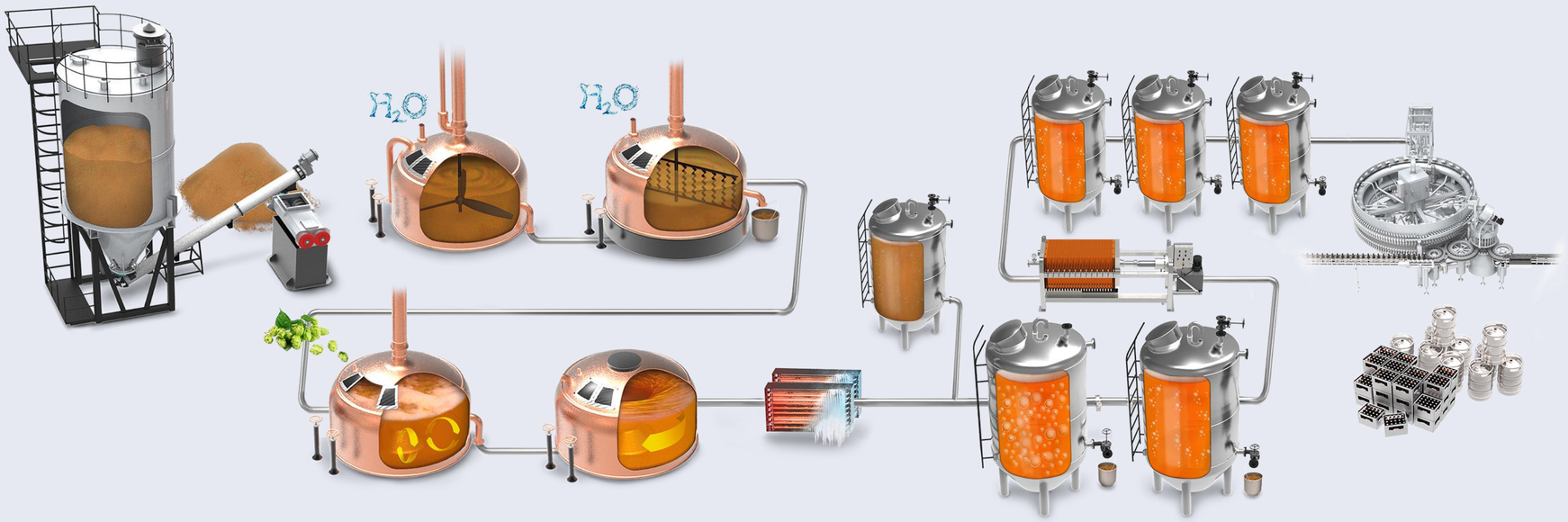

CRAFT BREWERS ANALYSIS SOLUTIONS - FROM WORT TO FINISHED PRODUCT

ANALITIČKA RJEŠENJA ZA CRAFT PIVARE - OD SLADOVINE DO GOTOVOG PROIZVODA

INTRODUCTION

Markus Peterherr

Product Management Beverage

Anton Paar GmbH

- Employeed with Anton Paar since 2004
- 10 years International Service & Customer Support
- 9 years Product Management Beverage

AGENDA

CRAFT BEER SEMINAR

- Company Introduction: Anton Paar
- Anton Paar‘s Sudhaus brewery
- Extract checks along the brewing process
- Alcohol checks along the brewing process
- CO_2 and O_2 checks along the brewing process
- Summary of important hints


Anton Paar
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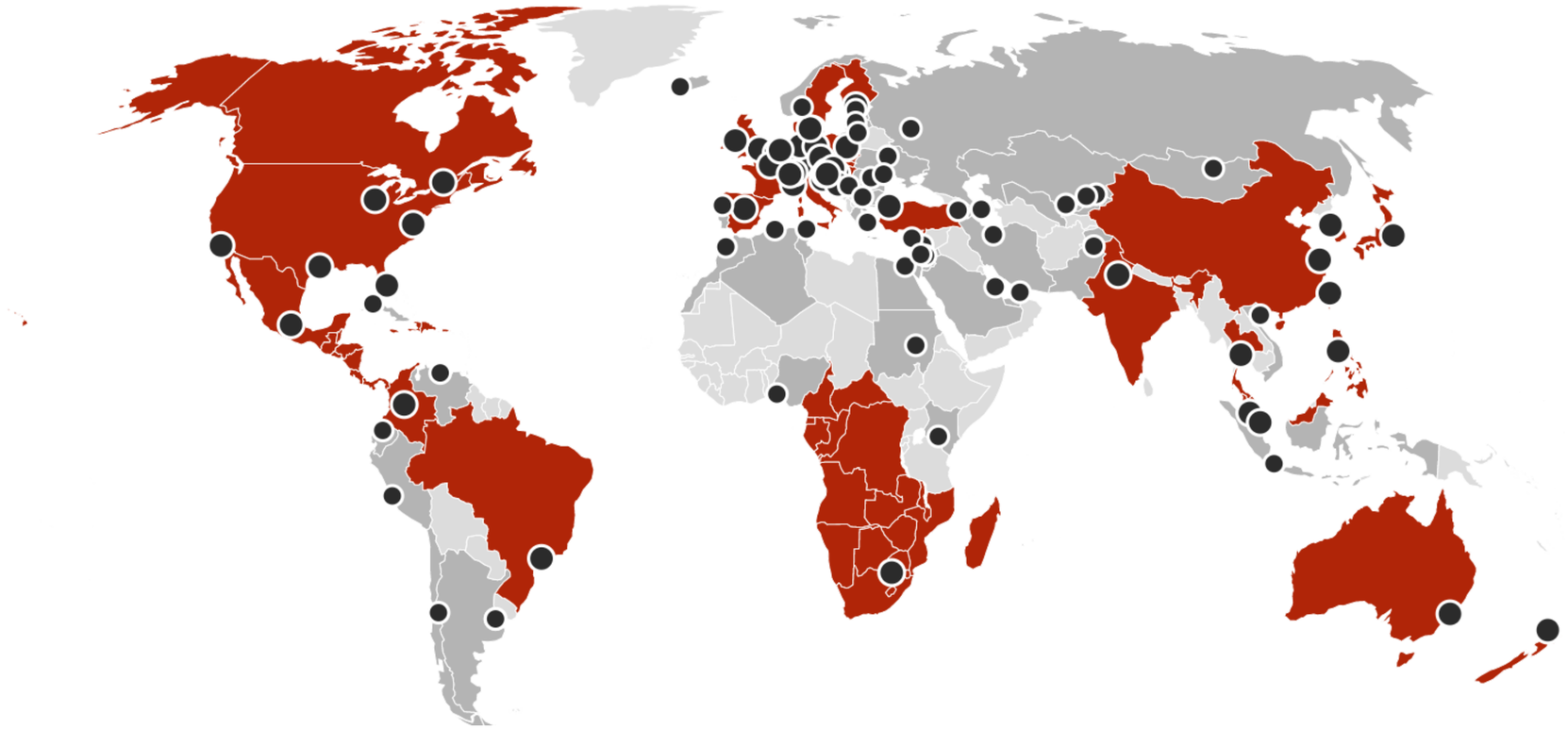
ANTON PAAR DEVELOPS, PRODUCES, AND SELLS HIGH-PRECISION MEASURING INSTRUMENTS AND CUSTOMIZED AUTOMATION AND ROBOTIC SOLUTIONS.

OPERATING WORLDWIDE



9

PRODUCING COMPANIES

35

SALES SUBSIDIARIES

50

DISTRIBUTION PARTNERS

FACTS & FIGURES

ESTABLISHED IN
1922

HEADQUARTERS
IN GRAZ / AUSTRIA

4,000+
EMPLOYEES

OWNED BY THE CHARITABLE
SANTNER FOUNDATION

16 % INVESTMENT
IN RESEARCH AND DEVELOPMENT

FROM ANNUAL TURNOVER
ANTON PAAR GMBH

ALL CRITICAL COMPONENTS
MANUFACTURED IN-HOUSE

ANTON PAAR‘S SUDHAUS BREWERY

FOUNDED IN 2018

ANTON PAAR‘S SUDHAUS BREWERY
THE AIM

- Micro Brewery & Showroom
  demonstrate all Anton Paar measuring equipment
- Test field installation for new developed
  measuring solutions
- Inhouse application Lab to support the Beverage
  R&D division
- Beer production for the Sudhaus restaurant

ANTON PAAR‘S SUDHAUS BREWERY

HIGH PRECISION LAB WITH A „SMALL BREWERY“ CONNECTED

WHY ESTABLISHING SEAMLESS QUALITY CONTROL

THE MISSION

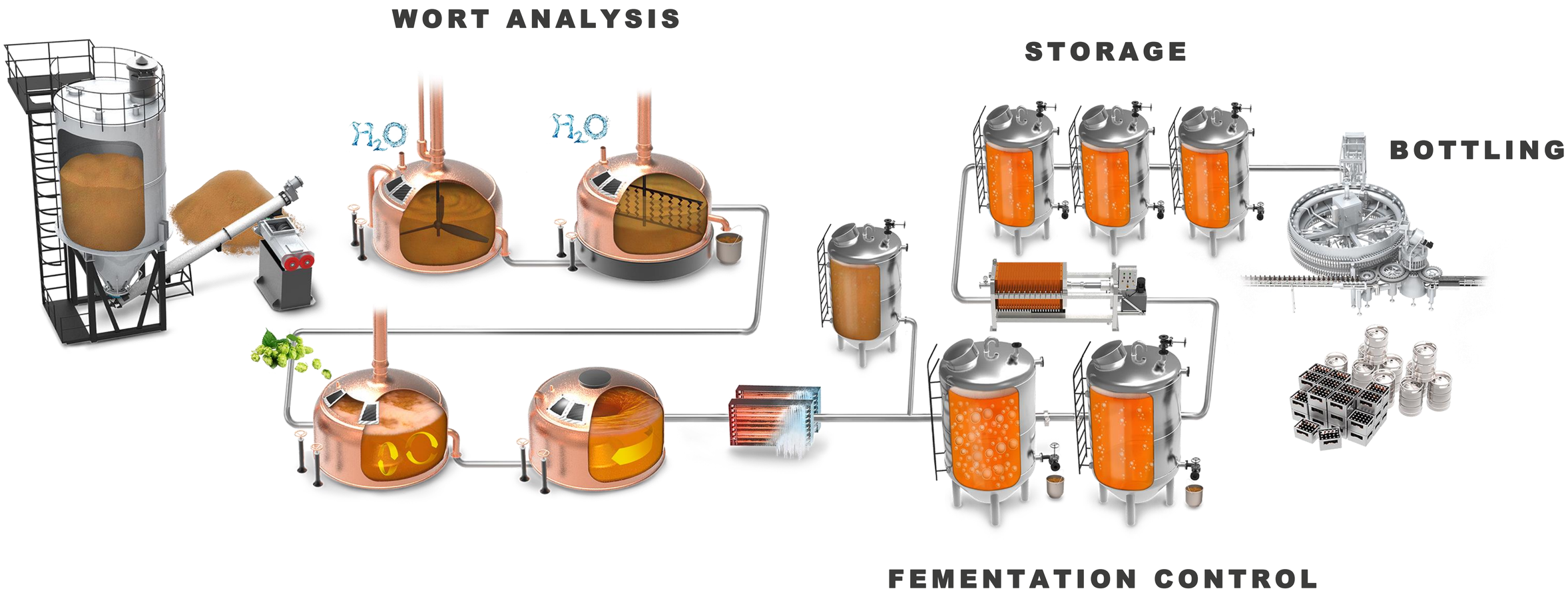
QUALITY CONTROL IN A CRAFT BREWERY
OVERVIEW

- Crafting the same beer from batch to batch
- Safeguarding product consistency
- Uncovering improvement potential
- Assuring customer satisfaction
- Complying with tax and excise declarations

THE BREWING PROCESS

PRODUCTION STEPS AND POINTS OF ANALYSIS

THE BREWING PROCESS
OVERVIEW



WORT ANALYSIS

POINTS OF ANALYSIS
WORT ANALYSIS

WORT ANALYSIS

– set the correct extract content for your beer style

– ensure final product properties

– safeguard consistent taste right from the start

– maximize repeatability for each brew

WORT ANALYSIS

- **Extract measurement (°Plato) in wort**
  - constant extract content per beer type
  - main parameter influencing alcohol content (enables prediction of final alcohol)
  - basis for tax calculation in many countries (categorization according to extract content)

- **Daily fermentation checks**
  - Step in in case of undesired deviations by temperature changes on the tank

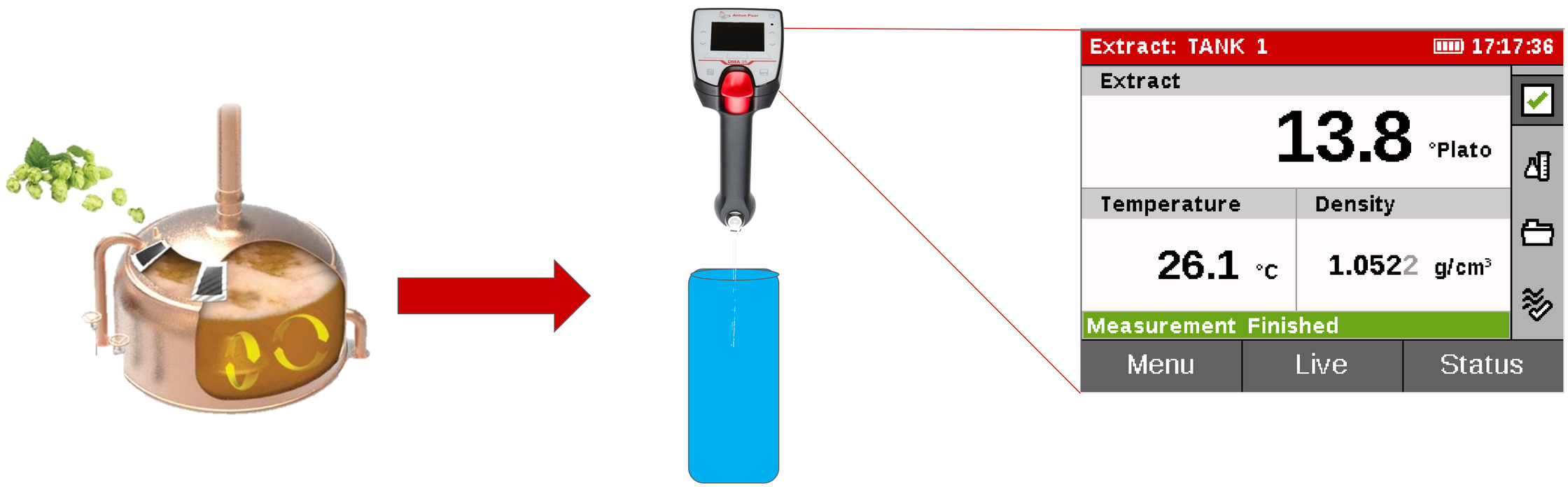
DMA 35 PORTABLE DENSITY METER
FEATURES AND BENEFITS

- Portable instrument for quick measurements directly on-site
- Requires only 2 mL of sample
- Measures density at ambient temperature
- Automatically calculates and displays % concentration or density @ reference temperature
- Uses the oscillating U-tube technology
- Sample filling via built-in pump or syringe

MEASUREMENT OF EXTRACT IN WORT

USING A DMA 35 PORTABLE DENSITY METER

- You can fill hot wort into the instrument directly from the wort kettle
- For perfect accuracy, wait until sample cools down to 40 °C in the measuring cell



DMA 35: WORT MEASUREMENT

DIFFERENT EXTRACT MEASUREMENTS ALONG THE BREWING PROCESS

- First Wort at the start of Lautering (e.g. 19,5 °P)
- Last running at the end of Lautering (e.g. 1,8 °P)
- Kettle Full Wort before the start of boiling (e.g. 11,2 °P)
- Original Extract at the end of boiling (e.g. 12,0 °P)

DMA 35: WORT MEASUREMENT

EXSAMPLE: FINE-ADJUSTING THE ORIGINAL EXTRACT

Q: How to fine adjust the original extract before knocking out?

A: Preferably by diluting it down with water OR prolonging the boiling time

Example:

$OE_{5min\ before\ end\ of\ boiling} = 12,3\ °P$

$OE_{target} = 12,0\ °P$

Total Volume = 540 L

Water Dilution = 13,5 L

Calculation based on the „Rule of Cross“

FERMENTATION CONTROL

POINTS OF ANALYSIS
FERMENTATION CONTROL

FERMENTATION CONTROL

- track and optimize fermentation processes for perfect final taste
- eliminate stuck fermentations
- avoid off-flavours
- take timely action to receive desired output

POINTS OF ANALYSIS
FERMENTATION CONTROL

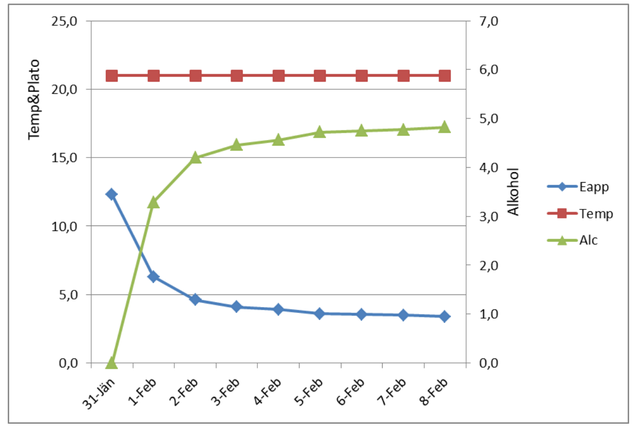
- **Daily fermentation checks**
  - Step in in case of undesired deviations by temperature changes on the tank
- **Visualisation of fermentation graph**
  - To track fermentation for each vessel

DMA 35: APPARENT EXTRACT MEASUREMENT

EXAMPLE 4: CHECKING THE FERMENTATION

- Daily check of the fermentation by measuring the apparent extract
- Tilt the instrument to prevent the influence of CO_2 bubbles

E_orig	Eapp	Temp	Alc
12,3	° Plato	°C	%v/v
31-Jän	12,3	21,0	0,0
1-Feb	6,3	21,0	3,3
2-Feb	4,6	21,0	4,2
3-Feb	4,1	21,0	4,5
4-Feb	3,9	21,0	4,6
5-Feb	3,6	21,0	4,7
6-Feb	3,6	21,0	4,7
7-Feb	3,5	21,0	4,8
8-Feb	3,4	21,0	4,8



WORT ANALYSIS AND FERMENTATION CONTROL
DMA 35 PORTABLE DENSITY METER

- **State-of-the-art** technology
- **Replacement** to common hydrometers
- **Pre-installed** output quantities (e.g. °Plato)
  - Measuring range 0 – 100°Plato
- **Result in seconds** directly from the sample container
- Automatic **temperature compensation** of the results
- **Operator independent** analysis
- **Traceability** of results (RFID, data memory)

STORAGE TANK AND BOTTLING

POINTS OF ANALYSIS
STORAGE TANK AND BOTTLING

- in-source analysis for instant product release
- eliminate out-sourced analysis
- comply with tax regulations and label declaration
- ensure final product quality
- guarantee customer satisfaction

STORAGE TANK AND BOTTLING

ALCOHOL DETERMINATION
IN THE FINAL PRODUCT

- **Alcohol measurement in beer**
  - Basis for tax calculation in many countries
  - Make sure that labels state correct alcohol content
    - consumers rely on correct labelling
    - authority may punish if wrong
    - check alcohol on bottle fermented beers
    - Blending checks for beer mixtures

ALEX 500
ALCOHOL AND EXTRACT METER

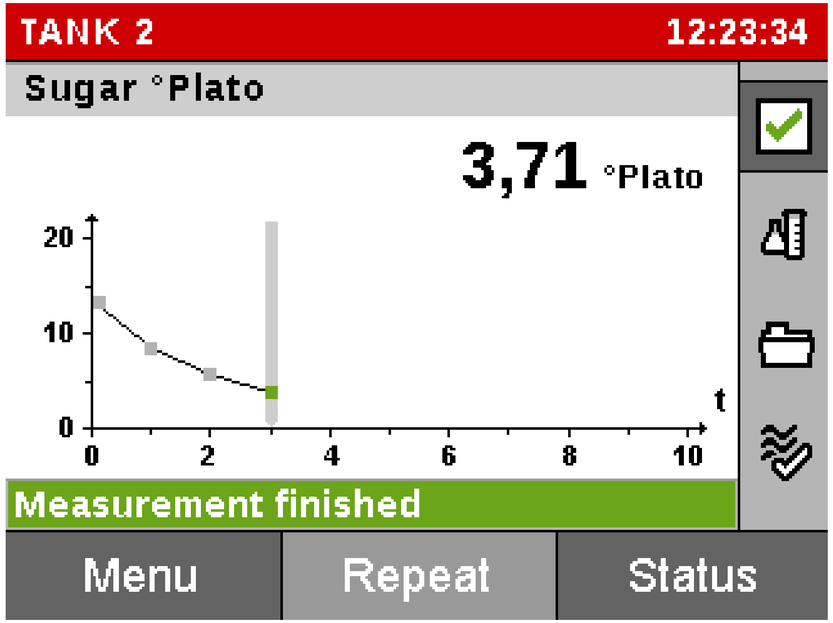
- Measure alcohol and extract content, as well as related parameters like calories or degree of fermentation whenever you wish
- No need to send samples to an external lab (be independent, and save costs and time)
- One instrument for measurements during all production steps from wort/juice to the packaged product

ALEX 500: TWO OPERATION MODES

1. FERMENTATION MONITOR MODE

The fermentation monitor mode:

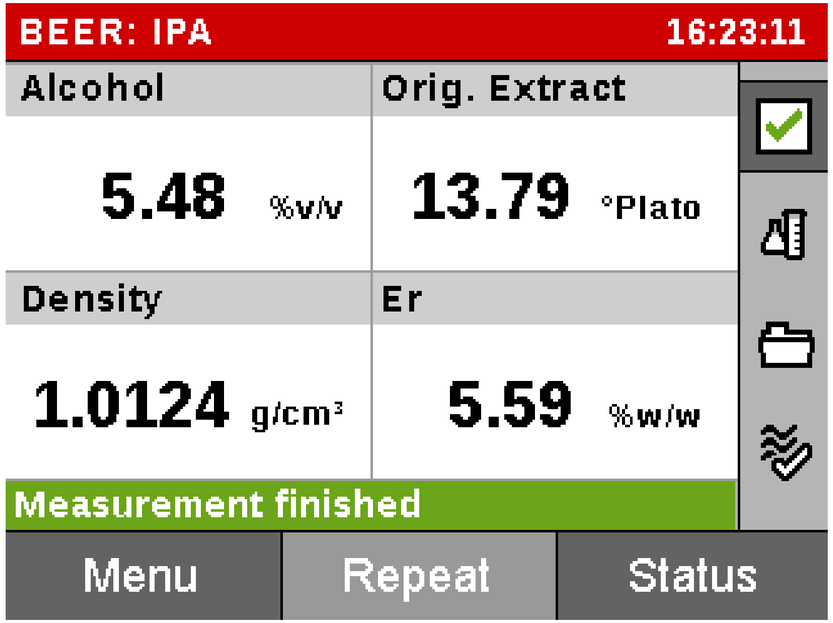
- For extract measurement in wort
- For fermentation control
- Fermentation curves for 40 different tanks
- Up to 100 results per sample ID
- Different units available (SG, °Plato, …)
- Basis: density measurement (apparent sugar/extract)



ALEX 500: TWO OPERATION MODES

2. STANDARD MEASURING MODE

The standard measuring mode:



- For determination of alcohol, real/original extract, degree of fermentation, calories, …
- Automatic turbidity warning in case sample requires additional preparation / filtration
- For measurements towards the end of fermentation & before bottling
- For blending checks (e.g. beer with juice)
- For checking the alcohol status on bottle fermented products

FEATURES AT A GLANCE
BEER ANALYZING SYSTEM 1001

Alcohol	**3 min**
Extract	
Color	
pH	
Density	

Analysis solution for all relevant parameters throughout the entire production process

1. designed for the analysis throughout the entire beer production process
2. minimal sample preparation
3. simultaneous measurement
4. automatic analysis
5. **compliant results**

BEER ANALYZING SYSTEM 1001
DETAILS

SELECTIVE

Selective alcohol determination

– alcohol analysis right at the facility

– no need for distillation to obtain the alcohol content

– insourcing of the most important analysis parameter: the alcohol content

– selective NIR absorption method

– compliance with reference methods

BEER ANALYZING SYSTEM 1001
DETAILS

QUICK

More than 10x quicker than distillation

- classic distillation and analysis of alcohol and extract content: ~30 minutes
- Beer Analyzing System 1001: ~3 minutes
  (under optimum conditions)

BEER ANALYZING SYSTEM 1001
DETAILS

SIMPLE

Simple adjustment and calibration

– adjusted with water and one binary solution only

– reference automatically determined density > alcohol conversion table > alcohol content

– guided adjustments and checks

– superior software support

BEER ANALYZING SYSTEM 1001
DETAILS

MODULAR

Modular setup:
up to 5 measuring modules more than 20 beer- specific parameters in one go

- get the most information from a single bottle
- modular setup to fit craft brewer‘s requirements
- minimized efforts to receive desired results
- automatic sample changer available

MODULARITY
BASIC SETUP

SIMPLE

DMA 4101
DENSITY/EXTRACT

Alcolyzer 1001 Beer
ALCOHOL

XSample 320
AUTOMATION

MODULARITY
OPTIONAL MODULES

pH 3101
PH VALUE

Option Color 430nm
BEER COLOR

Haze 3001
TURBIDITY VALUE

XSample 520
AUTOMATIC SAMPLE CHANGER

MODULAR

Anton Paar

PBA 1001 BEER
PACKAGED BEVERAGE ANALYZER

Analysis of all relevant parameters from the finished package

1. simultaneous measurement
2. all parameters from a single sample
3. automatic correction for the impact of CO_2
4. automated filling at the push of a button

Alcohol	**3 min**
Extract	
CO_2	
O_2	
Color	
Turbidity	
pH	
Density	

CO_2 AND O_2 CHECKS ALONG THE BREWING PROCESS

Analysis of dissolved gases

WHY IS DISSOLVED CO_2 MEASURED?

› **Importance of CO_2**

- Essential ingredient
- Freshness and flavor enhancer, adds fizz to the taste
- CO_2 transports aromas to the nose during tasting
- Preservative, shelf life

› **Constant values → consistent taste, experience and quality!**

- Each beverage must have a certain CO_2 content

WHY IS DISSOLVED O_2 MEASURED?

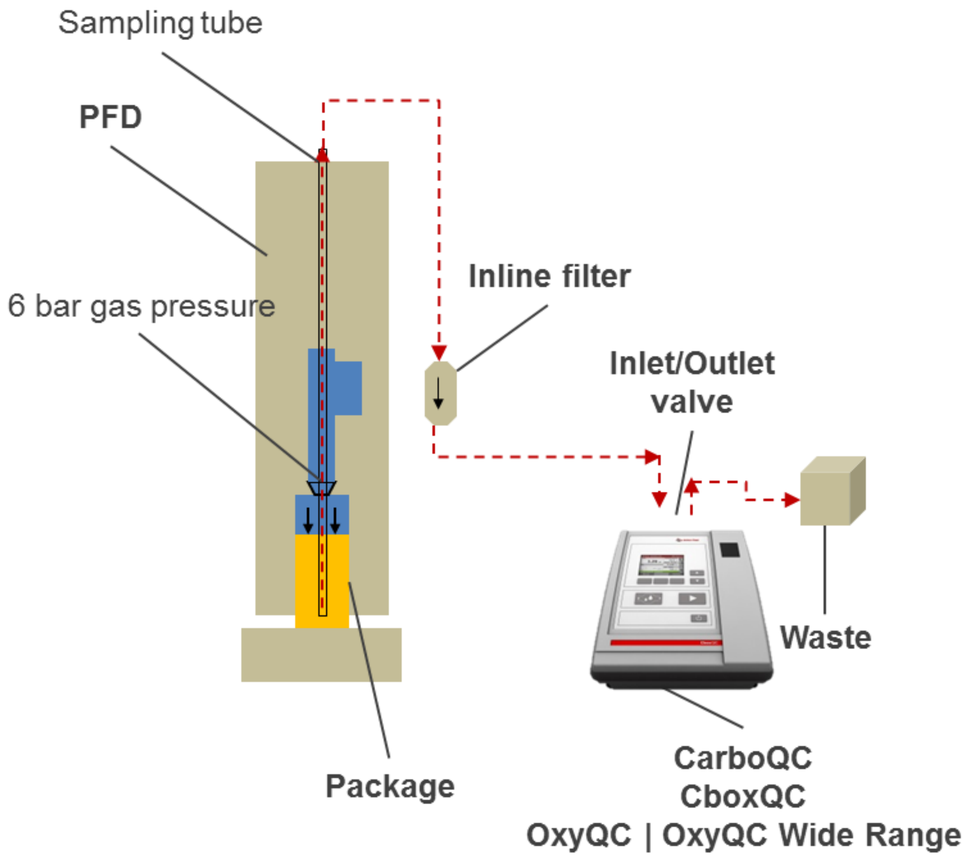
- **The O_2 content**
  - Strongly reduces the shelf life of beverages
  - Cause oxidation and off-tastes

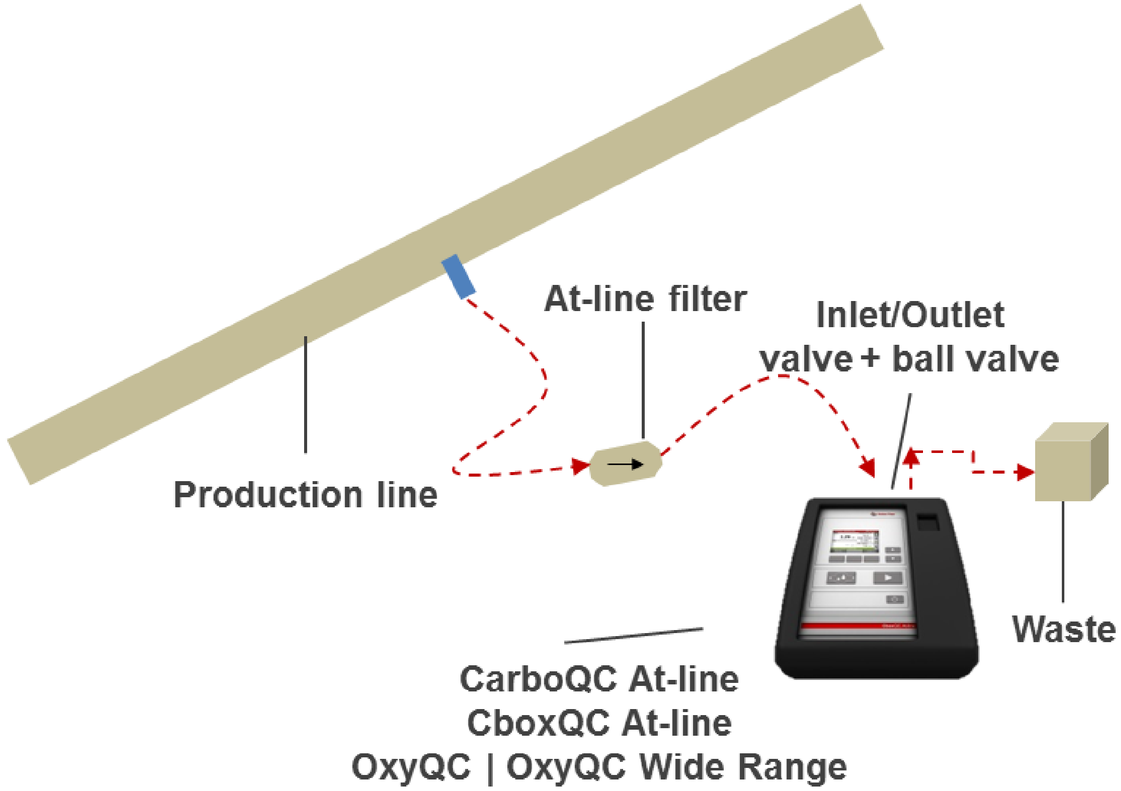
- **O_2 measurement ensures**
  - Product safety
  - Consistent beverage quality
  - Long shelf life

PIERCING AND FILLING DEVICE (PFD / PFD+ / SFD)

- What is a Filling Device for?
- Enables filling of sample into measuring instruments without loss of CO_2 and O_2.
- Applicable for cans, PET bottles, glass bottles.

INSTALLATION





CO_2 MEASUREMENT
DURING FILTRATION AND FILLING

- **Measurement of dissolved CO_2 based on the patented Multiple Volume Expansion Method**
  - CO_2 as important criteria for overall product quality
  - CO_2 strongly influences the fresh taste of beverages

O_2 MEASUREMENT
DURING FILTRATION AND FILLING

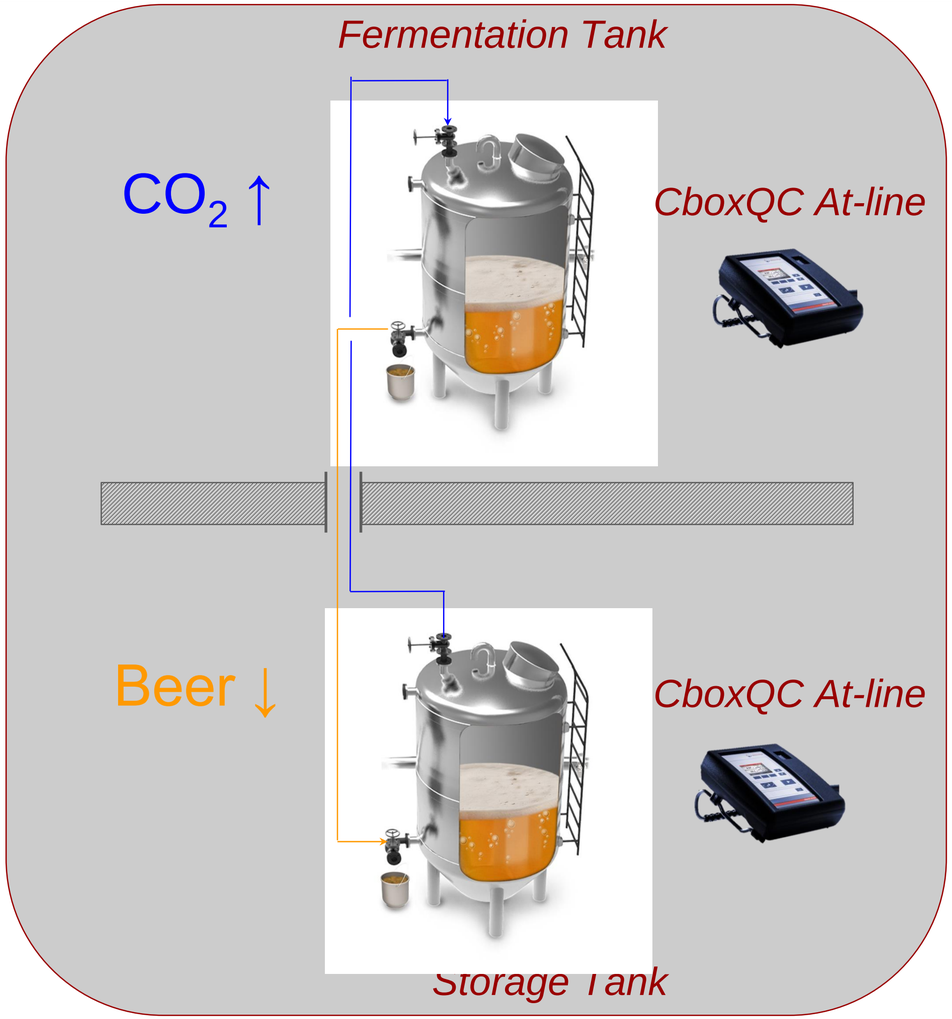
- **Measurement of dissolved O_2**
  - O_2 reduces the shelf life of beer
  - O_2 impacts flavor compounds in beer which can change over time
  - O_2 should be monitored throughout the brewing process to ensure consistency

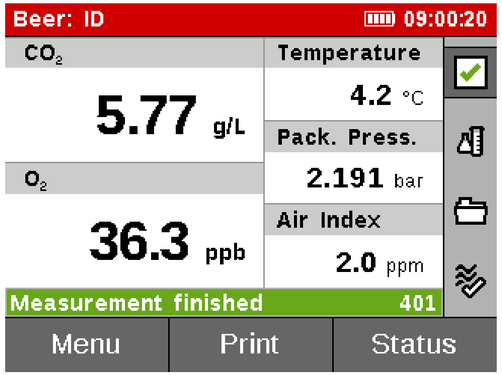
CO_2 AND O_2 METERS
COMPACT, EASY AND ROBUST

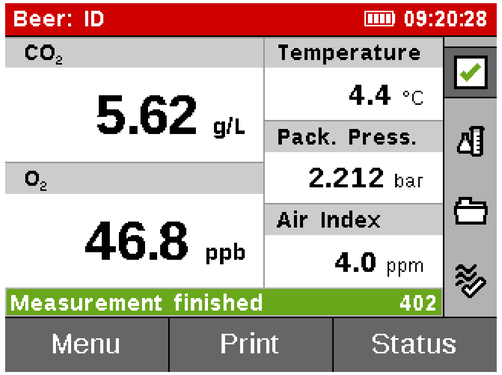
- Most precise CO_2 measurement based on Multiple Volume Expansion Method
  - no influence of residual gases
  - check of package pressure available
- High-resolution optochemical O_2 sensor
- Easy checks and cleaning routines
- Intuitive user Interface
- Low sample volume (< 150 mL) needed

CO_2 AND O_2 MEASUREMENT

EXAMPLE: BEFORE AND AFTER TRANSFERING THE BEER FROM FERMENTATION TO STORAGE TANK

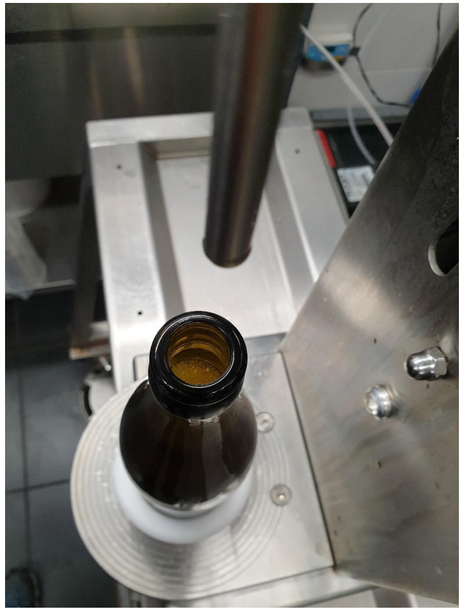






CO_2 AND O_2 MEASUREMENT
IMPORTANT HINT FOR BOTTLING

– Make sure that the beer foams over before closing the bottle with the cap!
This reduces the headspace oxygen significantly!



No over foam and closed	
HSO	3954 ppb
DO	163 ppb
TPO*	**4117 ppb**

With over foam and closed	
HSO	61 ppb
DO	135 ppb
TPO*	**196 ppb**

HSO…Headspace Oxygen
DO…Dissolved Oxygen
TPO…Total Package Oxygen
**measured by TPO 5000*

Anton Paar

INSTRUMENT PACKAGES

Invest in quality before quantity

The Craft2Craft instrument package for craft brewers

CarboQC At-line CO_2 meter **or**
CboxQC At-line CO_2 & O_2 meter **or**
OxyQC O_2 meter

Alex 500 alcohol and extract meter

DMA 35 portable density meter
incl**. protective rubber housing for measuring cell & operating panel**

SUMMARY

EXTRACT AND EXTRACT IN WORT

- To increase the product consistency: perform different extract checks along the brewing process

FERMENTATION

- Monitor the fermentation on a regular base

CO_2 AND O_2 MONITORING

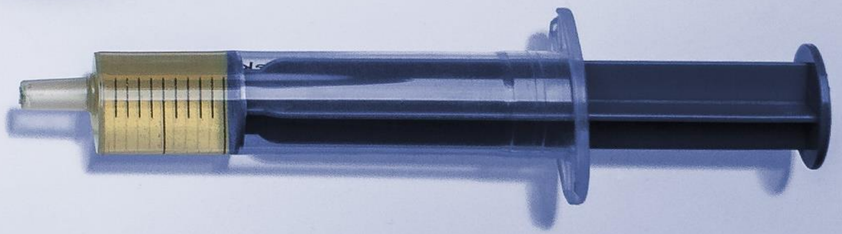
- Check the CO_2 / O_2 values especially after transfering the beer into tanks / Kegs / bottles
- Beer should overfoam before closing the bottle with the cap

CUSTOMS AND EXCISE DECLARATION

- Ensure your final quality parameters for tax and excise declarations

THANK YOU!

Anton Paar



www.anton-paar.com/beer