

We will start momentarily at 2pm ET



Download slides & presentation ONE WEEK after the webinar:

<http://acswebinars.org/beer-foam>

Contact ACS Webinars™ at acswebinars@acs.org

1

Have Questions?

Use the Questions Box!



Or tweet using #acswebinars



Download slides & presentation ONE WEEK after the webinar:

<http://acswebinars.org/beer-foam>

Contact ACS Webinars™ at acswebinars@acs.org

2

ONE WORD

TO DESCRIBE ACS WEBINARS...
THANK YOU FOR THE SUBMISSIONS!



Contact ACS Webinars™ at acswebinars@acs.org

3

Upcoming ACS Webinars™

www.acswebinars.org



Thursday, February 21, 2013

2013 Chemical Entrepreneurship Series Part 2 of a 9 part session

Neil Senturia and Barbara Bry, CEO and COO of Blackbird Ventures



Thursday, March 28, 2013

Using Water to Replace Organic Solvents: Switchable Water

Dr. Philip Jessop, Canada Research Chair, Queen's University and
the Technical Director, GreenCentre Canada

Dr. Joseph Fortunak, Professor, Howard University

Contact ACS Webinars™ at acswebinars@acs.org

4



Q: “Hungry for a brain snack?”

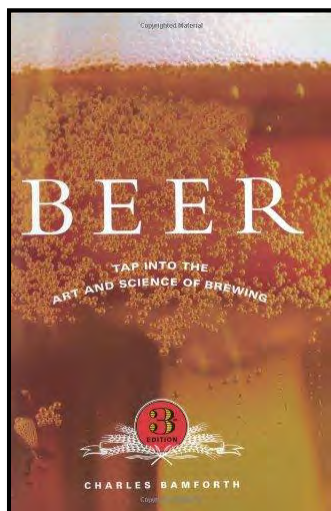
A: ACS Webinets™ on



“Feeling short on time? ACS Webinets™ are 2 minute segments that bring you valuable snippets from some of our most popular full length ACS Webinars™ ”

**See all of our ACS Webinets™ on YouTube at
<http://bit.ly/acswebinets>**

5



Stay tuned for a chance to win a book written by Dr. Charlie Bamforth!

6

ACS WEBINARS™
March 14, 2013



Getting A Head Through Chemistry: Great Beer and A Frothy Foam



Dr. Charlie Bamforth
Professor of Malting &
Brewing Sciences,
UC Davis

Dr. Steve Carlo
Bureau of Engraving
and Printing

Download the presentation ONE WEEK after webinar:
<http://acswebinars.org/beer-foam>

Contact ACS Webinars™ at acswebinars@acs.org

7

8



GETTING A HEAD THROUGH CHEMISTRY: GREAT BEER AND A FROTHY FOAM

Dr. Charlie Bamforth,
Professor of Malting & Brewing Sciences at UC Davis
March 14, 2013





“I maintain that widgets have done more for foam quality than all the eminent biochemists in the history of this industry.”



“Thank you for the copies of your book....on goalkeepers.... Were I unkind I might suggest that it is less (than) clear which publication (this or the papers on beer proteins) would be of greater value to someone wishing to establish a practical means of improving the quality of beer foam!”

Foam:

- **Critical factor in consumer assessment and purchase decisions**
- **Beer foam quality = combination of**
 - **Stability**
 - **Lacing**
 - **Whiteness**
 - **Texture**
 - **Robustness**



Beer Foam Physics

Four Key Processes:

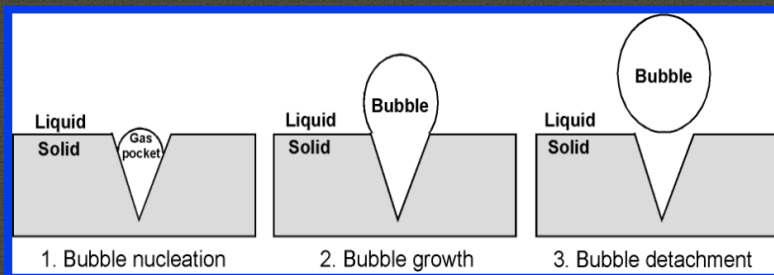
1. Bubble formation
2. Creaming (bubble rise or beading)
3. Drainage
4. Disproportionation



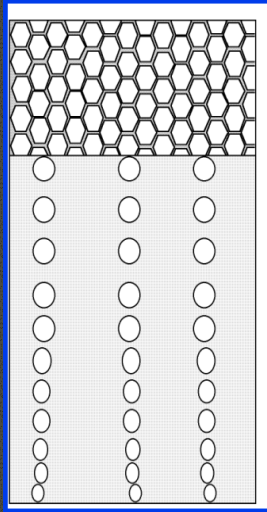
Beer Foam Physics

1. Bubble Formation

- dispense, nucleation, low beer surface tension



Beer Foam Physics



2. Creaming (bubble rise or beading)

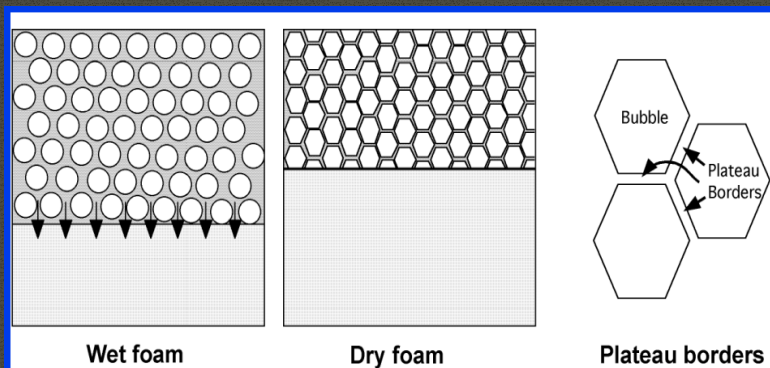
- nucleation activity
- surface tension
- beer density
- CO₂ content



Beer Foam Physics

3. Drainage

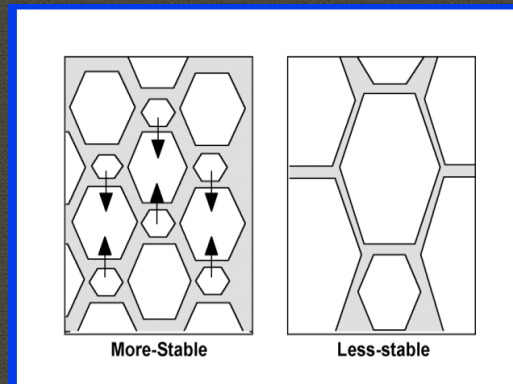
- localized viscosity +ve



Beer Foam Physics

4. Disproportionation

- gas composition



Beer Foam Physics

4. Disproportionation (continued)

$$r_t^2 = r_o^2 - \frac{4RTDS\gamma}{P\theta} t$$

r_t is the bubble radius at time t

r_o is bubble radius at the start

R is the gas constant

T is absolute temperature

D is the gas diffusion coefficient

S is the solubility of the gas

γ is the surface tension

P is atmospheric pressure

θ is the film thickness between bubbles

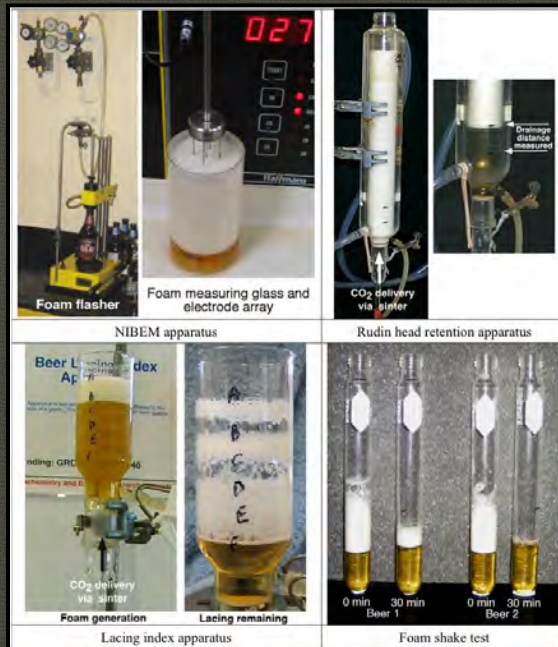


How will the radius of a 0.5 mm bubble change over time?

Seconds	CO ₂ /5°C	CO ₂ /25°C	N ₂ /5°C
10	0.49	0.49	0.5
20	0.48	0.48	0.5
30	0.47		0.5
60	0.44	0.44	0.5
180	0.32	0.3	0.5
240	0.23	0.19	0.5
300	0.03	-	0.49
600	-	-	0.49

Film thickness 100 μm

A Selection Of Foam Analysis Methods



Which do you Prefer?

- Drinking beer from a glass
- Drinking beer from the bottle
- I only drink from a Beer Stein

Foam

A balance of chemical species that either promote or inhibit foam.

The main foam positive element is Polypeptide.



Which Polypeptides?

- Discrete polypeptide hypothesis
- Generalized amphipathic polypeptide hypothesis



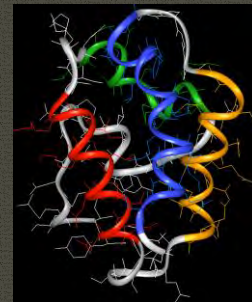
Some Proposed Foaming Proteins

Lipid Transfer Protein (LTP1)

From barley

Unchanged in malting and mashing

Activated during boiling by denaturation
(increased hydrophobicity?)

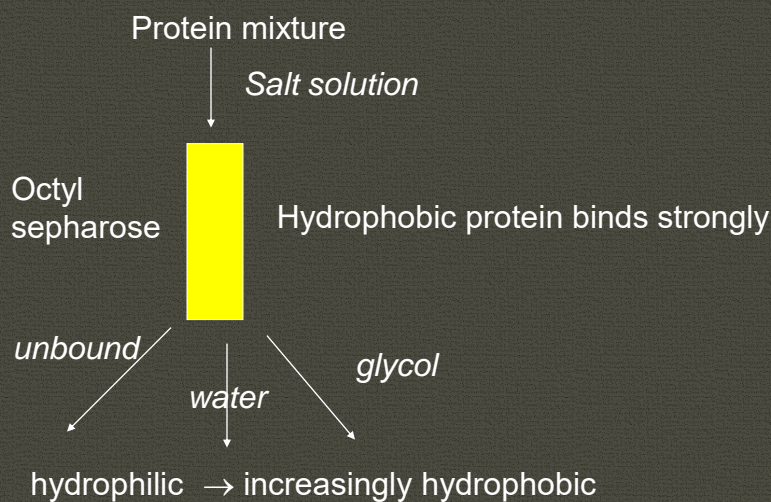


Protein Z (40kD protein)

- serpin from barley
- attached to β -amylase
- some say its elimination or absence (e.g. by using Pirkka malt) has no effect on foam
- others say that it correlates with foam stability better than LTP1

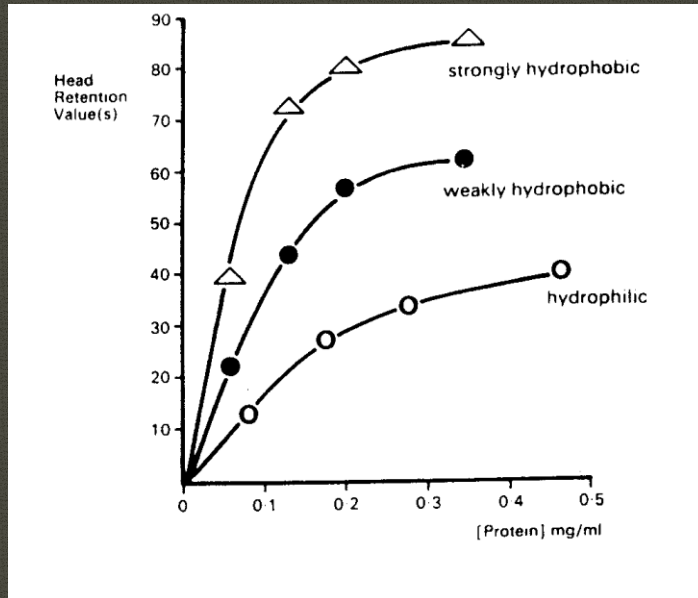


The Generalized Amphipathic Polypeptide Hypothesis

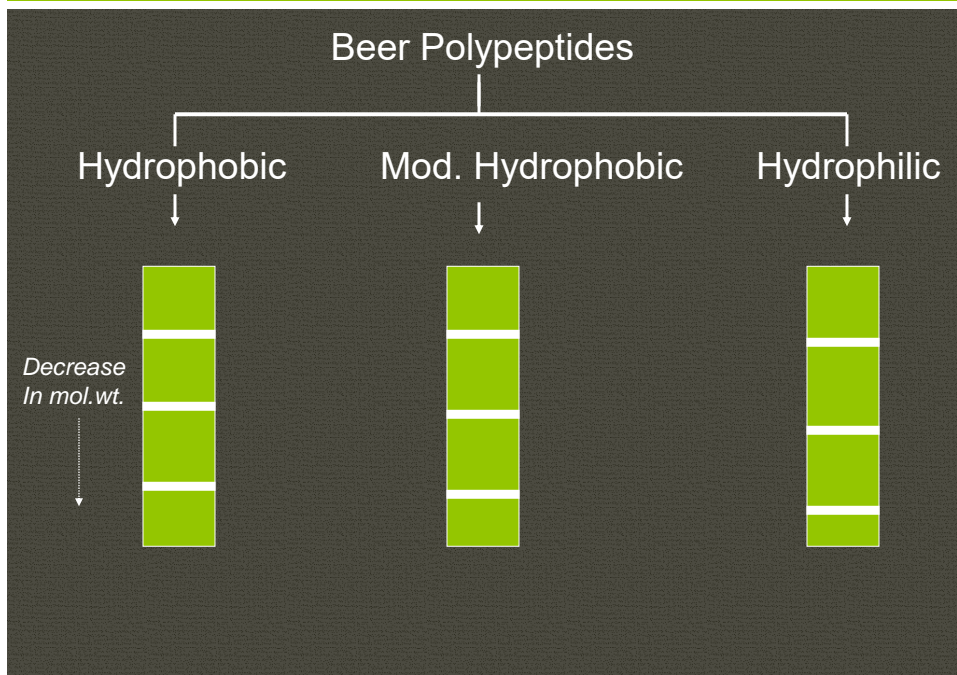


Slack & Bamforth, *J. Inst. Brew.*, 1983

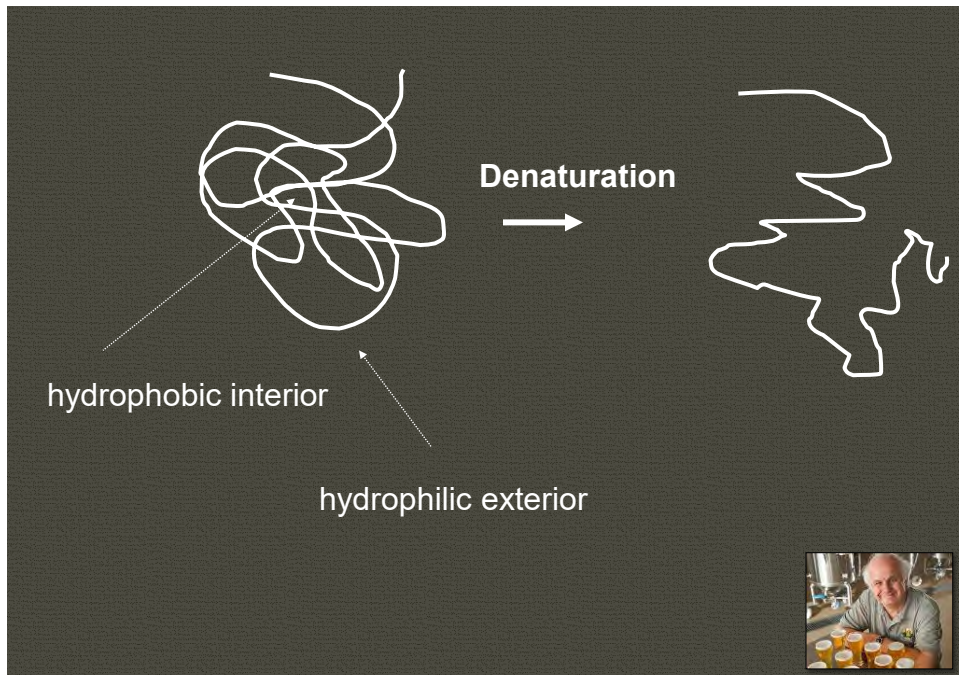
25



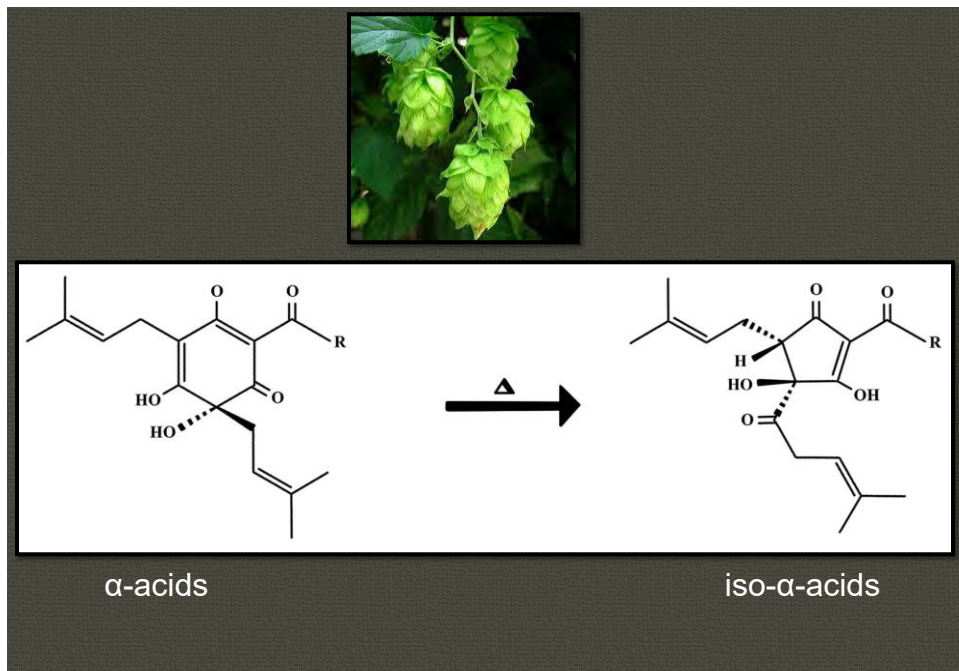
26

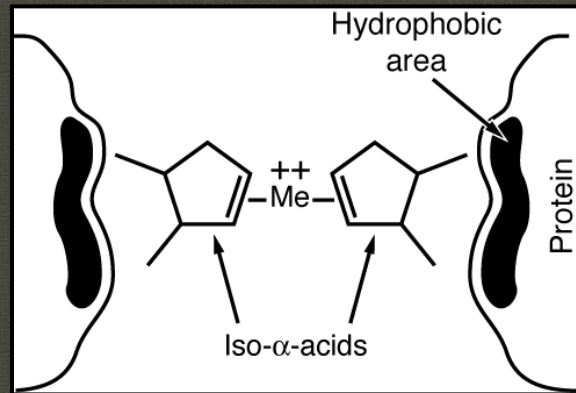


27

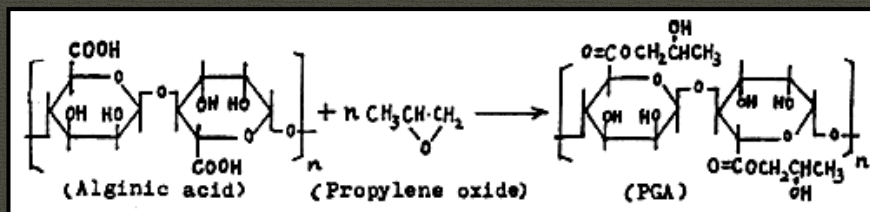


28

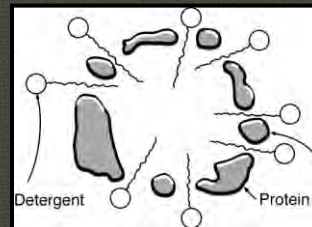
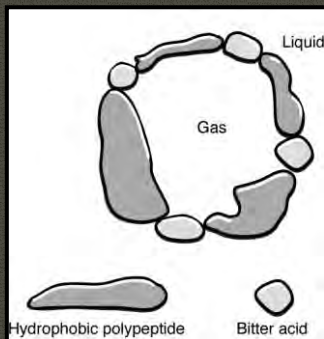
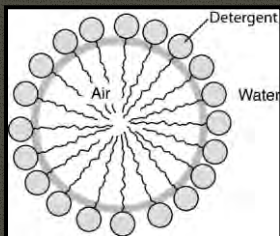
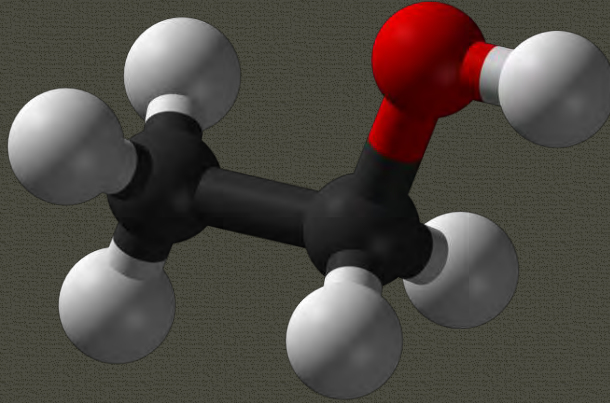




Propylene Glycol Alginate



Foam Inhibitors




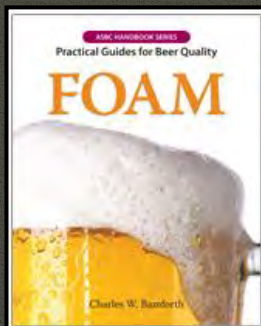
Beware lipids!

Do you think that foam clinging to the side of the glass is a good thing?

- Yes
- No
- If someone else is buying I couldn't care less

To Get Great Foam:

- Clean glass
 - Nucleation sites
 - Pour with vigor
 - Be patient
 - Sip from only one side of the glass
 - Get rid of the mustache/lipstick/both
- 
- A photograph showing three different styles of beer glasses filled with beer and topped with foam. From left to right: a tall, slender glass with a thin layer of foam; a tall, elegant glass with a thick, creamy head of foam; and a shorter, wider glass with a moderate amount of foam. The glasses are set against a dark background with a reflective surface below them.
- The dispense is much more important than the beer itself, but the best foams will come from high malt beers (especially if some wheat is used) with high bitterness. Nitrogen will help, but will greatly lessen hop aroma.



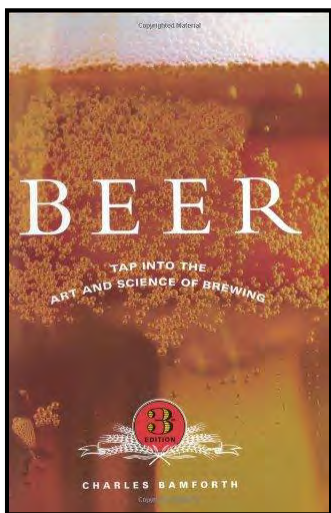
cwbamforth@ucdavis.edu

www.asbcnet.org



**FOR A CHANCE TO
WIN THE BOOK!**

**“In which city in the world
would you expect to find
the least amount of foam
in their ales?”**



Go to facebook.com/acswebinars
or send us email acswebinars.org

ACS WEBINARS™

March 14, 2013



Getting A Head Through Chemistry: Great Beer and A Frothy Foam



Dr. Charlie Bamforth
Professor of Malting &
Brewing Sciences,
UC Davis

Dr. Steve Carlo
Bureau of Engraving
and Printing

Download the presentation **ONE WEEK** after webinar:
<http://acswebinars.org/beer-foam>

Contact ACS Webinars™ at acswebinars@acs.org

37

ACS Webinars™

CLICK • WATCH • LEARN • DISCUSS



Stay Connected...

ACS Network
Where Chemists Connect

ACS Network (search for group acswebinars)
www.communities.acs.org

LinkedIn

LinkedIn (search for acswebinars)



www.twitter.com/acswebinars

facebook

www.facebook.com/acswebinars

Contact ACS Webinars™ at acswebinars@acs.org

38

Upcoming ACS Webinars™

www.acswebinars.org



Thursday, February 21, 2013

2013 Chemical Entrepreneurship Series Part 2 of a 9 part session

Neil Senturia and Barbara Bry, CEO and COO of Blackbird Ventures



Thursday, March 28, 2013

Using Water to Replace Organic Solvents: Switchable Water

Dr. Philip Jessop, Canada Research Chair, Queen's University and the Technical Director, GreenCentre Canada

Dr. Joseph Fortunak, Professor, Howard University

Contact ACS Webinars™ at acswebinars@acs.org

39

Upcoming ACS Webinars™

www.acswebinars.org



“Everyone today must think like an entrepreneur whether it’s in your own business, a large corporation or a nonprofit organization.”

Continues Thursday, March 21, 2013 @ 2PM ET

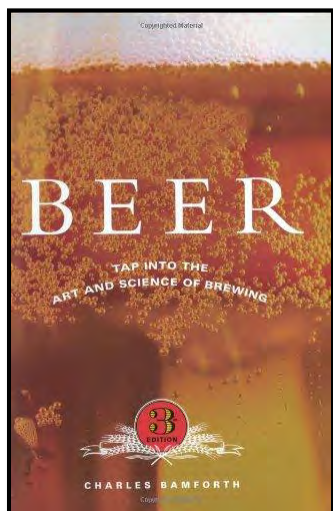
Learning how to develop the next big start-up has never been so entertaining!

ACS members who attend 7 out of 9 sessions get a Certificate of Completion.

Tune in every third Thursday of the month @ 2PM ET

Contact ACS Webinars™ at acswebinars@acs.org

40



**FOR A CHANCE TO
WIN THE BOOK!**

**“In which city in the world
would you expect to find
the least amount of foam
in their ales?”**

Go to facebook.com/acswebinars
or send us email acswebinars.org

41

ACS Webinars™
CLICK • WATCH • LEARN • DISCUSS



ACS Webinars™ does not endorse any products or services. The views expressed in this presentation are those of the presenter and do not necessarily reflect the views or policies of the American Chemical Society.

Contact ACS Webinars™ at acswebinars@acs.org

42