xylem

N-Realyzer

The Next Generation for Nitrogen/Protein Determination According to Dumas

Gerhardt
Analytical Systems

September 2024

Who is Xylem Lab Solutions?

Xylem Lab Solutions represents 7 brand lines and serves over 150 countries.

We are a division of **Xylem Inc.**, a Fortune 500 company focused on water issues around the world.

Xylem Lab Solutions: Provides innovative analytical laboratory instruments across many markets.

We work in **true partnership** with our clients to provide tailored solutions, leveraging our history of innovation in instrumentation and services.

xylem

Who is Xylem Lab Solutions?

Our **Lab Solutions** are provided under a variety of different brands:

Bellingham + Stanley®

-ebro-

O·I·Analytical

SI Analytics®

WTW

YSI®

Xylem is the **exclusive** North American Distributor for Gerhardt Analytical Systems products.

xylem

Xylem Lab Solutions & Gerhardt Analytical Systems

Our long collaborative relationship allows Xylem to offer cutting edge technologies to solve a customer's **entire** analytical workflow.

xylem

Markets We Serve

Food & Beverage

Environmental

Pharmaceutical

Chemical

- + alternative protein

With clients in over **150 countries**, we serve a wide range of markets.

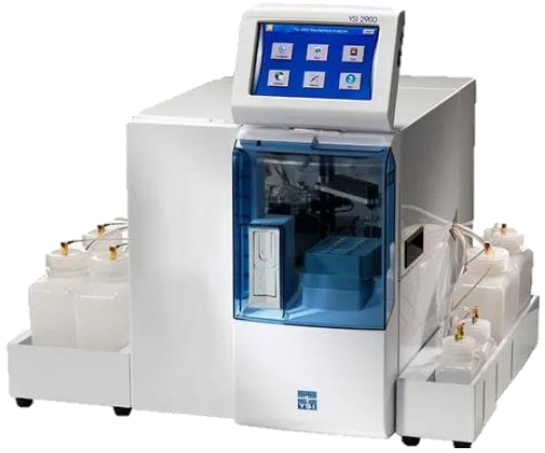
xylem

Comprehensive Product Offering

Refractometry & Polarimetry

Brix, Refractive Index & Purity

Bellingham + Stanley®



Biochemistry Analyzers

Glucose, Sucrose, Lactose, Lactate & more!

YSI

Handheld Measuring Devices

Temperature, Humidity, Pressure & more!

-ebro-

Selective Gas Chromatography

Sulfur, Phosphorus, Halogenated, Aromatic Compounds, and more!

O·I·Analytical

xylem

Comprehensive Product Offering

Multimeters & Probes

pH, DO, Conductivity & more!

YSI

Automated Chemistry

Nitrate, Nitrite, Phosphorus & more!

O·I·Analytical

Automated Titrators

Peroxides, Acidity, Water & more!

SI Analytics®

xylem

Comprehensive Product Offering

Automated Fiber Analysis
Crude Fiber, ADF, NDF & more!

Gerhardt Analytical Systems

Automated Extraction & Hydrolysis Systems
Total Fat & Free Fat

Gerhardt Analytical Systems

xylem

Comprehensive Nitrogen/Protein Solutions: Dumas & Kjeldahl

Extraction & Distillation
Kjedahl

Gerhardt Analytical Systems

Combustion Analysis
Dumas

Gerhardt Analytical Systems

NEW

N-REALYZER:
State of the Art
Combustion System

xylem

Your Speaker

Dr. Lukas Brieger

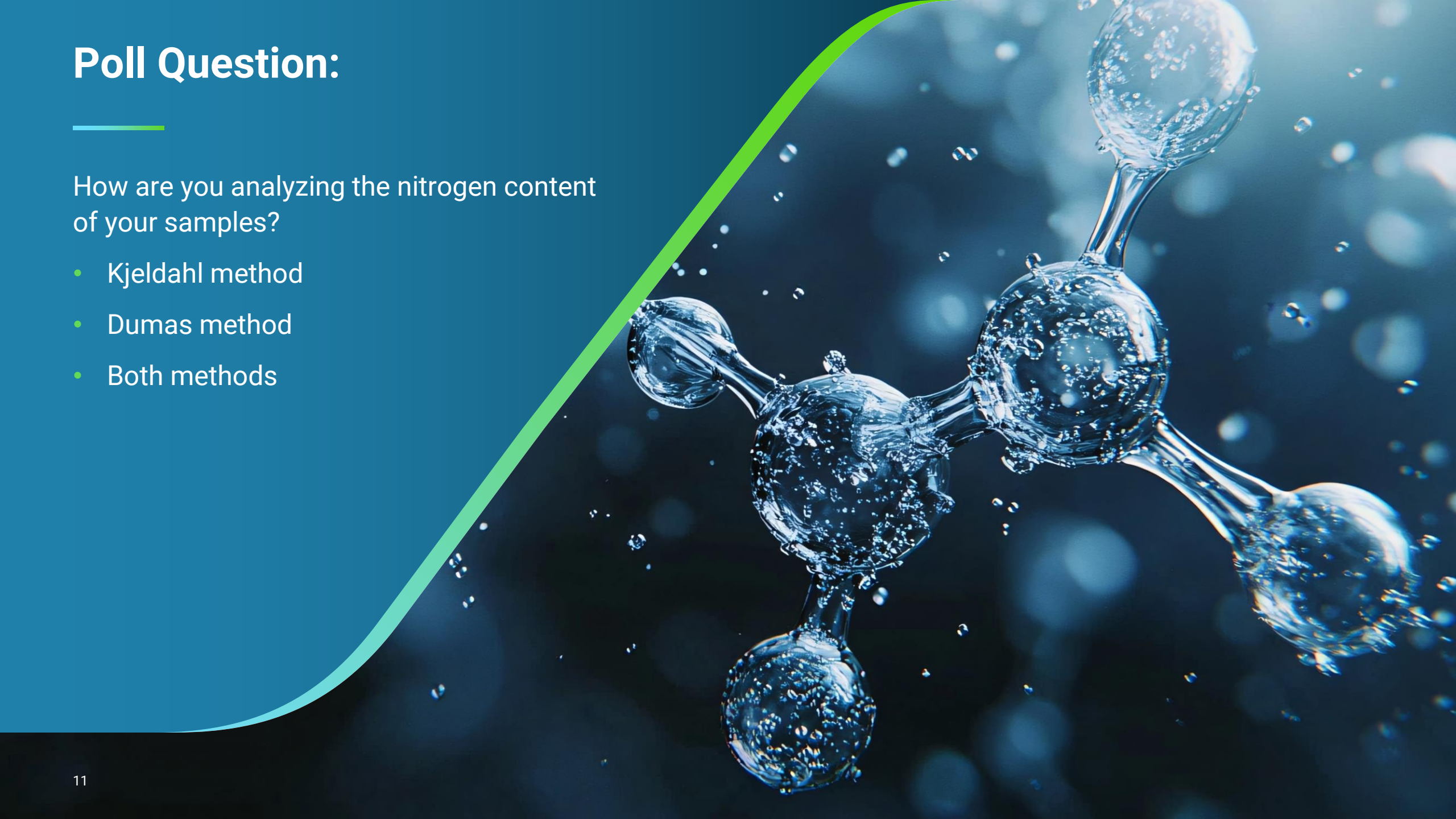
Chemist,
Customer and Application Consultant
with a focus on Dumas

xylem

Poll Question:

How are you analyzing the nitrogen content of your samples?

- Kjeldahl method
- Dumas method
- Both methods



Topics

1

Possibilities of nitrogen determination and comparability

- Nitrogen determination according to Kjeldahl and Dumas
- Advantages of the Dumas method

2

N-Realyzer

- Functional principle and technical details
- What is required for the analysis? - Consumables

3

Carrying out the analyses

- Sample preparation and sample weighing
- Sample handling

xylem

Johan Kjeldahl

Possibilities of Nitrogen Determination:

Method According to Kjeldahl

KJELDATHERM

Oxidation of the sample in boiling sulphuric acid:

$$C_nH_mN_x + H_2SO_4 \xrightarrow{400\ °C} n\,CO_2 + 0.5\,m\,H_2O + x(NH_4)_2SO_4$$

VAPODEST

Reaction of NH_4^+ with alkali (e.g. NaOH) to form NH_3:

$$NH_4^+ + OH^- \longrightarrow NH_3\uparrow + H\,O_2$$

Expulsion of ammonia with water vapor and collection in acid, e.g. boric acid:

$$NH_3 + H_3\,BO_3 \longrightarrow NH_4^+ + H_2\,BO_3^-$$

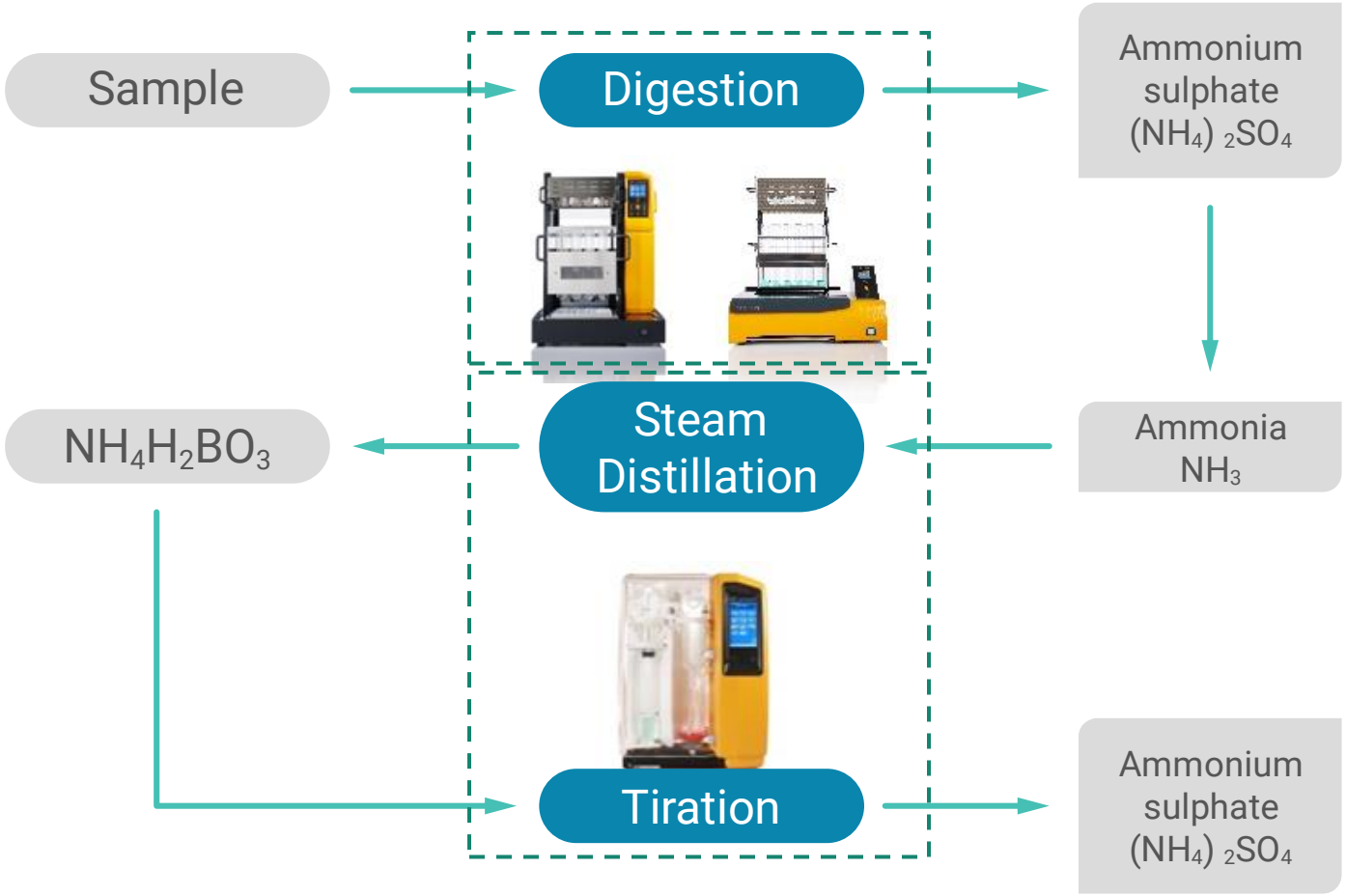
Endpoint titration with a weakly concentrated acid, e.g. $H_2\,SO_4$:

$$NH_4^+ + H2\,SO_4 \longrightarrow (NH)_4\,_2SO_4 + H_3\,BO_3$$

xylem

Possibilities of Nitrogen Determination

Method According to Kjedahl



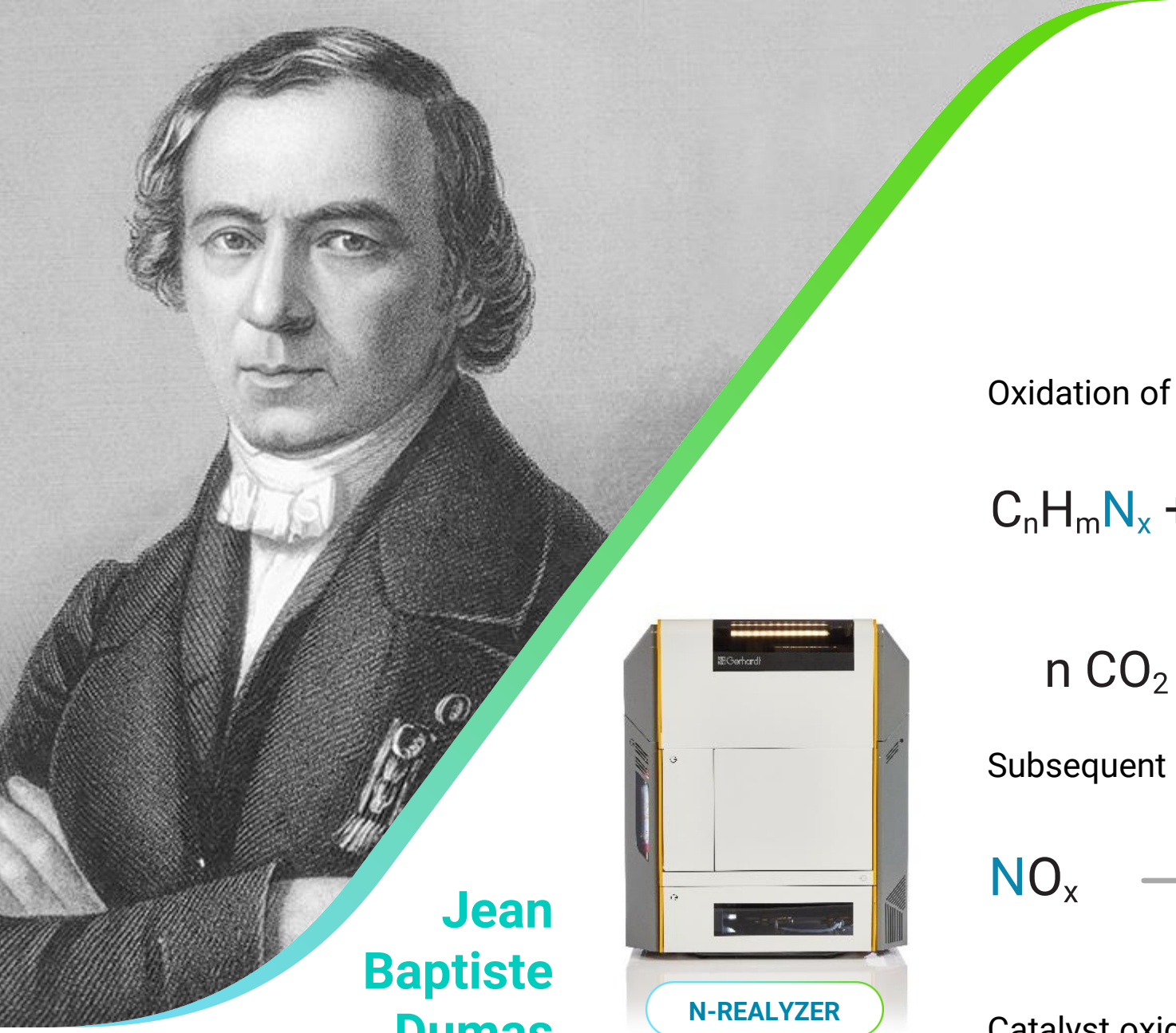
- 60-80 samples can be measured in 8 hours

Required devices:

- Digestion system (KJELDATHERM or TURBOTHERM)
- Distillation unit (VAPODEST)
- Titrator

Optional:

- Gas scrubber (TURBOSOG / VACUSOG / water jet pump)



Jean Baptiste Dumas

Possibilities of Nitrogen Determination:

Method According to Dumas

Oxidation of the sample with pure oxygen:

$$C_nH_mN_x + a\ O_2 \xrightarrow[\text{[Catalyst]}]{\sim 1000\ ^\circ C} n\ CO_2 + 0.5\ m\ H_2O + x\ \text{nitrogen oxides}$$

Subsequent reduction of nitrogen oxides to elemental nitrogen:

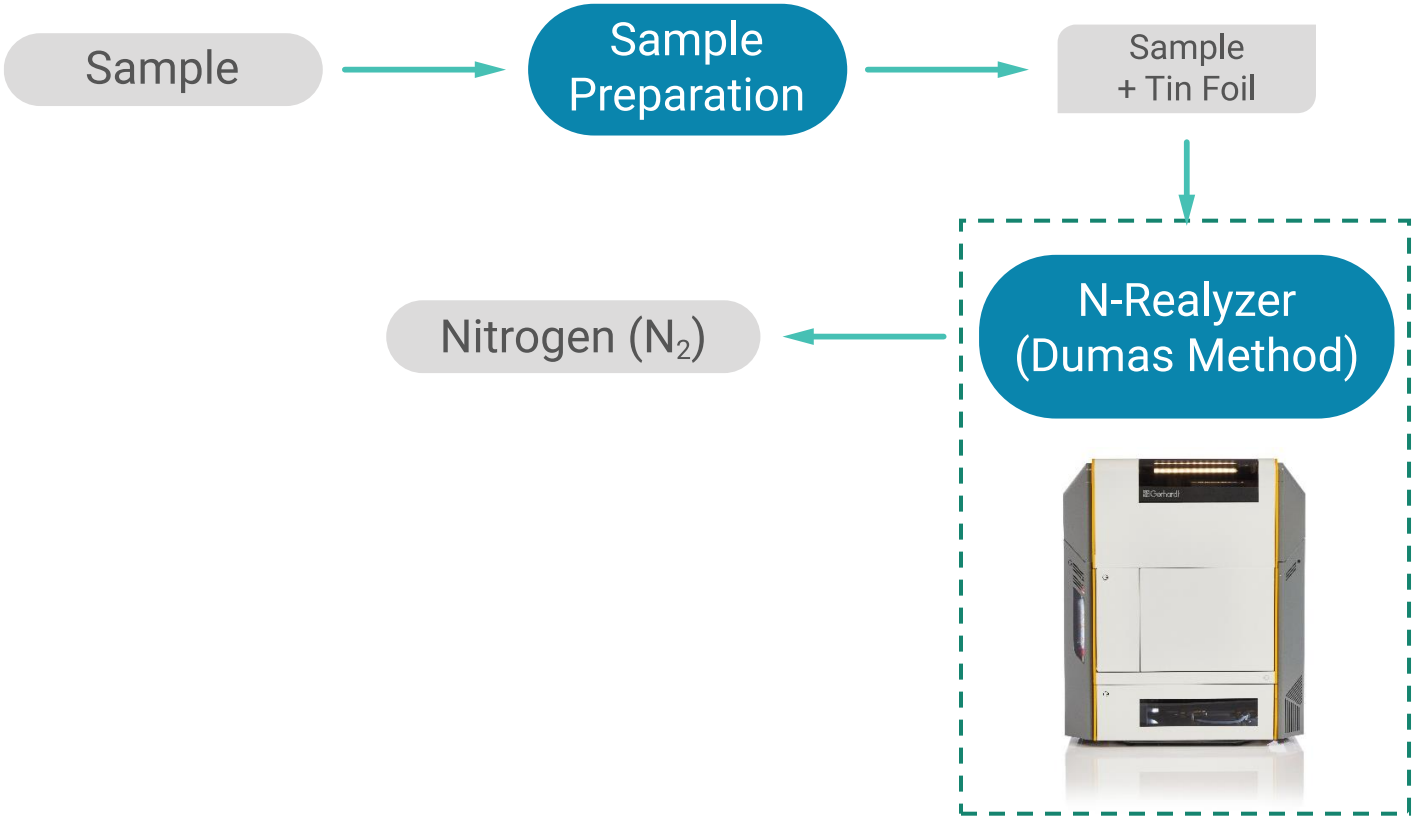
$$NO_x \xrightarrow[\text{[Catalyst]}]{800\ ^\circ C} N_2$$

Catalyst oxidation: [Al_2O_3 / CuO] Catalyst reduction: [Cu]

xylem

Possibilities of Nitrogen Determination

Method According to Dumas



- In 8 hours ~ 120 samples can be measured

Devices required:

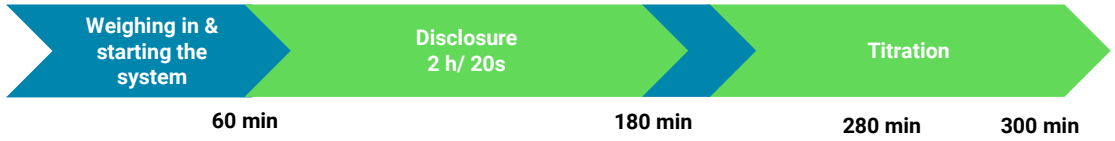
- N-Realyzer
- Monitor

Possibilities of Nitrogen Determination

Comparison of the Kjeldahl vs. Dumas methods:

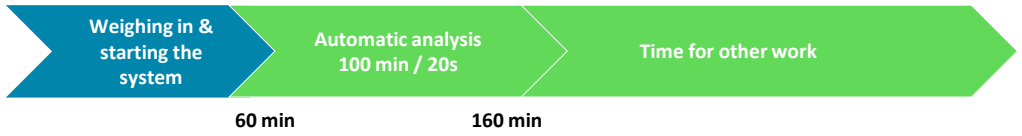
Arguments for Kjeldahl

- Maximum flexibility in weighing
- Perfect for low sample throughput
- Still **THE** universal reference method for all sample types
- Ideal for constantly changing applications
- Attractively price configurations possible



Arguments for Dumas

- Low use of consumables → low analysis cost
- With 3 - 5 min fast analysis time
- Simple routine conditioning of the system with simple maintenance work
- Virtually chemical-free technology can be operated without a fume cupboard



Comparability of the Methods

Sample	Ring test organization	Dumatherm Ø		Kjeldahl Ø		Δ Dumas-Kjeldahl [%] N
		[%] N	[%] SD	[%] N	[%] SD	
Animal feed	VDLUFA	**2,650**	0,018	**2,638**	0,006	**0,012**
Animal feed		**5,600**	0,017	**5,617**	0,027	**0,017**
Yogurt	MUVA	**0,770**	0,002	**0,770**	0,003	**0,000**
UHT milk		**0,540**	0,003	**0,531**	0,002	**0,009**
Basmati rice	GAFTA	**1,380**	0,008	**1,350**	0,004	**0,030**
Soy flour		**7,699**	0,020	**7,691**	0,096	**0,008**
Meat	AOAC	**1,823**	0,092	**1,794**	0,029	**0,029**
Boiled sausage	LVU	**2,318**	0,007	**2,295**	0,012	**0,023**

Conclusion:

- Very good comparability of the methods with different sample matrices
- Exception: samples with a high inorganic nitrogen content
  - Without the addition of Devarda alloy at Kjeldahl, Dumas is then significantly higher

Topics

1

Possibilities of nitrogen determination and comparability

- Nitrogen determination according to Kjeldahl and Dumas
- Advantages of the Dumas method

2

N-Realyzer

- Functional principle and technical details
- What is required for the analysis? - Consumables

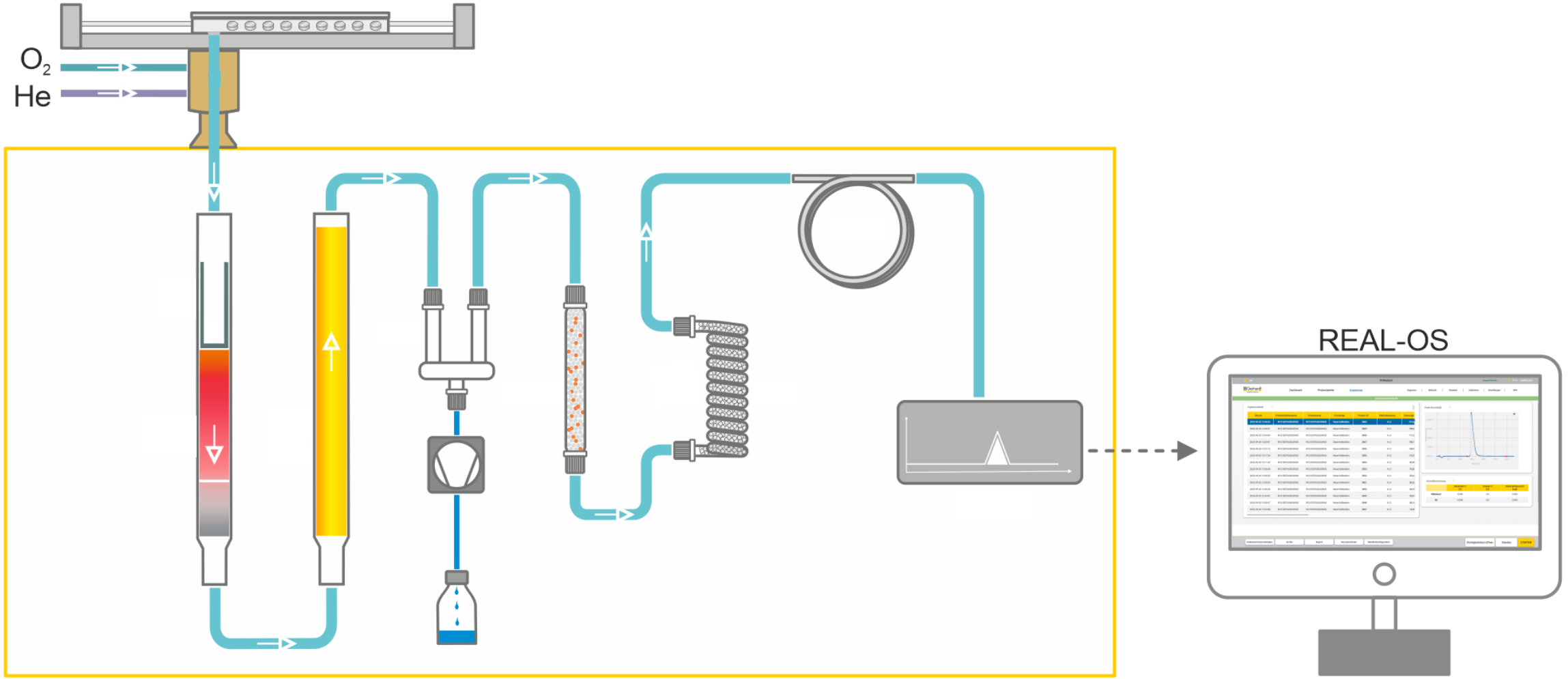
3

Carrying out the analyses

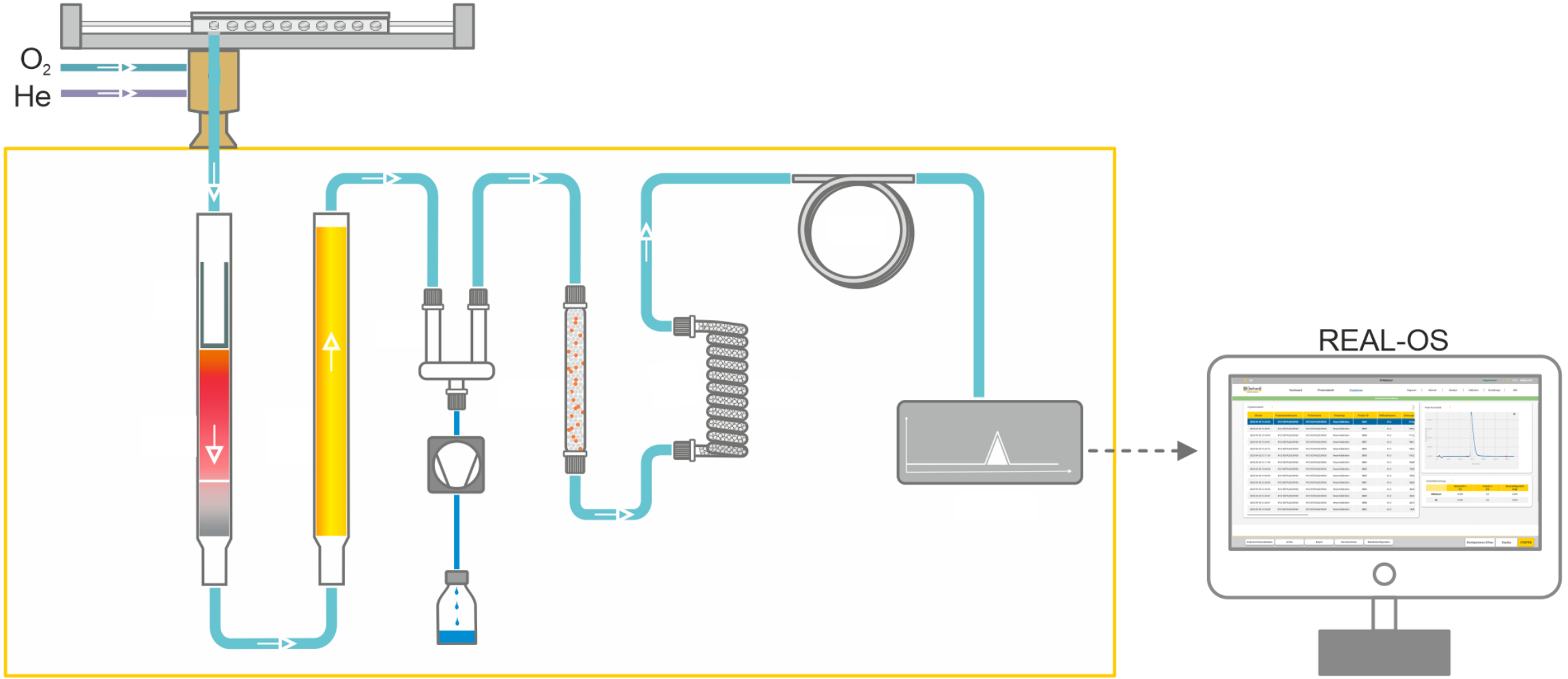
- Sample preparation and sample weighing
- Sample handling

xylem

Nitrogen determination with N-Realyzer

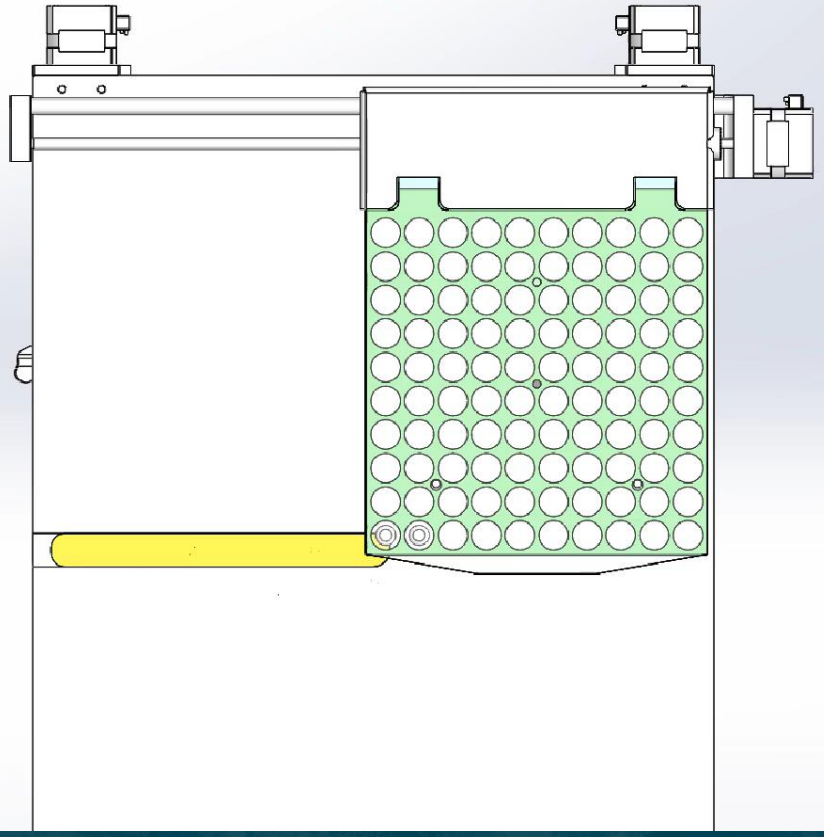


Nitrogen determination with N-Realyzer



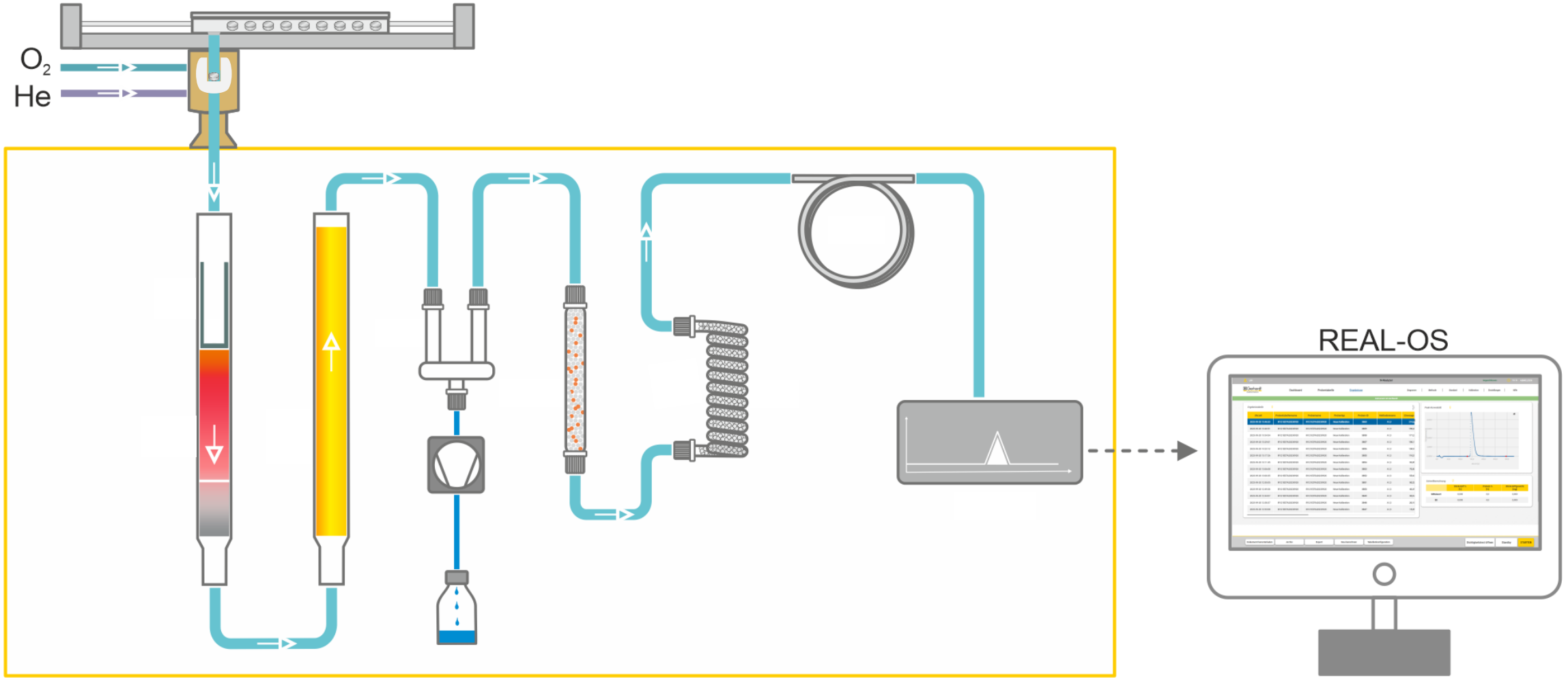
Nitrogen determination with N-Realyzer

Autosampler Function



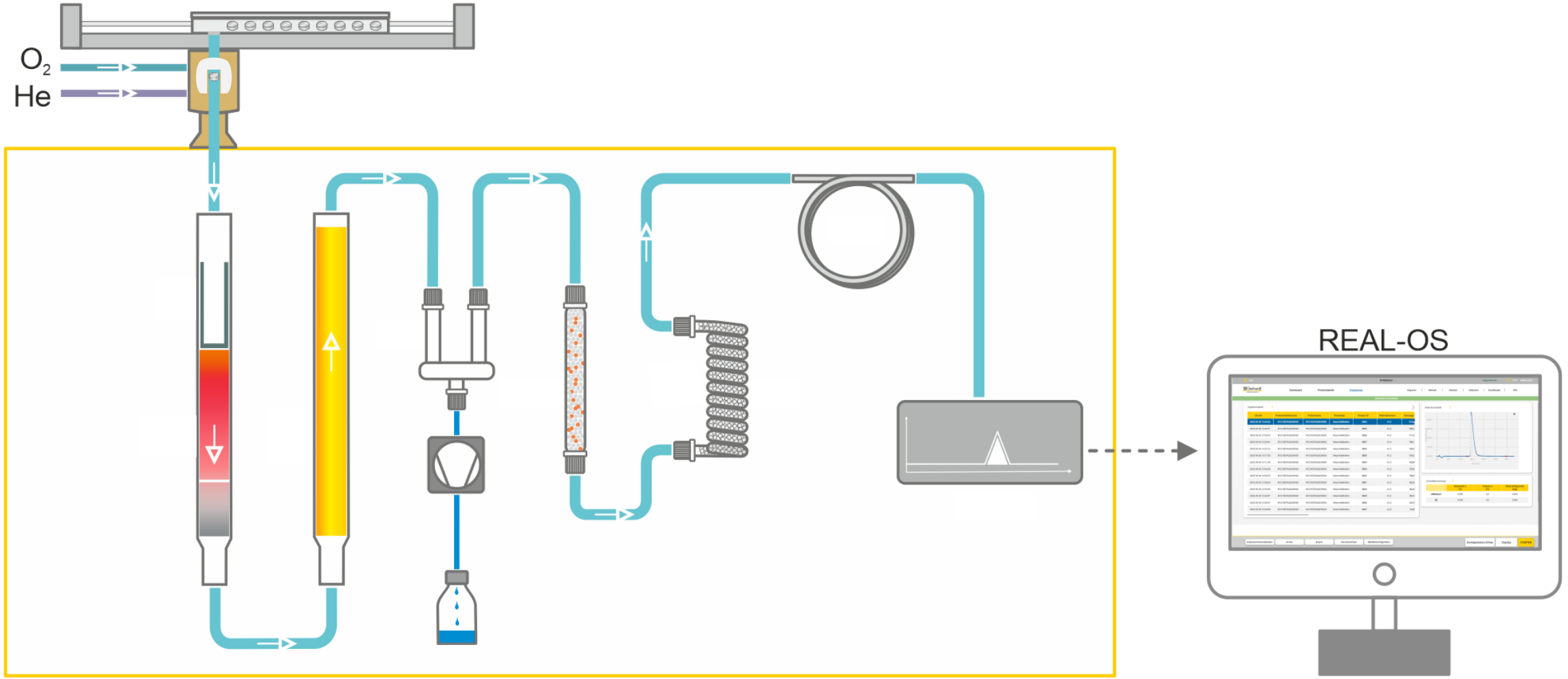
xylem

Nitrogen determination with N-Realyzer

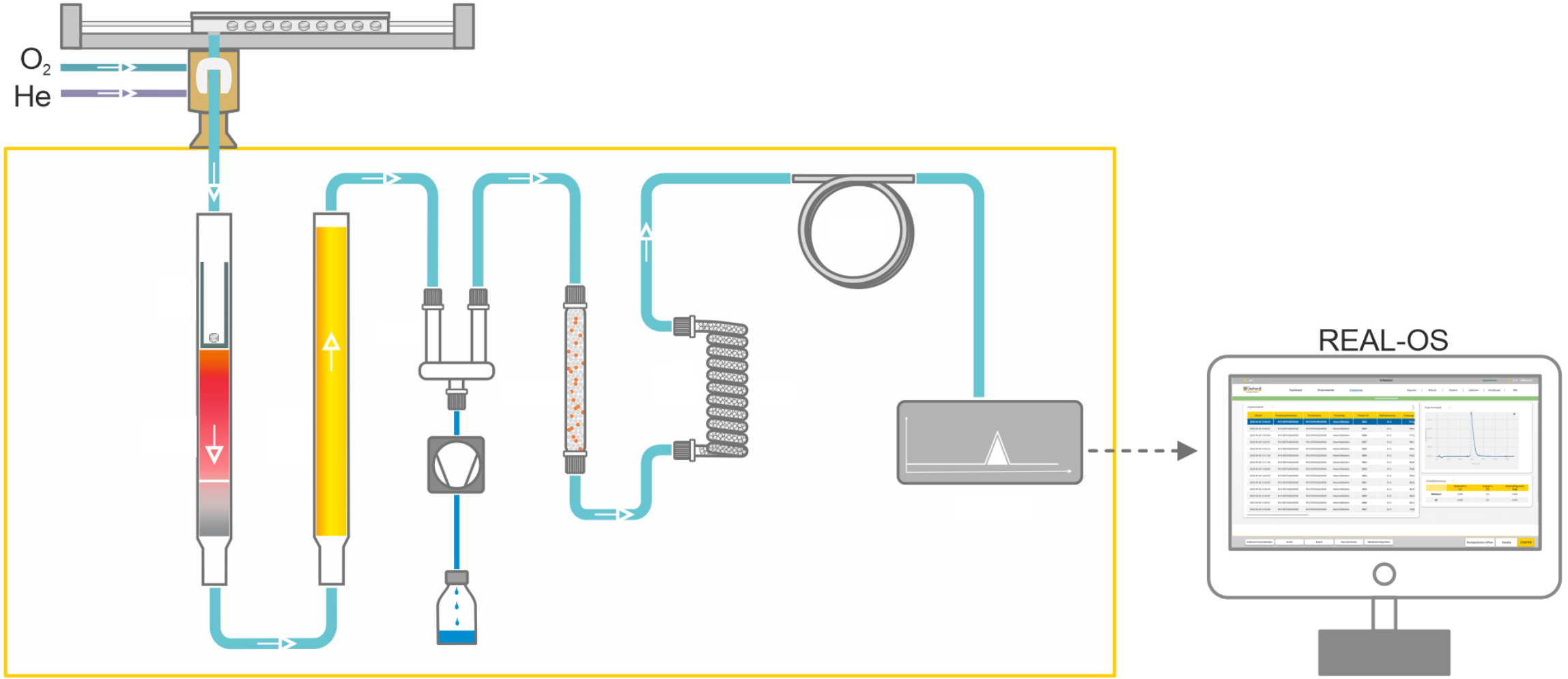


xylem

Nitrogen determination with N-Realyzer

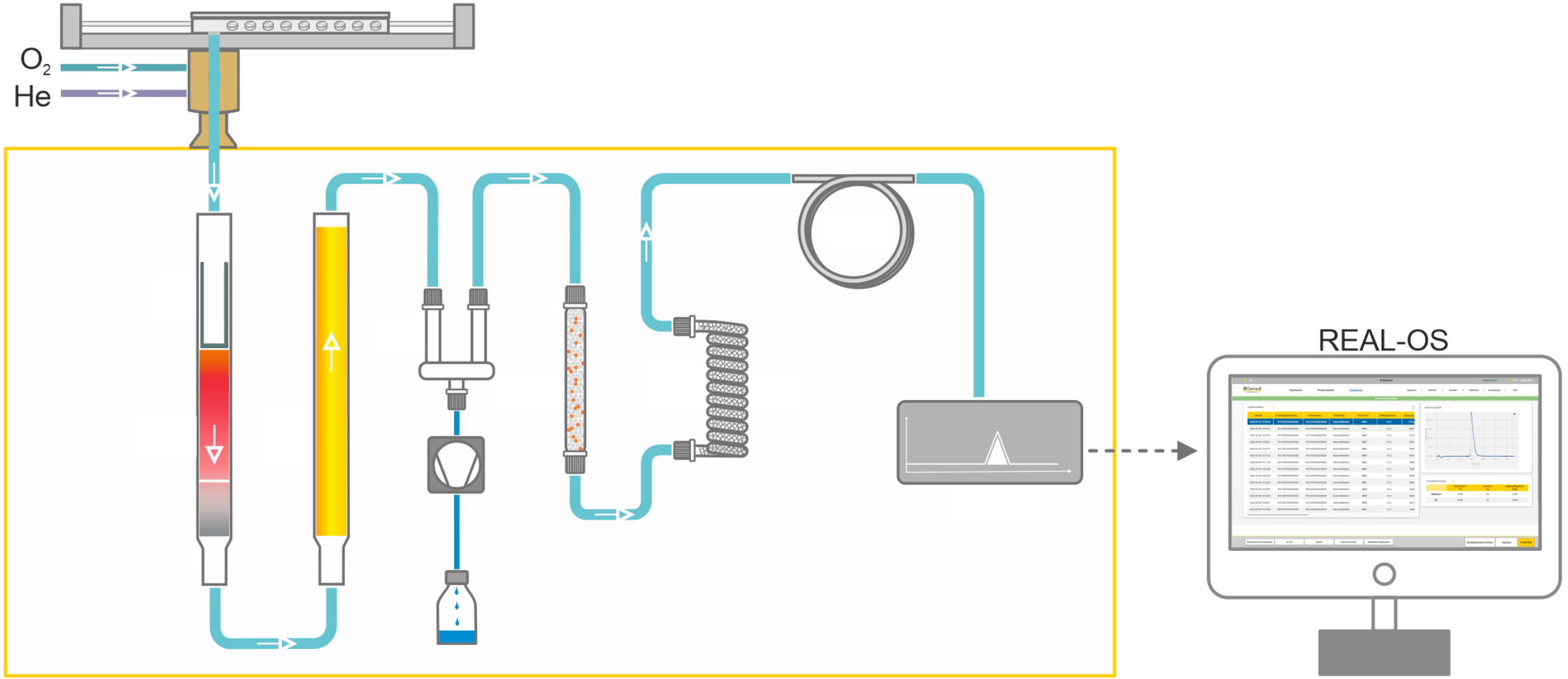


Nitrogen determination with N-Realyzer

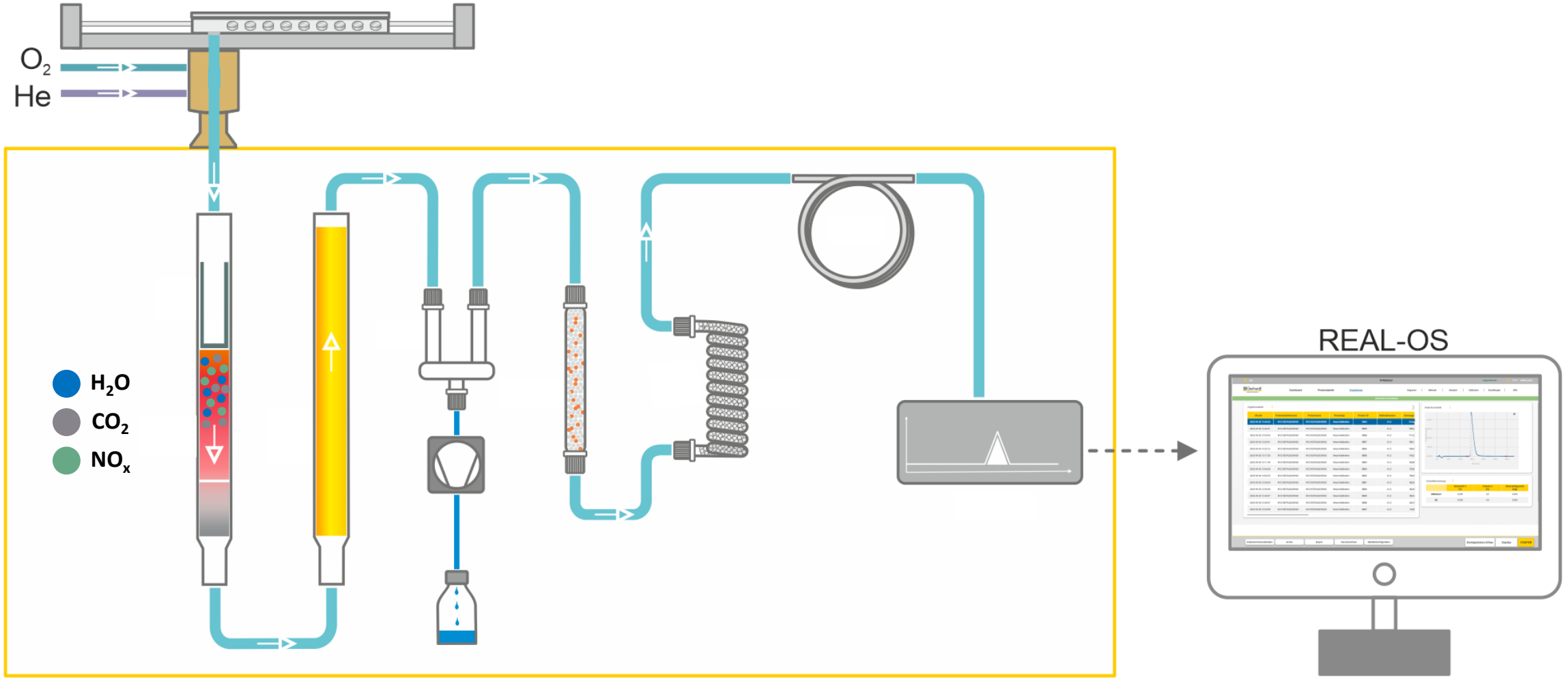


xylem

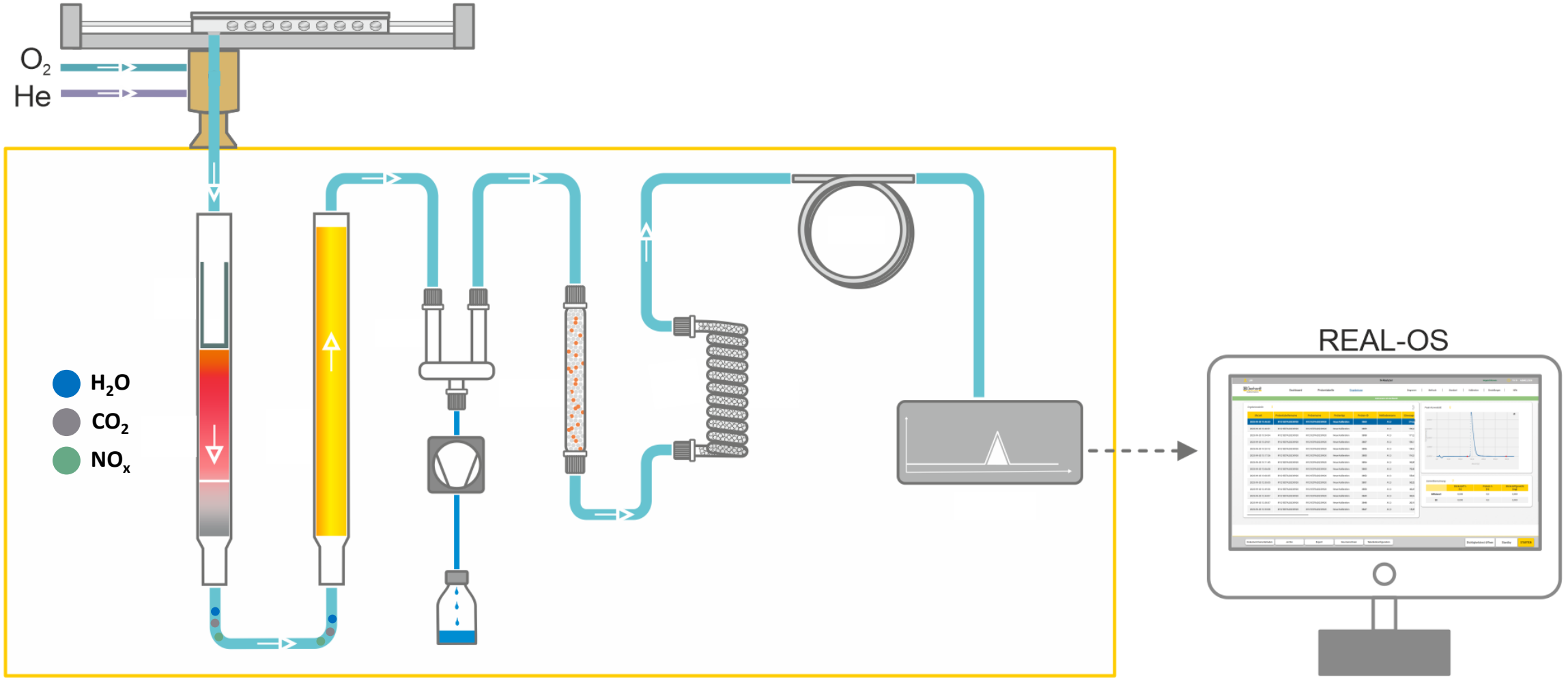
Nitrogen determination with N-Realyzer



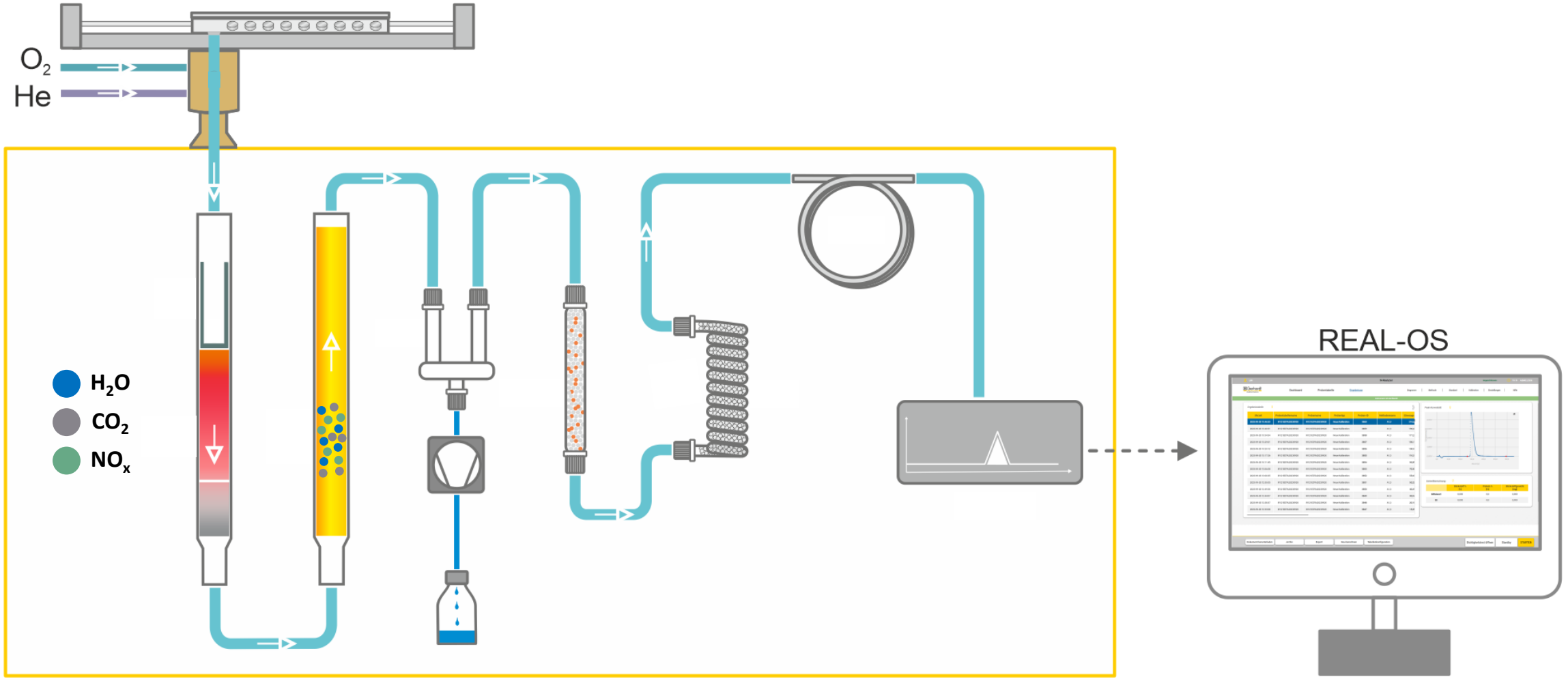
Nitrogen determination with N-Realyzer



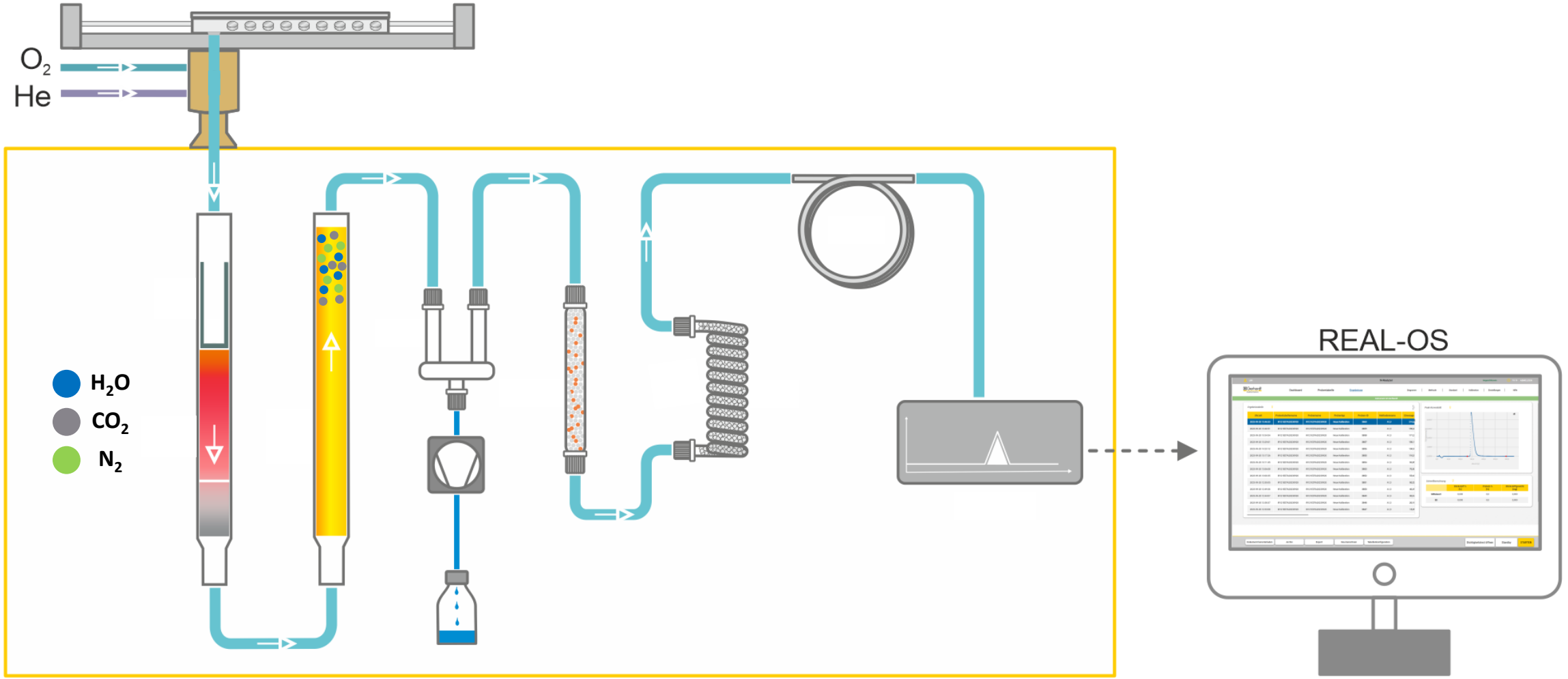
Nitrogen determination with N-Realyzer



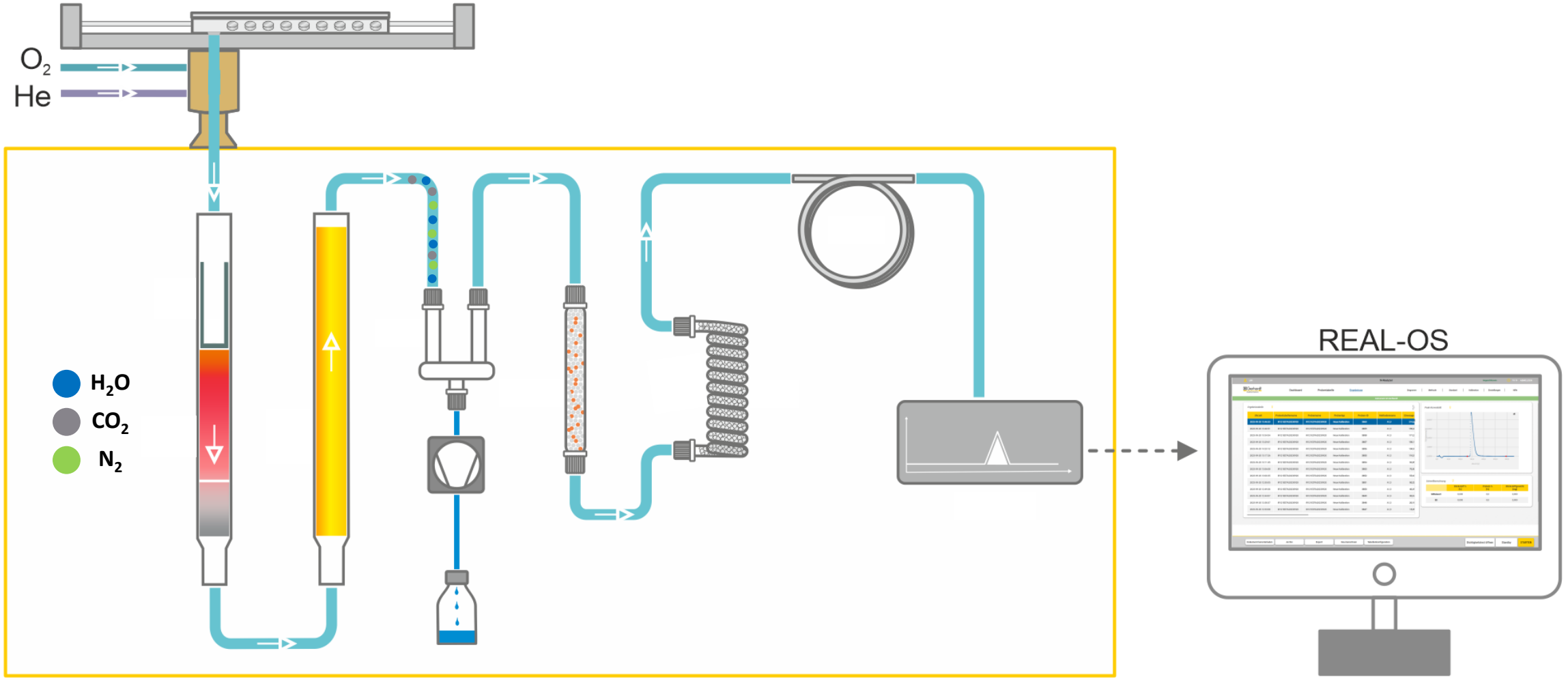
Nitrogen determination with N-Realyzer



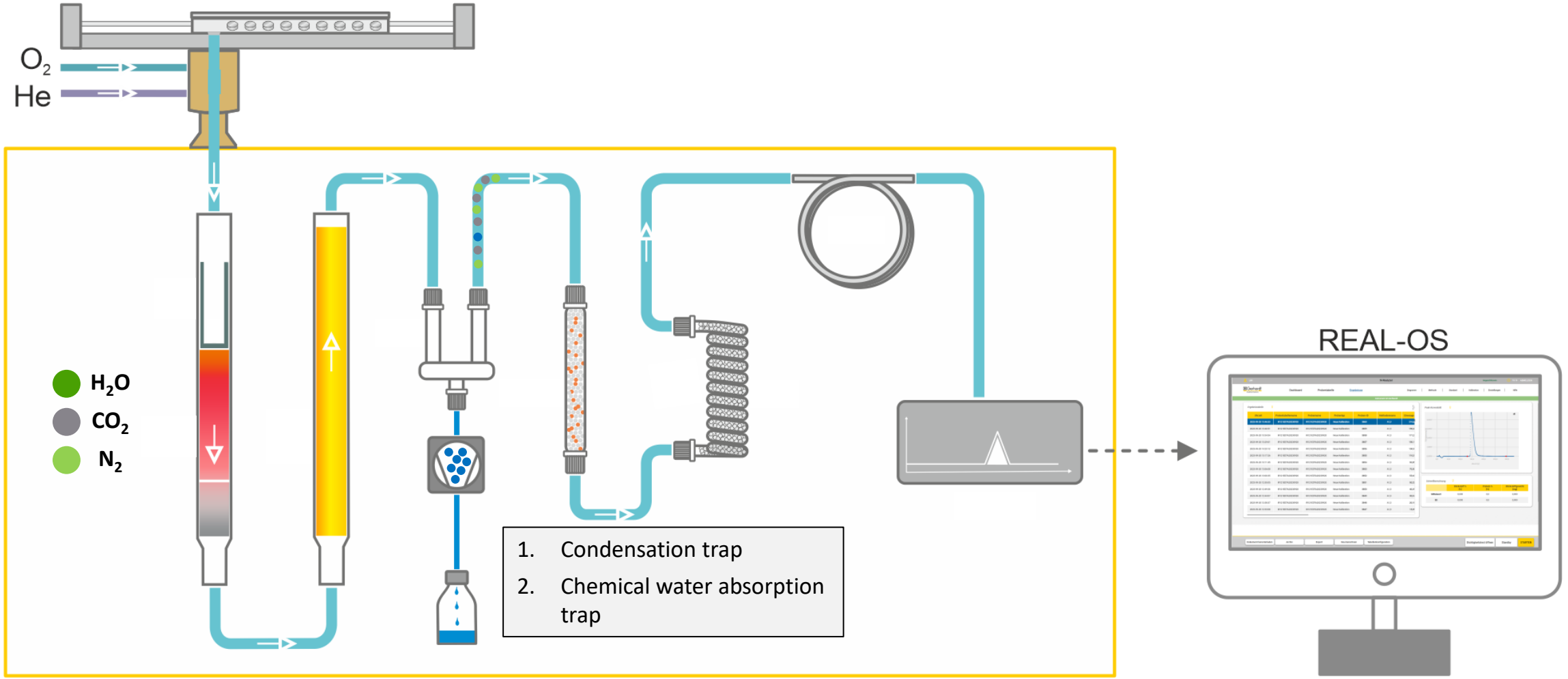
Nitrogen determination with N-Realyzer

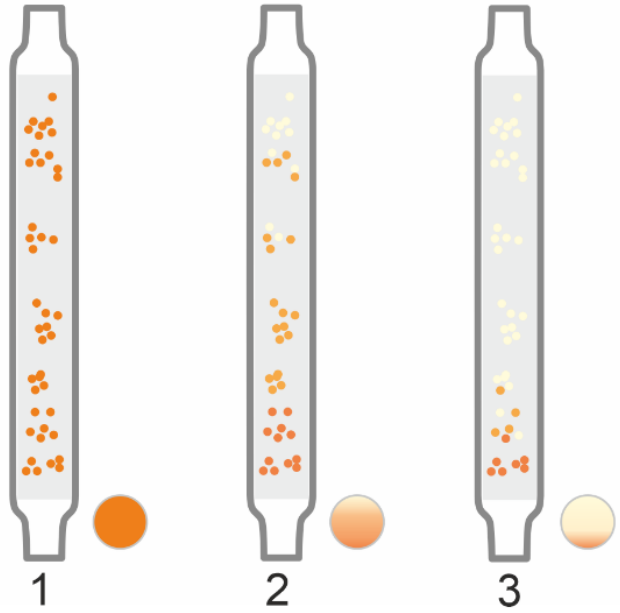


Nitrogen determination with N-Realyzer



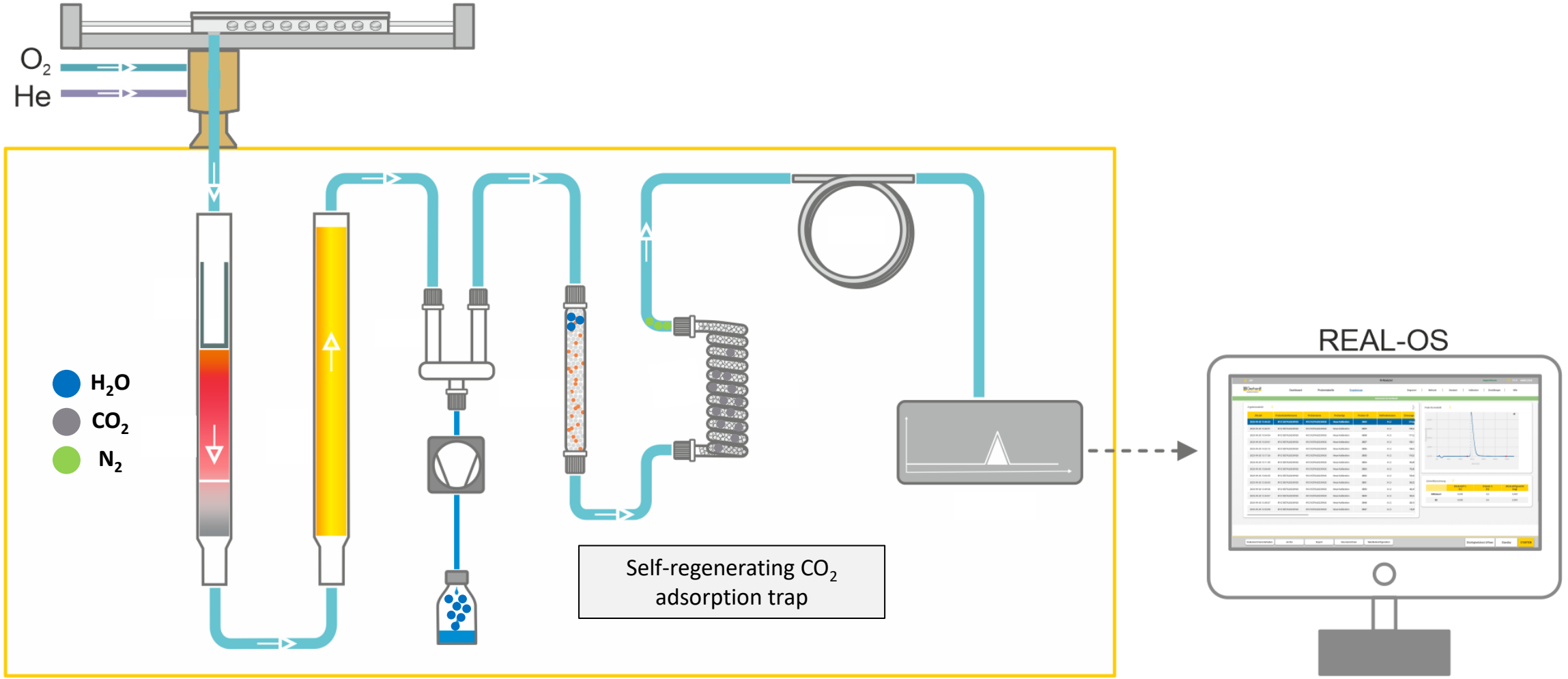
Nitrogen determination with N-Realyzer

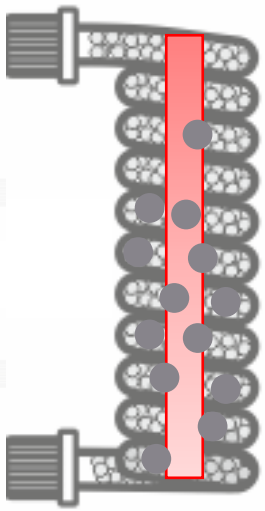


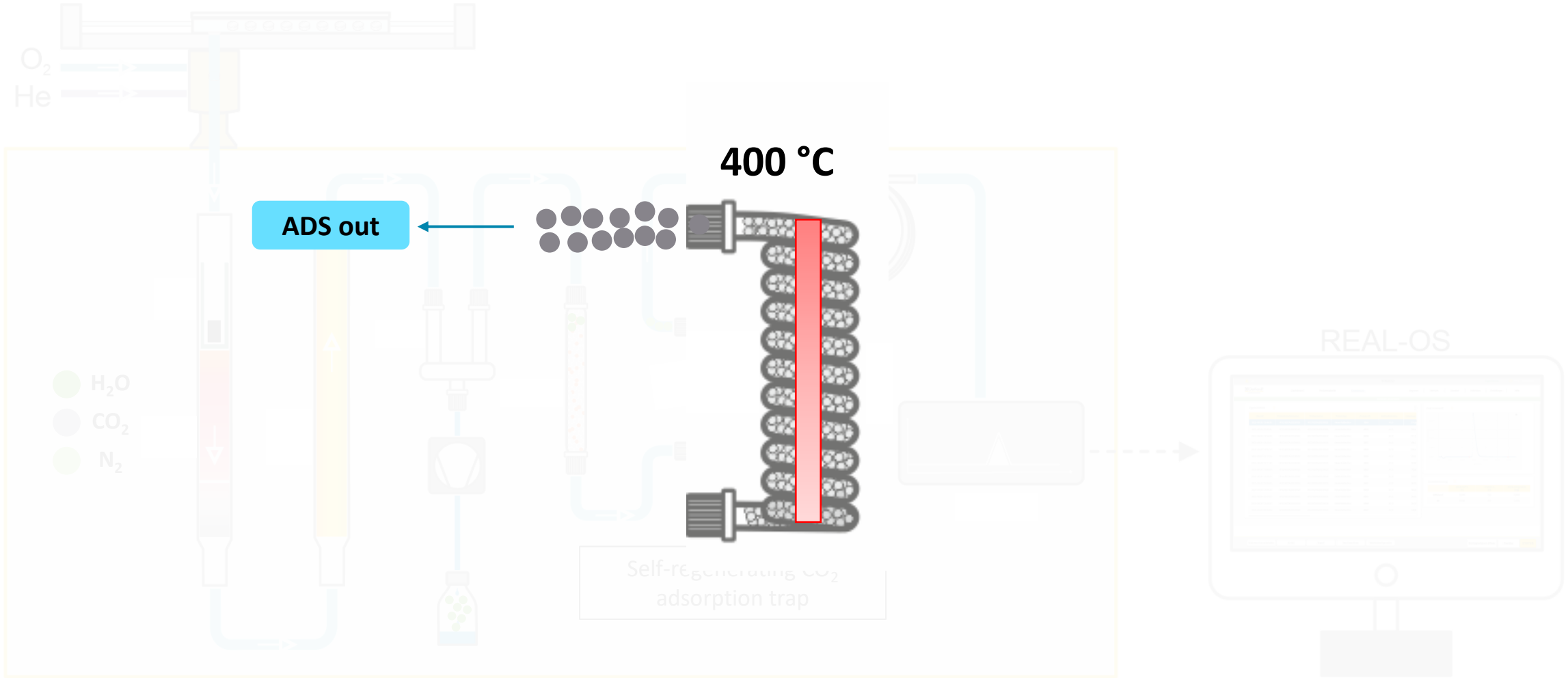


2. Chemical water absorption trap

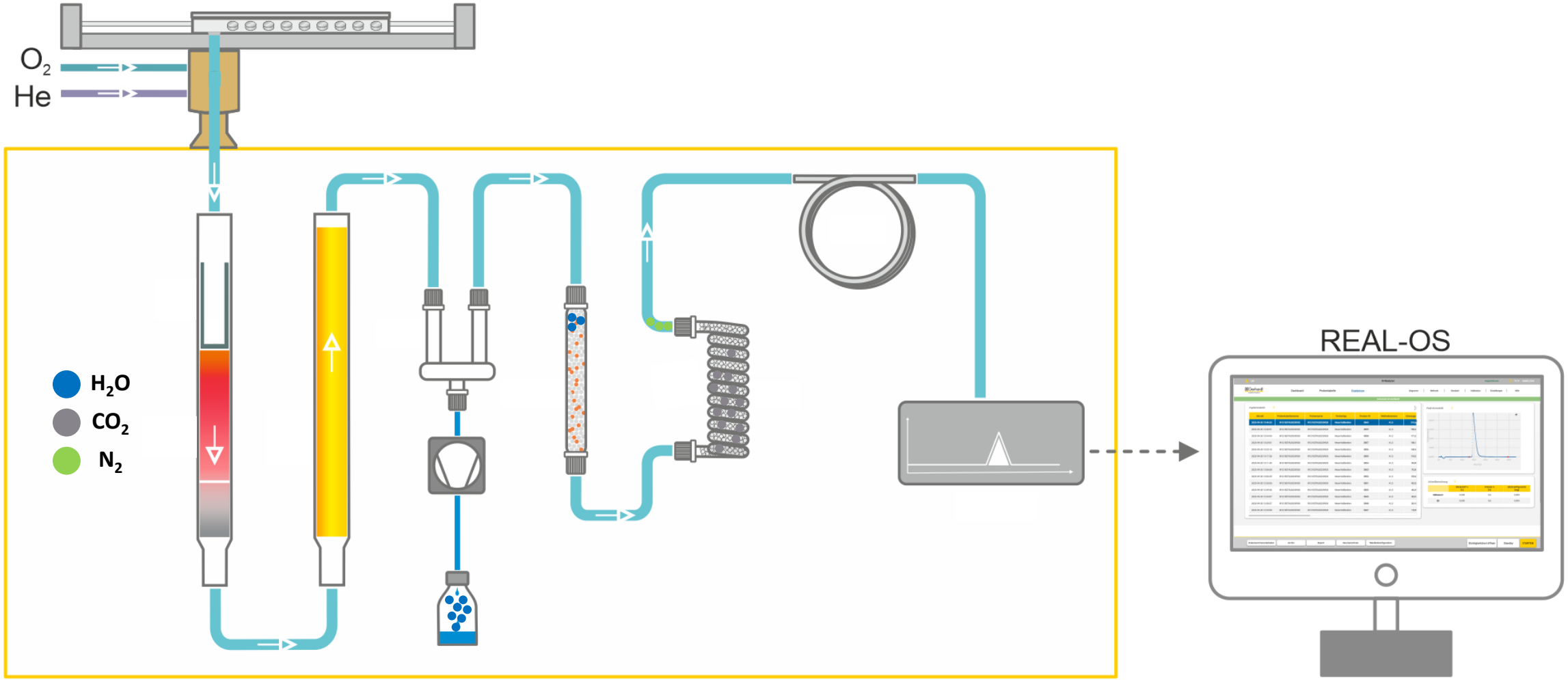
Nitrogen determination with N-Realyzer



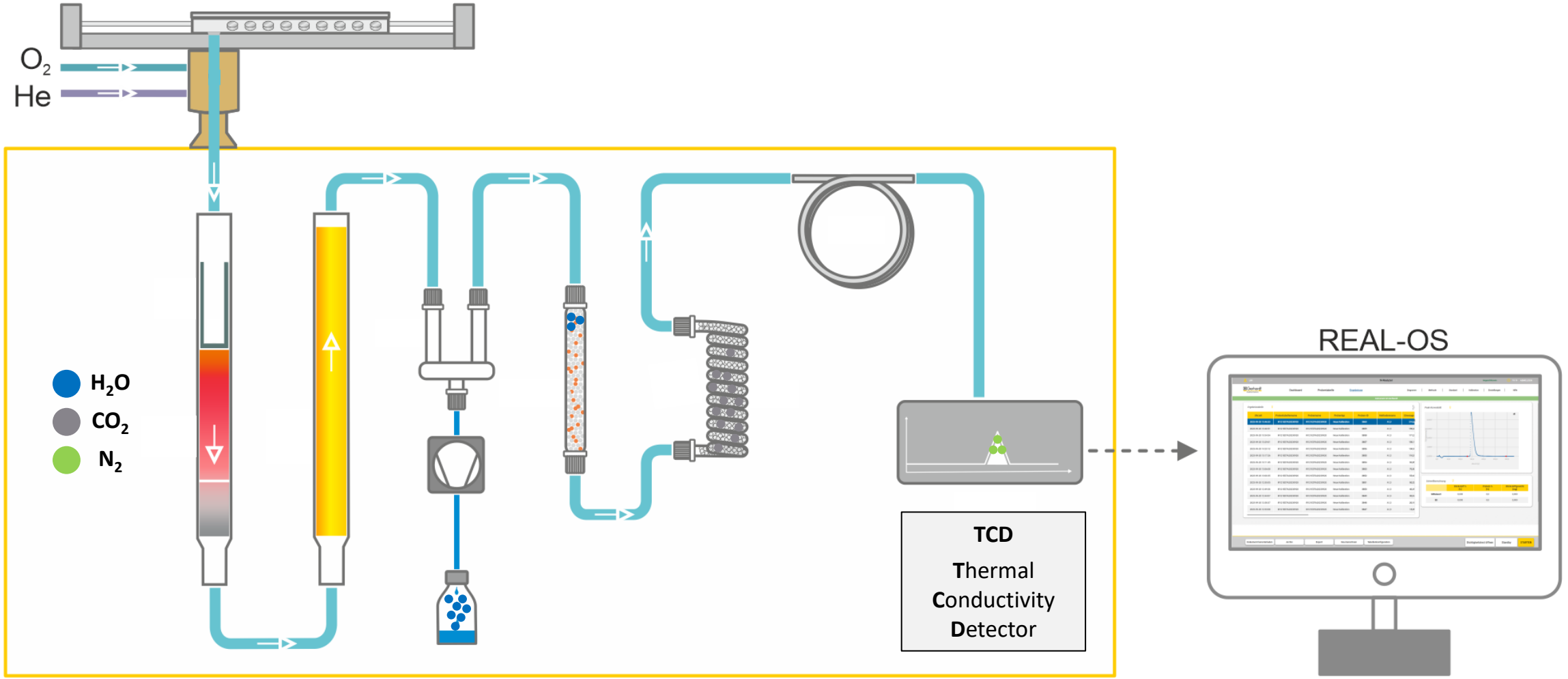




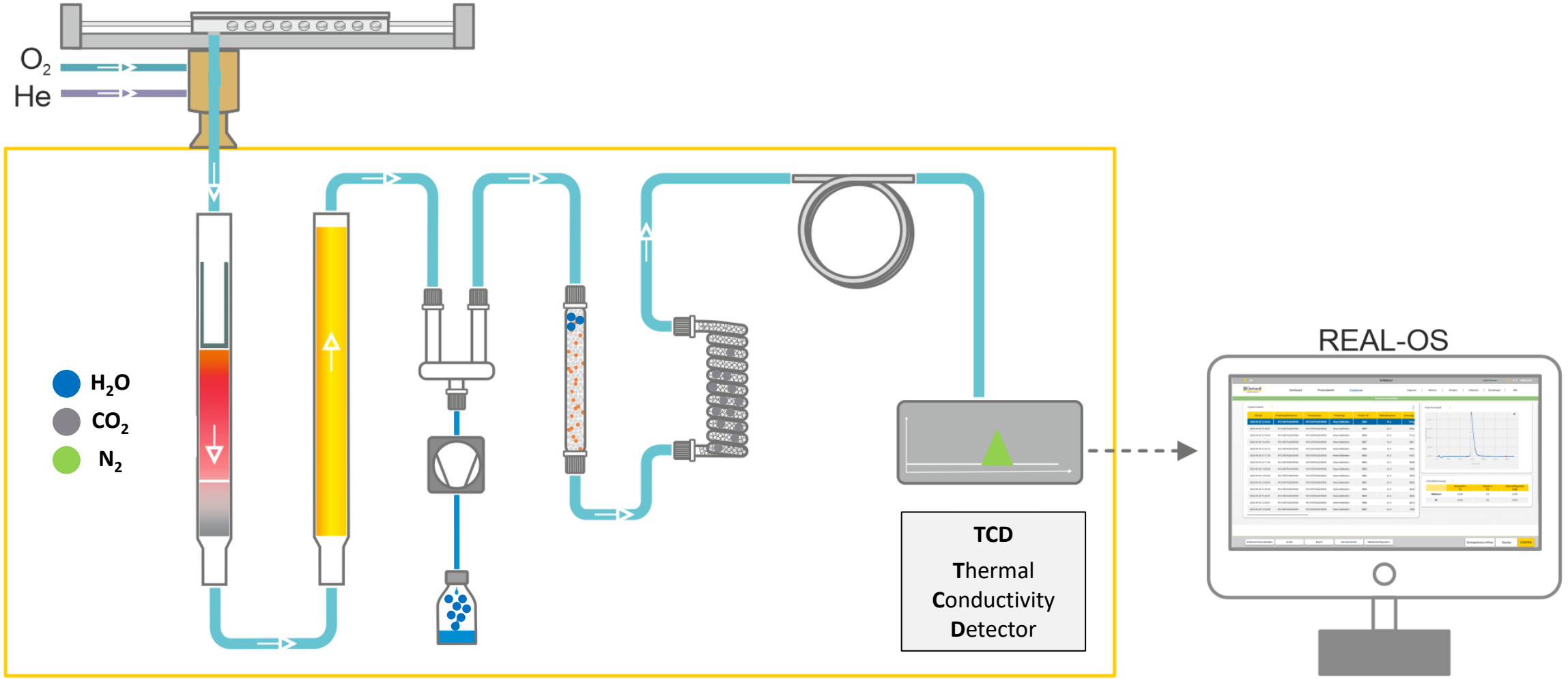
Nitrogen determination with N-Realyzer



Nitrogen determination with N-Realyzer

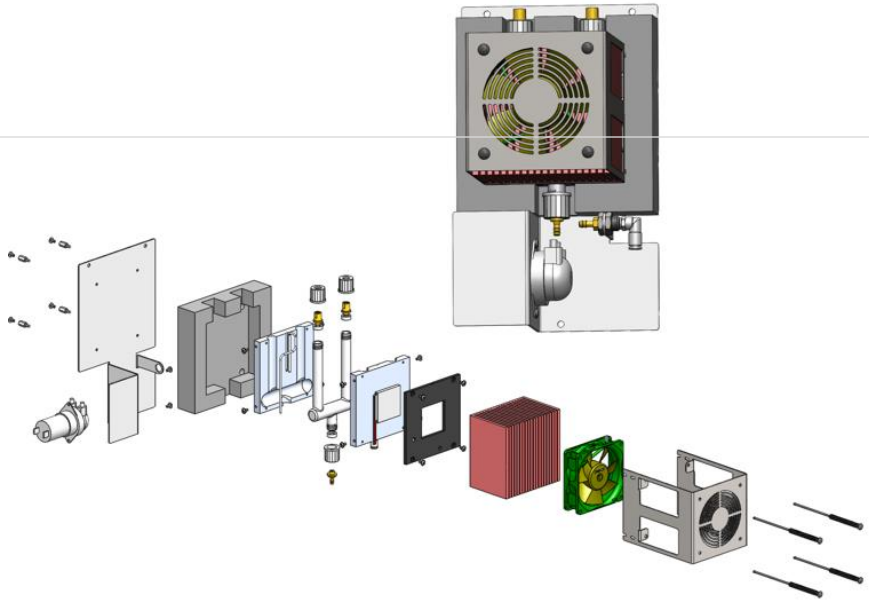


Nitrogen determination with N-Realyzer



Complete Water Separation

- Automatic water separation 95% effective from the combustion gas
- Low-cost safety water trap
- Liquid or solid samples in series are no problem

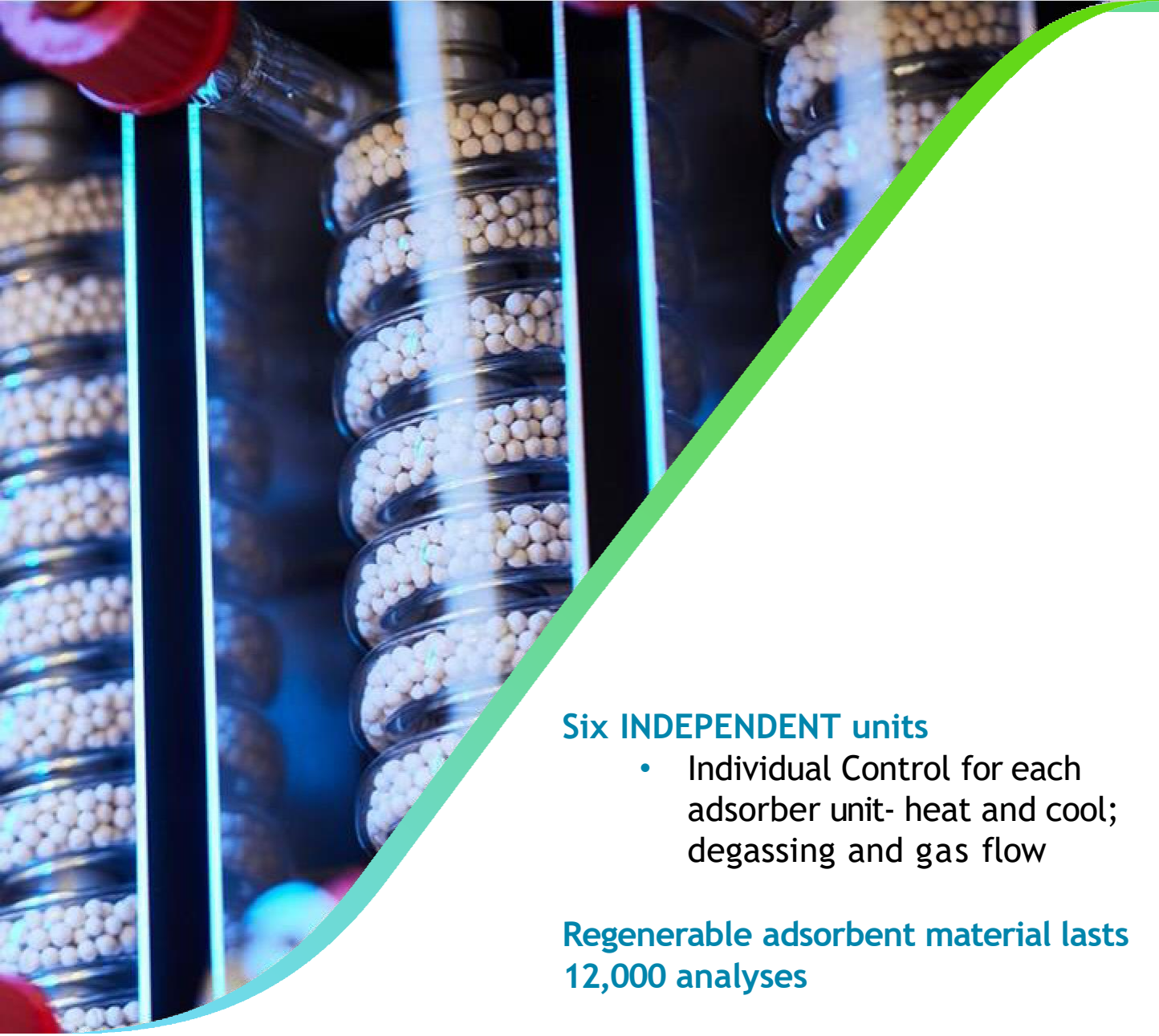


Peltier Element

Water Collecting Bottle

Safety Water Trap

xylem



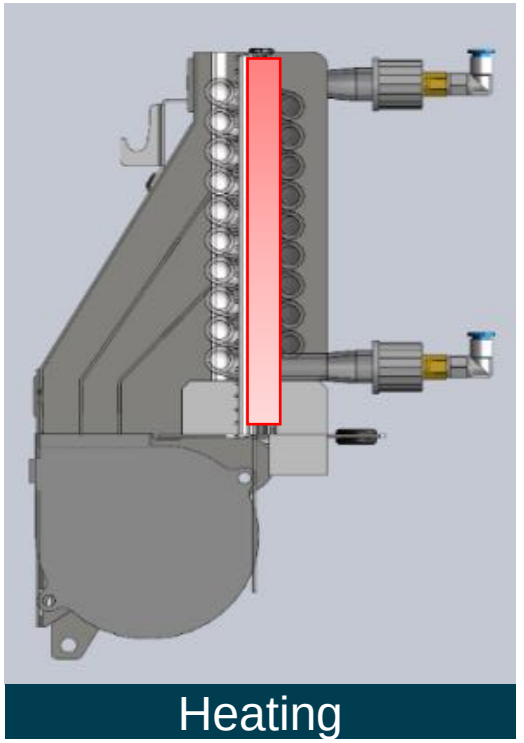
Sustainable CO_2 Filter

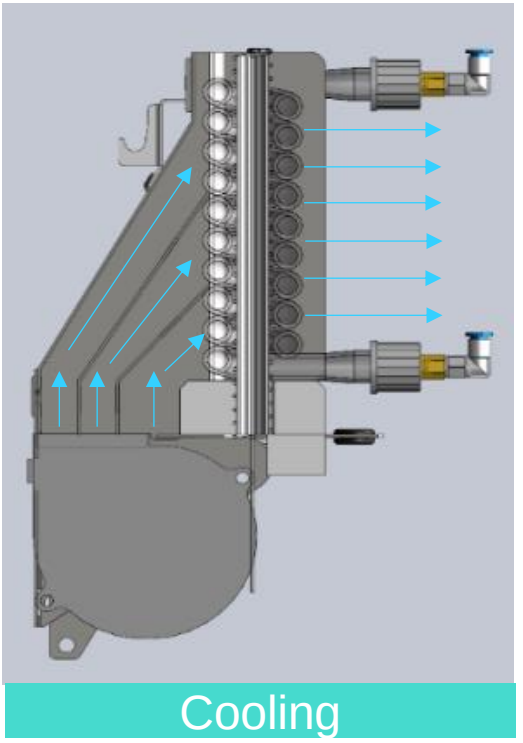
FAIL PROOF CO_2 Adsorber System

Six INDEPENDENT units

- Individual Control for each adsorber unit- heat and cool; degassing and gas flow

Regenerable adsorbent material lasts 12,000 analyses



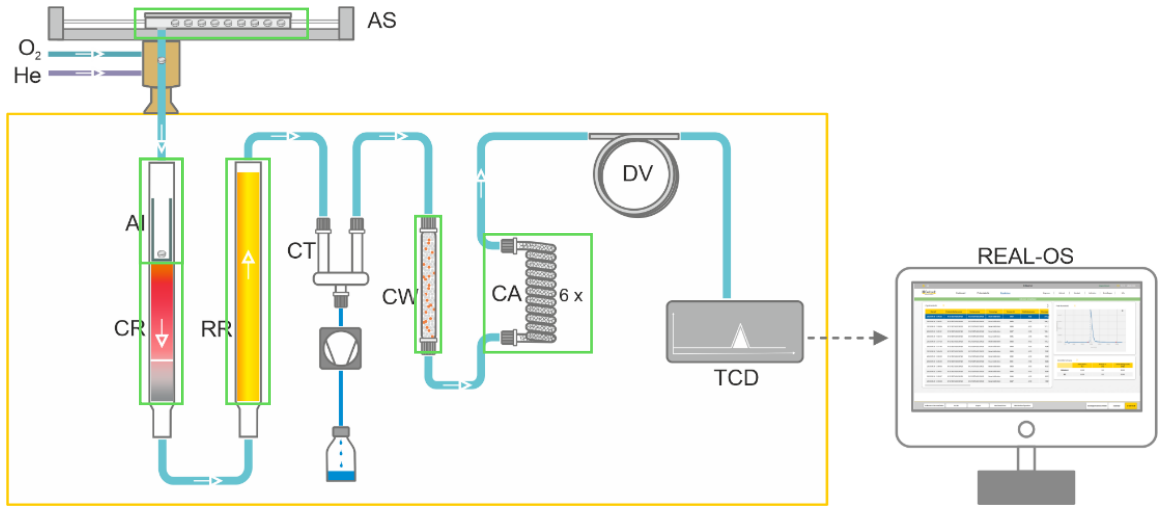


xylem

Consumables

Continuous Workflow

- **DumaFoil** – Sample weighing
- **DumaCollect** – Combustion residues
- **Catalyst** – Oxidation of the sample
- **DumaCop** – Reduction of nitrogen oxides
- **Chemical Water Trap** – Removal of the remaining H_2O ($Mg(ClO_4)_2$ + orange gel)
- **DumaCO_2** – Removal of CO_2



Topics

1 **Possibilities of nitrogen determination and comparability**

- Nitrogen determination according to Kjeldahl and Dumas
- Advantages of the Dumas method

2 **N-Realyzer**

- Functional principle and technical details
- What is required for the analysis? - Consumables

3 **Carrying out the analyses**

- Sample preparation and sample weighing
- Sample handling

xylem

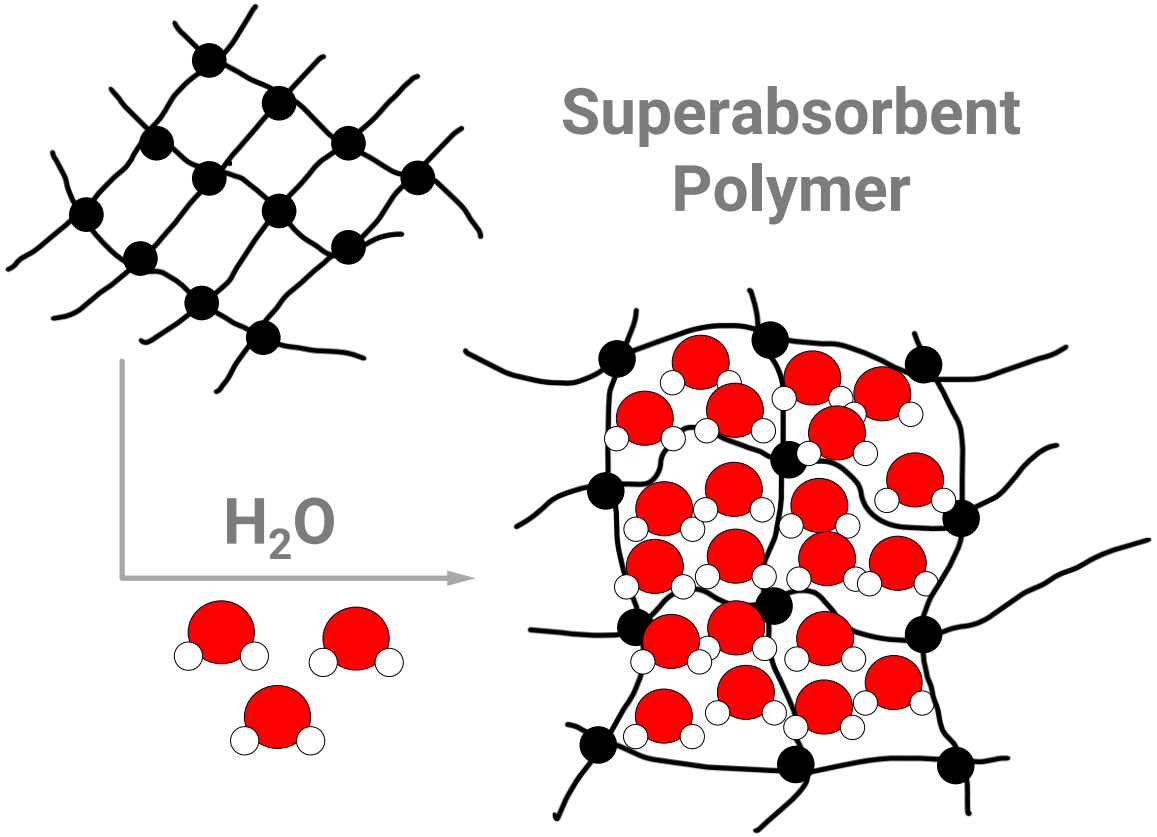
Sample Preparation

Homogenization

- **Grinding** of the sample to a **particle size** of 1 mm
  - Recommended by DIN or AOAC
- Higher **precision** of results
  - Comparable with Kjeldahl
- Suitable for almost **all sample types**
  - In exceptional cases smaller
- **Pulverisette 14** or comparable systems

xylem

Sample Weighing



Liquid Samples

- Weighing between **100 - 200 mg ± 5 mg**
  - Recommended sample weight approx. 100 mg + DumaSorb or Superabsorber
  - **Attention:** Pay attention to **homogeneity**, even liquid samples can be inhomogeneous
    - **Sedimentation** of particles in wastewater samples!

Superabsorber

- Suitable for almost all water-based liquid samples

xylem

Sample Weighing

Weighing Process

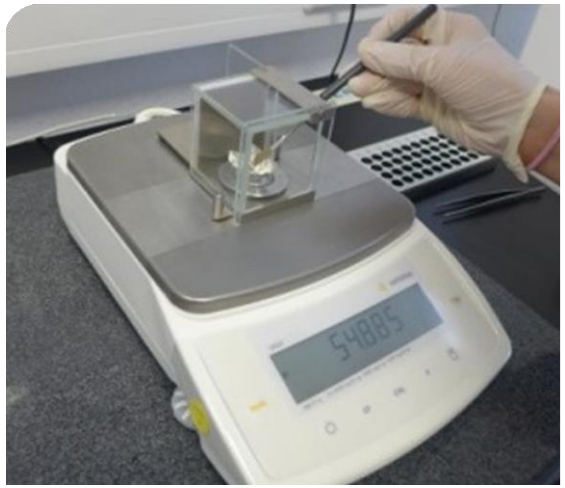
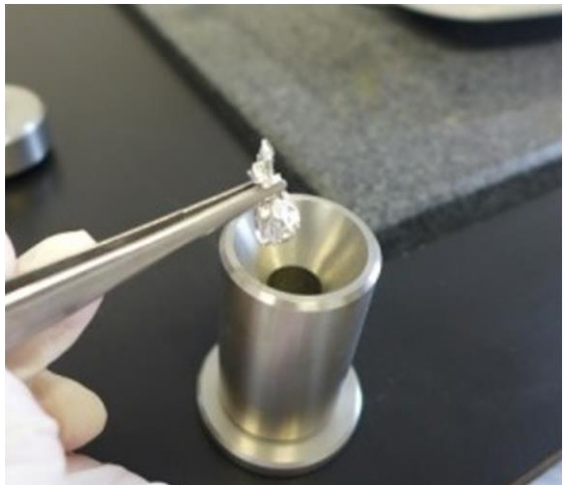
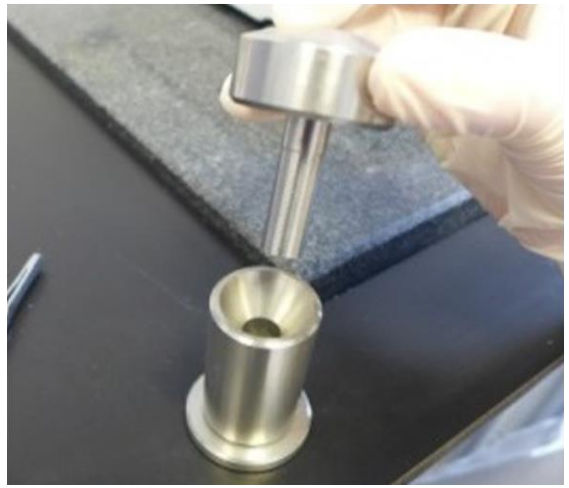
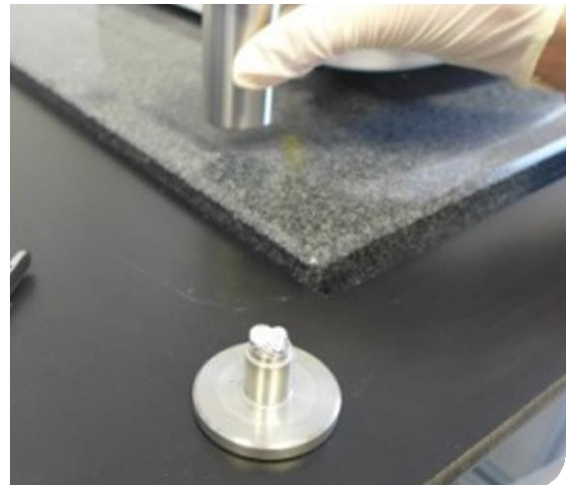
1. Weighing the sample in **tin foil** → Difference to Kjeldahl

   Goal: Airtight packaging

2. Transferring the sample to the pressing tool

3. Forming the sample capsule with a stamp

4. Removal of the molded sample capsule from DumaPress

Sample Handling

Sample Transfer

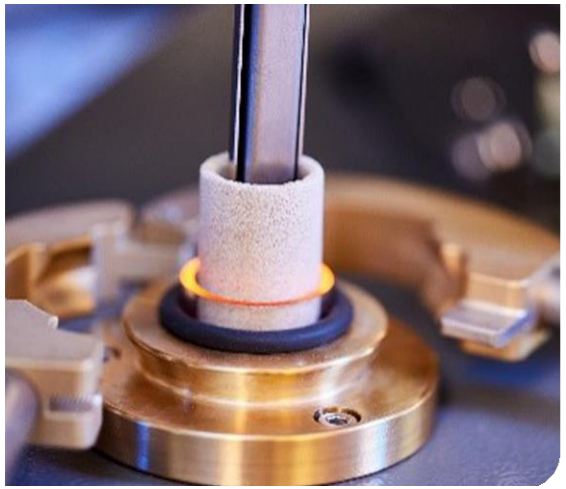
1. Sample transfer to **numbered sample transfer plate** → after the weighing in process
2. Placing the transfer plate on the sample tray
3. Pull out the numbered base plate → **Simultaneous transfer** of all samples to the corresponding positions
4. **Urgent samples** can be integrated into any unoccupied position

xylem

Sample Handling

Autosampler

1. **100 positions** in the sample rack
2. **Tilting mechanism** - save space behind the appliance
3. **Tool-free opening** of the reactor connection to the autosampler
4. **Laboratory safety** - built-in dampers prevent sudden tipping or falling
5. **Easy accessibility** and **quick replacement** of consumables
6. **Robust design** - low maintenance



Easy Maintenance: Fast Changeover

Easy access to process relevant components/consumables and tool-free sealing concept (TSC)

xylem

Advantages of the N-Realyzer

Efficient Operation

- Simple routine work
- Only 6 typical leakage points that are quickly accessible
- Simple inspection and quick replacement of consumables possible

Optimized Gas Consumption

- Catalytic combustion without excess oxygen
- Automatic calculation of oxygen demand based on sample weight and method

Variability

- Solid, pasty, and liquid samples can be measured

Precise Analysis

- Innovative TCD (thermal conductivity detector)
- Low detection limit of 0.003 mg N absolute

Advantages of the N-Realyzer

Occupational Safety

- No handling of corrosive chemicals, e.g. sulphuric acid ($H_2 SO_4$) or caustic soda (NaOH)
- Hardly any waste → No containers are required for chemical residues

Saves Valuable Workspace

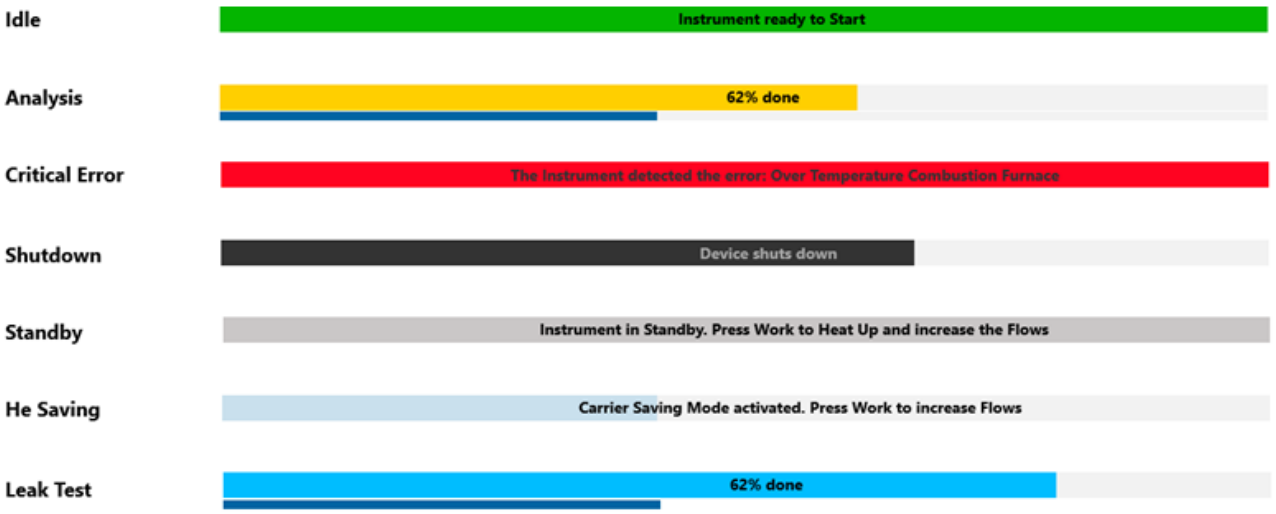
- No fume cupboard or additional equipment required for analyzing samples

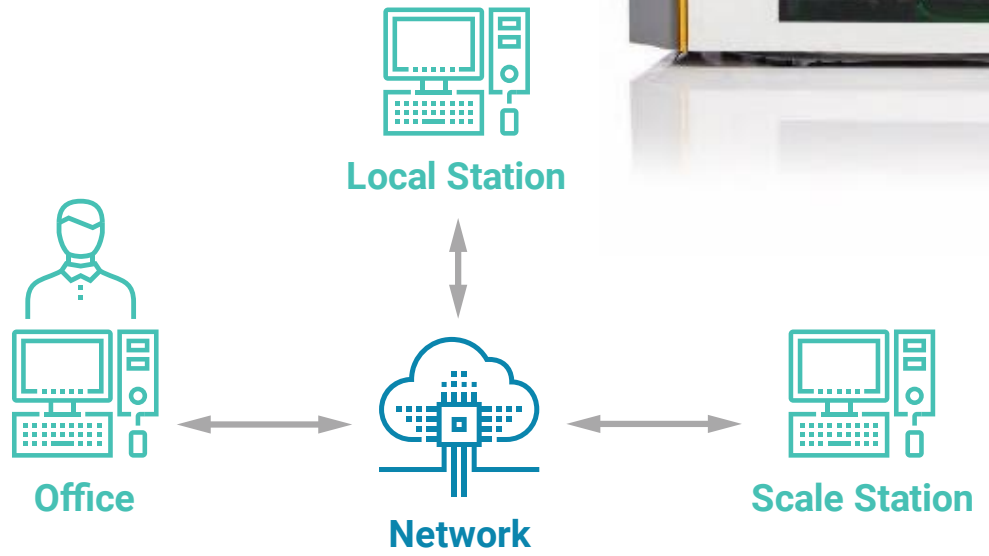
Time-saving

- Ready for operation in 30 minutes; including heating up and leak test (from standby mode)
- Rapid analysis of samples in just 3 - 5 minutes

Brand New User Interface

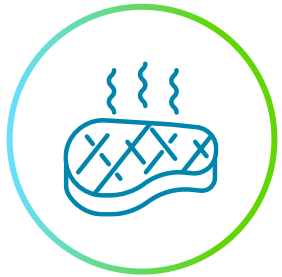
- Pioneering and Network-Integratable User Interface
- Intuitive Software Design with Color Matching to Guide the Way
- Conformity with FDA 21 CFR Part 11 and ISO 17025





xylem

Official Methods - Dumas Method



Meat

- AOAC 992.15
- AOAC 928.08
- § 64 LFGB 06.00-20

Beer

- AOAC 920.53
- AOAC 950.09
- AOAC 997.09
- MEBAK 2.6.1.2

Agriculture/Fertilizers

- AOAC 993.13
- DIN EN 13654-2
- DIN ISO 13878

Wine

- OIV-MA-AS323-02A

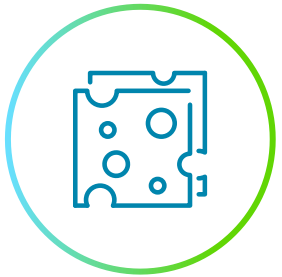
Official Methods - Dumas Method

Oilseeds

- DIN EN ISO 16634
- AOCS Ba 4e-93

Animal Feed

- AOAC 976.05
- AOAC 968.06
- AOAC 990.02
- AOAC 990.03
- AACC 46-30
- GAFTA Method 4:2



Milk & Dairy Products

- ISO 14891
- IDF 185
- § 64 LFGB 01.00.60
- § 64 LFGB 02.00.24
- § 64 LFGB 03.00.27

Pharmacy

- European Pharmacopoeia 5 method 7

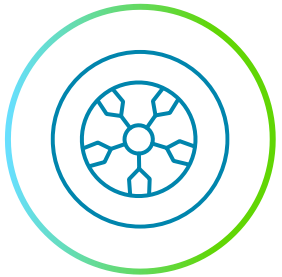
Official Methods - Dumas Method

Environment

- DIN EN 16168 (N)
- DIN EN 10694 (C)

Cereals

- AOAC 992.23
- AACC 46-30
- GAFTA Method 4:2
- ICC Standard No. 167



Rubber

- DIN EN ISO 19051
- ISO 24698-1

Food

- ISO 16634-1
- ISO TS 16634-2
- AOCS Ba 4f-00
- § 64 LFGB, methods 17.00-18; 18.00-18; 22.00.2; 48.01-26

Worldwide References

Hochland Group

WHEN YOU NEED TO BE SURE SGS

Good Food, Good Life

Jungbunzlauer

Eat Well, Live Well.
AJINOMOTO.

ARIAKE JAPAN Co.,Ltd.

ROQUETTE

ich liebe es

LANXESS
Energizing Chemistry

มหาวิทยาลัยเกษตรศาสตร์
Kasetsart University

xylem

xylem

Thank You

Comprehensive Protein Providers Your Only Source For Both Kjeldahl And Dumas

Learn More

Gerhardt
Analytical Systems

Xylem is the exclusive North American distributor of C. Gerhardt GmbH & Co. KG