Gonzalo started his career with the Archer Daniels Midland Company (ADM). At ADM he had merchandizing and general management roles within the United States and Mexico. In 1996 Gonzalo joined Cargill. He has held various roles within Cargill Malt, including merchandizing, general management, and commercial management. Gonzalo has an MBA from the Ohio State University and a B.S. degree from the University of Dayton.*

### O-3

#### Efficient use of energy in the brewhouse

Presenter: Udo Funk, Huppmann AG, Kitzingen, Germany

The brewhouse is the major consumer of thermal energy in the brewery. Reduction of energy usage in the brewhouse requires an integrated approach: improve energy efficiency, implement energy recovery and finally, develop additional energy sources. The author will review the brewhouse process to identify possibilities to reduce energy input or recover energy. Measures to reduce energy consumption and optimize the hot water balance can be based on equipment or on changes in operation. Both possibilities will be reviewed and evaluated. Most of the measures presented are standard in newly built industrial brewhouses, but can also be implemented as upgrades in existing plants. Opportunities for energy saving in specific applications should be identified and evaluated in an energy efficiency audit. It is a general prerequisite of any energy efficiency audit that the implemented measures should not compromise beer quality. On the contrary, they should help to improve product quality. The return on investment for a consistent energy recovery strategy cannot only be measured in monetary terms. The author will present additional advantages resulting from efficient use of energy in the brewhouse.

*Udo Funk is regional sales director of Huppmann for the United States and Canada. Since June 2007 he is based in the United States. Udo is a brewmaster with experience in sales and project management and as a commissioning brewmaster.*

### O-4

#### Heat markers for the brewing process

Presenter: Stephen McCarthy, Anheuser Busch Inc., St. Louis, MO  
Coauthor(s): Alastair Pringle, Anheuser Busch Inc., St. Louis, MO

5-Hydroxymethyl furfural (5-HMF) and furfural are compounds that increase in certain foods upon exposure to heat. 5-HMF and furfural were produced during wort hot time, principally during wort boiling. These two heat markers varied with wort hot time and temperature, with a base level being present in first wort. Tracking of analyte levels throughout the brewing process will be presented, as well as the effect of malt variety. The relationship of wort analyte levels to those in packaged beer will also be discussed.

*Stephen L. McCarthy is a senior chemist in the Brewing Technical Center Department of Anheuser-Busch Inc. He received a B.S. degree in chemistry at the University of Missouri-St. Louis in 1976 and was employed as a senior technologist at Smith-Kline Clinical Laboratories from 1977 to 1984. In 1984, he joined Anheuser-Busch as a chemist in the Analytical Services group. He currently works in the Brewing Research group. His duties include work on chillproofing, beer oxidation, and method development. His work on behalf of the American Society of Brewing Chemists includes chairing subcommittees on Iron in Beer by Ferrozine Method and Fermentable Carbohydrates by HPLC, as well as presentations at four annual meetings.*

## O-5

### **“FreeFlow” deep tube, wort boiling system**

Presenter: John Mallett, Bells Brewery Inc., Galesburg, MI

To meet growing production demand, a new wort kettle was needed for an existing brewery. After a review of available wort processing methods, the brewery decided to develop a new boiling system in collaboration with outside engineering firms, while under significant time constraints. The resultant “FreeFlow” system was implemented and is currently in service. The design was engineered to optimize the sometimes conflicting criteria of gentle wort handling with low thermal stress, thorough vessel mixing, energy efficiency, high throughput and ease of cleaning, all under a wide range of processing volumes. The results and experiences of the design, installation and operational processes are presented with relevant engineering details.

*John Mallett lives in Kalamazoo, MI, where he is responsible for the production of the fine beers made at Bells Brewery. John has served in numerous capacities over his brewing career: he was head brewer of Boston’s Commonwealth Brewery, brewmaster at the Old Dominion Brewing Co. in Ashburn, VA, and founder and president of SAAZ, an equipment and service provider for breweries both large and small. John has lectured and written extensively, serves on various technical committees, and is a widely known consulting resource. He has both attended the Siebel Institute and serves as a member of the extended faculty there.*

## O-6

### **Comparison of on-line viscosity measurement in mash with laboratory results—New measuring of mash variables**

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

Coauthor(s): Johannes Tippmann and Karl Sommer, Technische Universität München, Freising-Weihenstephan, Germany; Hans-Jörg Menger, Ziemann GmbH, Ludwigsburg, Germany

The viscosity of mash is a parameter of high importance for brewhouse performance and is mainly influenced by the raw materials used in a process which is adapted according to the wanted recipe and process handling. This has major effects for the performance of separation of wort in the brewhouse and subsequently in the filtration. Since mash is a two-phase liquid it is not very easy to measure viscosity during the mashing process. For the measurement the mash must be separated into a mainly liquid fraction and another more solid fraction. The paper describes the methods used to investigate and measure the viscosity of mash in laboratory scale and show differences with different ways of milling and variations according to the mashing recipe. This method can be used as a standard laboratory method for the determination of rheological values of mash, which is so far not a common method of analysis in brewery analytics. Furthermore the mash is characterized by particle size distribution. In a comparison, mash is measured with an industrial instrument for measuring viscosity in a pilot-scale brewing plant. The process viscosimeter belongs to the swinging systems and works according to the principle of reciprocating torsion. The comparison indicates that the correlation between the pilot-scale instrument and the laboratory method is not completely coherent, but it shows that the instrumentation can be used in industrial-size plants for process control operations.

*Jens Voigt received a degree as diploma engineer (M.S. degree) in Brewing and beverage technology from TU München-Weihenstephan, Germany, in 1985. He started his career with A. Steinecker GmbH, Freising, Germany, as a technical engineer in brewhouse and fermentation and filtration equipment. He held positions in sales and products and manager with Steinecker until 1995. He received his doctorate in brewing technology on beer foam (1988–1992) from Weihenstephan under Prof. Dr. 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, supplier of software solutions for the brewing industry. Since early 2004 he has been a research associate with Prof. Dr. Karl Sommer at Lehrstuhl für Maschinen- und Apparatekunde (chair for mechanical engineering and process technology) at the WZW (Wissenschaftszentrum Weihenstephan) (Center of Life Science, Weihenstephan) Jens is a member of the IGB and the editorial board and is a referee for papers in the Journal of the Institute of Brewing, London (JIB).*

## O-7

### **Strategic barley breeding design at Molson Coors Brewing Company**

Presenter: Jim Hettinger, Molson Coors Brewing Company  
Coauthor(s): Eric Samp and Alan Foster, Molson Coors Brewing Company

The Barley Research & Development Program at the Molson Coors Brewing Company exists to provide a competitive advantage by developing superior malting barley varieties strategically designed to enhance value throughout the growth of barley to the packaged beer process. To facilitate the strategic breeding process of these lines of barley, multivariate statistical modeling on experimental trial data was implemented in 2001, specifically focusing on beer filterability aspects while increasing extract and agronomic yield. The incorporation of PCA models and subsequent variety selection results will be discussed in this presentation, along with the benefits derived from over 5 years of breeding.

*Jim Hettinger is the manager of barley and malt R&D for the Coors Brewing Company in Golden, CO. He is responsible for variety development, testing, and qualification. Jim holds a M.S. degree from Colorado State University in botany and genetics and an MBA from the University of Colorado.*

## O-8

### **Use of fluorogenic proteinase assays to examine protein mobilization in barley varieties and across populations**

Presenter: Mark Schmitt, USDA ARS Cereal Crops Research Unit  
Coauthor(s): Allen Budde, USDA ARS Cereal Crops Research Unit

For a new barley variety to be accepted for use in the brewing industry, it must possess appropriate malting characteristics, as well as meet agronomic and disease resistance standards. During development of new lines, malting performance is commonly measured against benchmarks for a number of carbohydrate and protein modification parameters. In contrast to starch hydrolysis, where the principal enzymes involved in amylose and amylopectin degradation are known, the roles of the primary proteinases involved in breakdown of seed proteins into amino acids are less well understood. In order to help clarify the roles of the different proteinases in protein mobilization during malting and mashing, we have developed simplified proteinase assays that are useful for examining the proteolytic characteristics of individual malting varieties, and also make it feasible to examine proteolytic components and their distribution across large collections of germplasm (breeding lines, experimental populations, and wild barley progenitors). Results from such broad surveys of proteolytic capacity, taken in the context of the genetic background and in conjunction with malting quality characterizations, may clarify the biochemical bases of protein modification during malting and mashing, and suggest ways in which to improve the methods used for identification of superior malting barley varieties.

*Mark Schmitt received a Ph.D. degree in plant physiology from the University of Wisconsin, Madison, in 1983. Subsequently, he spent two decades working in the private sector in biotechnology and crop protection research. In 2003, he joined the USDA Agricultural Research Service, Cereal Crops Research Unit in Madison, WI, leading a project team performing basic malting quality research and providing malting quality analyses for U.S. public-sector barley breeders.*



**O-9****2006 Survey of Idaho, Montana, and North Dakota barley growers**

Presenter: Paul Schwarz, North Dakota State University

The supply of domestic malting barley in the United States is a serious concern. Acreage of barley has been declining for more than 10 years, and in fact, the area harvested in 2006 was the lowest since 1885, while production was the lowest since 1936. In order to address satisfaction and concerns with malting barley as a crop, the Institute of Barley and Malt Sciences (IBMS) conducted a survey of 5,000 barley growers in Idaho, Montana, and North Dakota. The rate of response to the survey was 32, 29, and 26% in Idaho, Montana, and North Dakota, respectively. Slightly more than 1,400 responses were received. The 12-question survey focused primarily on production/economic issues, and informational needs. Production/economic questions involved acreage over the past 10 years and the satisfaction or rank of barley relative to other crops produced. Information questions focused on information that is of value for barley production and current or desired sources of information. Results of the survey are discussed, along with recommendations for promotion of malting barley as a viable crop option.

*Paul Schwarz is a professor of plant sciences at North Dakota State University, where he directs malting barley quality research and serves as the director of the Institute of Barley and Malt Sciences. He also serves as an adjunct professor in the School of Biosystems Engineering and Food Science at Zhejiang University, Hangzhou China. Paul publishes and lectures extensively on barley, malt quality, and brewing. His recent research is primarily in the area of food safety and mycotoxins as related to malting and brewing. He has worked at the Kurth Malting Corp. and A. Egger Bierbrauerei and was a visiting scientist at the Coors Brewing Co.*

**O-10****Latent variable modeling of malt quality data**

Presenter: Eric Samp, Coors Brewing Co., Golden, CO

There are several malt parameters that are measured by maltsters to assess the quality of the malt. For example, soluble protein, Kolbach index, free amino nitrogen, alpha-amylase, diastatic power, beta glucans, viscosity, friability, fine and course extracts, pH, and S-methyl methionine are a few common measures used today. Relying on one individual measure can be misleading and trying to monitor each one individually becomes overwhelming. The question to the brewer is how to summarize this information in a logical and concise manner and also how to interpret the results. One approach is to consider the use of latent variable models that take advantage of the correlation structure inherent in these modification measures and use multivariate projection techniques to parsimoniously summarize the data. These results can then be displayed in a Shewhart statistical process control chart, allowing one to determine if there are shifts in the quality levels coming into the brewery. What we have found is that these latent variables represent underlying patterns in proteolytic and cytolytic modification and provide useful summaries in monitoring malt modification. This paper will discuss these efficient statistical approaches a brewer or maltster can employ with their own malt quality data.

*Eric J. Samp is a technical brewer for Molson Coors Brewing Company based out of Golden, CO, providing support for the U.S. Division. He holds a Ph.D. degree in applied statistics and is a Certified Quality Manager and Certified Quality Engineer (American Society of Quality). Eric also serves on the MBAA Technical Quarterly Editorial Review Board.*

## O-11

### **Navigating through a better wort filtration**

Presenter: Christian Artzner, The Saint Louis Brewery Inc.

An in-line densitometer was retrofitted on the lauter tun of a 25 bbl brewhouse. The instrument provides useful data to the brewer during and after wort production. Flowrate and extract are displayed in real time to the brewer during wort filtration. This enables the brewer to control the key parameters of this process (cycle time, extract, wort clarity) with dynamic quantitative data. Additionally, the extract and volume totalizer allow for accurate brewhouse efficiency calculations. The densitometer is particularly valuable to any brewery which is limited in capacity by brewhouse output.

*Christian Artzner studied at Heriot-Watt University and graduated with a B.S. degree in brewing and distilling in 1999. He worked five years in various departments for Scottish & Newcastle. Since 2005 he has overseen all aspects of beer quality at The Saint Louis Brewery Inc.*

## O-12

### **Preventing solids flow problems at breweries**

Presenter: Roger Barnum, Jenike & Johanson, Inc., Tyngsboro, MA

Industrial brewing operations involve the storage and feeding of various grains and additives as received from suppliers, as well as the handling of spent grains that are a byproduct of the process. Ensuring that these materials can be fed reliably from silos, bins and hoppers is an often overlooked consideration. Facilities that must be flexible in terms of product mix may find they are handling a wide range of materials with common equipment, such as base malts, specialty malts, barley, corn grits, rice and grists (flours), as well as purchased flours, sugars or starches. Incomplete discharge can result in cross-contamination, and the need for additional effort for clean out. Conditioning and tempering processes can present particular challenges as grains swell during hold periods. Problems with the loss of material flow, a lack of inventory control, a reduced live capacity and the spoiling of stagnant material can cause the operations to be at best inefficient, or result in varying and undesirable product. By characterizing flow properties, engineers can make informed decisions about the process and equipment design. Brewers can be proactive in their review of production changes or introduction of new products. This approach can be used to solve problems with existing systems as well. This paper will present the various ASTM test methods that can be used to measure bulk flow properties, including cohesive strength, wall friction, permeability, and compressibility, and will discuss how these properties can be used to prevent and solve problems. Typical results from these tests will be presented, along with methods for analyzing processes and equipment. The basic flow patterns that occur during gravity discharge from bins and hoppers will be covered, differences in which can have a strong influence on flow problems in the resulting stream of material. Methods for addressing or preventing common flow problems will be discussed through examples taken from industry, including the equipment changes that were developed and implemented as successful solutions. The presentation will also highlight important considerations such as wear and material-induced loads that must be included in the design and problem solution process.

*Roger Barnum is a senior project engineer at Jenike & Johanson, Inc. in Tyngsboro, MA. Jenike & Johanson is a specialized engineering firm focusing on providing reliable bulk solids flow for improved product quality. Roger is heavily involved in consulting, particularly within the pharmaceutical, glass, and energy industries, with projects ranging from furnace feed-bin design for reliable flow to solving solid dosage form content uniformity problems by analyzing entire solids handling systems. Examples of other projects include bunker retrofits for coal feeding of power plants, ceramic powder processing facility design, feed systems for contaminated soil, gravy mix storage and pneumatic conveying, synthetic gypsum-handling feeding at a cement plant, and high-temperature kilned lime storage and feeding at a paper mill. He received his B.S. in mechanical engineering from Rensselaer Polytechnic Institute in Troy, NY.*

### O-13

#### Novel options for stabilization of beer

Presenter: Mustafa Rehmanji, ISP (International Specialty Products)

Coauthor(s): Andrew Mola, ISP (International Specialty Products)

Stabilization is an important stage in the production of beer, where an attractive appearance and flavor are considered key quality determinants. While current procedures usually concentrate on additions after fermentation, e.g., on transfer to maturation, or at filtration, little has been reported on colloidal stabilization earlier in the brewing process. This presentation describes two novel composites for complete stabilization of beer by a single addition, one upstream in the kettle and the other downstream before filtration. 1) Polyclar Brewbrite, Composite of Kappa Carrageenan and micronized PVPP—A procedure for stabilizing beer in the brew-house has been developed that can be adopted to simplify downstream processing and reduce cost. Elsewhere, it could provide an additional mechanism to chill-proof ‘difficult’ beers in challenging environments. The benefits of this composite will be discussed. 2) Polyclar Plus 730, Composite of Silica Xerogel and Micronized PVPP—Traditionally, beers are stabilized prior to filtration. Use of this composition will enable combined stabilization of beer by simultaneous removal of both haze-active components in beer. Some of the advantages of this approach include a single addition of the stabilizer for complete stabilization of the beer requiring no specialized dedicated equipment for dosing the stabilizer into the beer. Properties, advantages and plant trial results with Polyclar Plus 730 will be discussed.

*Mustafa Rehmanji is senior manager-beverage products, marketing and technical service with International Specialty Products. His current interest is in the area of beer stabilization. Mustafa holds a B.S. degree in chemistry and a business degree and diploma in brewing technology. He is an active member of ASBC and MBAA. Mustafa has presented a number of brewing-related papers at industry conventions (IGB, ASBC, and MBAA).*

### O-14

#### Go with the flow: Pumps, pipes, and paranoia

Presenter: Michael Lewis, UC Davis

Craft brewers are not always able to optimize the way water, wort and beer flow in their breweries and these shortcomings can often have unpredictable, inconsistent and deleterious effects on the beers they make. Brewers do not always appreciate that the shortcomings are, in fact, shortcomings with imperatives for the product, but assume they are just part of the daily trials and exigencies of brewing in a small brewery. Some of these effects are simply a result of the way liquids flow in pipes and tanks, sometimes due to the way materials of different quality (e.g. specific gravity, temperature and composition) react with each other, and sometimes due to the way suspended particles behave in flowing systems. This paper will look at a number of specific examples of such behaviors and suggest reasonable solutions.

*Professor emeritus Michael Lewis taught the program in brewing science at the University of California at Davis for 30-odd years before retiring in 1995, and many former students now hold distinguished positions in the American brewing industry large and small. Michael has been recognized by the university with the Distinguished Teaching Award and by the industry with MBAA's Award of Merit and Life Membership. He remains active in the industry; he is academic director of brewing programs in University of California Extension, where the Master Brewers Program, which prepares students for the Institute of Brewing and Distilling examinations, is the flagship educational offering.*



**O-15****Olive oil addition to yeast as an alternative to wort aeration**

Presenter: Grady Hull, New Belgium Brewing Co., Fort Collins, CO

To extend the flavor stability of their beers, many breweries are researching ways of reducing oxygen ingress throughout the brewing process. However, the practice of aerating the wort prior to fermentation is almost universal in the brewing industry because oxygen is necessary for yeast health and growth. Recent studies have shown that alternative methods to traditional wort aeration, such as aeration of the yeast prior to pitching or the addition of the unsaturated fatty acid linoleic acid, can yield fermentation characteristics similar to wort aeration. It has also been shown that using these alternative methods instead of aerating the wort can reduce oxidation potential. This paper reports the findings of a series of full-scale production tests that were conducted in an operating brewery to evaluate the effects of another type of yeast treatment. By mixing olive oil into the yeast, during storage, instead of aerating the wort, fermentations can be achieved with only a minor increase in fermentation time. The beers produced from these fermentations were comparable in flavor and foam retention to beers produced by traditional wort aeration. The ester profile of the beers produced using olive oil addition was significantly higher than the controls, and the flavor stability of these beers was significantly improved.

*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-16****Improvement of yeast propagation in malt (barley)-free Japanese new genre beer**

Presenter: Yuichi Nakamura, Asahi Breweries, Ltd., Nishinomiya, Hyogo, Japan

The “new genre beverage” (so-called “third-category beer”) is a new type of alcoholic beverage launched into the Japanese market some years ago. It tastes like beer and is brewed from neither malt nor barley, but instead from ingredients such as peas, soybean, corn, and so on. When it is brewed from soybean peptide and yeast extract, fermentation often finishes after consumption of the designated level of extract although yeast propagates only a little. Therefore, a smaller amount of the yeast can be harvested than yeast from beer brewing. The taste and flavor often deteriorate due to the use of recycled yeast under the conditions mentioned above. We theorize that this is because the medium of the new genre beverage contains less than the required levels of some elements for yeast propagation or that it contains a kind of growth inhibitory factor. When we added amino acid,  $\text{Fe}^{2+}$ , and  $\text{Mg}^{2+}$  to the medium of the new genre beverage in a 100 mL table test, we found that the yeast propagation, extract consumption, and yeast flocculation improved. Next, we examined the effect of yeast extract with richer levels of amino acids,  $\text{Fe}^{2+}$ , and  $\text{Mg}^{2+}$  in a 5 kL pilot plant. As a result, we achieved improved fermentation and yeast flocculation, which kept the required amounts of the cropped yeast. In addition, we made a trial brew of the new genre beverage using the medium with dipeptide-rich soybean peptide and amino acid-rich soybean peptide. With the dipeptide-rich soybean peptide, we found that cropped yeast increased only a little, but that fermentation was sluggish. Through the addition of the amino acid-rich soybean peptide we achieved both the same amount of harvested yeast as that from beer brewing and excellent taste and flavor.

*Yuichi Nakamura completed the agriculture masters degree at the University of Tokyo in Tokyo, Japan. He began his employment with Asahi Breweries, Ltd. in April 1993. After working as a researcher in the laboratory, he was transferred to the brewing section in the Ibaraki Brewery. He went to study to TUM in Germany for one year (2001–2002) and then returned to the Nagoya Brewery. He has been working at the Nishinomiya R&D Promotion Office, Production Technology Center, Asahi Breweries, Ltd. since October 2005.*

**O-17****Influence of yeast physiology on beer quality**

Presenter: Mao Sugihara, Kirin Brewery, Yokohama City, Japan

Yeast physiology and wort aeration is closely related to substrate consumption and product formation during beer fermentation. These products include sugars, amino acids, organic acids, ester and higher alcohols; therefore, fermentation conditions greatly influence the taste and flavor of the beer. One of the fermentation parameters affecting beer quality is yeast physiology. As the yeast vitality in the actual brewing circumstances is very subtle, a much more sensitive method than the previous methods (staining methods, cell replication methods and methods based on physiological parameter such as polysaccharides, ATP, CO<sub>2</sub> evolution rate, oxygen uptake rate, acidification power, protease, Mg release, etc.) is needed. In this situation the highly sensitive ICP method (intracellular pH method) had been developed, and this method is now used practically. Another parameter is wort aeration. Until now, it has not been possible to correlate the extent of wort aeration to the fermentation performance of yeast during wort fermentation quantitatively. We developed a theory called total dissolved oxygen consumption (TDOC) which can be used to determine the timing and degree of aeration and the timing for pitching the yeast. Using the ICP Method and TDOC theory, it is possible to determine the optimum conditions for yeast handling and wort aeration in any kind of fermenter and various fermentation conditions. These techniques will help us to brew better quality beer.

*Mao Sugihara works as a researcher responsible for yeast physiology and beer filtration at Laboratories for Brewing, Kirin Brewery Co., Ltd. He graduated from the University of Hiroshima, where he received a M.S. degree in fermentation technology. In 2001, he joined Kirin Brewery as a brewing staff member at one of the largest plants in Toride. After four years in production, he transferred to his present position in 2004.*

**O-18****The impact of yeast nutrients on fermentation performance and beer quality**

Presenter: S. M. Van Zandycke, Lallemand Inc., Montreal, QC, Canada

Coauthor(s): T. Fischborn, Lallemand Inc., Montreal, QC, Canada

Whereas all malt wort contains all the minerals, vitamins and nitrogen necessary for a successful standard fermentation, their availability decreases in high-gravity brewing and fermentations where a high percentage of adjuncts are used. This causes stress to the yeast which may result in a stuck fermentation, slow fermentation rate, and decrease in biomass formation, as well as production of off-flavors. Yeast nutrients can be added to correct wort nutrient deficiency. Three different types of nutrient formulation will be presented: 'Basic products' for nitrogen deficiency wort; 'Enhanced yeast based products' for specific deficiency (e.g., zinc) and balanced nutrition; and 'Formulated products' for overall balanced nutrition adapted specifically to wort composition. Evidence will be provided that the use of nutrients can improve alcohol yield, reduce fermentation time, enhanced yeast viability and vitality, and increase diacetyl removal, as well as control undesirable flavor compounds.

*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 in oxidative stress and aging in Saccharomyces cerevisiae in July 2000. In 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 UK 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. Sylvie now occupies the position of brewing fermentation manager for Lallemand, supporting the brewing industry worldwide.*

## O-19

### Removal technology for unpleasant odor compounds in beer brewing water

Presenter: Hideki Matsuda, Asahi Breweries, Ltd., Nishinomiya, Hyogo, Japan

We, Asahi, severely control the quality of water used for beer brewing and CIP beyond the Japanese law standard of 50 water service method items. We especially pay more attention to some compounds inducing the unpleasant musty odor, such as 2-MIB (2-methylisoborneol), geosmin and TCA (trichloroanisole). These are products metabolized by microorganisms such as algae that are found in eutrophicated lakes and marshes. We give them severe ozonic and activated carbon treatment because they are organic compounds. Moreover, we have had to revise our water treatment procedures because the Japanese government added bromate, which is a carcinogenic compound, to the water service method standard. Our typical procedure of water supply treatment is as follows: "coagulating sedimentation, ozonic treatment, an activated carbon treatment, filtration, and ion removal processing." Compounds causing musty odors are removed by adsorption to the activated carbon after they are decomposed by ozone. On the other hand, bromate is an oxidized product of bromine with ozone. The more ozone is used to remove musty odor-causing compounds, the more bromate is produced. More bromate is produced through increased bromine, ozone, pH value, water temperature, and amounts of organic compounds. We found that we could reduce the level of the bromate by lowering the pH value and decreasing the amount of ozone and that there was a relationship among the ozone content, the amount of activated carbon, and the reduced level of musty odor-causing compounds. Furthermore, we found that there was a correlation between the TOC level and the content of musty odor-causing compounds after the activated carbon treatment. As mentioned above, we were able to reduce the content of the bromate in water by decreasing the ozone level and lowering the pH value or stopping the ozone treatment equipment. We also use equipment that supplies the activated carbon up to the required level so we can achieve the TOC level in the activated carbon treatment water under the fixed level. We overcame the dilemma of the trade-off, i.e., we attained both removal of mold odor-causing compounds and decreased the level of bromate.

*Hideki Matsuda completed an applied chemistry degree at the University of Kobe in Hyogo, Japan. He began his employment with Asahi Breweries, Ltd. in April 1997. He worked as an engineer in the Nagoya Brewery and in the Production Technology Center at Nishinomiya and as a researcher in the laboratory. Since September 2004, he has been working on production technical subjects in the Nishinomiya R&D Promotion Office, Production Technology Center of Asahi Breweries, Ltd.*

## O-20

### Reduction/replacement of cleaning and disinfectant solutions in brewhouse and cellar plants by developing and using a new cleaning and disinfection technology

Presenter: Hans-Jörg Menger, Ziemann Ludwigsburg GmbH, Ludwigsburg, Germany

Cleaning in place (CIP) in the brewhouse and CIP and disinfection in cellar plants are very intensive and expensive procedures because a lot of cleaning solutions, mostly caustic and acid and disinfectant solutions as well as water, are necessary. In view of environmental protection, cost reduction and product and cleaning safety, a new cleaning and disinfection technology is required. Based on an electronic chemically activated module a high disinfectant, pH neutral, metastable water agent with high bactericide, viricide and fungicide and cleaning effect has been produced. Using optimized diaphragm cell electrolysis, Annolyte® is produced from the original substances (H<sub>2</sub>O, NaCl) on two electrodes (anode and cathode), directly in the CIP plant and can be stored in a small storage tank and recovered as concentrate and final solution. The solution has a high redox and cleaning potential, is not toxic and has a chemical-physical effect on germs. No trichloromethane is formed, so a formation of chlorophenol is excluded. A corrosion formation is also not possible and stainless steel and elastomer are not attacked. The aims of this new cleaning and disinfection technology are replacement and reduction of traditional cleaning and disinfection solutions; lowering of AOX values in wastewater; prevention of a reinfection through the fresh water; perfect cleaning and microbiological values upon harmless use with regard to health impairments; no storage and logistics costs; lowering of consumption costs; and simple integration into the plant with simultaneous increased process security.

*Hans-Jörg Menger received a Ph.D. degree in natural science in April 2003 from the University of Stuttgart-Hohenheim, Germany. In 1990 he began studying food technology at the University of Stuttgart-Hohenheim. He began employment with Ziemann Ludwigsburg GmbH, Germany, in January 1998 in the Technology Department. Since April 2000 he has been responsible for the patent resort and since July 2003 he has been head of R&D and the Technology Department for Ziemann Ludwigsburg GmbH.*



## O-21

### **Alternative materials of construction to 304 stainless steel for fabrication of brewery tanks**

Presenter: Brian Uhlenkamp, DCI, Inc., St. Cloud, MN

The most common material of construction for brewery tanks and equipment is austenitic stainless steel, type 304. Type 304 stainless steel contains a minimum 8% nickel which is currently the main price driver of its cost fluctuation. Because the commodity price of nickel has risen significantly over the past few years to an all time high and continues to stay there, users and manufacturers are seeking economical alternative materials to 304 stainless steel. Generally these alternative materials contain lower nickel content. In choosing these alternative materials, fabricators and users must investigate their corrosion resistance, strength, and other attributes of the material to verify its correct application. This paper reviews mainly two alternative materials: austenitic stainless steel designated UNS# S20100 (commonly called 201 stainless steel) and a lean duplex stainless steel designated UNS# S32101 (commonly called duplex 2101). These are both possible alternatives to applications in which 304 stainless steel is currently used for brewery tanks and equipment. Both of these alloys have a low nickel content and can help offset the cost associated with it. This paper discusses the possible uses of S20100 and S32101 for product contact surfaces, insulation sheathing, and structural components, as well as alloy S32101 for tank heat transfer dimple jackets. The advantages and disadvantages of each alloy are investigated, including comparison to alloys other than 304 stainless steel. Alloy chemistry, ordering specifications and quality are addressed. The paper discusses corrosion resistance comparisons, including chloride pitting and stress corrosion cracking, along with comparing strength and fatigue characteristics. It also addresses fabrication practices, such as welding and forming, which may be different than those used for type 304 stainless steel. A brief history of nickel pricing and how it affects the cost of the materials is also reviewed. A summary of items users and manufacturers must consider before implementing an alternative to 304 stainless steel is presented. Note: Some portions on dimple jacket application of alloy S32101 was original work previously given at NACE Corrosion 2007 (reference paper 07218). Although this paper material is not necessarily from an experiment or original work and considered a review, since the material is combined from many sources, its application to brewery tanks is fairly new due to economic factors.

*Brian Uhlenkamp is vice president of engineering and R&D for DCI, Inc., a stainless-steel and high-alloy tank and equipment fabricator. Brian graduated from North Dakota State University with a B.S. degree in mechanical engineering. He is a NACE Certified Corrosion Technician. He has over 14 years of experience in the design, manufacturing, and quality assurance of sanitary stainless-steel and high-alloy tanks, pressure vessels, tank trailers, and processing equipment. His involvement with DCI has been in high-purity applications in the biopharmaceutical, food, dairy, beverage, brewery, and cosmetic industries, but he also serves the chemical, ethanol, and OEM industries. His main focus is in material and welding selection for specific applications and sanitary surface finishes. He is currently serving voting membership terms for the materials and welding sections of the ASME BPE (BioProcessing Equipment), a standard for the biopharmaceutical industry. He is a past voting member on 3-A Sanitary Standards, Inc., a standard for the food and dairy industries. His memberships include NACE, ASME, ASME BPE, AWS, ASTM, ISPE, and ASM.*

## O-22

### **Process analytical technology—A tool for brewing?**

Presenter: Eric Samp, Molson Coors Brewing Company

Coauthor(s): Chris McCready, Umetrics Inc.

Process analytical technology (PAT) is a regulatory framework sponsored by the FDA that allows manufacturers in regulated environments to develop, monitor, and improve their processes, under the premise that manufacturers who can demonstrate a sound understanding of their production process through PAT will be at lower risk of producing an inferior product. It is based on a systematic approach using advanced statistical and chemometric methods on process data to quantify the impact of raw material and in-process parameters. Although the brewing industry in the United States is not heavily regulated, these tools developed in the pharma industry may have potential benefits for brewers. This paper will provide an overview of PAT and will discuss some potential applications in brewing where applications may provide value.

*Eric J. Samp is a technical brewer for Molson Coors Brewing Company based out of Golden, CO, providing support for the U.S. Division. He holds a Ph.D. degree in applied statistics and is a Certified Quality Manager and Certified Quality Engineer (American Society of Quality). Eric also serves on the MBAA Technical Quarterly Editorial Review Board.*

**O-23**

**On hiring, training and motivating employees**

Presenter: Carrie Alden, Sierra Nevada Brewing Co.

Is a pulse enough to hire an employee? Isn't a paycheck enough motivation to come to work? Training? Isn't learning your job training enough? Learn what the correct answers are to these questions and what Sierra Nevada Brewing Co. does to hire quality employees, how they are beginning to foster an environment of continuous learning and what motivates employees to do their best, year after year.

*Carrie Alden has arguably the best HR position in California as the HR manager for Sierra Nevada Brewing Co. A 13-year veteran in human resources, she spent years doing people-related work in healthcare and education prior to arriving at SNBCo 6 years ago. Although her B.S. degree in public health from UNC-Chapel Hill may seem an anomaly in the brewing world, beer has been proven beneficial to your health in numerous studies, right? A staunch believer in the importance of people to any employer, she promises to provide an informative and entertaining look at the people side of brewery management.*

**O-24**

**Practical brewery project management**

Presenter: Tom Thomasser, Summit Brewing Company, St. Paul, MN

The Brewing industry is challenging when it comes to capital improvement projects. The main obstacle to all projects is the relatively short shelf life of the products. The timing of these projects has to be carefully synchronized to limit downtime which could lead to stock outages and unfilled customer orders. This discussion will deal with all aspects related to successfully completing a capital improvement project. Topics to be covered include planning, budgeting, interviewing and selecting outside contractors, site design/layout, current utilities evaluation, scheduling, installation and start up.

*Tom Thomasser is currently the plant manager at Summit Brewing Company in St Paul, MN. He has been in this position for 11 years and has the primary responsibility of overseeing all mechanical operations of the facility. He has a B.S. degree in mechanical engineering from the University of Minnesota and has also attended and received certificates from countless seminars and classes related to all aspects of the brewing industry. During his employment he has completed numerous capital improvement projects, with a great success rate of being both on time and under budget. In his spare time he enjoys spending time with his wife and daughter or taking trips on his motorcycle. He also volunteers for the Lightning Run, an event that raises money for the University of Minnesota's Diabetes Institute.*



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## O-25

### Safety in the brewery—A novel approach

Presenter: David Radzanowski, Radzan Associates

Safety in the brewery, as in all industries, has always taken second or even a lesser place to productivity and has often been ignored. If we add to this the current U.S. administration's loosening of the regulations under OSHA, safety has fallen even further behind. With the use of case histories and a reflection on the FDA's Good Manufacturing Practices, we shall examine what could be an easier approach to ensuring a safer workplace.

*After studying chemical engineering at Carnegie Tech (now Carnegie Mellon University), David Radzanowski began his brewing career in 1962 with the Duquesne Brewing Co., Pittsburgh, PA, in its microbiology and research laboratories and then as the associate supervising master brewer. He is a graduate of the Siebel Institute of Technology, class of 1970. In 1973 he joined the Huber Brewing Co., eventually serving as vice president of brewing. He moved to the Siebel Institute as vice president of educational services in 1992 and later became the institute's president. With the breakup of the original Siebel Institute, he became administrator of the then newly formed Alltech Institute of Brewing and Distilling and also served as the Alltech Alcohol Division manager of technical sales for the Asia/Pacific Region. Today Dave is head of Radzan Associates, acting as a consultant to the alcohol industries, as well as representing S.S. Steiner for hops in the Midwest and hop products throughout the world.*

## O-26

### Supply chain planning for regional brewers

Presenter: Nathan Turner, New Belgium Brewing Company, Fort Collins, CO

In today's ever-changing landscape of high-end beers, companies need to maximize their supply chains to achieve a competitive advantage. A smooth running supply chain can keep production and logistics costs low, while enabling sales agility to get the right products to market at the right times. It can also help to assure high product quality by keeping inventories low and beer fresh. A typical supply chain has five distinct management processes: planning, material sourcing, making, delivering and returning. There is also a collection of enabling processes linked to all five. To better maximize a supply chain, companies must first understand their supply chains. One of the most effective ways to do this is to map the flow of materials from sourcing through to delivering. What are the lead times? What are the process times? What are the batch sizes? Where are there bottlenecks? Where is there volatility or unpredictability? By understanding the flow of materials, companies can then "plan backward" to find the correct balance of costs and service levels. At New Belgium we have three key components that feed our annual business plan. The first is the sales plan, the second is the production plan and the third is the purchasing plan. The sales forecast, which is updated monthly, drives our production and purchasing plans. As the forecast changes from month to month there is a need to communicate, negotiate and collaborate around possible company directions. One best practice for maintaining alignment is sales and operations planning (S&OP). S&OP is a series of monthly meetings where sales, production and management review year-to-date performance, discuss upcoming demand drivers and production capabilities and re-align plans to match current assumptions. Breaking down walls between departments and providing a flow of information that keeps everyone in the loop is key to creating a supply chain that can be reactive, effective and efficient.

*Nathan Turner is supply chain director for New Belgium Brewing Company. Nathan graduated with honors from Colorado State University with a degree in landscape horticulture in May 1992. He completed a 2,500-mile solo bike trip from Fort Collins, CO, to Bar Harbor, ME, in November 1992. He has been employed with New Belgium Brewing Company since 1993 as a bottler (1993), warehouse manager (1994–1995), logistics and forecasting manager (1996–2001), and supply chain director / board member (2002–Present).*



**O-27****World class manufacturing—A balancing act**

Presenter: Rod McLeod, First Key Consulting Inc., Richmond, BC, Canada

Fifty years ago the mantra of corporate executives and business schools did not include terms such as “world-class manufacturing” and “best practices.” Today the use of these terms has become commonplace in spite of a lack of consensus about their meaning. This paper will define the term world-class manufacturing (WCM), and outline its development from a historical perspective including comparison with the so called traditional approach to manufacturing strategy. It will outline the essential features of WCM with a more detailed explanation of one of its essential components (i.e., benchmarking) in the specific context of the brewing industry. Examples of brewery key performance indicators constituting best in class will be given. While advocating the need to implement WCM techniques it will consider this within the context of profit-driven brewers, stressing the need for leadership in implementing a focused and balanced WCM strategy, characterizing one such strategy as practiced by a major brewing company. Simply stated, WCM means being the best in the field of several competitive priorities. The challenge for most brewers is to find the correct balance between solutions that focus solely on people first priorities and continuous improvement with very long-term profit horizons, and short-term cost reduction, quarterly profit performance, and half-hearted attention to a few of the other elements to sustain a competitive edge. The solution is to find a focused and balanced compromise from each of these two extremes that makes sense and will be accepted by shareholders, employees, and various publics. This paper will illustrate such a balance and stress the need for dedicated leadership regardless of chosen tactics within a brewing manufacturing strategy.

*Rod McLeod has specialized in brewery and winery operations for over 30 years. As a member of MBAA since 1973, his expertise encompasses operations management positions, including brewer, plant management, VP operations as well as general management for a major Canadian brewer. Following graduation from the University of British Columbia, he obtained his M.S. degree in food science at the University of California, Davis. He also attended Harvard Business School. Over the past 12 years Rod has been VP technical affairs for First Key Consulting Inc. based near Vancouver, Canada. During this time he has provided leadership on dozens of global brewing projects encompassing capacity and facility evaluations, strategic planning, due diligence, and productivity enhancement.*

**O-28****The influence of mashing conditions on the fermentation characteristics of all-malt wort to produce beer or whisky**

Presenter: Graham Stewart, ICBD, Heriot-Watt University, Edinburgh, Scotland, UK

Coauthor(s): Takeshi Yonezawa, Suntory, Ltd., Osaka, Japan; Stephen Martin, ICBD, Heriot-Watt University, Edinburgh, Scotland, UK

Five different batches of wort were produced in the ICBD pilot brewery. One batch used a deep mash bed with sparging at 76°C, and two batches used a shallow mash bed with sparging at 76°C and 90°C, respectively. The remaining two batches employed a shallow mash bed with 90°C sparging after the mash bed had dried, and the other simulated a mash tun without raking. The worts produced using a shallow mash bed had higher concentrations of solids and fatty acids. Dielectric monitoring of fermentations showed that the behavior of the yeast cells was different, probably affected by the concentration of fatty acids. In all likelihood, the yeast could resist stress more effectively in the presence of increased wort fatty acids. These results provide additional evidence that the method of mashing has a direct effect on yeast behavior during fermentation, and these differences will influence the quality of the beer or distillate.

*Graham Stewart is professor of brewing at the International Centre for Brewing and Distilling (ICBD), Heriot-Watt University, Edinburgh, Scotland, and was its director from 1994 to 2000. He was a lecturer in biochemistry in the School of Pharmacy at Portsmouth College of Technology (now Portsmouth University) from 1967 to 1969. From 1969 to 1994, he held technical positions with Labatt's in Canada and from 1986 to 1994 was its director of brewing technical affairs. He became a member of the Institute of Brewing (now the Institute of Brewing and Distilling) in 1969, was elected a fellow in 1987, and was the institute's president in 1999 and 2000. He is also a member of the MBAA and ASBC. He was the ASBC's international director from 2000 to 2002. In addition to coauthoring and editing 6 books, he has published more than 250 original papers, patents, and reviews.*

**O-29****Award of Merit Lecture: Supply chain vulnerability—Is it really God's fault?**

Presenter: Frank Kirner, St. Louis, MO

The lecture will cover the following topics: 1) control of genetically modified crops; 2) direct contamination of crops via tainted ground or irrigation water; 3) the impact on the grains supply of the increasing demand for corn to provide energy through the production of ethanol rather than food stocks; and 4) the hazards of brewing processing aids.

*Frank Kirner holds a B.S. degree in chemical engineering from the University of Notre Dame (1965); M.S. degree in chemical engineering from the University of Toledo (1970); and diploma in brewing technology from the Siebel Institute of Technology (1977). He served as a U.S. Navy submarine officer from 1965 to 1969. Frank has worked as a professional engineer in a variety of jobs, including environmental engineer, Chester Engineers, Coraopolis, PA; environmental manager and assistant brewing development manager, Jos Schlitz Brewing Company; and manager of brewing development, senior assistant brewmaster Los Angeles, director of research and development, director of brewing material control, Anheuser Busch Inc. Frank also has served as technical chair and MBAA president (2002–2003).*

**O-30****Improvement in design and delivery of green beer movement into maturation and the start up and installation of state-of-the-art centrifuges**

Presenter: Raymond Kanzleiter, Miller Brewing Co., Wauwatosa, MI

One of the areas identified for improvement in quality and cost was the movement of green beer through centrifugation into maturation. In 2006, the Trenton, OH, brewery was selected to implement an entire reconfiguration of piping to allow beer to exit the fermenting cellars on the way to maturation. Along with this project, Miller Brewing became the first brewer in the world to implement the new Westphalia GSE 550 centrifuge. This one unit replaced four Westphalia SA80 machines servicing the kieslguhr filters for one stream of beer into maturation. This presentation will provide an overview of the process and progress to date, demonstrating how the equipment guarantees were developed and tested and the improvements in quality parameters and asset care associated with this installation.

*Ray Kanzleiter began his brewing career with Miller Brewing in 1979 at the Eden, NC, brewery as a brewing supervisor. He then worked at the Fulton, NY, brewery and was a start-up team manager in the Brewing Department at the Trenton, OH, brewery in 1991. In 1994 he joined the corporate brewing staff in Milwaukee, WI, as a senior staff brewer and was heavily involved in the initial international launching of Miller Genuine Draft in Europe. He then served Miller Brewing as brewing manager at both the Albany, GA, and Fort Worth, TX, breweries. In 2002, Ray returned to Milwaukee as corporate brewing manager, responsible for all aspects of brewing and brewing processes at Miller. He is a graduate of the University of Illinois at Champaign-Urbana and of the Siebel Diploma Course in Brewing.*

### O-31

#### An assessment of the physiological status of yeast during high and low gravity wort fermentations determined by flow cytometry

Presenter: Paul Chlup, International Centre for Brewing and Distilling (ICBD), Heriot-Watt University, Edinburgh, Scotland  
Coauthor(s): Graham Stewart, International Centre for Brewing and Distilling (ICBD), Heriot-Watt University, Edinburgh, Scotland

The use of flow cytometry as a analytical tool during high and low gravity wort fermentations has been investigated. A flow cytometer is a powerful instrument capable of determining the physiological status of *Saccharomyces cerevisiae* cultures in nearly real time. Flow cytometry possesses technology that performs simultaneous multiparametric analyses of yeast's physical and chemical characteristics based on cell size, relative granularity and fluorescence. The differentiation of subpopulations permits the classification of stressed and non-stressed cells of brewing yeasts. Flow cytometry and fluorescent dyes provide a rapid and accurate means to monitor the viability and vitality of yeast throughout fermentation. The viability method distinguishes between dead, live and damaged cells. Propidium iodide (PI) and fluorescein diacetate (FDA) probes are used as markers to determine functioning cells. The vitality of the cells is determined by their intracellular pH and employs the pH-dependent fluorescent probe carboxy SNARF-4F. SNARF possesses two inversely related emission signals at two different wavelengths, which makes it possible to calculate the pH from the ratio between the fluorescence intensities measured at the two wavelengths. Predictors of yeast performance such as intracellular glycogen and trehalose concentrations, assayed by flow cytometry, have been established. In addition, a flow cytometric method has been developed to detect mannan, an unfilterable beer haze constituent, that is released from the yeast cell wall by hydrodynamic stresses during processing. Furthermore, flow cytometry provides an innovative, rapid and viable option for brewers to evaluate yeast cells during fermentation and the influence that beer processing conditions have on yeast and beer stability.

*Paul Chlup is currently conducting research for his Ph.D. thesis at Heriot-Watt University, Edinburgh, Scotland. He received his M.S. degree in brewing and distilling from Heriot-Watt University in July 2005. In 2000, he received a Master Brewer diploma at the University of California, Davis. He has worked for Anheuser-Busch, Spozel Brewery, and Harpoon Brewery.*

### O-32

#### Visual versus instrumental perception of haze

Presenter: Karl Siebert, Cornell University, Geneva, NY  
Coauthor(s): Christine Fleet

In order to set specifications for beer clarity, either 'as is' or after forcing tests, it is helpful to know the relationship between what laboratory (or in-line) instruments tell you and what people can actually see. Remarkably little has been published in this area. In part this is because re-suspending haze collected from beer at different concentrations produces artifacts since a large portion of it is water soluble. Synthetic polymer beads of three different sizes (0.15, 0.31 and 0.70  $\mu\text{m}$  diameter) were obtained, and each was suspended in liquids of three different colors (clear, amber and dark brown) at a range of known concentrations, resulting in nine sample sets. A box containing a viewing window and four light sources near the corners was constructed. The box was lined with black velvet. Perception thresholds for individual panelists for each sample set were determined using the ascending method of limits. Each panelist was individually shown samples in groups of three, all of the same color. Two samples were blanks, and the third had added particles; the position (left, right or center) of the sample with added particles was randomized. The panelist was asked to indicate which sample looked hazier. The samples were then removed and replaced with another group of three in which the particle concentration was doubled in the sample with the addition. Each panelist's individual threshold for a given sample set was calculated as the geometric average of the lowest sample concentration identified correctly and the next lower concentration and could be expressed as the weight concentration, particle number concentration, or the haze measured with a turbidimeter. The panel mean threshold was then calculated and expressed in each way. Panel thresholds for the different sample sets were quite different when expressed as weight concentration or particle number concentration, but remarkably similar when expressed in terms of turbidimeter measurements (ranging from 0.206-2.19 NTU). This shows a good relationship between instrumental observations (90° scattering) and human perceptions. There was a distinct tendency for thresholds to be higher in the dark colored solutions. Cutting illumination intensity in half resulted in lower thresholds than with brighter illumination (i.e., haze was more readily perceived). Reducing illumination considerably further resulted in thresholds intermediate between the two higher illumination levels. Changing the viewing background from black to white resulted in as much as a 40-fold increase in threshold for the same sample set, indicating it was much more difficult to perceive turbidity against a light rather than a dark background.

*Karl Siebert received a Ph.D. degree in biochemistry from Penn State in 1970. He then joined the Stroh Brewery Company in Detroit, MI, where he spent 18 years and held positions from research associate to director of research. In January of 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, received the ASBC Eric Kneen Memorial Award (for the best paper in the Journal of the American Society of Brewing Chemists in the prior year) three times. Karl was made an Honorary Professor of the Moscow (Russia) State Academy of Food Processing in 1996, and in 1999 he received the ASBC Award of Distinction. He is currently a member of the ASBC Journal Editorial Board. Karl's research interests involve foam and haze in beverages, the application of chemometric methods in food science, and assessment of microbiological risk.*



**O-33****The recovery of polyphenols from PVPP and their antioxidant capacity**

Presenter: Charles Bamforth, University of California, Davis, CA  
Coauthor(s): Cale May, University of California, Davis, CA

The adsorption onto, and desorption of polyphenols from, PVPP has been investigated. Water, caustic and alcohol have been evaluated for their relative ability to recover polyphenol, but it appears that polyphenol binding is somewhat tenacious. The ability of recovered polyphenols to act as antioxidants has been assessed in comparison with beer, wines and other materials. Recovered polyphenols retain antioxidant capacity.

*Charlie Bamforth, Ph.D., D.Sc., is chair of the Department of Food Science & Technology and Anheuser-Busch Endowed Professor of Malting & Brewing Sciences at the University of California, Davis. He has been part of the brewing industry since 1978. He was formerly the 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 and of the Institute of Biology. Charlie is editor-in-chief of the Journal of the American Society of Brewing Chemists and has published innumerable papers, articles, and books on beer and brewing.*

**O-34****Dry lubricant technology for the brewery industry**

Presenter: Chad Thompson, Ecolab, Inc., Eagan, MN  
Coauthor(s): Leanne Adkins, Ecolab, Inc., Eagan, MN

The brewery industry is constantly striving for increased efficiency. Water is becoming an increasingly important component in our operations. This work explores the use of dry lubricant in the brewery industry. Discussion of laboratory analysis will be explored to include line lubricity, compatibility and cleanliness. In addition, the work will include the review of the engineering of the system in a large brewery to substantiate water reduction, operational gains, safety enhancements, and plant aesthetics.

*Chad Thompson is a new member of MBAA; however, he has more than 15 years of packaging engineering experience. He combined his passion for brewing with packaging design and development by taking on the role of scientist in the Brewery & Beverage Division of Ecolab, Inc. He has been involved in the brewing process for 10 years and has been with Ecolab for 3 years. During his time at Ecolab, he has contributed to numerous business segments within the corporation. Chad received a degree from Michigan State University in packaging engineering and has been granted three patents for his work.*

**O-35****Reducing potential quality problems in the modern brewery while simultaneously improving pasteurizer service life**

Presenter: Jack Bland, ChemTreat, Inc., Richmond, VA

Coauthor(s): Jeff Tito, SAB/Miller, Albany, GA; Ken James, ChemTreat, Inc., Lilburn, GA; Bruce Johnston, ChemTreat, Inc., Ojai, CA; Tom Soukup, ChemTreat, Inc., Baltimore, MD; Tom Szabo, ChemTreat, Inc., Jackson, NJ

Virtually every global brewery has successfully implemented water conservation measures in the packaging area to include pasteurizers and associated water reclamation systems. These efforts, coupled with the increased water and energy efficiencies of modern pasteurizer designs, have led to much longer water retention times within pasteurizer systems. The increased retention times no longer allow for “solution by dilution effect” for any external organic contaminants entering the pasteurizers compared to previous operation. A new series of consumer complaints has arisen as a result of this increase in efficiency and reduced water consumption in both bottle and can pasteurizers. This paper will examine the various potential problems related to a reduction in water usage such as: increased complaints from “medicinal” or “musty” taste and odors, can lacquer overcoat varnish deterioration, bottle crown rusting, pasteurizer corrosion issues, and increased chemical consumption. Recommendations for problem resolution and a path forward in reducing the above problems, as well as case histories of successful implementation of corrective action, will be detailed in this paper.

*Jack Bland, director, corporate sales, ChemTreat, Inc. in Richmond, VA, has been a member of MBAA since 1980, formerly District Baltimore and currently District Mid-Atlantic. Jack has authored five MBAA papers on a variety of topics related to brewery water treatment, and he received the MBAA Presidential Award for two of these papers in 1986 and 1995.*

**O-36****Energy-saving technology that enhances pasteurization control in tunnel pasteurizers**

Presenter: J. David Duff, Barry-Wehmiller Company, St. Louis, MO

Advanced pasteurization control allows the brewer to eliminate the harmful affects of product over pasteurization caused by frequent packaging line stops. The advantage of this control technology comes with the disadvantage of higher utility consumption during those times when the tunnel pasteurizer needs to adjust its operation to preserve the normal pasteurization profile. With the addition of a new technology called IntelliFlow the tunnel pasteurizer has the enhanced capability of controlling pasteurization to the same standard without the added utility consumption. Hot and cooler water sources which are manipulated during the pasteurization control process are kept separate. This separation eliminates the need for additional energy required to maintain zone temperature set points. This review covers a more specific description of the pasteurization control and IntelliFlow technologies coupled with a utility consumption comparison using flash pasteurization technology versus tunnel pasteurization technology when the tunnel pasteurizer includes the IntelliFlow system.

*David Duff has been a member of the MBAA since 1982 and has held positions in his local district, as well as contributed on the Technical Committee as an organizer and session moderator for the MBAA National Conference in Minneapolis, MN, in 1998. David began his career with Labatt Brewing Company and after completing the Labatt Management Trainee Program, he held various packaging management roles in five different Labatt facilities throughout Canada. In 1997 David left Labatt to join forces with the Stroh Brewing Company and worked at their headquarters in Detroit, MI, as director of packaging operations until the brewery ceased operations. For a short time after leaving Stroh, David worked with Pepsi Bottling Group as plant manager in their Detroit facility before returning to the beer industry in 2005 as the North American sales executive for Barry-Wehmiller Company.*

**O-37****Fine adjustment of amount of beer filling according to can size and improvement of accuracy in filling with a mechanical can filler**

Presenter: Yasuo Kawai, Asahi Breweries, Ltd., Suita, Osaka, Japan

Coauthor(s): Masatake Taguchi, Asahi Breweries, Ltd., Moriya, Ibaraki, Japan

At Asahi Breweries, 350 mL and 500 mL cans are produced as the principal canned beer product; however, frequent switching between 350 mL and 500 mL cans is required because production is synchronized with daily sales. A vent tube is a filler component to control the amount of filled beer, and the amount filled is determined by the distance from the bottom of the can to the vent tube. While the distance between the top rim of the can and the liquid surface is the same for both 350 mL and 500 mL cans, any difference from the specified filling amount is due to the difference in the rotation rate of the filler and the filling rate of beer when a vent tube of the same length is used. Accordingly, vent tubes with a different length are used and manually changed when the can size changes. Because of possible microbial contamination during this process, CIP is performed every time a vent tube is changed. At Asahi Breweries, non-pasteurized beer is produced. To solve this problem, a vent tube that can be switched with a simple operation for two different filling amounts was developed. Since switching can be made simply by using a special metal tool, the possibility of microbial contamination and the time for CIP are eliminated. Furthermore, by improving the venting configuration, the accuracy of the filling amount for individual cans is improved.

*Yasuo Kawai received a B.E. degree in mechanical engineering from Osaka Institute of Technology, Japan. He started his employment with Asahi Breweries, Ltd., in April 1988 as an engineer at the brewery: Tokyo brewery (5+ years); Hokkaido brewery (3 years); Nagoya brewery (2 years); Research and Development Laboratory (2 years); Engineering Training Center (3 years); and Production Technology Center (3+ years).*

**O-38****Streamlining data flow through M.E.S.**

Presenter: Jean Toumi, Boulevard Brewing Co., Kansas City, MO

Manufacturing execution system, or MES, is a database that replaces the paperwork and spreadsheet systems that most small companies use for monitoring their batch processes. An MES is an effective method for breweries to track and trace their ingredients and processes from maltster to final product. Although the paper and spreadsheet method is a good way to store data, it can be extremely difficult to gather information from multiple tasks to evaluate holistically in case of product recall and benchmarking “the golden brew.” An MES is able to facilitate root cause analysis by relating all incoming ingredients to the batch processes that use them and relate lab data to the batches that generated the samples. The MES does this by recording the movement of batches through complex many-to-one/one-to-many relationships generated by the transfer of wort and beer from unit to unit within a brewery which facilitates measurement of operational efficiency and the setting of quality limits. The success of the project is determined by how efficiently the MES is able to provide quality and production reports to its end users. To achieve this ultimate goal a cross-functional team of management, lab staff, engineering, and brewery staff needs to document the process flow and critical data of the brewery and deliver them as requirements to the MES supplier.

*Jean Toumi started his brewing career in 1997 at Humboldt Brewing Company in packaging. In 1999 he joined Boulevard Brewing Company. Since 1999 Jean has worked in packaging, brewing, filtration, QA, and in MES implementation/maintenance. Jean received his degree from DeVry University in business and technology management, Kansas City, and has attended the Siebel Institute's Short Course in Brewing Technology and the Brewing Microbiology Course.*

**O-39****Shipping wort as an innovative approach to maximizing brewpub efficiencies**

Presenter: Larry Chase, Granite City Food & Brewery, Ellsworth, IA

Coauthor(s): Bob McKenzie, Granite City Food & Brewery, St. Louis Park, MN

The recently patented brewing process, Fermentus Interruptus®, is a novel approach to maintaining proprietary beer within a multiple-site brewery/restaurant concept. To maximize efficiency, consistency, and financial obligations the wort is produced at a central brewery and then shipped to each restaurant location for fermentation, maturation, and filtering. This flies in the face of conventional brewing wisdom which states that yeast should be added to the wort immediately after wort cooling. Along with discussing the financial motivations, we will describe brewing operations at both our central wort house and at our restaurant sites. We will share what we have learned from storing and shipping wort to build a chain of 20 plus brewery/restaurants using only 1 brewhouse and 2 delivery trucks.

*Larry Chase learned brewing on the job prior to attending the American Brewers Guild in 1998. An MBAA member since 2001, he is the St. Paul-Minneapolis District secretary. He has worked in brewpubs for 10 years, with the past 6 years at Granite City Food & Brewery. Chase has been involved with the operational development of Granite City Food & Brewery's wort-shipping program since its beginnings in 2001. He is currently the worthouse manager at Granite City Food & Brewery's central wort production facility in Ellsworth, IA.*

**O-40****Zen and the art of brewery maintenance**

Presenter: James Ottolini, The Saint Louis Brewery, St. Louis, MO

In terms of breweries and the associated technology needed to make quality beer, we look at the components and what they are. The art of making our quality products and maintaining those standards lies more in a look at the components and what they mean to us. We use this viewpoint to look at the maintenance of all the equipment necessary as well. The art of maintenance also lies in having a look at who is responsible, not just necessarily what is responsible. In this, we look at the practical side of applying theory in brewery maintenance and the tools and manners we can use to effect this. The result is new openings for transforming the current regimen from within an organization and carrying out the quality and meaning that drives our production.

*James Ottolini has been a member of the MBAA since 1994, contributing as a member of the Technical Committee in District St. Louis. He has received the MBAA scholarship to the Packaging and Technology Course and another toward attending Brewery Engineering and Maintenance at the Siebel Institute. He began his career in brewing at The Saint Louis Brewery Inc., producers of Schlafly brand beers in St. Louis, MO, in 1992. He is currently head of brewing operations for the Schlafly Bottleworks in St. Louis.*



**O-41****A discussion of wastewater opportunities for the craft brewer**

Presenter: John Mercer, Deschutes Brewery, Bend, OR

No matter if your brewery is located in a big city, small town, or in the country, problems with brewery wastewater are universal. This discussion presents real-world wastewater technologies and advice for all breweries, including successes and challenges from a variety of brewers around the country.

*John Mercer has been in the water and wastewater field since 1996 and the wastewater manager at Deschutes Brewery in Bend, OR, since 1998. He has a B.S. degree in environmental biology from Eastern Illinois University and has a Level II Wastewater Operators certification for the state of Oregon. He is surprisingly interested in brewery wastewater and the challenges of being downstream from 50 people putting things down the drain.*

**O-42****Sensory characterization of hop oil fractions in classical beer styles**

Presenter: Ray Marriott, Paddock Wood, Kent, UK

Coauthor(s): Christina Schoenberger, Joh. Barth & Sohn, Nuremberg, Germany

The chemistry of hop oil and hop oil fractions has been extensively studied over the last two decades, but their organoleptic properties and their application in a wide range of beer types is less well understood. A potent flavor-impact hop molecule, dry hop characters and hop oil fractions have been evaluated in classical beer styles by an expert taste panel with the appropriate flavor descriptors. The sensory impact of hop oil fraction is very versatile, producing enhancing as well as suppressing effects, which were observed in different beers. These hop oil fractions comprise versatile possibilities to react to changing consumer expectations. In contrast to hop oil fractions the dry hop characters exhibit enhanced aroma in the headspace of the beer and allow the relative aroma intensity rather than the flavor intensity to be manipulated. These sensory results should help the brewer to understand the impact of hop oil molecules and the possibilities of these molecules for new brewing innovations as an alternative or an addition to traditional hopping methods.

*Ray Marriott obtained his first degree at Cambridge and followed this with a Ph.D. degree in terpene chemistry at the University of Bath. Ray is R&D director of Botanix Ltd, a company that specializes in the development of advanced hop products for brewing and many other applications. Ray has spent over 30 years in the food and flavoring industry in the United Kingdom, mostly in technical management. He is a biochemist and has been primarily concerned with the extraction and processing of natural products and the mechanism and enhancement of enzyme pathways responsible for the generation of key active compounds, particularly those that can be derived from U.K. crops. Ray is a member both of the IGB and ASBC and regularly presents papers on the applications of hop compounds, covering all aspects of their use from aroma to antimicrobials. He is also visiting professor of chemistry at the University of York, UK.*

#### O-43

##### **The impact of a new heavy metal-adsorbing filter aid on flavor stability**

Presenter: Markus Herrmann, Lehrstuhl für Technologie der Brauerei I, Freising, Germany

Coauthor(s): Martina Gastl, Lehrstuhl für Technologie der Brauerei I, Freising, Germany; Nikolaj Schmid and Spika Gero, BASF Aktiengesellschaft, Ludwigshafen, Germany; Werner Back, Lehrstuhl für Technologie der Brauerei I, Freising, Germany

Flavor stability is a complex topic and cannot easily be related to a single process in brewing technology. The effect of ageing originates on the one hand from the loss of positive flavor and aroma compounds and on the other hand by the formation of ageing compounds. The development of the ageing taste is caused mainly by oxidation reactions. Slight concentrations of oxygen are already enough as they are inevitable even with optimum bottling. Antioxidative beer ingredients can delay the formation of the ageing aroma and thus counteract the oxidation reactions. The three most important influence factors are the formation of ageing components (e.g., Strecker-aldehydes), the protective attributes of antioxidative substances (SO<sub>2</sub>, Phenols, etc.) and the masking effects of flavor compounds (linalool, esters, etc.). With regard to the reaction mechanism of beer staling metal-catalyzed reactions (e.g., radical mechanism, heavy metals) influence flavor stability negatively. For example heavy metals like iron and copper catalyze the Haber-Weiss and Fenton reaction causing the formation of radicals. Ageing components, antioxidative substances and flavor compounds can be objectively measured by various methods (e.g., GC, HPLC, and ESR) to evaluate flavor stability analytically. Each of these analyses correlate individually under the correct circumstances with the sensory evaluation of the beer. The application of filter aids provides an opportunity to remove negative prooxidative substances by filtration. The application of Divergan HM polymer is a new approach to improve the quality of beer flavor and colloidal stability in the brewing process. Lehrstuhl für Technologie der Brauerei I, TUM-Weihenstephan/Germany measured the effect of Divergan HM polymer on flavor stability of beer by analytical and sensory evaluation. BASF Divergan HM polymer is a novel filter aid which works by adsorbing the heavy metal particles in aqueous and aqueous alcoholic liquids. It is insoluble in water and all common solvents, biologically inert and easy to handle. In the presented investigations Divergan HM was added in different concentrations to a kieselguhr filtration as a filter aid to check the effect on flavor stability. We show results from pilot scale (50 L) and half-industrial scale (8 hL) trials. A trial on an industrial scale is currently being prepared. The fresh and forced aged beers were analyzed for their concentration of heavy metals, ageing indicators, and in addition, a sensory evaluation was done. The addition of Divergan HM polymer resulted in a significant improvement in flavor stability.

*Markus Herrmann graduated at the Technical University of Munich Weihenstephan as a diploma engineer degree in brewing and beverage technologies in 2000. Since then he has worked on his doctorate on the topic of flavor compounds in Bavarian wheat beers under the chair for brewing technology I (Prof. Back), finishing it in 2005. Since 2004 he has been the scientific assistant to Prof. Back and also head of the chair's gas chromatographic and liquid chromatographic laboratories.*

#### O-44

##### **Influence of beer matrix composition on bitter sensation**

Presenter: Martina Gastl, TUM Lehrstuhl für Technologie der Brauerei I, Freising, Germany

Coauthor(s): Stefan Hanke and Werner Back, TUM Lehrstuhl für Technologie der Brauerei I, Freising, Germany

It is a fact that the drinkability of beer is promoted by a good harmony between the different beer ingredients and aroma compounds. Today there is a very clear trend toward mild beers with bitter units between 10 and 25 BU or lower. The main contribution to the bitter flavor of beer is due to isohumulone. It is known that components of the beer matrix like alcohol content, dextrin, pH (organic acids) and proteins have an influence on the bitter taste and the drinkability of beer. This paper shows the influence of different substances of the beer matrix on the bitter taste threshold. In addition to a human taste panel, a "taste sensing system" is used. Hop flavor, but also the impression of bitterness can advance the harmony and drinkability of the beer. The taste sensing system is an analytical instrument that is able to differentiate components in solution. Taste sensors with different characteristics, bitterness, sourness, umami and saltiness, are available. In these trials the taste sensing system SA402B (Intelligent Sensor Technology, Inc.) is used. Trials have been done to investigate the flavor threshold of iso-alpha-acid depending on the matrix composition of the beer. In the first step monomer composites have been investigated to detect the influence of the single-matrix compounds. The alcohol, dextrin and pH of the medium have been tested. In the second step dimer mixtures have been investigated to determine the interactions of each on the threshold of bitter taste by the use of iso-alpha acids. Determination of bitter substances, bitter threshold and sensory evaluation of beer were executed according to MEBAK or Analytica-EBC. An influence of the matrix on the taste of bitterness can be determined. The results of different matrix compositions in aqueous solutions are already presented. This paper presents the next step of these investigations. After the investigation of defined matrix compositions in aqueous solutions, trials have been done to investigate the flavor threshold of iso-alpha-acid by a human taste panel and matrix effects depending on the composition of beer matrix itself caused by defined changes of the beer matrix. The results of the taste sensing system and human perception will be presented and compared.

*Martina Gastl was born in 1974. She graduated as a brewer and maltster in Klosterbrauerei Andechs, Germany (1994–1996) and studied brewing science and beverage technology at TU München-Weihenstephan, Germany (1996–2002). From 2002 until 2006 she worked on her doctoral thesis under the chair for brewing technology Lehrstuhl für Technologie der Brauerei I (TU München-Weihenstephan) on "Technological Influence on Lipid Degradation in Terms of Improvement of Beer Flavour Stability." Since 2002 Martina has been a scientific employee and since 2005 a scientific assistant and head of the GC/HPLC laboratory at Lehrstuhl für Technologie der Brauerei I (TU München-Weihenstephan).*

## O-45

### The effect of acids on the perception of astringency

Presenter: Karl Siebert, Cornell University, Geneva, NY  
Coauthor(s): Claire Euzen Nestle – PTC Beauvais, Beauvais, France; Atsushi Maekawa, General Mills, Carson, CA

Astringency is caused by several dissimilar classes of chemicals, two of which, polyphenols and acids, are present in beer. Polyphenol astringency is caused by binding of ingested polyphenols to the proline-rich proteins (PRPs) in saliva. The resulting precipitation reduces the lubrication these proteins normally provide to oral surfaces and results in the sensation of astringency. Acids alone in water are also astringent, and sensory testing showed they intensify polyphenol astringency. It was recently suggested that the effect of acids on astringent intensity is a result of the effect of pH on protein-polyphenol interaction (Siebert & Chassy, Food Qual. & Pref. 15:13-18, 2003). When the pH of saliva was adjusted, either with or without added polyphenol, it demonstrated a sharp maximum in light scattering (caused by insoluble particles) slightly above pH 4. When acid drops the pH of saliva from its normal level near pH 7, stronger interaction between ingested polyphenols and PRPs would occur, which would result in greater astringency. This wouldn't, however, explain why acids alone in water are astringent unless there is normally polyphenol as well as PRP in saliva. Measurements of total polyphenols in saliva were carried out soon after consuming tea and after overnight abstinence from anything but water. Measurable amounts of polyphenol were detected in both cases, with higher levels soon after tea consumption. It was concluded that polyphenols are normally present in saliva. Experiments were carried out with tea drinking that showed that the baseline level of an individual's polyphenol content could be increased by tea drinking. As a result, individuals may differ in the strength of their astringency perceptions not only because of their recent history of consumption of polyphenol-containing foods (e.g., coffee or tea), but also because they have different baseline polyphenol levels due to their particular dietary habits. Sensory experiments were conducted with dilute HCl solutions of several concentrations. Measurements of the pH of expectorated samples were performed, and the results showed a clear relationship with astringency perception.

*Karl Siebert received a Ph.D. degree in biochemistry from Penn State in 1970. He then joined the Stroh Brewery Company in Detroit, MI, where he spent 18 years and held positions from research associate to director of research. In January of 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, received the ASBC Eric Kneen Memorial Award (for the best paper in the Journal of the American Society of Brewing Chemists in the prior year) three times. Karl was made an Honorary Professor of the Moscow (Russia) State Academy of Food Processing in 1996, and in 1999 he received the ASBC Award of Distinction. He is currently a member of the ASBC Journal Editorial Board. Karl's research interests involve foam and haze in beverages, the application of chemometric methods in food science, and assessment of microbiological risk.*

## O-46

### Reducing beer loss on the racking line: A practical case study

Presenter: Darren Moser, Trumer Brauerei, Berkeley, CA

Loss reduction and ensuring product consistency are vital concerns in brewery packaging. In order to reduce losses and improve fill consistency in draught product, a volumetric fill system replaced the existing overflow sensing fill. Over the course of racking operations using the overflow sensing fill apparatus, product loss was high as a result of overfilled kegs. It was also suspected and tested that fill volumes differed from keg to keg as a result of damage suffered to kegs as well as design differences between three different keg manufacturers. Kegs were monitored for fill differences by weight using an in-line scale. Beer loss strictly due to fill levels, before and after the change in equipment, was tested and compared across the float. Installation and use of a volumetric fill system is worthwhile for breweries of any size as a relatively simple means of reducing beer loss. It was estimated that the equipment modification would pay for itself within 7 to 9 months, based on the volume of beer saved per keg filled. Continued data monitoring will verify long-term cost savings.

*Darren Moser has been employed with the Trumer Brauerei in Berkeley, CA, since June 2005 and is currently the lead brewer. He holds a B.S. degree from Juniata College in Huntingdon, PA, and is a graduate of the Master Brewers Program from the University of California Davis. Darren has been an active MBAA member since 2005.*

**O-47****Development of a system to reduce residual beer in keg filling**

Presenter: Masaaki Shinonaga, Asahi Breweries, Ltd., Japan  
 Coauthor(s): Masatake Taguchi, Asahi Breweries, Ltd., Japan;  
 Takaya Nagafune, Asahi Food & Healthcare, Ltd., Japan;  
 Satoshi Kusano, Siga Yamashita, Co., Ltd., Higashioumui,  
 Shiga, Japan

We studied the possibility of reducing residual beer that remains in the beer-filling machine after filling each keg. The keg filler used at our brewery is a linear lane type filler from a Japanese manufacturer, and a certain amount of beer remains in the filling block when filling is complete. The residual beer is removed with a blowing process that is initiated after each filling; the removed beer is sent to the save tank. The residual beer amounts to several kiloliters per day, and thus, a more effective filling method was required. In order to reduce residual beer, we studied a method to reduce the interior volume of the filling block as well as a method to reuse the residual beer. In cooperation with the manufacturer of the keg filler, we developed a method where the residual beer in the filling block is pushed back to the inlet side piping by the pressure of CO<sub>2</sub> gas, and the recovered beer is temporarily stored in a variable volume tank using a resin membrane and then used to fill the next keg. This method is called the blowback filling method, and an evaluation of this method on a commercial production line shows a reduction of residual beer in the filling block to about 75%, which is equal to a reduction of 120 kL of beer annually.

*Masaaki Shinonaga, B.S., Faculty of Agricultural Chemistry, Tokyo University of Agriculture and Technology joined the Packaging Department, Suita Brewery, Asahi Breweries, Ltd. in 1997 and Yantai Beer Asahi Co., Ltd., Shandong, China, in 2000. In 2002 Masaaki joined the Production Technology Center, Asahi Breweries, Ltd. Since 2006 Masaaki has worked in Packaging Department No. 1, Ibaraki Brewery, Asahi Breweries, Ltd.*

**O-48****Quality control of barrier-enhanced bottles**

Presenter: Roland Folz, VLB, Berlin, Germany

Plastic containers and closures have taken on an important role as packaging materials for the brewing industry. Alongside the many well-known advantages there is the problem of plastic's inherent permeability to gases (O<sub>2</sub> and CO<sub>2</sub>). To enhance the barrier properties of plastic material, different bottle systems, for example multilayer, internal coatings and blends, were developed. The quality of these various systems can be evaluated through the measurement of permeation. Since the demand for permeation measurement has reached the market, novel methods for measurement are proposed and offered. The diversity of systems leads to a situation in which measurement results from different sources cannot be compared which each other. The lecture contains a comparison of existing methods with novel methods and at the same time an evaluation of the latest development in barrier-enhanced plastic bottles and closures. Methods: The existing VLB method for the permeation measurement of O<sub>2</sub> and CO<sub>2</sub> as a real-time method is presented, and a new method is introduced that works with a non-destructive and non-invasive measurement. The methods are compared. Results and Practical Relevance: Deviations in the results of different permeation measurement methods that do not work with the real kinetic exist and must be an essential part of any discussion about barrier effects. The existing quick permeation measurements will not substitute for a real time permeation test but may be seen as important methods to detect relevant quality deviation in delivered bottles or self-coated bottles in an incoming goods inspection and routine control for breweries and bottlers.

*Roland Folz attended an apprenticeship as a brewer and maltster at Beck's Brewery in Bremen, Germany. After working another year for Beck's brewery, he started his studies in Berlin and received a diploma engineer degree in brewing technology from the Technical University, Berlin. After graduation, he was head of the Technical Department/Production at the Preussen Pils brewery in Pritzwalk, Germany, for two years. In October 2006, he returned to VLB-Berlin as a consultant for brewing technology and now works for the Engineering and Packaging Department as the specialist for the filling department and PET topics.*



**O-49****Solar energy collector to heat bottle washer water**

Presenter: Cornelia Stumpe, Kronos AG

The many processes in a brewery—like boiling, CIP, and bottle washing—are energy consumers. In these days with a continuous increase in energy prices, it is more and more important for companies to become free from this unpredictable variable. Kronos AG has developed a concept to use solar thermal energy in the brewery to support traditional energy sources, and this we want to present. By the use of a solar collector (with water as the heat transfer medium) from our partner, Paradigma GmbH, the vision is coming closer to reality. As an example, the fossil fuel energy requirement of a bottle washer can be substituted for by nearly 90% with solar thermal energy during the summer in Germany. The overall economic benefit depends upon the actual location of the brewery and the amount of solar energy reaching it. But, if it is possible in Germany, it must also be possible almost anywhere else in the world.

*Cornelia Stumpe studied the technology and biotechnology of food at the Technical University of Munich, Weihenstephan, Germany, and finished with a diplom ingenieur degree in 2003. After that Cornelia started working with Steinecker GmbH on the commissioning team. In 2006 Cornelia became lead of a group of 12 people within the commissioning team. Cornelia is now working with the R&D group in Neutraubling.*

**O-50****Gluten-free beer from proso millet malt (*Panicum miliaceum*)**

Presenter: Martin Zarnkow, TU München Weihenstephan, Freising, Germany

Coauthor(s): Elke Arendt, University College Cork, Ireland; Werner Back and Felix Burberg, TU München Weihenstephan; Freising, Germany; Matthias Keßler, Saaten-Union GmbH, Isernhagen, Germany; Stefan Kreis, TU München Weihenstephan, Freising, Germany

Celiac disease (CD) is a condition in which the person's body reacts to the prolamins found in wheat, rye, barley, and oats. Gluten consumption by sufferers of celiac disease excites an inflammation of the small intestine leading to the malabsorption of several important nutrients. The only way to treat CD is through a total lifelong avoidance of gluten consumption. Recent studies have shown that CD is as frequent in the United States as in Europe. It is assumed that proso millet was domesticated and first cultivated in northern China, where it was the primary crop before barley and wheat were established. Today about 5 million tons are harvested worldwide, most of it originates from the former Soviet Republics, China and India. *Panicum miliaceum* is widely spread in arid and semi-arid areas. The objective of this study was to optimize the malting, mashing and fermentation conditions for *Panicum miliaceum* using different methods. Response surface methodology was used to investigate the influence of three malting parameters, like degree of steeping, germination time, and temperature, on the quality of proso millet malt. Germination times varied from 5, 6, and 7 days, degrees of steeping were 44, 48, and 52%, and germination temperatures were 16, 20 and 24°C. Kilning temperatures of 65°C were used for all the malts. The optimal malting program was achieved with 5 days germination time, 44% steeping and 22°C steeping and germination temperature. Based on this pattern different varieties of proso millet were malted. Concerning malt quality and availability, the best variety was chosen. This variety is named braune Wildform (brown wild form). With this optimal malt (with optimal variety) different protein fractions (method: size exclusion chromatography) were investigated for their amylolytic enzyme activity. The defined fraction was added under various conditions (temperature, pH, time) to enzyme inactive proso millet malt wort. The carbohydrate content of these worts was examined to obtain optimal mashing conditions. Mash under optimal conditions was then lautered in conventional facilities, cooked with hop products, cooled, and fermented with different yeast strains. A promising result was obtained with Alt, Kölsch, and Champagne strains.

*Martin Zarnkow apprenticed as a brewer and maltster from 1989 to 1991 at a small brewery in Frankonia, finishing a diplom-ingénieur (FH) degree with an option in brewing technology in 1996 at TU München Weihenstephan. Martin worked as a brew master for one year in a medium-sized brewery in Germany. Since 1997 Martin has been science assistant and head of the beer laboratory at the Lehrstuhl für Technologie der Brauerei I at TU München Weihenstephan. Since September 2005 Martin has worked as a Ph.D. research fellow at the University College of Cork, Ireland, on malting and brewing with nontraditional cereals.*

## O-51

### **Emmer (*Triticum dicoccum*): Ancient grain for highly aromatic malts and beers—Technology and process in modern brewing**

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

Coauthor(s): Martin Zarnkow and Werner Back, Technische Universität München, Freising-Weihenstephan, Germany; Elke Arendt, University College Cork, Ireland; Andreas Richter, Weyermann Specialty Malting, Bamberg, Germany

The ancient grain Emmer dates back to 8000 B.C. Nowadays the ancient grain, which is an archetype of today's wheat varieties, is still being cultivated in small amounts in Central Europe, northern Africa and North America. Emmer is a tetraploid spelt wheat. Similar to malting of wheat, Emmer requires special attention during steeping, germination and kilning. Its use for brewing was investigated in statistical lab-scale trials from both the brewing and the process technology aspect. In a statistical malting trial, the variation of steeping, germination time and temperature was optimized to achieve a highly aromatic dark malt. The range of steeping was 37 to 47% moisture content; vegetation time, which is germination including steeping, was 6 to 8 days; and germination temperature ranged from 15 to 18°C. In a pilot scale of 100 kg and brewing trials >50% was used. Emmer malt from German cultivation was used as a grist charge in top-fermented beers and compared to standard wheat malt. The dark emmer malt provides a unique flavor profile and is therefore an interesting new grain for beer production. The poster describes specific characteristics of this grain, the process technology in malting and brewing, as well as the resulting beers.

*Jens Voigt received a degree as diploma engineer (M.S. degree) in Brewing and beverage technology from TU München-Weihenstephan, Germany, in 1985. He started his career with A. Steinecker GmbH, Freising, Germany, as a technical engineer in brewhouse and fermentation and filtration equipment. He held positions in sales and products and manager with Steinecker until 1995. He received his doctorate in brewing technology on beer foam (1988–1992) from Weihenstephan under Prof. Dr. 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, supplier of software solutions for the brewing industry. Since early 2004 he has been a research associate with Prof. Dr. Karl Sommer at Lehrstuhl für Maschinen- und Apparatekunde (chair for mechanical engineering and process technology) at the WZW (Wissenschaftszentrum Weihenstephan) (Center of Life Science, Weihenstephan) Jens is a member of the IGB and the editorial board and is a referee for papers in the Journal of the Institute of Brewing, London (JIB).*

## O-52

### **“Koda Energy”—Biomass to energy for economic survival**

Presenter: Paul Kramer, Rahr Malting Co., Shakopee, MN

The Shakopee Mdewakanton Sioux Community, a federally recognized Indian tribe and Rahr Malting Company have joined together to form Koda Energy. The Koda Energy combined heat and power plant will generate 16.5 net megawatts of baseload renewable electricity and deliver 125 million BTU per hour of process heat to Rahr Malting Co. The fuels sources for Koda Energy will be 100% biomass. These fuels will consist of byproducts from the malting operation, other local agri-business byproducts, dried waste wood and dedicated energy crops. Koda Energy will require 180,000 tons per year of these biofuels.

*Paul Kramer has been an employee of Rahr Malting Co. since 1979 and currently is the vice president of malt operations and president of Koda Energy LLC. He has held a variety of positions at Rahr Malting Co., including process engineering, assistant plant manager, and director of malt operations. He was the project manager responsible for the design and construction of Rahr Malting Co.'s tower malt production facility built in 1994, and he was part of the design team responsible for Rahr's malt production facility in Alberta, Canada, and Rahr's wastewater treatment facility in Shakopee, MN. Paul's current efforts include the permitting and construction of a 16.5 MW biomass-fueled CHP power plant located adjacent to the Rahr Malting Company malt production facility in Shakopee. Koda Energy is scheduled to begin operation in the fall of 2008. Paul received a B.S. degree in food science and technology from the University of Minnesota. Prior to joining Rahr Malting Co. Paul worked a research specialist at the University of Minnesota. Paul is a past president of both the Master Brewers Association of the Americas and MBAA District St. Paul-Minneapolis.*

**O-53**

**Brewed in Dixie—Nashville brewing from the Civil War to the modern day**

**Presenter: Scott Mertie, BCCA, NABA, ABA**

Known for country music, antebellum homes, the Parthenon, and Civil War battlefields, Nashville also has a rich brewing history that spans 100 years. Several breweries were established in the late 1800s, but the William Gerst Brewing Company alone endured into the 20th century and even survived Prohibition. Once one of the largest breweries in the South, Gerst brewed its last batch in 1954, leaving Nashvillians unable to enjoy locally brewed beer until the dawn of the recent microbrewery revolution. *Nashville Brewing* offers readers a pictorial account of the William Gerst Brewing Company—an important but almost forgotten part of Nashville history ([www.gerstbeer.com](http://www.gerstbeer.com)).

*Scott R. Mertie was born and raised in Ohio and has been living in Tennessee since 1992. Scott began picking up beer cans from the side of the road at the age of six and quickly became an avid collector. By the time Scott was a teenager, his passion grew to collecting all kinds of breweriana. While in college at The Ohio State University, his interest in the beer industry expanded to home brewing and the craft-beer revolution. Within a week of moving to Nashville in 1992, Scott visited the Gerst Haus for the first time. He was amazed at the vast amounts of breweriana displayed throughout the restaurant, which started his fascination with the William Gerst Brewing Company. Scott is a member of various national home brewing and breweriana collecting organizations. When he's not attending breweriana events or brewing a batch of beer, Scott works as a healthcare consultant for a regional CPA firm. He lives in Brentwood, TN, with his wife Candy and two dogs.*

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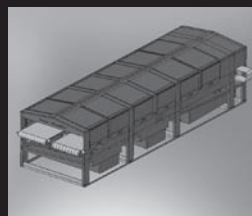
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**Micro SE  
Tunnel Pasteurizer**



The MicroSE Single End (SE) Pasteurizer is designed to meet the needs of the craft brewer and beverage manufacturer. The single end pasteurizer is available in two sizes to accommodate line speeds from approximately 100cpm to 200cpm. Containers travel the length of the machine, then transfer to a mat top chain running in the opposite direction, bringing the containers back to the packaging line conveyor.

# Abstracts

## Poster Presentations

**P-54**

### **The loss of carbon dioxide and oxygen buildup in process vessels caused by the circulation of cleaning-in-place solutions**

Presenter: George Agius, JohnsonDiversey Canada Inc., Oakville, ON, Canada

Due to its many advantages brewers are more frequently using acidic detergents instead of alkaline detergents to carry out cleaning in place (CIP) of fermenters, aging tanks and bright beer tanks. Unlike alkaline detergents, acidic detergents do not react with carbon dioxide. This means that the tanks or vessels being cleaned need not be purged of their carbon dioxide thereby considerably shortening the CIP cycle and providing associated savings. During the CIP of the vessel, rinse water or detergent solution is pumped from a CIP solution tank that is open to the atmosphere to the vessel being cleaned and kept under carbon dioxide pressure. The solution or the rinse water is then returned to the CIP tank or sent to drain. Often the rinse water or the water for detergent solution make up is not de-aerated and could be saturated with dissolved oxygen. The carbon dioxide at a pressure of 14 to 28 psi dissolves in the circulating solution or the rinse water. On returning to the CIP solution tank this dissolved carbon dioxide is released to the atmosphere where the partial pressure of carbon dioxide is very small. This mechanism can cause a gradual loss of carbon dioxide from the vessel. Using a similar mechanism, oxygen can be transported into the tank from the outside during CIP. Equations were developed to calculate the amount of both carbon dioxide and oxygen transported out and into the tank, respectively, during CIP. The safety implications from the release of carbon dioxide around the CIP tank are also discussed. Calculations show that during a typical 40 minute CIP cycle, with a CIP solution flow of 360 L/min, a 40 hL tank filled with carbon dioxide pressure of 14-28 psi can lose up to 3 to 4 psi excluding other losses from leaks. In the same interval the tank can accumulate up to 10,000 ppm of oxygen. The paper discusses ways to limit the loss of carbon dioxide and suppress the introduction of oxygen during CIP of the tanks.

*George Agius received his master's degree in chemistry and was a lecturer in organic and physical chemistry at the Royal University of Malta between 1971 and 1981. In 1982 he joined JohnsonDiversey, where he has held several research positions, leading to the position of technical director (1990). As technical director he was responsible for new product development, engineering systems, and customer technical support. During that time, George directed the development of synthetic lubricants, new sanitizers, bottle scuff maskants, low environmental-impact and acidic CIP cleaners, bottle washing programs, pasteurizer treatments, bottle washing settling flocculants, and engineering systems. George is currently working on the application of chlorine dioxide in the brewing industry. He has contributed a number of papers on various topics to brewing, educational, and archaeo-astronomy journals. He currently holds the position of technical director for brewing applications at JohnsonDiversey. George is married to Joyce and has two daughters Suzanne and Louise. He enjoys canoeing, photography, and reading about the history of science.*

**P-55**

### **Dehumidification systems in brewing operations**

Presenter: Brian Demers, Niagara Blower Co., Buffalo, NY

Maintaining proper environmental conditions throughout a brewery is vitally important to the longevity of equipment as well as maintaining consistent product quality. To prevent condensation from forming on structural components, tanks and ancillary equipment, the surrounding air must have a dew point temperature lower than the coldest surface. Liquid desiccant cooling systems have the ability to address this need. Low space dew point temperatures required to maintain dry surfaces, facilitate quick recovery from wash down and prevent mold growth can be maintained without the need for low refrigerant suction temperatures and their associated high horsepower requirements. Furthermore, energy associated with the latent heat load (moisture removal) can be transferred from high cost electric compressor energy to a lower cost source such as natural gas or plant steam. Additionally, a liquid desiccant cooling system which utilizes a liquid chemical absorbent solution will provide steady leaving air conditions. These steady conditions give a refrigeration system the ability to provide a constant dry environment at the required temperature. This is valuable to the many breweries which brew semi-continuously. With most liquid desiccant cooling systems there is no need for a defrost cycle. This not only allows for continuous operation and consistent room conditions, but also makes for much cleaner air. The use of a liquid desiccant system captures and permanently inhibits over 90% of all airborne microorganisms. During a defrost cycle, a typical refrigeration system will reintroduce a portion of the moisture and bacteria that was trapped on the coil back into the conditioned space. Sanitizing the air eliminates the chance of product contamination caused by destructive airborne microorganisms. These features make liquid desiccant cooling systems an ideal solution for many breweries.

*Brian M. Demers is a No-Frost® project engineer at Niagara Blower Company in Buffalo, NY. Niagara provides engineered solutions for heat transfer applications worldwide. No-Frost® refrigeration and dehumidification technology is a patented process serving a wide range of customers in the food and beverage industries. Brian recently wrote the article "Dehumidification in Brewing: Controlling Moisture with Liquid Desiccants," which appeared in the MBAA Technical Quarterly (Vol. 44, No. 1). He received his electrical engineering degree from the State University of New York at Buffalo.*



**P-56****Maintaining beverage gas quality in recovered CO<sub>2</sub> via multi-layer adsorption beds**

Presenter: Chris Duffell, Parker domnick hunter ltd, Stanley, Co Durham, UK

Carbon dioxide (CO<sub>2</sub>) is used in the brewing industry for carbonating, conveying, packaging and dispensing. Normally this gas is recovered from the fermentation process and so is a cost effective byproduct. Some breweries even produce a surplus of carbon dioxide that they can sell for extra revenue. When used with different types of beer cross-contamination from beer volatiles can have a detrimental impact on the flavor or appearance of the beverage. This paper details measures that may be adopted in breweries to offer plant level protection using multi-layer purifiers and high-lights their effectiveness at removing beer spoilage compounds found in recovered CO<sub>2</sub>. This is presented from a systematic viewpoint including other process components such as trap filtration for the removal of beer spoilage organisms, thus giving a multiple barrier approach for naturally preserving beer taste and freshness. This multi-layer barrier filter technology is currently being utilized globally at plant level and more recently has been applied to offer the same benefits to draught beer and carbonated soft drinks (CSD) dispensing outlets. In recent years there has been increased awareness of the importance of carbon dioxide quality and its effects on products. Bodies such as the International Society of Beverage Technologists (ISBT) publish quality guidelines for the CO<sub>2</sub> used in the beverage industry. These guidelines are intended to offer protection from contaminants that could result in flavor defects in the beer. Contaminants may also affect the appearance of the foam head and hence presentation. In addition, contaminants are controlled by regulation for the prevention of physiological detriment. The maximum concentration of each group of contaminants may be motivated by either their effect on the taste or smell of the product, quality control or by regulatory measures to protect consumer's health. In summary, it is shown that cross-contamination can occur when using recovered CO<sub>2</sub> and that the brewing industry would benefit from the adherence to quality standards and introduction of multi-layer filtration to ensure the quality of one of the major ingredients.

*Dr. Chris Duffell completed his master's degree in astrophysics from Cardiff University in 1997. He then began employment at the National Engineering Laboratory in Scotland as a project engineer researching fluid dynamics for the oil and gas industry. Chris achieved Chartered Physicist status with the Institute of Physics in 2000. He then joined Strathclyde University to continue his research into flowmeter development. His Ph.D. project was entitled "Application of Optimization Techniques to the Design of Ultrasonic Transit-Time Flowmeters." Upon completion of his Ph.D. degree, Chris began employment with domnick hunter ltd, in Newcastle, as senior development engineer in the Filtration Division. His work now involves product verification and development. The Science Council awarded Chris Chartered Scientist status in July 2004. Chris has been heavily involved in the beverage gas industry since 2003 and was a key member of the team that produced the ISBT Fountain Carbon Dioxide Quality Guidelines published in 2006. He is now contributing to the new revision of the ISBT Bulk Carbon Dioxide Guidelines.*

**P-57****Driving packaging innovation in the brewing industry—Peel N Reveal technology**

Presenter: David Gnad, Miller Brewing Company, Milwaukee, WI

Delivering packaging innovation in the beverage industry is a difficult task; high speed lines and moving from the norm causes great pain in the brewery. But, if innovation is not delivered, the product you are selling becomes just like the rest in the cooler or the on-premise account. Getting the consumer to want your product, or at least try it, is the next challenge in the beer industry. Offering the consumer an interactive way to engage the senses will allow the consumer to remember what they tried and this will hopefully lead to retrial. While the idea of peeling a label is not new, doing it with a message ("you have won") and delivering a clean tear is what this technology does. The label is divided into thirds, top section, middle and bottom. The back of the label is printed with a message and coated in the middle third of the label. This coating keeps the cold adhesive from adhering to the label and allows the label to release from the bottle. The top and bottom third of the label is not coated and remains on the bottle after the consumer completes the tear. The label is perfed after printing; this creates three visible sections of the label. After the label is printed, coated, and perfed, it is die cut to create notches in the label that allow the consumer to guide the tear. Running a perfed label can be a challenge at high speeds, since the perf is the weak point of the label, it wants to rip coming off the pallet. Together with the coating technology, properly placed perfs, and some up-front technical meetings with brewery personnel, delivering innovation to the consumer was accomplished. Driving packaging innovation in the brewing industry will play an important role over the next several years. Getting the consumer's interest is even more important during these times of short attention spans, quick satisfaction and delivering consumer value. Innovations like this will help drive incremental sales and positive talk value. In an industry looking to excite consumers to want to consume a beer rather than a mixed drink, delivering packaging innovation is key for the future growth of the beer industry.

*Dave Gnad is a 2007 addition to the MBAA. He joined Miller Brewing in September 2006 in the Packaging Division. Dave has spent 17 years in packaging innovation work and new product development with companies like The Dial Corporation and Unilever. He has worked in each company to drive packaging innovation and new product launches and, with other team members, has accumulated over 30 patents related to package design and functionality. Dave is a graduate of Michigan State University, (B.S. degree in packaging engineering).*

**P-58****Detection and identification of haze active proteins through proteome analysis**

Presenter: Takashi Iimure, Sapporo Breweries, Ltd., Ota, Gunma, Japan

Coauthor(s): Nami Nankaku, Okayama University, Kurashiki, Okayama, Japan; Naohiko Hirota, Tenso Syuu, Makoto Kihara, Katsuhiko Hayashi, and Kazutoshi Ito, Sapporo Breweries, Ltd., Ota, Gunma, Japan; Kazuyoshi Takeda and Kazuhiro Sato, Okayama University, Kurashiki, Okayama, Japan

Needless to say, beer colloidal haze is an important problem to be prevented. Many reports have suggested the importance of some proteins in haze formation although most of these analyses were confined to an individual protein. Recently, proteome analysis, such as two-dimensional gel electrophoresis (2DE), has enabled us to analyze proteins comprehensively. In this study, we constructed a novel beer protein database using 2DE and MALDI TOF-MS analysis and analyzed the relationship between proteins and haze formation. Proteins extracted from beer made from a single malt sample (cv. Haruna Nijo, ex-steep moisture 37%) were separated by 2DE, and then major protein spots were analyzed by MALDI TOF-MS. The identification of these proteins was carried out by searching a disclosed database (NCBI database, etc.) and our original protein database constructed by Okayama University, which is composed of barley ESTs and cDNA sequences. As a result, 88 out of 199 protein spots were identified and categorized into 23 protein species. According to the description of the DBs, 21 out of the 23 protein species originated from barley, and the remaining 2 proteins were from yeast. Among the 21 proteins from barley, 15 protein species were newly identified proteins in beer, which is retrieved only in the unpublished dataset of the EST database and cDNA database of Okayama University. The proteins extracted from five haze samples were analyzed by 2DE. We found several protein spots common to all of the samples. Identification of these protein spots was carried out by referring to the protein database described above. As a result, these proteins are identified as barley dimeric alpha amylase inhibitor I (BDAI-I) and CMb component of tetrameric alpha amylase inhibitor (CMb). It is suggested that these proteins could play an important role anywhere in the formation process of beer haze. This finding will bring us a new viewpoint to understand haze formation mechanisms in terms of the protein in beer. We will examine the relationship between other beer qualities and specific proteins using both proteome analysis and the beer protein DB we constructed. This work was supported by the Program for Promotion of Basic Research Activities for Innovative Biosciences (PROBRAIN).

*Takashi Iimure received a master's degree in molecular chemistry from Hokkaido University, Sapporo, Japan, in 2001. He has worked in the Bioresources Research and Development Department (formerly Bioresources Research and Development Laboratories), Sapporo Breweries, Ltd. since 2004. His career in Sapporo has concentrated on the improvement of storage substances in barley seeds by means of protein and DNA techniques, RFLP, etc. He is currently a researcher in the R&D Support Center at Gunma.*

**P-59****Polishing of wastewater effluent: Practical applications of Norit's membrane bioreactor to reduce water consumption in breweries and malt houses**

Presenter: Jack Jordan, Sudmo North America Inc.

Coauthor(s): Joost Jacobs and Ronny Konink, Norit Membrane Technology BV

Breweries, malt houses, and beverage manufacturers are challenged to reduce water consumption. Environmental regulations, as well as the need to reduce operational costs, are the main drivers forcing them to look for alternative technologies to meet these demanding targets and turn wastewater into a very valuable source of process water. Most breweries, malt houses, and beverage manufacturing sites are equipped with either aerobic or anaerobic wastewater treatment equipment supplying biological treated effluent. A skid-mounted cross-flow membrane bioreactor equipped with Norit X-Flow ultrafiltration membranes is directly connected to the existing bioreactor. The benefits of this technology are: 1) substantial reduction of water intake up to 8; 2) effluent discharge costs are significantly reduced; the amount is decreased, while the quality is improved, allowing direct discharge to the local surface water; 3) improved return on investment due to double savings; reduced incoming water and reduced discharge costs; 4) Norit MBR technology is very compact and requires only a small footprint; 5) the cross-flow system is robust, with a simple process setup requiring low chemical use for a stable long-term operation; 6) the side-stream and modular setup MBR reduces maintenance and guarantees a clean operating environment; 7) as the organic load reduction is achieved almost exclusively in the biological stage, chemical use in the process is minimized; 8) low-fouling tubular membranes have a proven record of a very long lifetime (5-10 years depending on the application); 9) treated water can be used as drinking water, process water, or utility water. The technology is already in place in a large number of breweries, malt houses, and beverage manufacturing sites in Europe, Russia, and Asia, with capacities varying between 10 m<sup>3</sup>/h of wastewater up to 200 m<sup>3</sup>/h of wastewater. During the presentation, different case studies (including detailed ROI and OPEX calculations) will be presented. For example, at one of the most modern malt houses in the world, steeping water is re-used 5 times before the water is discharged to the sewage. One of the largest brewers in the world has equipped several breweries with a membrane bioreactor in order to dramatically reduce water consumption from an average of 5 hL of water/hL of beer to 2 hL of water/hL of beer. The treated effluent is currently used as process water in applications like boiler feed water, CIP and bottling (rinsing, pasteurizing and bottle washing).

*Jack Jordan is president of Sudmo North America, a supplier of process components and solutions to the dairy, food, and related industries. He has been involved in the automation of dairy, food, beverage, and biotech/pharmaceutical plants for the past 25 years, with particular emphasis on process and CIP integration. He has been very active in promoting mix proof valve technology to increase plant efficiencies and reduce downtime. This technology has become the standard for automating process and CIP designs in process plants worldwide. He is a native of Ireland and has lived in the United States since 1990.*

**P-60****Optimizing the bottling plant efficiency with diagnosis for fault localization**

Presenter: Axel Kather, Technical University of Munich, Chair of Food Packaging Technology, Freising, Germany

Coauthor(s): T. Voigt and H. Langowski, Technical University of Munich, Chair of Food Packaging Technology, Freising, Germany

Although the machines in a bottling plant are designed to keep the central machine running, plant efficiency-reducing downtimes can occur. Not only the failures of the main aggregate, in bottling plants generally the filling machine, but also the behavior of the up- and downstream machines can cause it to stop. To increase plant efficiency, the machine causing the most plant downtime must be identified for maintenance and correction. To save money and exonerate the staff in the bottling line, this identification should be automated. Up to now, a group of technical experts has had to observe the plant and detect the propagation of failures along the line. The aim of the current research project is to replace these experts using artificial intelligence (AI) methods. To analyze data with AI methods, standardized data is needed. To assure this, a standard for production data acquisition of bottling plants was developed in cooperation with the industry. An international survey was carried out in 2006, and these standards have been accepted and implemented by the industry, so a machine-readable data set can be used to solve the problem with AI Case Based Reasoning (CBR); Rule Based Reasoning (RBR); and Model Based Reasoning (MBR). The different paradigms can be used individually and in combination to get the best results. The individual use of CBR can lead to good results but is very time-consuming and inflexible. With RBR a very high hit rate was reached, but some of the cases were not explicit. The flexibility was much higher than with the CBR methods. A combination of both can be a good solution, but is connected with some technical implementation for every single plant. An easier way to implement the system is the MBR approach. Because of existing software and a model-database, the implementation can be very easy and efficient. The flexibility is very high, because the database of models can always be updated, so new developments can be easily adapted. In summary, the automated diagnosis of bottling plants can be realized with the help of AI. The different paradigms have individual advantages, which can be combined in a hybrid system to attain the best results. The proof of concept will follow in simulation studies and pilot plants.

*Alex Kather was born in 1978 and studied from 1998 until 2003 at the Technische Universitat Munchen-Weihenstephan. In June 2003 he graduated as an engineer (Dipl.Ing.) in brewing science and beverage technology. From 2003 until 2006 he worked toward a certificate in practical informatics and in July 2007 he graduated as a master of computer science at the Fern Universitat Hagen. In 2004 he started working as a doctoral candidate and research associate with the Chair of Food Packaging Technology at the Technische Universitat Munchen. His fields of activity are computer-aided production data acquisition and automatic fault diagnosis in bottling plants.*

**P-61****A summary of utility usage rates for craft brewers, including typical utility ratios**

Presenter: John Mercer, Deschutes Brewing Co., Bend, OR

This poster presents a simple discussion regarding common utility ratios in a brewery, such as wastewater/bbl, water/bbl, kwh/bbl, and therms/bbl. COD/bbl is also included. Ratios like these are important to know, for planning growth at your brewery, for financial planning and budgeting, for utility capacity studies, and for determining how your brewery's utility consumption compares to other craft brewers.

*John Mercer has been in the water and wastewater field since 1996, and the wastewater manager at Deschutes Brewery in Bend, OR, since 1998. He has a B.S. degree in environmental biology from Eastern Illinois University and has a Level II Wastewater Operators certification for the state of Oregon. He started doing utility management for Deschutes in 2000 and is fascinated by utility ratios and their uses in a brewery.*

**P-62**

**Temperature control solutions in a fermentation cellar**

Presenter: Edward Montgomery, Siemens Energy and Automation

One of the most important processes in a brewery is the fermentation process. Proper temperature control is a key to this achieving the proper flavor profile for the finished product. It is generally accepted in the brewing industry that the fermentation temperature should be controlled within 0.2°C. Achieving such results is simple with a modern day process control system. Additional costs can be avoided by controlling the temperature via On/Off type valves, as opposed to more expensive control valves. This poster will present the different techniques for controlling the fermentation temperature while maintaining your plant budget. Several techniques for optimizing the cooling capacity of a fermentation cooling system will also be discussed.

*Edward Montgomery has been a member of the MBAA District St. Louis since 1998. He has presented numerous papers and presentations on process control systems to the industry. Edward graduated with a degree in chemical engineering from the University of Missouri – Rolla. He has been with Siemens Energy and Automation for 11 years and is currently the brewing industry manager with the Food and Beverage Business unit.*

**P-63**

**Prediction model to forecast the lautering properties of commercial malts**

Presenter: Frank Rath, VLB, Berlin, Germany

Increased mechanization and automation of the whole brewing process and the trend toward ever larger production changes has considerably increased the demands on the quality of the raw materials and especially their trouble-free processability. Around 150 commercial malts of varied origins were processed in brewing trials on an industrial scale, and their lautering properties were characterized. A prediction model is presented that, based on multivariate statistical evaluation, uses the results from a modified conventional malt analysis to forecast the processing risks during industrial lautering. The regression model, so developed, opens up unknown possibilities for risk evaluation of malts.

*Frank Rath was born in 1957. From 1980 to 1986 he studied agricultural science at the Rheinische Friedrich-Wilhelms-University of Bonn; In 1993 he obtained his Ph.D. degree. In 1986 he was appointed a scientific collaborator at the Research Department/Plant Production and Physiology, Weissheimer Malzfabrik, Andernach. From 1986 to 1990 he was a scientific collaborator at the Research Institute of Raw Materials within the Research and Teaching Institute of Brewing in Berlin (VLB). From 1990 to 1998 Frank was head of the Research Department/Plant Production and Physiology, Weissheimer Malzfabrik, Andernach. Since 1999 he has been the head of the Research Institute of Raw Materials within the Research and Teaching Institute of Brewing in Berlin (VLB) and since 2006 has been a professor at the TU of Berlin. Frank is a member of various national and European panels of experts.*



**P-64****Forecasting for a long-range hop contract**

Presenter: Christopher German, Brewers Supply Group, Kasota, MN

Coauthor(s): K. Sean McGree, Brewers Supply Group, Yakima, WA

A decade of an ample supply of hops has led to hops trading at less than production costs, as a result many growers have fled the industry. Now the industry has entered an era of limited supply and high demand. Craft brewing volume is up by more than 10%, but U.S. aroma variety acreage is estimated to drop 5-10% in 2007. The global demand for beer is rising rapidly, resulting in a high demand for alpha acid to bitter the world's production of lager beer. The agronomic yields of modern alpha varieties far outstrip that of aroma types. With the comparative weakness of the dollar, the world's major brewers are shopping in the United States for alpha varieties. American hop growers, therefore, are receiving considerably better returns for high alpha hops than they are for growing aroma varieties. Small- and medium-sized breweries should learn to forecast their long-range needs and forward contract more than one year out to secure their supply.

*Chris German has been a member of the MBAA since 2005. He currently holds a sales position with Brewers Supply Group, which is his first employment in the brewing industry.*

**P-65****The development of TR06918 lipoxygenase-1-less two-row malting barley with good agronomic, malting and brewing performance**

Presenter: Wataru Saito, Sapporo Breweries, Ltd., Ota, Gunma, Japan

Coauthor(s): Naohiko Hirota, Sapporo Breweries, Ltd., Ota, Gunma, Japan; Kazunori Sawada, Kiyoshi Takoi, and Hideki Chiba, Sapporo Breweries, Ltd., Yaizu, Shizuoka, Japan; Susumu Takahashi, Sapporo Breweries, Ltd., Ota, Gunma, Japan; Katsuhiko Hayashi, Sapporo Breweries, Ltd., Yebisu, Tokyo, Japan; Kazutoshi Ito, Sapporo Breweries, Ltd., Ota, Gunma, Japan; Brian Rossnagel, Peter Eckstein, Eric Lefol, Graham Scoles, and Bryan Harvey, University of Saskatchewan, Saskatoon, SK, Canada; Kazuyoshi Takeda, Okayama University, Kurashiki, Okayama, Japan

TR06918 or LOX-1-less CDC Kendall has been developed by molecular marker assisted (MMAS) backcross (BC) breeding. This study was designed to demonstrate that the agronomic and malting performance of TR06918 is equal to that of the recurrent parent CDC Kendall. 5 kL micro-brewing was also performed with TR06918, and the malting and brewing performance will be described. CDC Kendall was chosen as the recurrent parent for introgression of the LOX-1-less character from barley landrace OUI003. The breeding process included five BCs to CDC Kendall with MMAS at each BC with selection of lines carrying LOX-1 in a homozygous state. This MMAS BC program was conducted at the University of Saskatchewan. The resultant BC derived line, designated TR06918, was entered into the Canadian Western Co-operative Two-Row Barley Registration trials in 2006. Data from those trials showed that TR06918 had essentially the same agronomic performance the recurrent parent CDC Kendall with no detracting features. Experimental fields of TR06918 were grown under commercial conditions in Saskatchewan, Canada, in 2006, and malting-grade barley was selected. Micro-malting trials with the three levels of casting moisture, 41%, 43% and 45% were conducted at the Bio R&D Department, Sapporo Breweries, Japan. The malting performance and quality of TR06918 and its recurrent parent CDC Kendall at the same total protein level showed no differences and no negative results. For further brewing trials, one tonne of TR06918 barley per batch was malted at Cargill Malt Technical Center (Herent). 5 kL brewing trials were performed at the Product & Technology Development Center, Sapporo Breweries, Ltd., Japan. A commercial marketing trial is planned for Tokyo in May 2007. Evaluation of TR06918 indicates that this breeding line has good agronomic and malting performance, essentially the same as its recurrent parent CDC Kendall with no negative effects from the LOX-1-less trait. The brewing performance of TR06918 and effects on improved beer flavor and foam stability and the effects of the LOX-1-less character on other important beer qualities will be evaluated and discussed.

*Wataru Saito received a master's degree in plant genetics from Okayama University, Kurashiki, Japan, in 1984. He has worked in the Bioresources Research and Development Department (formerly Bioresources Research and Development Laboratories), Sapporo Breweries, Ltd. since graduation. His career at Sapporo has concentrated on malting barley breeding for Hokkaido in Japan, Heilongjiang in China, and Saskatchewan in Canada, etc. He is currently a lead barley breeder at the Barley R&D Center at Gunma.*

**P-66**

**Sensory comparison of a commercial lager and a composed lager in regard to bitterness and hoppy aroma**

Presenter: Christina Schoenberger, Joh. Barth & Sohn, Nuremberg, Germany

The use of post fermentation bittering and aroma products has continuously increased throughout the last years. Often brewers claim that these products cause a bitterness and aroma of lower quality than traditional hop products such as pellets and pure resin extracts. In this study a commercial lager, brewed according to the German purity law, was compared to composed lager beers made of unhopped beer, light stable bittering products and light stable hop aroma products to match the original commercial lager in terms of bitterness (sensory bitterness) and hoppy aroma. The use of hop downstream products is often subject to the specific brewery's philosophy. However this comparison shows that in terms of quality of bitterness, taste and aroma these products can have an impact equivalent to traditional hop products such as pellets and pure resin extracts. It was also shown that the bitterness rating of rho-iso-alpha acids results in high variations. Which proves that consumers are only accustomed to iso-alpha acid bitterness. These findings show that it is possible to compose a light stable version of a commercial "purity law" brewed lager that matches very well in terms of bitterness level and aroma characteristics.

*Christina Schoenberger holds a degree in brewing and beverage technology from the Technical University of Munich-Weihenstephan, Germany (1995–1999). She graduated as an engineer in 1999. She held a brewing internship in 2000 in Kyoto/Tokyo Japan at the Suntory Brewing Company, and from 2000 to 2003 she was a scientific assistant at Lehrstuhl für Technologie der Brauerei I (TU-Muenchen/Weihenstephan). Christina's doctoral thesis was on "Sensory and Analytical Characterisation of Non-volatile Taste Compounds in Bottom Fermented Beer." From 2004 to 2005 she was a consultant at the German Brewers Association for Brewing Science Funding, Technical and Governmental Issues. Since 2005 Christina has been the manager of technical sales at Joh. Barth & Sohn in Nuremberg, Germany.*

**P-67**

**Barley CAP: A multi-disciplinary research effort to apply genomics approaches to the genetics of malting barley quality**

Presenter: Paul Schwarz, North Dakota State University

The overall goal of the Barley Coordinated Agricultural Project (CAP) is to access agronomic and economically important genes in barley, thus facilitating the development of superior barley cultivars. More specifically the Barley CAP is designed to address current technical barriers to widespread incorporation of high throughput marker assisted selection (MAS) in barley breeding. The project is a true multi-disciplinary effort, representing 30 scientists from 19 institutions with a wide range of expertise, including genetics/genomics, breeding, pathology, databases, computer science, food science, malt quality, and statistics. Funding is provided by the USDA Cooperative State Research, Education, and Extension Service. Each of 10 U.S. breeding programs are submitting 96 contemporary barley lines that have been screened for numerous agronomic, disease and malt quality traits. A 3,072 single nucleotide polymorphism (SNP) map is to be constructed, and SNP markers will be used to conduct genome-wide association mapping for traits of interest. Partnership between the Barley CAP and USDA Genotyping Centers will ensure that SNP markers that tag important traits will be quickly moved into a high-throughput format suitable for MAS in barley breeding programs. The very large population being utilized in this project increases statistical power, and ensures that genes discovered are relevant to stakeholder needs. The current presentation focuses on the value of molecular markers in malting barley breeding.

*Paul Schwarz is a professor of plant sciences at North Dakota State University, where he directs malting barley quality research and serves as the director of the Institute of Barley and Malt Sciences. Paul is one of 30 scientists from 19 institutions involved with the Barley Coordinated Agricultural Project (CAP). His research area for this project involves the measurement of beta-glucanase and lipoxygenase activity in the Barley CAP germplasm.*

**P-68****A rapid, non-destructive, and automated microbial enumeration system for the brewing industry**

Presenter: Julie Schwedock, Rapid Micro Biosystems, Bedford, MA

Coauthor(s): Jamie Meadows, Kevin Walsh, David Jones, Damon Dehart, and Donald Straus, Rapid Micro Biosystems, Bedford, MA

Breweries can improve plant utilization and save costs by improving the time to results for microbiological QC tests. We will introduce a new rapid microbial enumeration platform, the Growth Direct™ system and will show the system's efficacy for key brewery applications including tests for beer spoilage strains, wild yeast contamination, and plant hygiene. The novel technology is based on the same principles as visual plate counting but can save days by detecting colonies in the earliest stages of growth. Like visual plate counting, the current "gold standard," the Growth Direct™ system measures the number of microbial colonies that grow as a result of replication on standard growth media and membranes. This new test achieves faster results by detecting microbial micro-colonies approximately 100 cells in size, far smaller than the millions of cells required for a colony to be visible by eye. To achieve this sensitivity, the system uses non-magnified digital imaging of native cellular autofluorescence to detect the micro-colonies. All cells fluoresce in the yellow-green range when illuminated with blue light due to the presence of ubiquitous fluorescent biomolecules, such as oxidized flavins. The system illuminates micro-colonies with a brief pulse of blue light to elicit an autofluorescent signal strong enough to allow them to be imaged efficiently by a CCD-based digital camera. The method is reagent-free, and non-destructive (i.e., it does not harm the microorganisms). To obtain accurate detection and enumeration of viable cells, system software differentiates fluorescent micro-colonies from fluorescent debris by automatically acquiring multiple images of each sample over time, and tracking and counting objects with increasing intensity indicative of growing micro-colonies versus debris which exhibits static signal intensity. We will present data demonstrating that the automated Growth Direct™ system saves substantial time in brewery quality control, while allowing recovery of microbial contaminants for later identification.

*Julie Schwedock received her B.S. degree in life sciences from MIT in 1985 and her Ph.D. degree in biological sciences from Stanford University in January 1992. Her Ph.D. focused on the molecular interactions between the bacterial symbiont Rhizobium meliloti and its host plant alfalfa. She has seven years of research experience in leading molecular microbiology laboratories at Harvard University, where she studied the developmental cycle of the bacterium Streptomyces coelicolor and the symbioses of the bacterial endosymbiont of the clam Solemya velum. She is currently a principal scientist at Rapid Micro Biosystems, Inc., where she has nine years of experience moving rapid microbiology technologies from concept to product.*

**P-69****Impact of different fermentation tank outlets on product quality**

Presenter: Christoph Tenge, TUM-Weihenstephan, Freising, Germany

Coauthor(s): Kristina Böe, Tuchenhagen Brewery Systems GmbH, Büchen, Germany

After filling the fermentation vessels residues remain in the horizontal tank outlets. As horizontal pipes are in the majority of cases neither insulated nor temperature-controlled, an undefined process takes place in these lines. Analyses of samples out of these lines and the corresponding tanks should show if the process in the line is different than in the tank and if quality losses may occur as a result of these processes. In comparison to a conventional piping system a new construction for piping was evaluated. Samples were taken daily through the whole fermentation time and were analyzed for extract, pH, cell count, viability and fermentation byproducts. The analyses were carried out after the appropriate EBC or MEBAK methods. Viability was determined with methylene blue staining. Fermentation byproducts and volatiles were analyzed with GC. The results show large differences in the values between the tank and the line samples for the conventional piping. The new system shows more comparable results. Extract degradation is much faster in the line compared to the tank. The pH value even increases, and the yeast viability declines very soon in the line. The profile of fermentation byproducts exposes wide differences between the sample and the tank. Also the amount of proteases increases to the end of regular fermentation time in the line. The new systems also shows optimal cleaning results by shorter CIP times. Regarding the results it can be concluded that a totally uncontrolled fermentation process takes place in the line. This leads to different fermentation results in the line compared to the tank. Various fermentation byproducts or proteases can affect beer quality negatively. Technologies should be used to remove the residues right after pitching or alternative piping systems should be taken into account for new installations.

*Christoph Tenge is assistant professor with the chair for Brewing Technology II, Technische Universität München in Weihenstephan. He holds a Dipl.-Ing. degree and Ph.D. degree in brewing and beverage sciences. His current research activities are in the field of yeast and fermentation, especially the physiology of brewing yeast and optimization of yeast technology. Christoph is teaching students in biological quality control and special areas of fermentation and conditioning. He is also a member of the taste panel of the DLG, MEBAK, and EBC Brewing Science Group.*

**P-70****Instant verification of the hygienic condition of process lines using recently developed persulfate technology**

Presenter: Philip Thonhauser, Thonhauser USA Inc., Cincinnati, OH

Production demands and required hygiene have created increasing interest in methods to optimize cleaning and verification of cleaning results. The traditional methods for verifying the effectiveness of a cleaning regime include microbiological methods, sensory analysis, ATP, and others that offer various levels of accuracy and practicality. A new verification technology, utilizing persulfate technologies, is based on a manganometric measurement principal in an alkaline media, where organic residues are mineralized completely by an oxidation process. The change in the color of the solution during the oxidation process correlates to the actual level of soiling in the device. These changes are captured by means of digital imaging and compared to a color blank from the preparation tank. By using unique software the pictures are automatically analyzed, drawing a direct correlation from the color value to the organic amount in the whole device. Persulfate technology has been used to instantly in-line verify the hygienic condition of process equipment and lines at breweries in Europe and the United States after CIP. Results have demonstrated the effectiveness of different CIP operations and the persulfate technologies own cleaning capabilities. The mechanism and method of application of this technology will be reviewed and recent case studies presented.

*Philip Thonhauser's educational background focused on modern economics and high tech-based enterprise. He received his degree from the University of Vienna in finance and SME management and his masters degree from the University of Bocconi in Milan, Italy. Philip joined Thonhauser Co. Ltd. in 1996. Through his initiative, the concept of visualizing the hygienic status of beverage lines was developed and accepted in Europe as an in-line monitoring system. Philip is currently CEO of Thonhauser Co. He joined the ISBT last year and has presented a paper in the Fountain Committee.*

**P-71****Anaerobic treatment of brewery wastewater: Examining twenty years of data and feedback**

Presenter: Michael O'Neil, Applied Technologies, Inc., Brookfield, WI

Coauthor(s): Dennis Totzke, Applied Technologies, Inc., Brookfield, WI

Anaerobic treatment is often the best solution to cost-effectively treat the relatively high-strength wastewater of breweries. The earliest recorded application of anaerobic treatment technology in the brewing industry took place in the early 1980s at the Heileman Brewing Company in La Crosse, WI. Additional installations quickly appeared in Europe and South America and continued to increase due to heightened awareness of the technology and the desire to implement renewable energy systems. As of early 2007, over 400 anaerobic treatment systems were being used in the brewing industry worldwide, ranging from small single reactor systems that flare biogas to large, multi-reactor systems that clean biogas for a beneficial end use. This presentation will summarize important application data, such as design and performance results, from a number of worldwide anaerobic systems in the brewery industry, providing a valuable guide and reference to others considering the installation of an anaerobic wastewater pretreatment system.

*Mike O'Neil has been a senior environmental process engineer with Applied Technologies, Inc. for eight years and has been working in the environmental engineering field for over 10 years. He holds B.S. and M.S. engineering degrees from the University of Illinois-Champaign, where he conducted research in feasibility studies for anaerobic systems. Mike specializes in anaerobic systems and solids management and has extensive experience in the design and construction of wastewater treatment plant systems.*



**P-72****Comparison of genetic tools to differentiate related lager yeast strains**

Presenter: Sylvie Van Zandycke, Lallemand Inc., Montreal, QC, Canada

Coauthor(s): Dave Bertrand and Chris Powell, Lallemand Inc., Montreal, QC, Canada

Lager yeast strains are traditionally *Saccharomyces pastorianus* and were first used in the early nineteenth century by Bavarian brewers. Compared to ale strains, which are believed to have been used by the Egyptians many centuries ago, lager strains are a relatively new group of yeast. Consequently the genome of lager yeast has not evolved as much as ale strains, and these yeasts are typically less genetically and phenotypically diverse. During the last 20 years, genetic methods have been developed to obtain discriminant profiles or 'fingerprints' which can be used to differentiate between yeast strains. Due to their close genetic heritage, differentiation of lager strains has typically been more of a challenge than for ale strains, in particular because some methods do not offer the degree of discriminance required to differentiate closely related yeasts. In this study we describe the ability of different molecular-based methods, targeting different regions of the genome, to differentiate between lager strains. Eight commercially available and particularly closely related lager yeasts were investigated. It was observed that although no single method was able to differentiate between all 8 strains, the majority were identifiable using a combination of techniques. A comparison of the efficacy of each method suggested that microsatellite PCR may be particularly useful for the differentiation of closely related strains. Given the hybrid nature of lager yeast, it is suggested that the development of primers more specific to *S. pastorianus* is likely to increase discrimination further. Furthermore, by increasing the number of primers used for analysis, greater discrimination can be achieved. This study illustrates the importance of using an array of different methods to achieve differentiation of closely related strains. It is anticipated that the techniques described in this study could be implemented for quality control purposes.

*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 in oxidative stress and aging in Saccharomyces cerevisiae in July 2000. In 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 UK 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. Sylvie now occupies the position of brewing fermentation manager for Lallemand, supporting the brewing industry worldwide.*

**P-73****The first large-scale craft beer testing**

Presenter: Christopher White, White Labs Inc.

Beer sample testing was completed on over 200 beers from craft breweries in the United States and abroad. This is believed to be the first large-scale testing of craft-brewed beers. Each brewery sent in 2 beer samples in containers provided by White Labs. Beers were tested for alcohol, color, density, IBUs, real extract, total VDK, wild yeast, aerobic bacteria, and anaerobic bacteria. The overall results are discussed, and the results may shed light onto the craft brewing industry in general. For example, 60% of the beer samples had over 25 IBUs, and 50% of the beer samples had over 100 ppb total VDK levels. 80% of the beer samples were free from detectable contamination. The statistics are also broken down by beer styles.

*Chris White founded White Labs Inc. in 1995, soon after completing graduate work focusing on yeast protein chemistry. Chris' interest in beer came from undergraduate studies at UC Davis, and he started White Labs as a yeast and fermentation laboratory for brewers. He continues to be president of White Labs, and he enjoys growing the company worldwide and moving into new areas of fermentation, such as distilled products and wine. Chris also likes to teach and has been a lecturer in the Biochemistry Department and the School of Medicine at UC San Diego since 1999. Chris is also a faculty member at the Siebel Institute of Technology in Chicago. He is a member of the American Society of Brewing Chemists and the Master Brewers Association of America. Chris enjoys traveling, golf, talking beer, and barbecues with friends.*

**P-74**

**The effects of modified atmosphere in malting**

Presenter: Annika Wilhelmson, VTT Technical Research Center, VTT, Finland

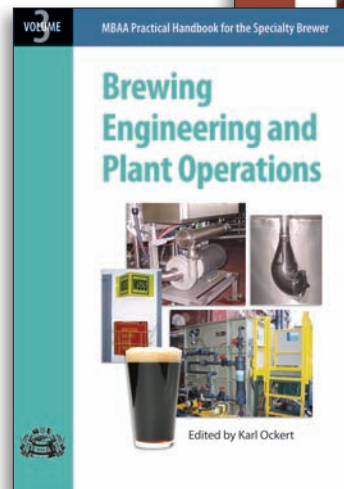
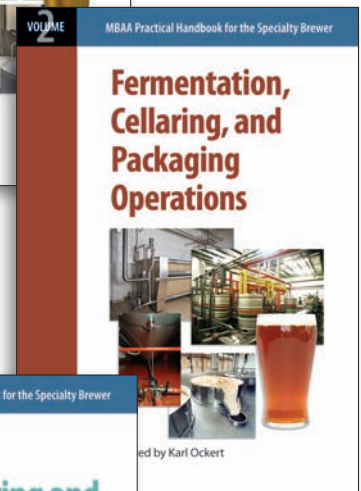
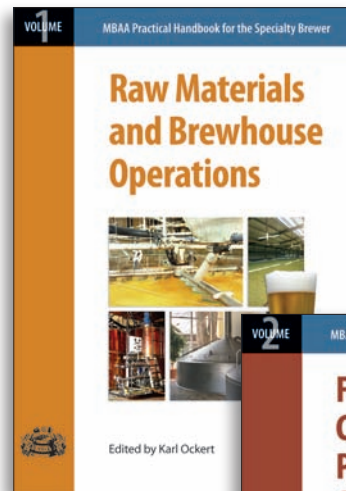
Coauthor(s): Arja Laitila and Arvi Vilpola, VTT Technical Research Center, VTT, Finland; Timo Huttunen, Viking Malt, Lahti, Finland; Esa Rasanen, LP Research Centre Ltd., Lahti, Finland; Erja Kotaviita, Raisio Malt, Faisio, Finland; Silja Home, VTT Technical Research Center, VTT, Finland

Nitrogen gas was applied during the air rest in steeping with the aim of controlling heat production. This procedure was compared to air recirculation. Moreover, nitrogen gas was applied at the beginning of kilning to suppress fungal growth and improve malt quality. Nitrogen gas restricted heat formation in some cases more efficiently than circulating air. Nitrogen slowed down germination, but had a negligible effect on malt quality. When nitrogen gas was applied during kilning, malt *Fusarium* levels were significantly decreased. The reducing conditions also led to a decrease in malt lipoxygenase activity and an increase in endopeptidase and limit dextrinase activities.

*Annika Wilhelmson (M.Sc.) works as a research scientist at VTT Technical Research Centre of Finland. She graduated from Helsinki University of Technology in 1992. Since then, she has been working mainly in malting- and brewing-related projects financed by the Finnish malting and brewing industry. In 1994-1995, she also spent 6 months at the ICBD at Heriot-Watt University as a visiting research student. Annika's research topics have included starch hydrolysis in malting and brewing, barley and malt quality, and malting biochemistry. Since 2001 she has also been working on plant biotechnology projects and will defend her doctoral thesis in 2007.*

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# Exhibits

The Exhibit Hall will be filled with representatives from more than 60 leading industry suppliers. Have your questions answered and learn about the latest products and services available to the industry! The Exhibit Hall will also be the place to go for technical posters and lunch on Saturday and Sunday.

## Exhibit Floor Plan Ryman B1-B2 Exhibit Halls

### Exhibition Hours

#### Friday, October 26

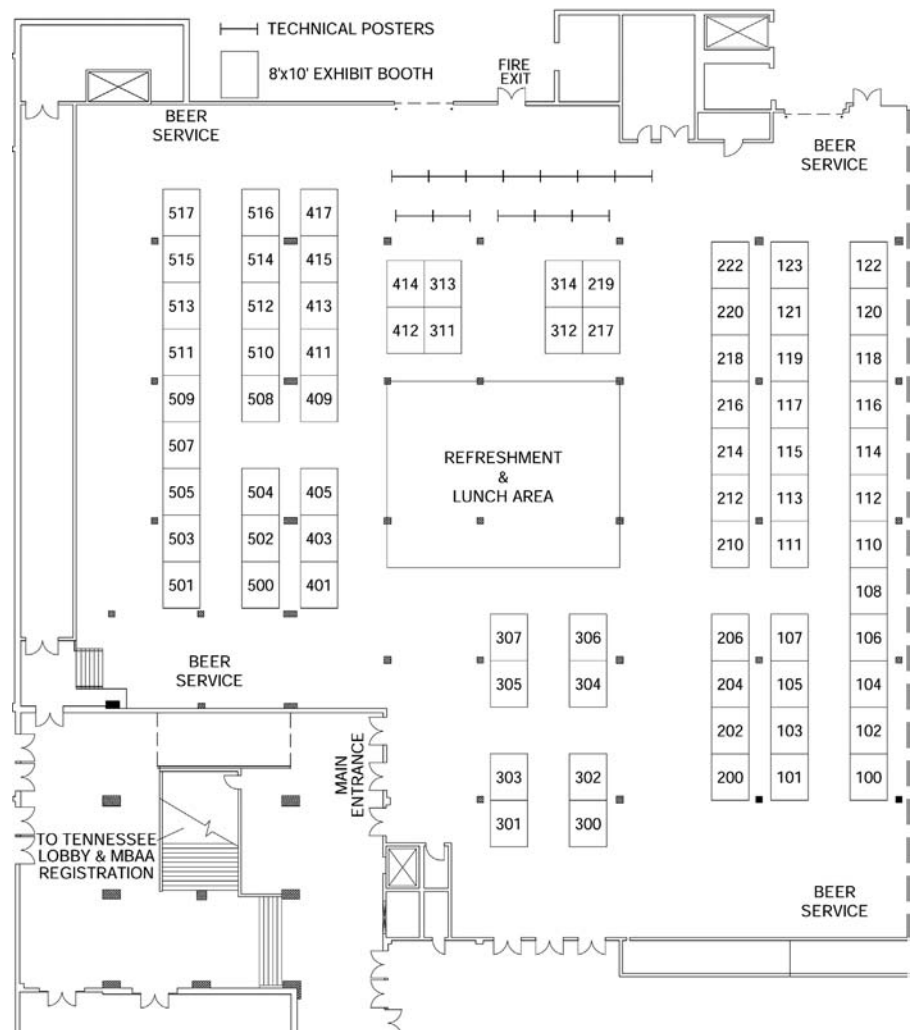
2:00 – 5:00 p.m. Set Up

#### Saturday, October 27

8:50 – 9:50 a.m. Exhibits Open  
12:00 – 2:00 p.m. Exhibits, Posters, & Lunch

#### Sunday, October 28

12:00 – 2:00 p.m. Exhibits, Posters, & Lunch  
2:00 – 5:00 p.m. Take Down



## 2007 Exhibitors—Numerical Listing

100-102	Krones Inc.	123	VLB Berlin	409	Briggs of Burton, Inc.
101	Emerson Process Management	200	Paul Mueller Company	411	domnick hunter
103	Perlick Corporation	202	Pall Corporation	412	Barben Analyzer Technology LLC
104	GF Piping Systems	204	Weyermann Specialty Malts	413	GKD-USA, Inc.
105	INEOS Silicas Americas	206	Ecolab Inc.	414	Birko Corporation
106	Kalsec®	210	Thermo Scientific	415	Danisco USA Inc.
107	Irmato	212	Westfalia Separator, Inc.	417	Mettler-Toledo Ingold
108	BEGEROW USA	214	Tuchenhagen Flow Components, LLC	500	optek-Danulat, Inc.
110	Enerfab, Inc.	216	Huppmann Brewery Systems	501	Steinfurth, Inc.
111	White Labs, Inc., Pure Yeast & Fermentation/Frings America	217	Centec LLC	502	Thonhauser USA Inc.
112	Waukesha Cherry-Burrell, An SPX Process Equipment Operation	218	American Tartaric Products, Inc.	503	Filtrox North America
113	Phoenix Packaging International Corp.	219	Symbiont	504	AFCO-Alex C. Fergusson
114	Lechler, Inc.	220	International Specialty Products	505	PQ Corporation
115	Cargill	222	AcquiData, Inc.	507	Buhler Inc.
116	ChemTreat, Inc.	300	Bruker BioSpin Corporation, EPR Division	508	Anton Paar USA
117	Loeffler Chemical Corporation	301-303	Siemens Energy & Automation	509	S. S. Steiner, Inc.
118	Canongate Technology Inc.	302	Cambridge Wire Cloth Company	510	Bio-Chem Laboratories
119	Wittmann	304-306	A. ZIEMANN GmbH	511	Barry-Wehmler Company
120	Tyco Valves & Controls	305	Millipore Corporation	513	Oregon Tilth
121	A. Handtmann Armaturenfabrik	307	Gusmer Enterprises, Inc.	514	Alfa Laval Inc.
122	Barth Haas Group	401	Süidmo North America	515	BASF Corporation
		403	Haffmans North America	516	JohnsonDiversey
		405	Norit Process Technology	517	Atlas Carriers, Inc.

# Exhibitor Descriptions

Descriptions are listed, as supplied by exhibitor, in alphabetical order.

- 121 A. Handtmann Armaturenfabrik**, Arthur Handtmann Str. 23, Biberach, Germany 88400; Telephone: +49 73513424542, Web: [www.handtmann.de](http://www.handtmann.de). A leading supplier of valves, fittings and complete process equipment for the beverage industry. The patented deep-bed filter MultiMicroSystem for fine and sterile filtration of beer and the new CSS (Combined Stabilizing System) for beer stabilization demonstrate Handtmann's innovative expertise to realize new ideas for the benefit of the brewer.
- 304-306 A. ZIEMANN GmbH**, Schwieberdinger Str. 86, Ludwigsburg, Germany, 71636; Telephone: +49 7141 4080, Fax: +49 7141 408222, Web: [www.ziemann.com](http://www.ziemann.com). The ZIEMANN GROUP is the world's leading company in brewing technique and brewing technology. ZIEMANN stands for exact design planning from the feasibility study to engineering with computer animation up to the execution of the construction work, commissioning and handing over of the turn-key brewery, including the filling block.
- 222 AcquiData, Inc.**, 400 Garden City Plz., Ste 445, Garden City, NY 11530; Telephone: +1.516.408.3585, Fax: +1.516.408.3586, Web: [www.acquidata.com](http://www.acquidata.com). Testream®/CS, AcquiData Inc's premier product quality information system, delivers web-enabled programs for the automatic acquisition and display of test measurements directly from any lab instrument as well as from in-line control systems. Also announcing 'ReportWriter': easily integrate graphs, spreadsheets, Word documents and pictures into powerful lab reports.
- 504 AFCO - Alex C. Fergusson**, 5000 Letterkenny Rd., Chambersburg, PA 17201; Telephone: +1.800.345.1329, Web: [www.afcocare.com](http://www.afcocare.com). AFCO (Alex Fergusson) is a full service specialty chemical company providing solutions for cleaning/sanitizing products and conveyor lubricants to the food/beverage industry. Services include CIP design, Web based training and reporting. See how TM Smart Track (featured product) waterless lube can save you money!
- 514 Alfa Laval Inc.**, 5400 International Trade Dr., Richmond, VA 23231; Telephone: +1.866.ALFA.LAVAL, Fax: +1.215.443.4220, Web: [www.alfalaval.us](http://www.alfalaval.us). Leading global supplier of centrifugal separators, heat exchangers, flow and tank components, process modules, and yeast systems for the brewing industry. From design planning to production, Alfa Laval is committed to world-class service throughout the lifetime of your brewing processes. With worldwide installations and more than 400 employees dedicated to the industry, Alfa Laval brewery technology has the engineering experience and process expertise to keep your brewery running at the height of efficiency.
- 218 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, Web: [www.americantartaric.com](http://www.americantartaric.com). American Tartaric Products, Inc. is the largest supplier to the wine industry and is now proud to present a range of products to the brewing industry. Our product range includes brewing process aids, economic yeast nutrients, enzymes, brewhouse antioxidants, foam stabilizers, filtration aids, clarifiers, stabilizers, fine chemicals, bottling equipment, bench-top and handheld analytical equipment, filter sheets, filter elements, cartridges, dosing units, and filtration equipment and pasteurizers. Some of the manufacturers that ATP represents include AEB/Spindal Group, Carlson, CFM, EaglePicher, Hanna Instruments, ISP, TMCI Padovan and others. Our objective is to become your one-stop shopping center with prompt technical service and meeting all of your requirements.
- 508 Anton Paar USA**, 10215 Timber Ridge Dr., Ashland, VA 23005; Telephone: +1.804.550.1051, Fax: +1.804.550.1057, Web: [www.anton-paar.com](http://www.anton-paar.com). Anton Paar specializes in developing and producing highly accurate instrumentation to measure CO<sub>2</sub>, alcohol, and real and original extracts of beer, both online and in the lab. Our density meters, sound velocity sensors, and carbonation meters are designed for the most demanding environments. We offer an accurate and easy-to-use viscometer for measuring the dynamic viscosity of congress wort (MEBAK approved). Our high-quality, high-performance products deliver reliable and accurate results, ensuring control of product quality within tight tolerance limits.
- 517 Atlas Carriers, Inc.**, 6623 13th Ave., Brooklyn, NY 11219; Telephone: +1.718.759.9333 or +1.570.848.1944, Fax: +1.718.759.9314, Web: [www.atlascarriers.com](http://www.atlascarriers.com). Introducing the patented Atlas Beverage Carrier, a revolutionary carrier with an advanced design that has significantly higher tear strength than carriers currently in use. The Atlas Carrier provides unmatched efficiencies in production, packaging and shipping and is environmentally responsible. Strengthen your brand and increase your presence with the Atlas Carrier.
- 412 Barben Analyzer Technology LLC**, 1701 S. Sutro Terrace, Carson City, NV 89706; Telephone: +1.800.993.9309, Fax: +1.775.883.6388, Web: [www.bat4ph.com](http://www.bat4ph.com). Manufacturing a complete line of PH/ORP conductivity turbidity and dissolved oxygen sensors. Introducing our new optical dissolved oxygen sensor measuring down to 1 ppb plus or minus .4 ppb.
- 511 Barry-Wehmiller Company**, 8040 Forsyth Blvd., St. Louis, MO 63105; Telephone: +1.314.616.1051, Fax: +1.314.862.2457, Web: [barry-wehmiller-company.com](http://barry-wehmiller-company.com). Barry-Wehmiller Company is the world leader in providing solutions for product stability for breweries across the world. With over 120 years serving the brewing industry, Barry-Wehmiller is passionate about providing state-of-the-art pasteurizing and bottle washing machinery. Barry-Wehmiller provides both flash and tunnel pasteurizing technology for beverage applications globally. As well Barry-Wehmiller supplies a complete complement of aftermarket services, engineering, parts, and machine upgrades. Contact Barry-Wehmiller at +1.314.862.8000, or visit our website at [www.barry-wehmiller-company.com](http://www.barry-wehmiller-company.com).



- 515 BASF Corporation**, 100 Campus Dr., Florham Park, NJ 07932; Telephone: +1.800.527.9889, Fax: +1.800.348.1394, Web: [www.divergan.basf.de](http://www.divergan.basf.de). BASF's high-quality Divergan® PVPP products protect two of the most important aspects of your beer: flavor and appearance. Divergan® F and Divergan® RS eliminate chill-haze and lengthen shelf life. Divergan® HM removes beer-soluble iron (BSI) and prevents oxidation. Contact your BASF representative to learn how we can help make your beer better.
- 108 BEGEROW USA**, 5755 Clovermeadow Ln., Farmington, NY 14425; Telephone: +1.585.398.2783 or +1.585.410.8714, Fax: +1.585.398.0067, Web: [www.begerow.com](http://www.begerow.com). BEGEROW, a worldwide provider of filtration technology to the Brewing Industry, with products specifically engineered for brewing applications including BECO Filter Sheets, BECODISC Stacked Disc Modules, BEGEROW Membrane Cartridges, new and refurbished sheet filters, SIHA brand of Yeasts and fining agents. Warehousing is guaranteed throughout the United States and Canada.
- 510 Bio-Chem Laboratories**, 1049 28th St. SE, Grand Rapids, MI 49508; Telephone: +1.616.248.4900, Fax: +1.616.248.4904, Web: [www.bio-chem.com](http://www.bio-chem.com). Bio-Chem Laboratories, is a full-service laboratory providing a variety of services to the brewing industry. Bio-Chem delivers quality analytical testing in a timely manner through the use of state-of-the-art technology with a goal of providing customer service that exceeds the expectations of our clients.
- 414 Birko Corporation**, 9152 Yosemite St., Henderson, CO 80640; Telephone: +1.303.289.1090, Fax: +1.303.289.1190, Web: [www.birkocorp.com](http://www.birkocorp.com). Birko Corporation is a leading supplier of cleaning, sanitizing, process aids, antifoams, dispensing equipment and food grade acids for the brewing industry. We service what we sell, 24/7. Our technical staff is second to none. We solve tough problems, give us a call!
- 409 Briggs of Burton, Inc.**, 5 Marway Circle, Rochester, NY 14624; Telephone: +1.585.426.2460, Fax: +1.585.426.0250, Web: [www.briggsplc.co.uk](http://www.briggsplc.co.uk). Briggs excels in mash conversion, mash separation, wort boiling, yeast management, dry goods, the process block and keg racking. Briggs Symphony External Wort boiling technology is now bringing major benefits in North America. Learn about our experienced engineering support, dedicated service and range of in-house project management and automation services.
- 300 Bruker BioSpin Corporation, EPR Division**, 44 Manning Rd., Billerica, MA 01821; Telephone: +1.978.663.7406, Fax: +1.978.670.8851, Web: [www.bruker-biospin.com](http://www.bruker-biospin.com). Bruker Corporation is the worldwide leader in EPR Instrumentation. Bruker's *e-scan* is a bench-top EPR spectrometer tailored to provide rapid, automated analysis for optimizing your beer's shelf life.
- 507 Buhler Inc.**, 13105 12th Ave. N., Plymouth, MN 55441; Telephone: +1.763.847.9900, Fax: +1.763.847.9911, Web: [www.buhlergroup.com](http://www.buhlergroup.com). Buhler is a worldwide organization providing solutions and partnerships for the food processing industry. For the brewing and malting industry, this comprises the whole process from the intake of the grain, including malting in the malthouse, up to the grinding of malt in the brewery.
- 302 Cambridge Wire Cloth Company**, 105 B Goodwill Rd., PO Box 399, Cambridge, MD 21613; Telephone: +1.877.226.9473 or +1.410.228.3000, Fax: +1.800.884.2723, Web: [www.camwire.com](http://www.camwire.com). Premium brews deserve our premium leaf. Cambridge Wire Cloth Continu Weld® 360 filter leaves represent innovation in pressure filtration technology. These leaves feature continuous nonporous welding of filter cloth to solid bar frame for the ultimate in sanitary leak-proof performance. Cambridge can easily repair your 360's to "like new" condition.
- 118 Canongate Technology Inc.**, 2045 South Arlington Heights Rd., Ste 109, Arlington Heights, IL 60005; Telephone: +1.847.593.1832, Fax: +1.847.593.1629, Web: [www.canongatetechnology.com](http://www.canongatetechnology.com). Canongate Technology will exhibit a full line of sensors for measurement and control of Carbon Dioxide, Dissolved Oxygen, Plato and %Alcohol. Included in the range is CarboCheck. With over 1,000 sensors in production and packaging lines worldwide CarboCheck is the instrument of choice for carbonation of the best-known beer brands.
- 115 Cargill**, 15407 McGinty Rd. W., Wayzata, MN 55391; Sweeteners—Telephone: +1.937.237.1236, Fax: +1.937.237.1238; Malt—Telephone: +1.952.742.0117, Fax: +1.952.742.5050, Web: [www.cargill.com](http://www.cargill.com). Cargill is a leading provider of malt products, brewing adjuncts and innovative solutions to the worldwide brewing industry. Products featured include the world's most complete line of brewing adjuncts, sorghum syrup, organic glucose syrup and malt products. All products can be shipped anywhere beer or a beverage is made. Let the Cargill team help you create great beverages for your customers. Visit the Cargill booth at the MBAA convention or call us.
- 217 Centec LLC**, PO Box 820, Germantown, WI 53022; Telephone: +1.262.251.8209, Fax: +1.262.251.8376, Web: [www.centec-usa.com](http://www.centec-usa.com). Manufacturer of water deaeration, high-gravity blending, carbonation, flash pasteurizers, nitrogenators, on-line alcohol analyzers and OG meters.
- 116 ChemTreat, Inc.**, 4461 Cox Rd., Glen Allen, VA 23060; Telephone: +1.804.935.2000, Fax: +1.965.6974, Web: [www.chemtreat.com](http://www.chemtreat.com).
- 415 Danisco USA Inc.**, Four New Century Pkwy., New Century, KS 66031; Telephone: +1.913.764.8100, Fax: +1.913.794.8239, Web: [www.danisco.com](http://www.danisco.com). Danisco is one of the world's leading producers of ingredients for food. Danisco's broad product portfolio includes antimicrobials, antioxidants, cultures, emulsifiers, enzymes, hydrocolloids, tailored blends, and sweeteners. An extensive knowledge of food ingredients formulates Danisco's proactive approach to the development of new products tailored to market needs.
- 411 domnick hunter**, 5900-B Northwoods Pkwy., Charlotte, NC 28269; Telephone: +1.800.345.8462 or +1.704.921.9303, Fax: +1.704.921.1960, Web: [www.domnickhunter.com](http://www.domnickhunter.com). Manufacturer of CO<sub>2</sub> purification systems, process water chillers, sterile air and culinary

grade steam filtration and compressed air treatment products.

- 206 Ecolab Inc.**, 370 Wabasha St. N., St. Paul, MN 55102; Telephone: +1.651.293.2233 or +1.800.392.3392, Fax: +1.651.293.2260, Web: [www.ecolab.com](http://www.ecolab.com). Ecolab is the market leading global supplier of sanitation products, systems and services to the dairy, food and beverage processing industries. Products include advanced cleaner, sanitizers and conveyor lubricants, CIP and automated systems and services, comprehensive water management and pest elimination services.
- 101 Emerson Process Management**, 504 Trade Center Blvd., Chesterfield, MO 63005; Telephone: +1.636.681.1500, Fax: +1.636.681.1981, Web: [www.emersonprocess.com](http://www.emersonprocess.com). Emerson Process Management offers the industry's broadest array of process-automation products. Our technology know-how and application experience enable us to develop measurement and analytical instruments, final-control devices, and systems and software that deliver the proven performance and reliability our customers expect. And our open, standards-based PlantWeb architecture unleashes the power of intelligent field devices, systems, and software to deliver better process, plant, and business results.
- 110 ENERFAB, Inc.**, 4955 Spring Grove Ave., Cincinnati, OH 45232; Telephone: +1.513.641.0500 or +1.513.482.7701, Fax: +1.513.242.6833, Web: [www.enerfab.com](http://www.enerfab.com). ENERFAB is a process solutions provider to the brewing market. Core competencies include brew-house equipment and renovation, fermentation/aging tanks, shop and field fabrication, piping systems, tank lining systems, turnkey construction, parts and service.
- 503 Filtrix North America**, 9805 NE 116th St., Ste A-200, Kirkland, WA 98034; Telephone: +1.800.473.4526 or +1.425.820.4850, Fax: +1.425.820.2816, Web: [www.filtrix.ch](http://www.filtrix.ch). FILTROX offers everything for your filtration process through quality product and technical application support. Due to our comprehensive assortment of filter media, we offer solutions tailored to your individual requirements. If you're looking for filter equipment, sheets, or modules, count on FILTROX, the name that represents the high standard of Swiss quality in all its products and services.
- 104 GF Piping Systems**, 2882 Dow Ave., Tustin, CA 92780; Telephone: +1.800.854.4090 or +1.714.731.8800, Fax: +1.714.731.6201, Web: [www.gfpiping.com](http://www.gfpiping.com). Manufacturer of COOL-FIT ABS Plus the special designed pre-insulated plastic piping system for glycol systems in Breweries. COOL-FIT ABS Plus is a quick installed, cost effective solution with top quality that is maintenance free. GF Piping Systems produces a complete range of pipes, fittings, manual valves, actuated valves and flow meters.
- 413 GKD-USA, INC.**, 825 Chesapeake Dr., Cambridge, MD 21613; Telephone: +1.410.221.0542, Fax: +1.410.221.0544, Web: [www.gkdusa.com](http://www.gkdusa.com). GKD's Neverleak design filter leaves build consistent cake for filtration. No leaks or mesh puckers. GKD's techniques for continuous seam and tightly fitted mesh media are keys to unparalleled performance. As one of the world's premier technical waving mills, we design and produce our filter medias on our own weaving machines. We assure the finest finished product available. We also warranty our products.
- 307 Gusmer Enterprises, Inc.**, 1165 Globe Ave., Mountainside, NJ 07092; Telephone: +1.908.301.1811, Fax: +1.908.301.1812, Web: [www.gusmerenterprises.com](http://www.gusmerenterprises.com). For more than 80 years, Gusmer Enterprises has been dedicated to providing service with knowledge to the brewing industry. Gusmer Enterprises supplies the brewing, malting, and distilling industries with a wide variety of products. Instrumentation, malt mills, malting equipment, filtration media, processing aids, and spent grain handling equipment are only a few examples of our extensive product line. Gusmer Enterprises represents the product lines of Aber Instruments, AB Vickers, Cellulo, D.D. Williamson, Millipore, Novozymes, Paguag Schlauchtechnik, PQ Corporation, Ponndorf, Schmidt-Seeger AG, and Thermo.
- 403 Haffmans North America**, 1330 Anvil Dr., Machesney Park, IL 61115; Telephone: +1.815.639.0322, Fax: +1.815.639.1135, Web: [www.haffmans.nl](http://www.haffmans.nl). Norit Haffmans is a leading supplier of Total CO<sub>2</sub> and O<sub>2</sub> management systems, offering a wide range of quality control equipment, water deaeration systems, and blending and carbonation units. Norit Haffmans' CO<sub>2</sub> Recovery technology, including brewery-type CO<sub>2</sub> recovery plants, liquid CO<sub>2</sub> stripping systems and the energy-efficient Heat Recovery System LiquiVap, ranks among the world's best.
- 216 Huppmann Brewery Systems**, 1600 O'Keefe Rd., Hudson, WI 54016; Telephone: +1.715.386.9371, Fax: +1.715.386.9376, Web: [www.niroinc.com](http://www.niroinc.com). Huppmann Brewery Systems - your partner for brewing equipment, systems, solutions, and process technology. The North America brewery activities of Niro Inc. are marketed under the umbrella name Huppmann Brewery Systems. This group offers the technologies of Huppmann, Tuchenhausen Brewery Systems, GEA Diessel, and Niro Inc.
- 105 INEOS Silicas Americas**, 111 Ingalls Ave., Joliet, IL 60435; Telephone: +1.815.727.3651, Fax: +1.815.727.5312, Web: [www.ineossilicas.com](http://www.ineossilicas.com). Global supplier of silica-based beer stabilizers, including the Lucilite and Chill-Garde product range. Please stop by to learn about our products for protein and tannoid removal, and discuss how we can help reduce costs and improve beer quality.
- 220 International Specialty Products**, 1361 Alps Rd., Wayne, NJ 07470; Telephone: +1.973.628.4000, Fax: +1.973.872.1583, Web: [www.ispcorp.com](http://www.ispcorp.com). ISP is recognized worldwide for its Polyclar line of PVPP products used for stabilizing, clarifying, and removing astringent flavors from beer and other beverages.
- 107 Irmato**, Graafschap Hornelaan 143, Weert, The Netherlands, 6001 AC; Telephone: +31 (0) 495.453502, Fax: +31 (0) 495.493549, Web: [www.irmato.com](http://www.irmato.com). Irmato offers a MES-solution especially suited for breweries. It enables breweries to optimally control their information flows. It gives an up-to-date overview about your recipes, production status, material use and quality. MES Compass enables you to manage your processes in a better way, helping to achieve a constantly high product

quality. Reference: Boulevard Brewing Company in Kansas City.

- 516 JohnsonDiversey**, 3630 E. Kemper Rd., Cincinnati, OH 45241; Telephone: +1.513.554.4200, Fax: +1.513.956.4841, Web: www.johnsondiversey.com. JohnsonDiversey Inc. is a global cleaning and sanitation company with 20,000 associates in more than 60 countries serving the Brewing industry. JohnsonDiversey leads with technology and expertise in both cleaning and sanitizing products as well as Engineering Services that meet and exceed your hygiene standards. This ensures a better looking and better tasting product while minimizing the environmental impact through the reduction of water and energy consumption, and choice of cleaning products designed with the environment in mind.
- 106 Kalsec®**, PO Box 50511, Kalamazoo, MI 49053; Telephone: +1.269.349.97811, Fax: +1.269.382.3060, Web: www.kalsec.com. Kalsec® introduces HopRival™ Natural Hop Extracts. HopRival™ Natural Hop Extracts deliver flavor and aroma attributes that rival traditional hopping. Look to HopRival™ Natural Hop Extracts to deliver consistent, distinctive, hop flavor and aroma when added at the kettle or post fermentation. We invite you to work with us to develop custom formulations that meet your brewing objectives.
- 100-102 Kronos Inc.**, 9600 S. 58th St., Franklin, WI 53132; Telephone: +1.414.409.4000, Fax: +1.414.409.4100, Web: www.kronos.com. Kronos will feature Steinecker Brew House Systems that cover all aspects of brewing, from malt intake to filtered beer, including brewhouse and filter plants, as well as fermentation and storage cellars. Merlin, Pegasus, Twin-Flow-System Filters, Stromboli, ShakesBeer, and WhirlShip Calypso rank among the best known Steinecker innovations.
- 114 Lechler, Inc.**, 445 Kautz Rd., St. Charles, IL 60174-5301; Telephone: +1.630.845.6823 or +1.800.777.2926, Fax: +1.630.377.6657, Web: www.lechlerusa.com. Lechler, Inc. manufactures a broad range of tank cleaning nozzles. This includes PTFE Whirly Nozzles developed for glass-lined Schoene tanks and bright beer tanks; Gyros and Stainless Steel Whirls for wort kettles; and the M20 Tank Cleaning Machine for fermenters. Lechler's tank cleaning products contain no lubricants.
- 117 Loeffler Chemical Corporation**, 5700 Bucknell Dr., Atlanta, GA 30336; Telephone: +1.800.769.5020 or +1.404.629.0999, Fax: +1.404.629.0690, Web: www.loefflerchemical.com. Comprehensive line of sanitation products specifically formulated for the brewing industry. Automated dosing systems, CIP systems, foamers and other equipment. Consulting services for both brewing and packaging operations.
- 417 Mettler-Toledo Ingold**, 36 Middlesex Turnpike, Bedford, MA 01730; Telephone: +1.781.301.8800, Fax: +1.781.301.8701, Web: www.mt.com/pro.
- 305 Millipore Corporation**, 290 Concord Rd., Billerica, MA 01821; Telephone: +1.800.645.5476, Fax: +1.800.645.5439, Web: www.millipore.com. With proven products and 50+ years of experience, beverage manufacturers have been relying on Millipore to provide Filters and Process Monitoring Tools (PMT), including the new Bevistat Rapid Detection System, which support beverage safety, quality and flavor. Because a lot depends on what's NOT inside!
- 405 Norit Process Technology**, 1330 Anvil Dr., Machesney Park, IL 61115; Telephone: +1.815.639.0322, Fax: +1.815.639.1135, Web: www.noritpt.nl. Norit Process Technology is a leading supplier of crossflow beer membrane filtration as an alternative to kieselguhr in the brewing industry. Norit Process Technology also offers solutions for water and wastewater treatment. Our membranes provide the highest quality standards, which allow substantial quantities of discharge water to be recovered and re-used.
- 500 optek-Danulat, Inc.**, N118 W18748 Bunsen Dr., Germantown, WI 53022; Telephone: +1.888.837.4288 or +1.262.437.3699, Web: www.optek.com. optek's in-line UV-VIS-NIR absorption-based photometers and scattered-light turbidimeters monitor and control color, haze and concentration. Real-time measurements provide process optimization and control in fermentation, filtration, separation, yeast pitching, wort color and clarity, DE and PVPP dosing and more. Achieve uninterrupted processing with reduced product loss, improved profitability and greater efficiency.
- 513 Oregon Tilth**, 470 Lancaster Dr. NE, Salem, OR 97301; Telephone: +1.503.378.0690, Fax: +1.503.378.0809, Web: www.tilth.org. Oregon Tilth—The most respected name in organic certification services. We certify producers, manufacturers, food handlers, and others—worldwide. Oregon Tilth took part in developing the USDA's National Organic Standards, and we were among the first USDA accredited certifiers. Count on our expertise in organics to help bring your products to market.
- 202 Pall Corporation**, 25 Harbor Park Dr., Port Washington, NY 11050; Telephone: +1.866.905.7255, Fax: +1.516.625.3610, Web: www.pall.com. Pall Corporation is the largest and most diverse filtration, separations and purifications company in the world. You can rely on Pall for a proven solution to all of your filtration or separations needs. We design, develop and manufacture an unparalleled range of advanced filter media, associated equipment, separation systems and membrane processes. For the food and beverage industries, Pall 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 even deal with process effluent.
- 200 Paul Mueller Company**, 1600 W. Phelps, PO Box 828, Springfield, MO 65801; Telephone: +1.417.575.9565 or +1.417.575.9282, Fax: +1.417.575.9669, Web: www.muel.com. Paul Mueller Company, centrally located in Springfield, Missouri, specializes in the design and manufacture of stainless steel processing systems and equipment for food, dairy, beverage, chemical, pharmaceutical, biotechnology, and pure water.

- 103 Perlick Corporation**, 8300 W. Good Hope Rd., Milwaukee, WI 53223; Telephone: +1.414.353.7060, Fax: +1.414.353.7069, Web: [www.perlick.com](http://www.perlick.com). Perlick is a leader in the beverage dispensing, bar equipment and brewery fitting industry. Just a few of our new products that are now available are the ASME Code approved Pressure Safety Device, the air actuated and manually operated sanitary sampling valve and forward sealing NSF all stainless steel beer faucet.
- 113 Phoenix Packaging International Corp.**, 847 McCaffrey, St. Laurent, QC, Canada H4T 1N3; Telephone: +1.514.487.6660, Ext. 28, Fax: +1.514.487.6661, Web: [www.phoenixpackaging.com](http://www.phoenixpackaging.com). Phoenix has a unique line of ceramic bottles. We can also design a specific container to meet your needs. This also includes glass, aluminums and specific closures.
- 505 PQ Corporation**, PO Box 840, Valley Forge, PA 19482; Telephone: +1.610.651.4740, Web: [www.pqcorp.com](http://www.pqcorp.com). Britesorb beer stabilizers are manufactured by PQ Corporation, headquartered in Valley Forge, Pennsylvania, U.S.A. Founded in 1831, PQ today has become the world's leading volume producer of sodium silicates. Together with our affiliate companies, we operate a total of 62 manufacturing facilities located in 20 countries on five continents—North America, South America, Europe, Asia and Australia. These locations work interactively to ensure PQ products meet the highest quality standards. As a result, PQ is in a unique position to help our customers establish and maintain world-class quality for a variety of critical applications in a number of different industries.
- 301-303 Siemens Energy & Automation**, 11601 Lilburn Park Rd., St. Louis, MO 63146; Telephone: +1.314.872.1150, Fax: +1.678.297.8102, Web: [www2.sea.siemens.com/Industry+Solutions/FoodandBeverage/](http://www2.sea.siemens.com/Industry+Solutions/FoodandBeverage/). As the premier partner to food and beverage manufacturers around the world, we offer highly effective process control and quality assurance solutions. Our systems and technology have enabled users to achieve significant business returns; from small, focused laboratories to large-scale production plants in global networks of manufacturing. We provide complete end-to-end solutions.
- 509 S.S. Steiner, Inc.**, 655 Madison Ave., New York, NY 10021; Telephone: +1.212.838.8900, Fax: +1.212.593.4238, Web: [www.hopsteiner.com](http://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<sub>2</sub> extract, and other modified hop products in a variety of package sizes is available on our website at [www.hopsteiner.com](http://www.hopsteiner.com).
- 501 Steinfurth, Inc.**, 5148 Kennedy Rd., Ste 600, Forest Park, GA 30126; Telephone: +1.678.500.7035, Fax: +1.500.7036, Web: [www.steinfurth.com](http://www.steinfurth.com). Steinfurth, specialist for customized quality control instruments for beverages and beverage packages will be presenting its automatic Foam Stability Tester and the SF-PastControl System (pasteurization logger). The highly accurate and effective instruments are very easy to operate and can be used in the laboratory or directly on the filling line. Steinfurth's range of products for the beverages industry comprises CO<sub>2</sub> measuring systems, devices for calibrating pressure and temperature, torque tester, logger for pressure, temperature and pasteurization, packaging testing devices, measuring systems for beer quality, laboratory carbonization systems and sampling devices.
- 401 Südmö North America**, 1330 Anvil Dr., Machesney Park, IL 61115; Telephone: +1.815.639.0322, Fax: +1.815.639.1135, Web: [www.sudmona.com](http://www.sudmona.com). Norit Südmö is a leading supplier of high-quality stainless steel mix proof valves, and of standard, long stroke, sampling, regulating, tank outlet, aseptic, butterfly, flow diversion, ball, and diaphragm valves to the brewing industry. In addition, our IntelliTank Matrix™ allows valves to be connected directly to the tank, eliminating long lines between tanks and manifolds.
- 219 Symbiont**, 6737 W. Washington St., Ste 3440, West Allis, WI 53214; Telephone: +1.414.291.8840, Fax: +1.414.291.8841, Web: [www.symbiontonline.com](http://www.symbiontonline.com). Symbiont, founded in 1981, is a full-service engineering and consulting firm that plans, builds, controls and optimizes food and beverage facilities. Our in-house staff includes: civil, mechanical, environmental, chemical, electrical, structural, and process engineers. Symbiont's projects include facilities, packaging, process, and wastewater treatment for the beverage industry. Symbiont is headquartered in Milwaukee, Wisconsin, with offices in Indianapolis, Indiana and Decatur, Illinois.
- 210 Thermo Scientific**, 501 90th Ave. NW, Minneapolis, MN 55433; Telephone: +1.763.783.2500, Fax: +1.763.780.2315, Web: [www.thermo.com](http://www.thermo.com). Thermo Scientific's CrystalVision Systems replace conventional, manual methods of measuring CO<sub>2</sub> concentration. Even in-line instruments that require consumables such as diaphragms or membranes are now not necessary. By utilizing the CrystalVision sensor, users can experience freedom of maintenance, higher accuracy, easy deployment and a depth of information that comes only from an in-line sensor. Visit [www.thermo.com/crystalvision](http://www.thermo.com/crystalvision) for full details.
- 502 Thonhauser USA Inc.**, 3036 Chardale Ct., 170 Crowne Point Pl., Ste 100, Cincinnati, OH 45262; Telephone: +1.513.771.6263 or +1.513.703.8080, Web: [www.thonhauser.net](http://www.thonhauser.net). Thonhauser, an Austrian based company, is a leader in in-line verification of clean in Europe. Thonhauser will be exhibiting its unique in-line instant verification of clean system. The technology uses a color change solution and photo eye equipment to ensure the hygienic condition of the system in quantified readouts. This technology can be used for beverage process and beverage dispensing system. This technology has enjoyed great success with European breweries and is now available in the US.
- 214 Tuchenhausen Flow Components, LLC**, 90 Evergreen Dr., Portland, ME 04103; Telephone: +1.207.797.9500, Fax: +1.207.878.7914, Web: [www.tuchenhausen.us](http://www.tuchenhausen.us). Tuchenhausen Flow Components is a world-renowned manufacturer of sanitary flow components, including Mixproof, Single-seat, Divert, Control, Pressure Relief, Vacuum and Butterfly valves, manifold expansion compensators, in-line instrumentation, CIP devices, Modular Tank cleaning and over- and under-pressure protection systems and factory-prefabricated valve manifold modules.



**120 Tyco Valves & Controls**, 83 General Warren Blvd., Ste 201, Malvern, PA 19355; Telephone: +1.610.296.2000, Fax: +1.610.296.8038, Web: www.tycovalves.com. Tyco Flow Control brings together 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 flow control applications. We are the world's largest manufacturer of valve products featuring the Hovap Mixproof valves.

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**112 Waukesha Cherry-Burrell, An SPX Process Equipment Operation**, 611 Sugar Creek Rd., Delavan, WI 53115; Telephone: +1.262.728.1900 or +1.800.252.5200, Fax: +1.262.728.4904, Web: www.gowcb.com. Waukesha Cherry-Burrell, an SPX Process Equipment Operation, is a major supplier of component equipment including pumps, valves, fittings, and heat exchangers. At this show we are featuring our NEW brewery mix proof technology with minimal CIP loss, superior mechanical strength and reliability, and Set & Forget Feedback Switch technology.

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**111 White Labs, Inc., Pure Yeast & Fermentation/Frings America**, 7564 Trade St., San Diego, CA 92121; Telephone: +1.888.593.2785 or +1.303.530.0469, Fax: +1.888.693.1026, Web: www.whitelabs.com. A full service lab, specializing in pitchable, certified pure, liquid brewers, distillers and wine yeast, laboratory equipment, testing services and easy to use, quality control test kits. Our mission is to provide the highest quality liquid brewers yeast and lab products at a fair price with unparalleled service.

**119 Wittemann**, 1 Industry Dr., Palm Coast, FL 32137; Telephone: +1.386.445.4200, Fax: +1.386.445.7042, Web: www.wittemann.com. Founded in 1874, Wittemann is the recognized leader in design and manufacture of complete systems for the recovery of CO<sub>2</sub>. Wittemann has installations in over 100 countries and offers complete service, including installation supervision, commissioning and spare parts. Products for breweries include recovery systems, stripping systems, and energy saving vaporizers (EPV).

## Author Index

Adkins, L., O-34	Jones, D., P-68	Saito, W., P-65
Agius, G., P-54	Jordan, J., P-59	Samp, E., O-7, O-10, O-22
Alden, C., O-23		Sato, K., P-58
Arendt, E., O-50, O-51	Kanzleiter, R., O-30	Sawada, K., P-65
Artzner, C., O-11	Kather, A., P-60	Schmid, N., O-43
	Kawai, Y., O-37	Schmitt, M., O-8
	Keßler, M., O-50	Schoenberger, C., O-42, P-66
Back, W., O-43, O-44, O-50, O-51	Kihara, M., P-58	Schwarz, P., O-9, P-67
Bamforth, C., O-33	Kirner, F., O-29	Schwedock, J., P-68
Barnum, R., O-12	Konink, R., P-59	Scoles, G., P-65
Bertrand, D., P-72	Kotaviita, E., P-74	Shinonaga, M., O-47
Bland, J., O-35	Kramer, P., O-52	Siebert, K., O-32, O-45
Böe, K., P-69	Kreis, S., O-50	Sommer, K., O-6
Budde, A., O-8	Kusano, S., O-47	Soukup, T., O-35
Burberg, F., O-50		Stewart, G., O-28, O-31
	Laitila, A., P-74	Straus, D., P-68
Chase, L., O-39	Langowski, H., P-60	Stumpe, C., O-49
Chiba, H., P-65	Lefol, E., P-65	Sugihara, M., O-17
Chlup, P., O-31	Lewis, M., O-14	Syuu, T., P-58
		Szabo, T., O-35
Dehart, D., P-68	Maekawa, A., O-45	
Demers, B., P-55	Mallett, J., O-5	Taguchi, M., O-37, O-47
Duff, J., O-36	Marriott, R., O-42	Takahashi, S., P-65
Duffell, C., P-56	Martin, S., O-28	Takeda, K., P-58, P-65
	Matsuda, H., O-19	Takoi, K., P-65
	May, C., O-33	Tenge, C., P-69
Eckstein, P., P-65	McCarthy, S., O-4	Thomasser, T., O-24
Euzen, C., O-45	McCready, C., O-22	Thompson, C., O-34
	McGree, K.S., P-64	Thonhauser, P., P-70
Fischborn, T., O-18	McKenzie, B., O-39	Tippmann, J., O-6
Fleet, C., O-32	McLeod, R., O-27	Tito, J., O-35
Folz, R., O-48	Meadows, J., P-68	Totzke, D., P-71
Foster, A., O-7	Menger, H.-J., O-6, O-20	Toumi, J., O-38
Funk, U., O-3	Mercer, J., O-41, P-61	Turner, N., O-26
	Mertie, S., O-53	
Gastl, M., O-43, O-44	Mola, A., O-13	Uhlenkamp, B., O-21
German, C., P-64	Montgomery, E., P-62	Van Zandycke, S.M., O-18, P-72
Gero, S., O-43	Moser, D., O-46	Vilpola, A., P-74
Gimbel, L., O-1		Voigt, J., O-6, O-51
Gnadt, D., P-57	Nagafune, T., O-47	Voigt, T., P-60
	Nakamura, Y., O-16	
Hanke, S., O-44	Nankaku, N., P-58	Walsh, K., P-68
Harvey, B., P-65		White, C., P-73
Hayashi, K., P-58, P-65	O'Neil, M., P-71	Wilhelmson, A., P-74
Herrmann, M., O-43	Ottolini, J., O-40	
Hettinger, J., O-7		Yonezawa, T., O-28
Hirota, N., P-58, P-65	Petschen, G., O-2	Zarnkow, M., O-50, O-51
Home, S., P-74	Powell, C., P-72	
Hull, G., O-15	Pringle, A., O-4	
Huttunen, T., P-74		
	Radzanowski, D., O-25	
Imure, T., P-58	Rasanen, E., P-74	
Ito, K., P-58, P-65	Rath, F., P-63	
	Rehmanji, M., O-13	
Jacobs, J., P-59	Richter, A., O-51	
James, K., O-35	Rossnagel, B., P-65	
Johnston, B., O-35		

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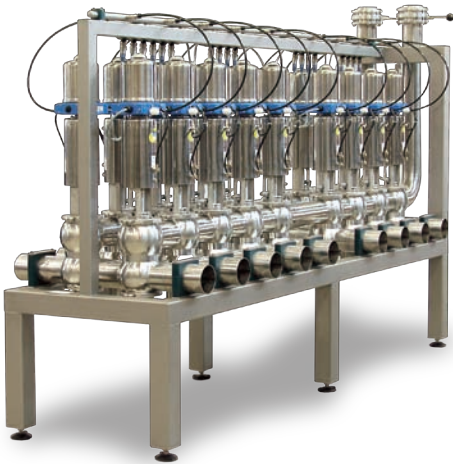


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