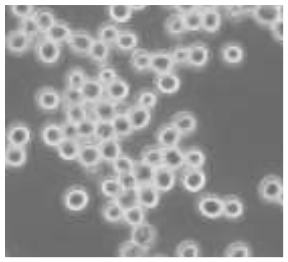





Innovation Trends in Brewing Technology

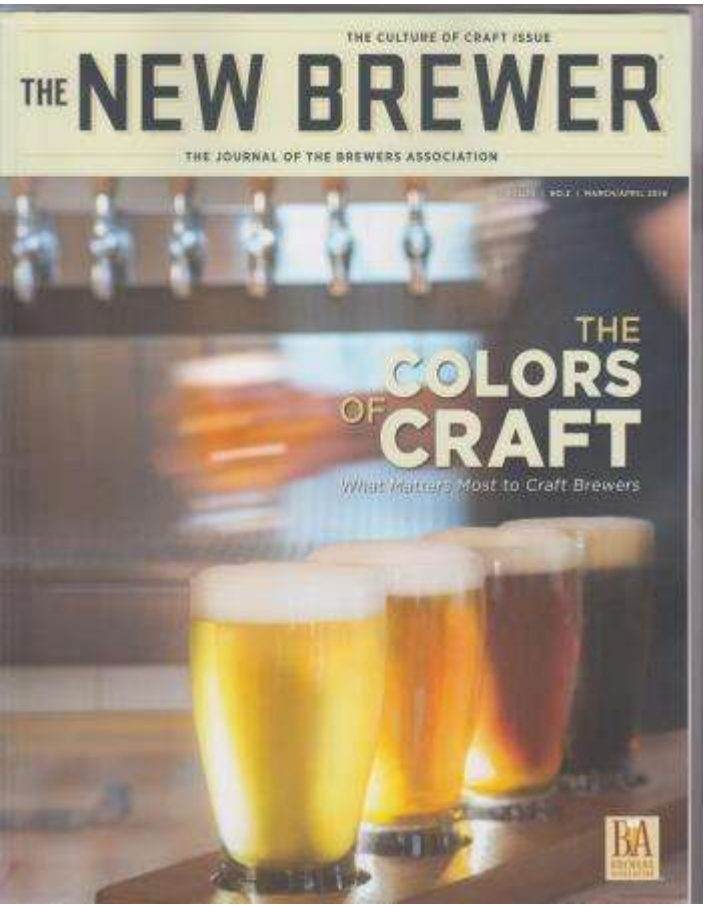
Status & Outlook

Versuchs- und Lehranstalt für Brauerei in Berlin (VLB) e.V.

◎ Brewing Conference Bangkok 2019 ◎

Mick Holewa

Craft Brewer Approach (?)



Charlie Papazian, founder and long-time president of the „Brewers Association"

WHY DO WE BREW?
Competent brewers are not only mixing up a bunch of ingredients and „make" beer. (…)
Creating a beer is a process similar to nurturing a child, beginning by selecting and collecting ingredients. It's going on by combining these ingredients competently and and processing them magically.
Beer develops personality during fermentation and maturation (…)
When the beer is finished (…) the brewers are controlling the presentation of their beers in bottles, kegs, cans and glasses.

Hopfenaroma

Pfanne

- ✓ Extraction
- ✓ Evaporation
- ✓ Oxidation

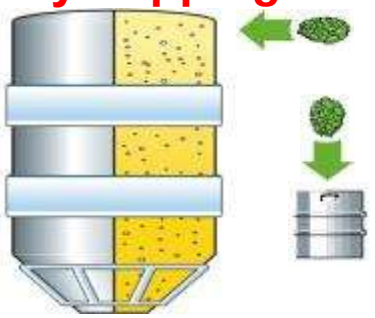
(noble)

Whirlpool

- ✓ Extraction
- ✓ Evaporation
- ✓ Oxidation

(harsh/fruity/noble)

“dry hopping”

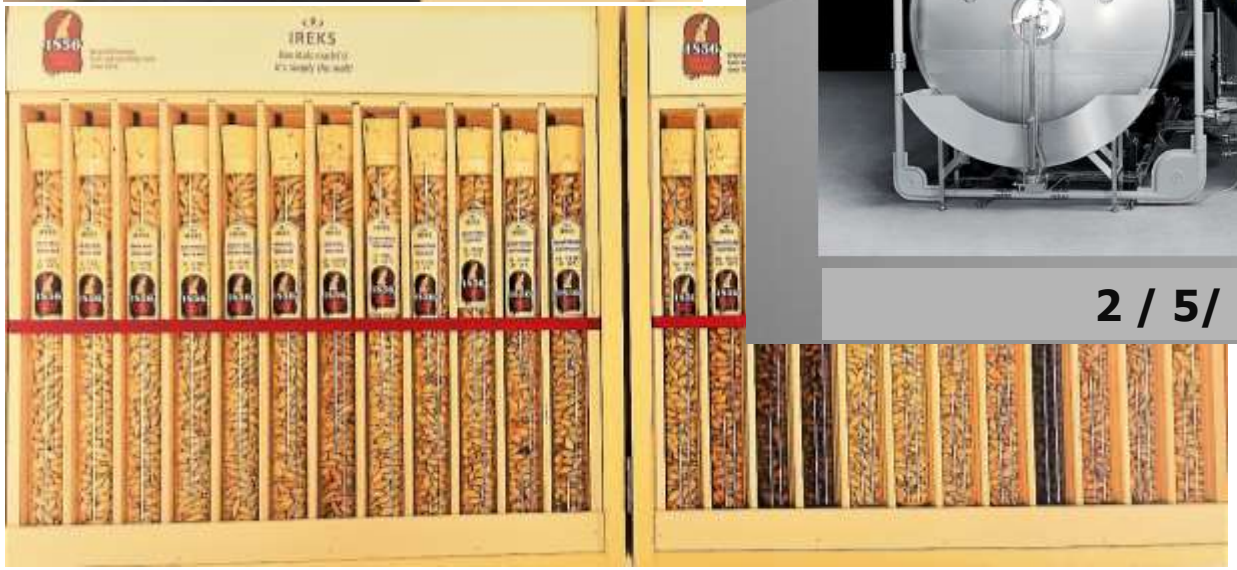


- ✓ Extraction
- ✓ Biotransformation
- ✓ Hydrolyse
- ✓ Esterification
- ✓ Adsorption
- ✓ Stripping

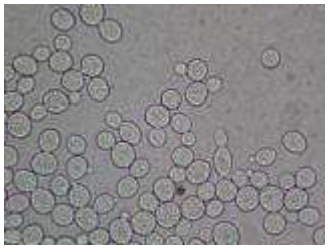
(fruity/floral/citrusy/”dry-hop”)

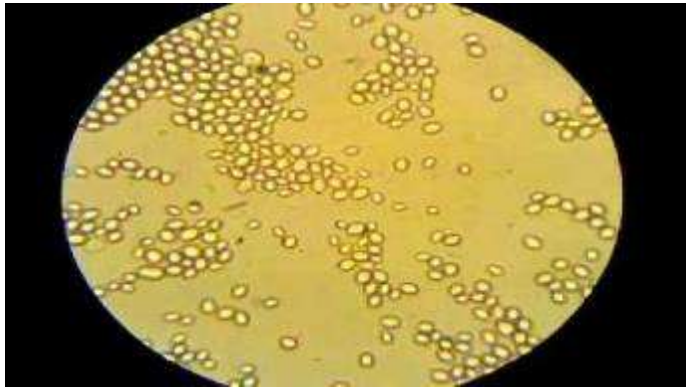
Grafik nach DBB

Craft Malt / Micro malting



Diversity of Saccharomyces





Properties

Technology

+ attenuation performance
+ sugar utilisation
+ alcohol & CO_2 resistance
+ temperature/pressure
+ flocculation behaviour

Sensory

+ esters
+ higher alcohols
+ diacetyl
+ organic acids
+ sulphury compounds
+ phenolic compounds

many strains available

VERSUCHS- UND LEHRANSTALT FÜR BRAUEREI IN BERLIN E.V.

VLB BERLIN
Forschung, Lehre, Beratung, Information und Dienstleistung seit 1883

yeast strain	yeast type	flocculence	produced beers	remarks
Rh	bottom fermenting	medium flocculent	lager	neutral
He.-Bru.	bottom fermenting	flocculent	lager	fruity
Nr. 42	bottom fermenting	flocculent	lager	neutral
Nr. 221	bottom fermenting	medium flocculent	lager	aromatic
1901	bottom fermenting	non flocculent	lager	neutral
SMA-S	bottom fermenting	non flocculent	lager	neutral
St.F.	bottom fermenting	non flocculent	lager	aromatic
160 obg.	top fermenting	non flocculent	Ale, "Altbier"	fruity, malty
109	top fermenting	flocculent	Ale, "Altbier"	sweet-and-sour
110	top fermenting	flocculent	Ale, Stout	malty, slight fruity
111	top fermenting	medium flocculent	Ale, "Altbier"	string, light vanillic
68 obg.	top fermenting	nearly non flocculent	"Weizenbier"	focus on isoamyl acetate
94	top fermenting	nearly non flocculent	"Weizenbier"	focus on 4-vinylguajacol
O.K.3	top fermenting	nearly non flocculent	"Koelschbier"	neutral

VLB Yeast Collection

commercial: ~120 strains
research: ~1500 strains

Carlsberg Research Laboratory

50,000 strains
vintage yeast beer

Hefebank WEIHENSTEPHAN

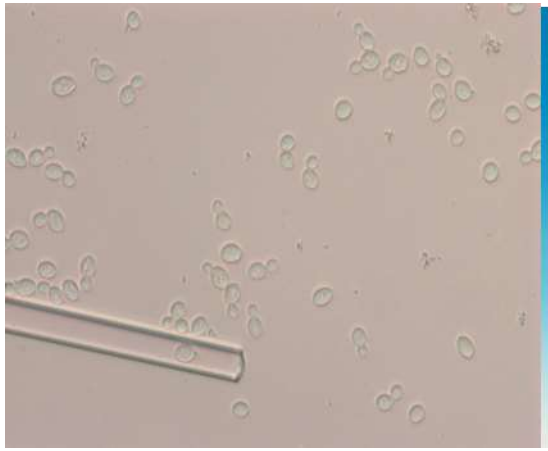
commercial: ~120 strains
BLQ research: treasure hunt for old/new strains

tailor made strains in focus

Target: Performance

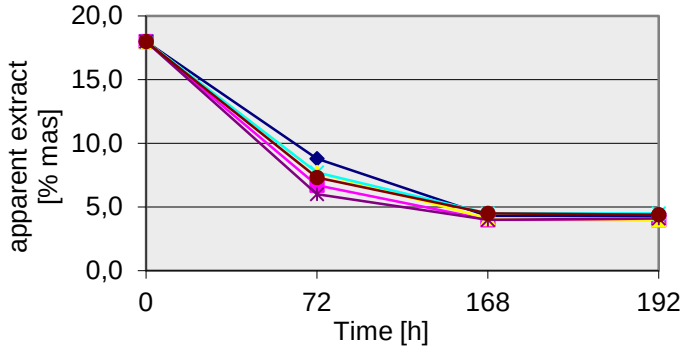
+ micro-scale tests of large numbers of strains
+ selection on:
  - fast growth
  - high attenuation
  - diacetyl reduction
  - alcohol resistance
+ upscaling of high-performers, evaluation of flavour profile

VLB approach for yeast strain optimisation

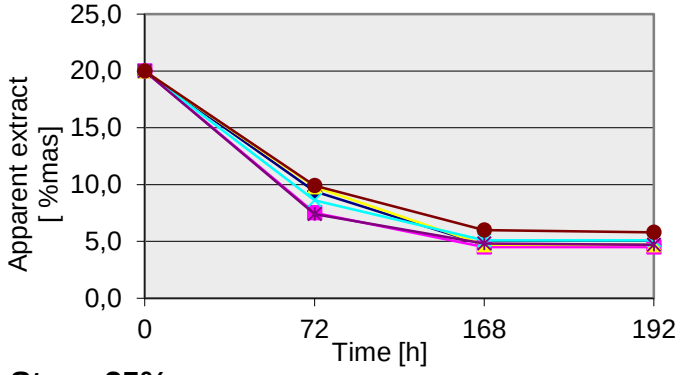


- Isolation of single cells of the same strain
- Micro scale fermentation
- Good results → upscale to 1L
- Good results → uspscale to 5L pilot plant scale

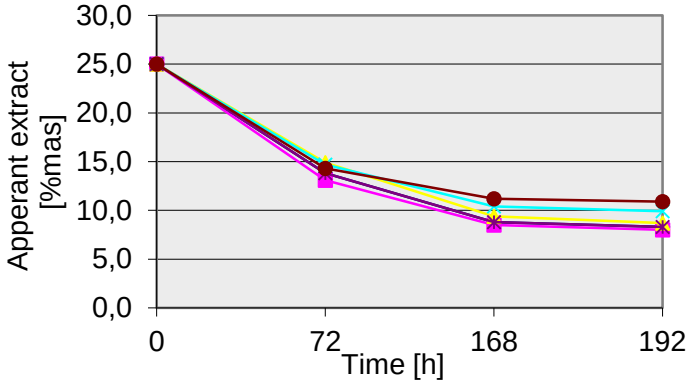
Stwg. 18%-mas



Stwg. 20%-mas



Stwg. 25%-mas



Process Optimisation by Yeast Selection

"High Gravity"

Different strains were tested on fermentation performance under high gravity conditions

18°P / 20°P / 25°P

Lab scale fermentation at 26°C

High Gravity - Yeast Nutrition

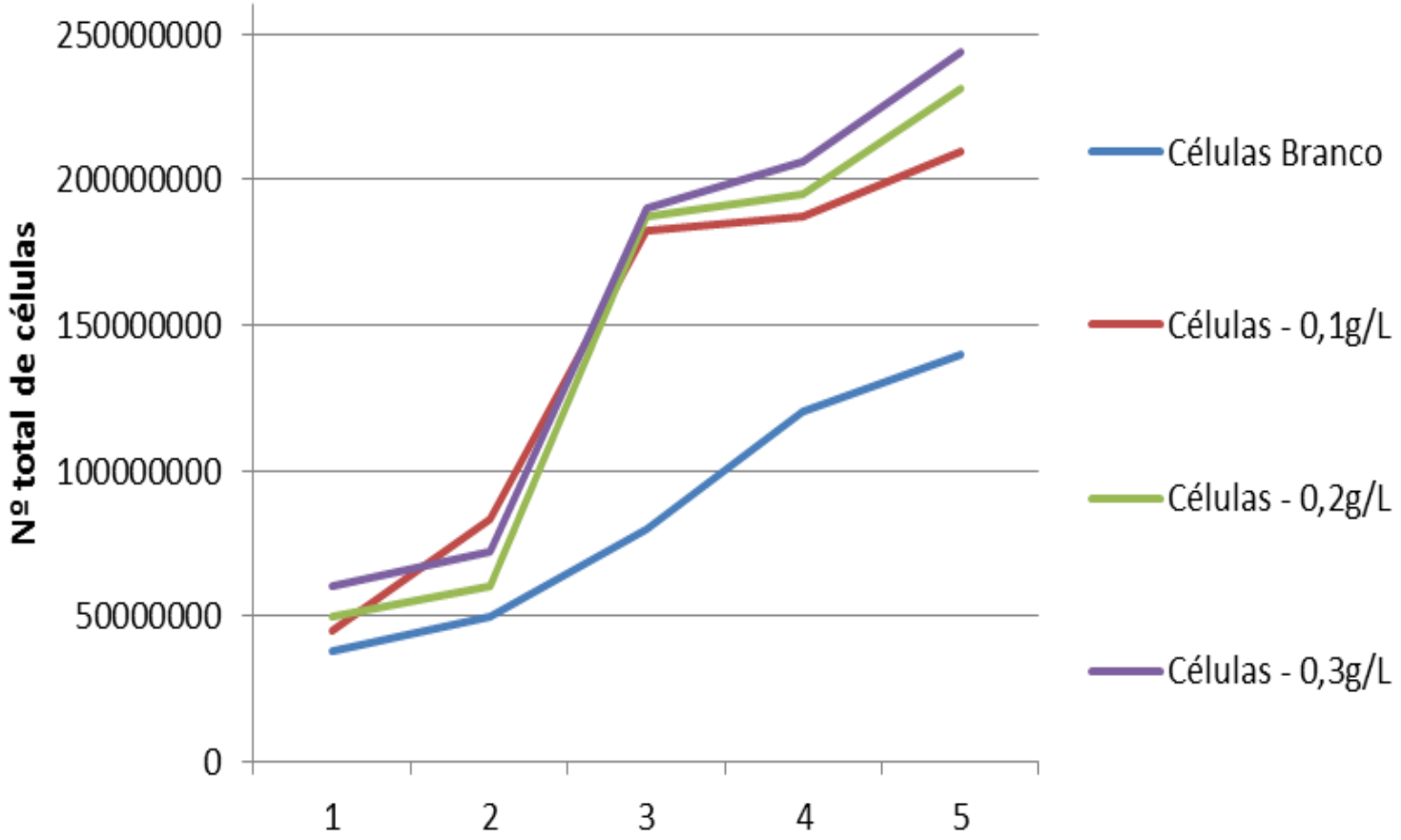
- Some authors suggest that going as high as 24 °P is possible as long as the yeast has the correct nutrition
- Enough FAN:
  - 140 ppm FAN is usually quoted as a minimum rule for a 12 °P wort
  - increase in proportion to the gravity (i.e >210ppm in a 18 °P wort)
- Elevated levels of metal ions especially Mg^{2+} (co-enzym of De-/Carboxylase) and Ca^{2+} (Yeast multiplication) allow to reach higher ethanol levels without impairing yeast performance
- Application of yeast foods containing Zn^{2+}, Mg^{2+}, FAN and unsaturated fatty acids → Clean label?

Very High-Gravity – External Nitrogen e. g. $(NH_4)_2HPO_4$

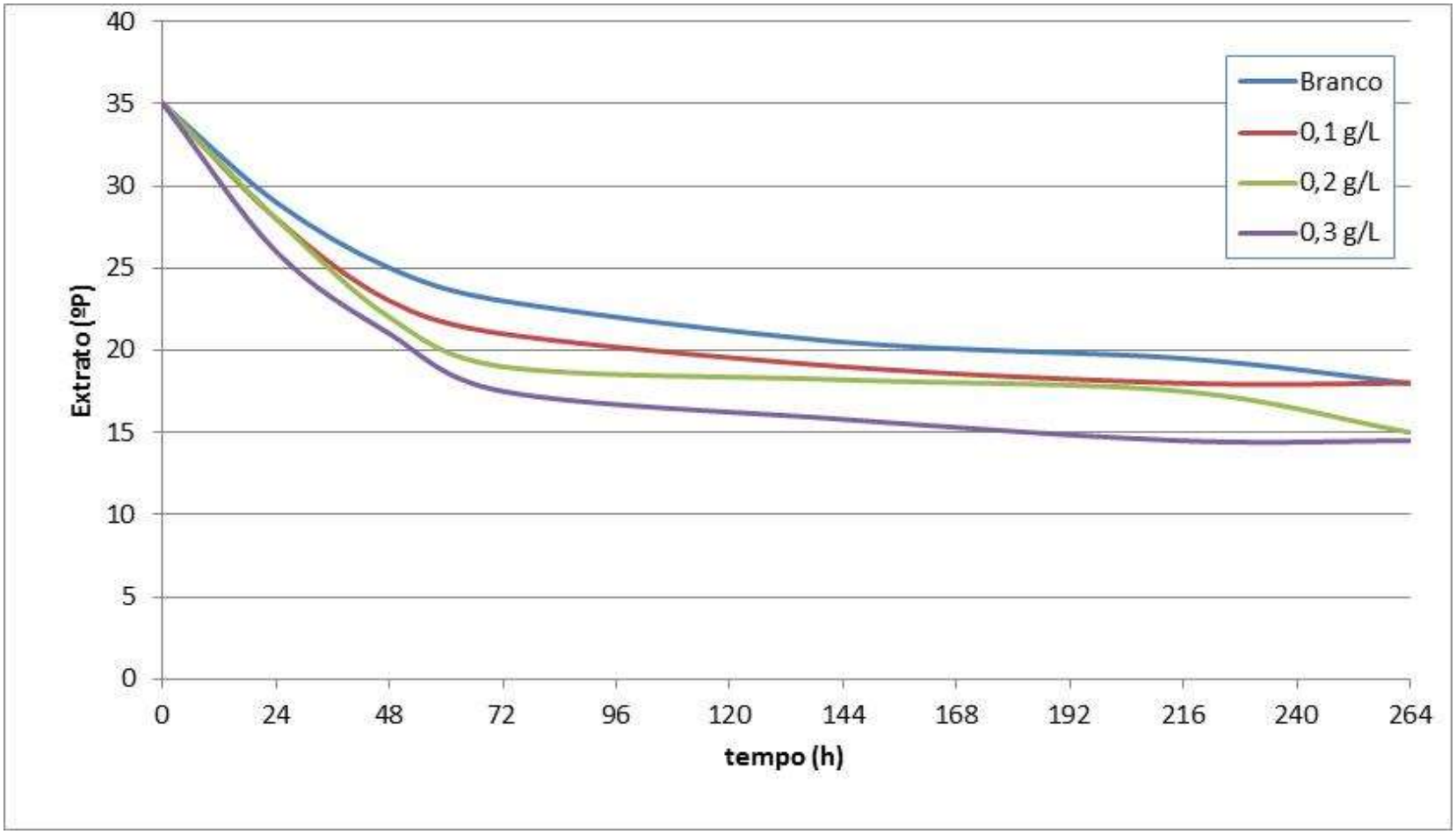
+ inorganic ammonia as nutrient salt
  - activation of phosphofructokinase (glycolysis)
  - activation of maltosepermease (inactivated by proteases when N is lacking)
+ phosphate relevant for:
  - ATP synthesis
  - Phospholipides
  - DNA, RNA
+ Benefits:
  - better fermentation performance: up to 5 days shorter
  - reaching final attenuation

Source: Senai

Propagation – Diammoniumphosphatezugabe



Gärung –
Zugabe von Diammoniumphosphat



Source: Senai

Global Player Approach

//steadydrinker.com/reviews/lager/budweiser-prohibition-brew/

budweiser prohibition brew

Budweiser "Prohibition Brew" alcohol-free (0%) lager review

By Tom Hallett on March 8, 2018

—

Share Tweet Pin

https://steadydrinker.com/reviews/lager/budweiser-prohibition-brew/

Steady Drinker is an independent website that helps you discover great low-alcohol and non-alcoholic beers and lagers (under 0.5% ABV) so you can cut down your alcohol intake.

READ MORE

FIND THIS SITE USEFUL?

If you find the reviews and resources on the site useful, please consider donating some cash to Society of St James, a charity that supports people who have issues with homelessness, drugs, alcohol and mental health.

DONATE TO CHARITY

NAB and LAB Strategy AB InBev (EBC Symposium Breslau, Sept. 2016)

- Ensure No- or Low-Alcohol beer products represent at least 20% of AB InBev's global beer volume by the end of 2025

- Place a Guidance Label on all of our beer products in all of our markets by end 2020 and increase alcohol health literacy by end 2025

- Reduce the harmful use of alcohol by at least 10% in six cities by 2020

Demand for Non-/Low-alcoholic Beer

- After lagging and losing volume during the 1990s and 2000s, the segment has roughly doubled in output over the last five years worldwide
- healthy food trends (low carb, gluten-free, meat substitutes etc.)
- religious reasons
- strict alcohol policies in car traffic
- demand for LAB around 2.5% abv almost only due to trade restrictions or beer tax policy

LAB und NAB Strategie AB InBev (continued)

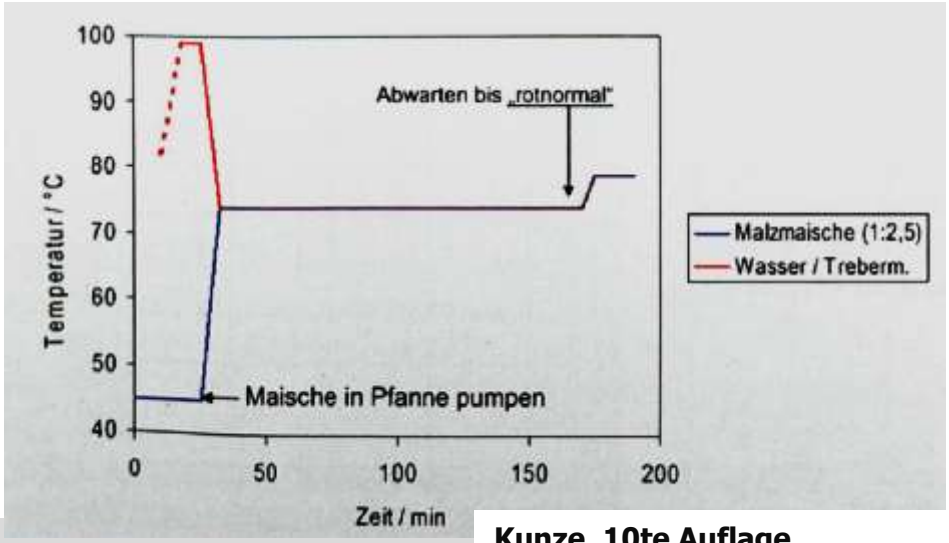
- Quote „Business Insider.de“ at „Budweiser Prohibition Brew“:
- „Budweiser Canada said the company used "the latest de-alcoholization technology" to create the brew.”

- So, what are the latest technologies?

Wort adjustment for LAB / NAB

Process parameters:

- Use of special malts to improve the body
- Mashing procedure: low fermentation degree
  - single step infusion around 74°C – ADF 57 %
  - “Jump” mashing process- ADF 47 %
- Original gravity: 8-9 °P
- Adjusted hop usage
- ….



Kunze, 10te Auflage

Overview different procedures during fermentation

Complete fermentation

1. Beer for dealcoholizsation
2. Special beer for blending
   - Hop products
   - Special yeast (Ester, higher Alcohols)

Incomplete Fermentation

1. Interrupted fermentation
2. Cold contact procedure
3. Use of maltose-negative Yeast

„Incomplete“ Fermentation: Use of maltose negative Yeast

- „A method from first half of 20th century“
  - Annemüller / Manger “Gärung und Reifung des Biers”
- Yeast is not able to ferment maltose
- Glucose, fructose or saccharose is assimilated
- Adjusting pH-value to beer pH is necessary
- Low alcohol formation during fermentation:
  0,5- 1,0 vol. % for 12-14 °P wort
- Significant decrease in wort flavour compounds

Overview different procedures of dealcoholisation

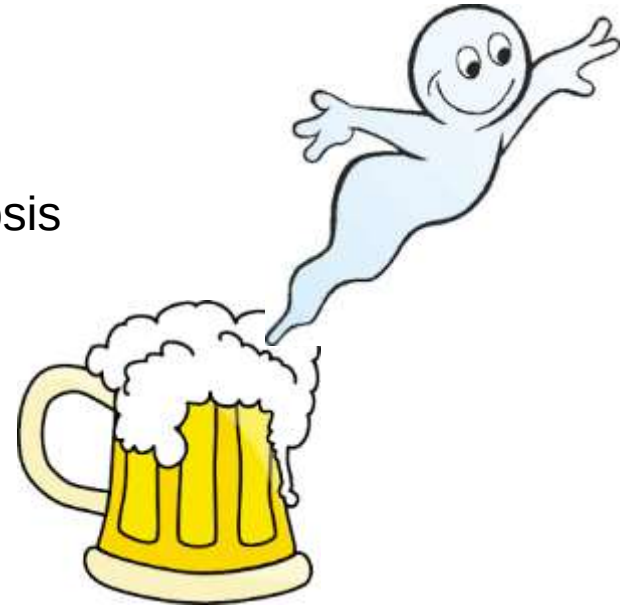
Beer often not „standard“ but adjusted
+ Body, hops, pH, …

Filtration/ Stabilisation
Special focus on non-biologic stability

Dealcoholisation

1. Thermal procedures

2. Membrane based procedures: Dialyse/ reverse osmosis



Combination and optimization potential

VLB BERLIN

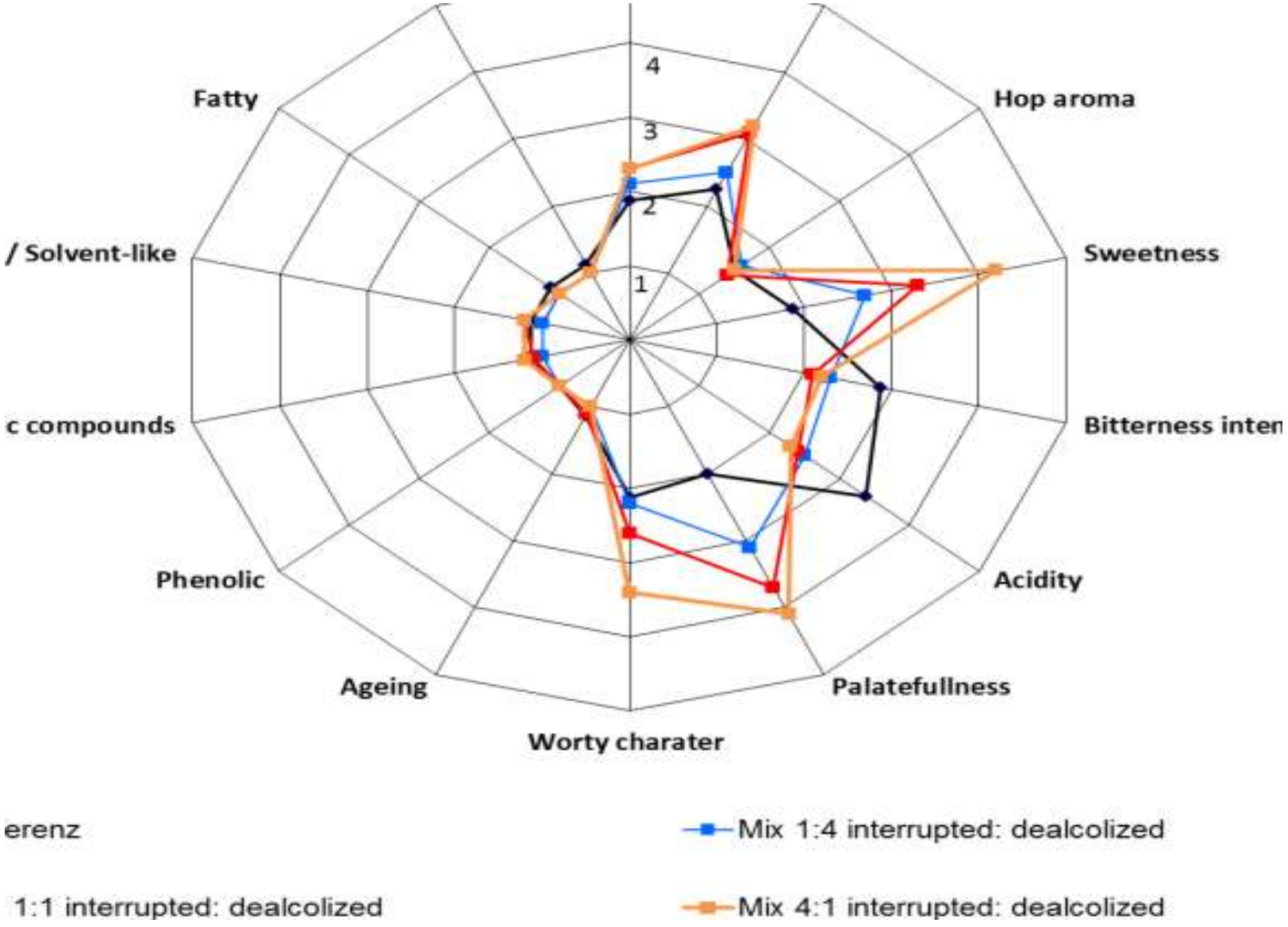
Aroma recovery out of the process

Recovery and re-addition of Aroma e.g. from de-carbonization step prior de-alcoholization

+ higher aliphatic alcohols and esters can be brought back into the de-alcoholised beer.
+ This gives a higher body / mouthfullness and a more balanced taste (even at very low alcohol levels)
+ A combination with addition of Kräusen or alcoholic beer can be useful (alcohol level to be obeyed)
+ Outside of the purity law one can also use pure substance additions

Source: Brauwelt 38, 1993, 1806 - 1820

Blending between dealcolized and interrupted



Non-Saccharomyces Yeasts – Maltose Negative

- *Saccharomycodes ludwigii* – a maltose negative yeast, which has established for pitching in non-alcoholic beer production
- Usually special mashing procedures und low gravity (7 – 9 °P)
- More examples of maltose negative yeast:
  - Saccharomyces Dairensis
  - Torulaspora Delbrueckii

GMO

- Gene scissors CRISPR/Cas9 has been used 4 additional genes were introduced into a yeast genome
- 2 genes derived from peppermint and basil, producing geraniol and linalool from the precursors
- 2 genes derived from yeast itself and promote the production of the precursors
- Results: in comparison the beer from this yeast was judged as more hoppy

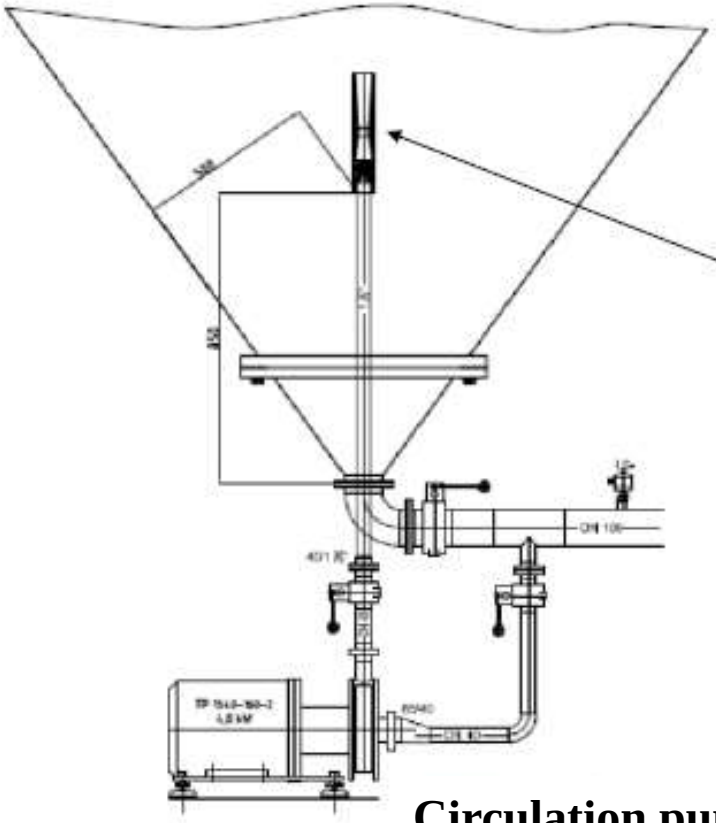
  – http://www.scinexx.de/wissen-aktuell-22552-2018-03-21.html
  – (University of California – Berkeley, 21.03.2018 - NPO)

Trial with external loop CCVs

- German middle sized brewery
- One-tank system, 34 CCVs
- Aim: lower the number of CCVs
- Systems in test:
  - Ecoferm by GEA
  - Isomix by AlfaLaval
  - Volume ~ 2600 hl
  - Fermentation: 14°C
  - Maturation: 2 °C
  - 3 x yeast harvest

  - Talk by: P. Quester, Dresdener Brauertag of VLB

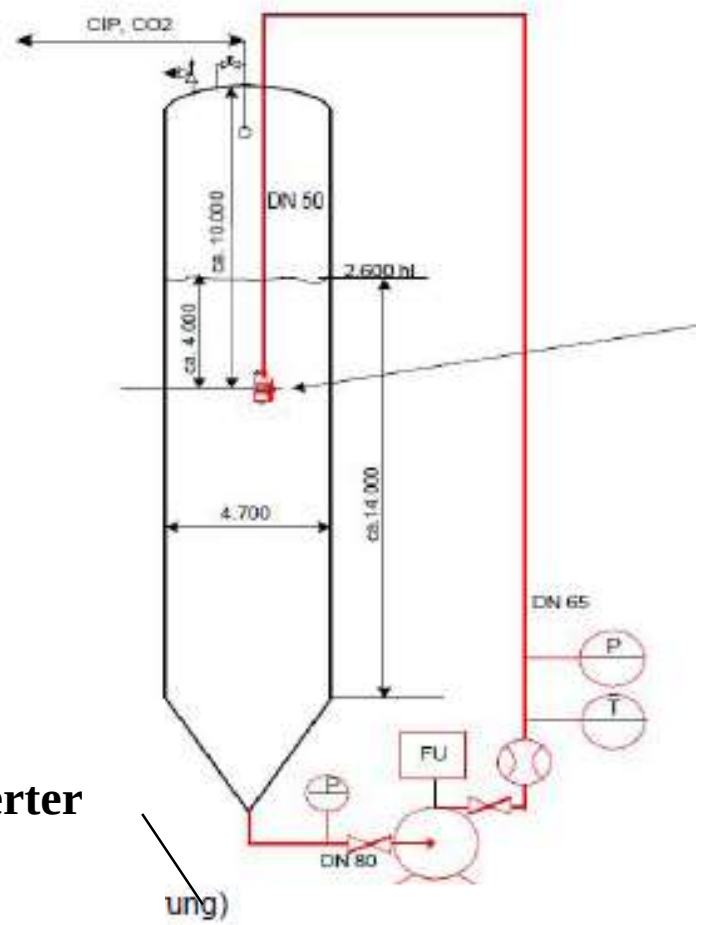
System Ecoferm - GEA



Circulation pump
Frequency converter
•50 (-80) hl/h at 3 bar
•2900 rpm / 4 kW

GEA Jet-pump 1-80
•Stainless steel
Driving flow 50 hl/h at 2,5 bar
Total flow 200 hl/h
Max velocity in jet: 9 m/s

System Isomix - AlfaLaval

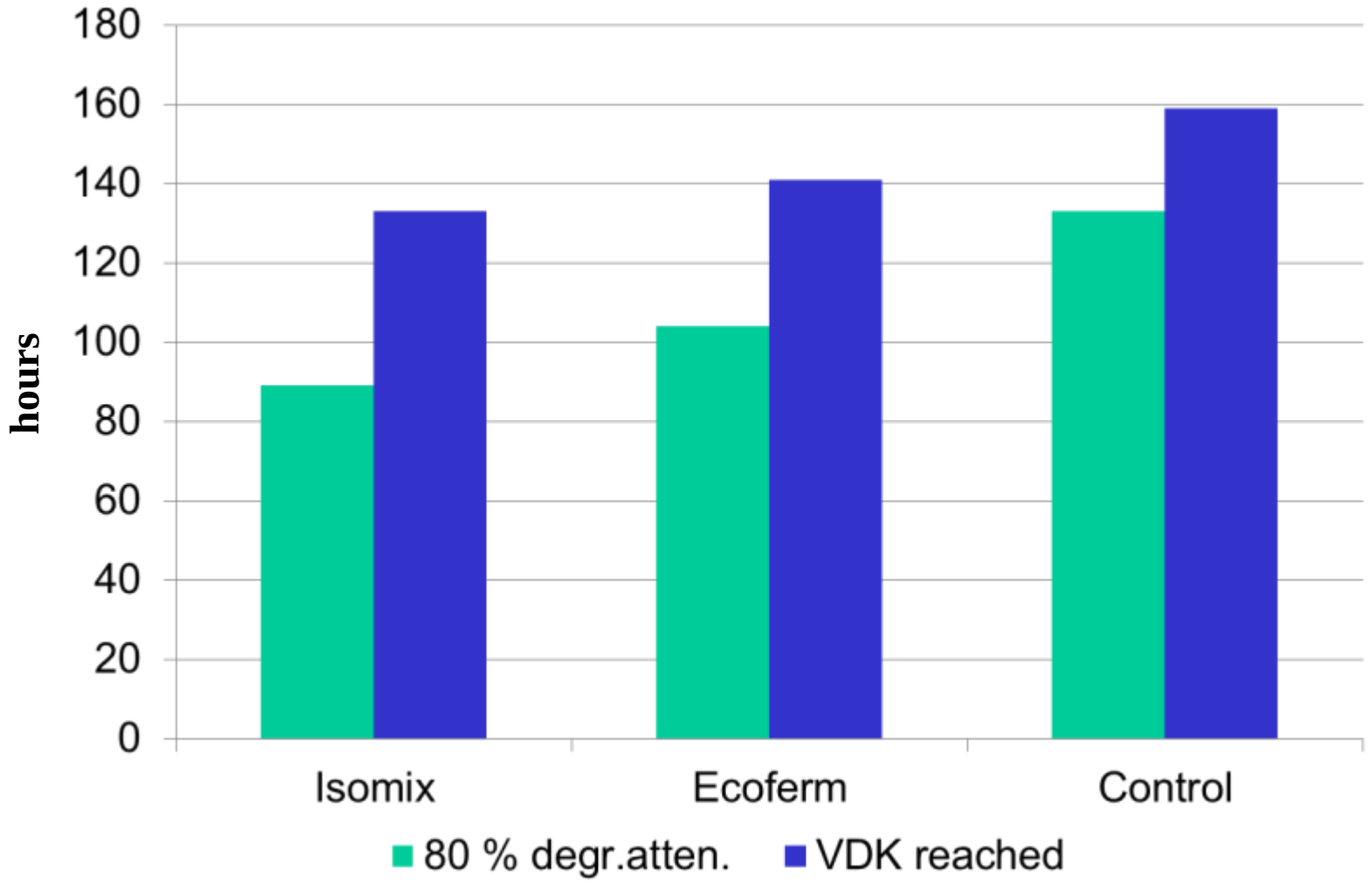


Pump:

- **Frequency converter**
- **250 hl/h at 3 bar**
- **11 kW**

- Leistung: 11 kW

Fermentation performance



P. Quester, Dresdener Brauertag of

Conclusion

+ No difference in **Quality, Sensory and Filtrability** compared to control
+ In average reduction of **1,5 days**
+ Allows reducing tank farm by **3** CCVs
+ Average power consumption (six fermentation days):
  - Iso-Mix: 1.100 kWh
  - ECO-FERM: 400 kWh
  - (Optimisation possible)

Revival of continous beer production

- Many systems were in industrial use during the 1960s and 70s, but most were abandoned due to stability problems
- These systems include Hough & Ricketts, Ash, Portno, Pollock, Wellhoener, APV, Bio-Brew, Bishop, O'Malley and Coutts
- Today solutions from eg MEURA and GEA are being discussed intensely again
- Reasons: High volumetric productivity and significant savings in investment cost
- Quote: "…involves a mother beer strategy…" (R. Michel, GEA)

Full bottle inspecting devices

- Detection technology
  - Optical
  - X-ray
  - Piezzo sensor

Source: www.heuft.com

Source: www.bbull-technology.com

Source: www.krones.com

Full bottle inspecting devices

http://www.krones.com/de/branchen/4656.htm

KRONES RotoCheck

Die Lösung: Sicherheit mit KRONES RotoCheck

Die Inspektionsmaschine RotoCheck ermöglicht die Erkennung von Glasscherben mit einer Kantenlänge ab 0,5 mm.
Dank CCD-Kameratechnik können kleinste Glaspartikel und bodennahe organische Produkte detektiert werden.

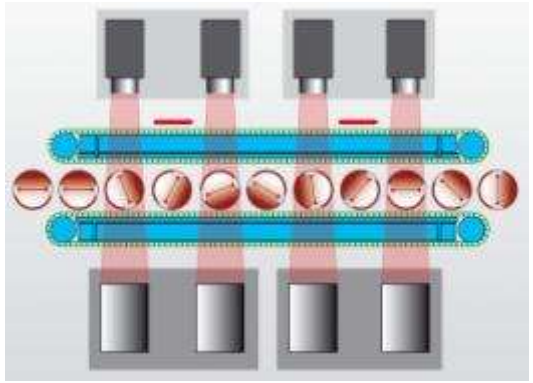
Jede Flasche wird in Rotation versetzt und anschließend wieder gestoppt.
Das noch drehende Produkt bringt vorhandene Glassplitter in Bewegung.

1 2 3 4 5 6 7 Kontakt

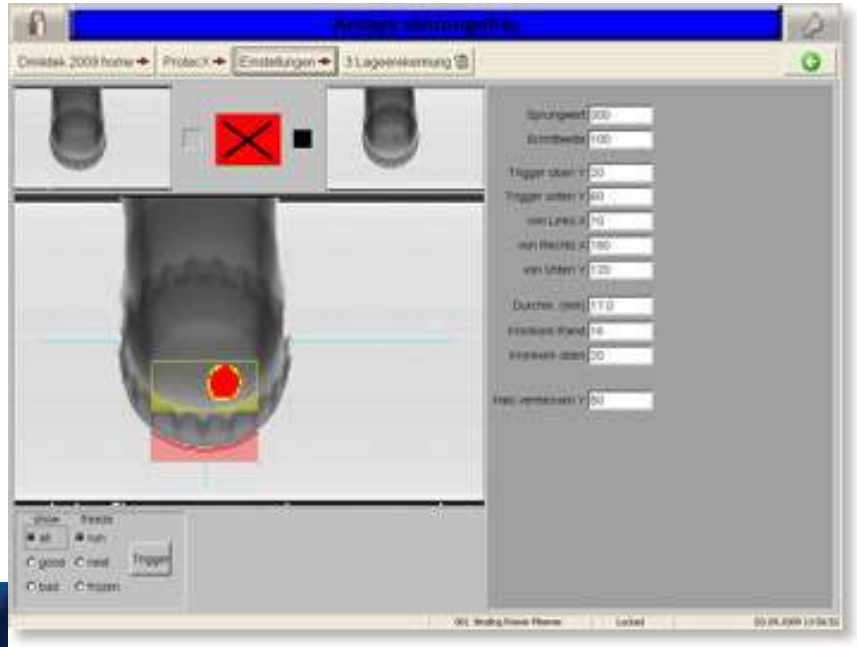
wiederholen

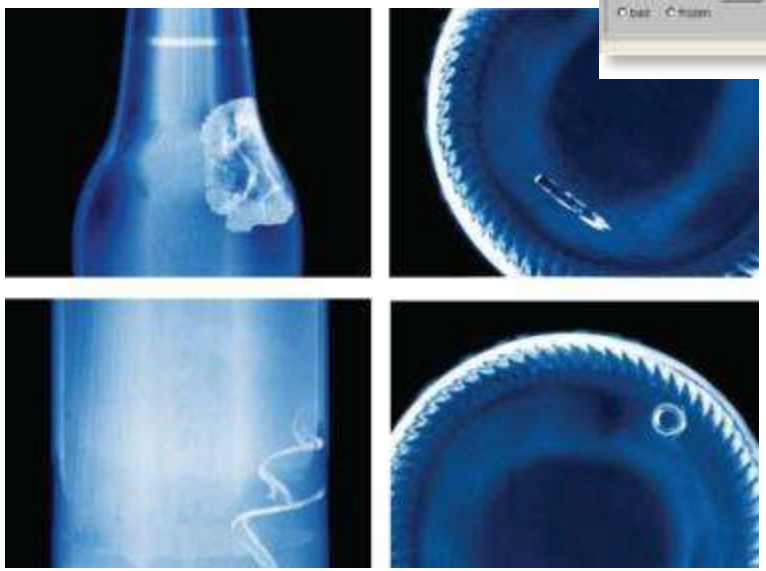
Full bottle inspecting devices

- X-ray systems



Source: www.heuft.com





Source: www.bbull-technology.com

Thank you for your Attention!

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