



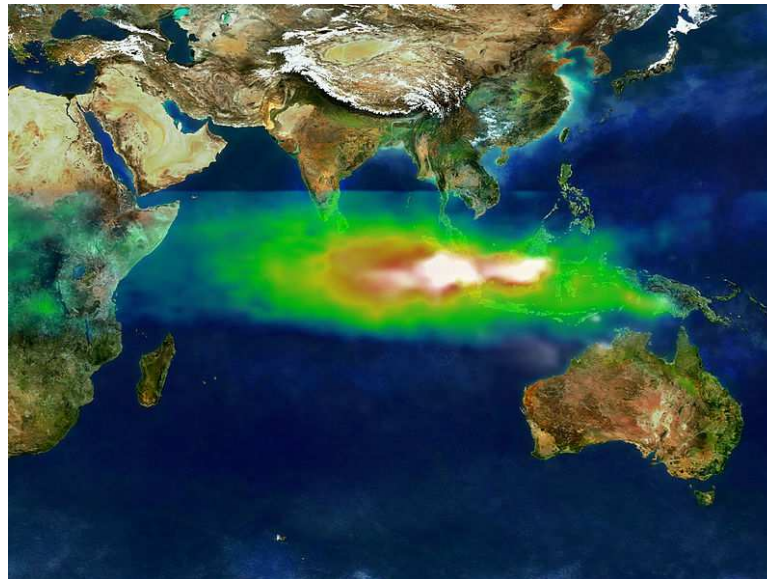
Online Gas and Liquid Analyzer Experts



Chromatotec introducing new product range
Portable analyzers and detectors

Ozone precursors

- Ozone concentration has multiplied 5 times in the last century in the middle latitudes of the northern hemisphere:
 - From 10 ppb in 1874
 - To approximately 50 ppb today (increase of 1.6% per year)
 - The trend is higher (2.4% a year) over the last decades.¹
- In order to stop this global trend, directives have been written concerning the reduction of ozone precursors emissions (NO_x, VOC like formaldehyde) to define national emission maxima.



¹The International Geosphere-Biosphere Program - World Climate Research Program

²http://visibleearth.nasa.gov/view_rec.php?id=1651

- 100+ different chemicals
- Anthropogenic sources
 - BTEX from road traffic
 - Chlorinated compounds from industries
- Biogenic sources
 - Isoprene and Monoterpenes from trees
 - Natural emissions occur predominantly in the tropics (23° S to 23° N)
- VOCs and PM 2.5 relation
 - 50% of dry mass PM 2.5 are composed by OA: Organic Aerosol
 - 60% SOA Secondary Organic Aerosol from VOCs ^{1,2}



¹ Kanakidou et al. Atmos. Chem. Phys., 5 2005.

² Haddad et al. Atmos. Chem. Phys. Discuss., 2010

- European list 31 VOCs including **BTEX** and **formaldehyde** (WG13 work on new European list)
 - In Europe, ambient air legislation targets Benzene
 - With annual target value of 5 $\mu\text{g}/\text{m}^3$
- US EPA lists
 - PAMS 56 including **BTEX** or 58 (including alpha and beta pinenes) – **formaldehyde included**
 - New PAMS 61 including **BTEX, 1-3 Butadiene, alpha and beta pinenes** – **formaldehyde included**
 - TO14: including **BTEX**, Cl-VOCs
 - TO15: including **BTEX**, Cl / Br / O-VOCs

cc5

A. Objectives

The main objectives of such measurements are to analyze any trend in ozone precursors, to check the efficiency of emission reduction strategies, to check the consistency of emission inventories and to help attribute emission sources to observe pollution concentrations.

An additional aim is to support the understanding of ozone formation and precursor dispersion processes, as well as the application of photochemical models.

B. Substances

Measurement of ozone precursor substances shall include at least nitrogen oxides (NO and NO₂), and appropriate volatile organic compounds (VOC such as formaldehyde). A list of volatile organic compounds recommended for measurement is given on next slide.

C. Siting

Measurements shall be taken in particular in urban or suburban areas at any monitoring site set up in accordance with the requirements of this Directive and considered appropriate with regard to the monitoring objectives referred to in Section A.

Diapositive 5

cc5

Can you bullet the points within each section, a. b. and c.? It's a lot of text

chromatotec chromatotec; 22/06/2021

Ozone precursors

Analyzed by airmoVOC C2 to C6

- C2** Ethane = C2
Ethene / ethylene
- C3** Propane = C3
Propene
isobutane (2-méthyl propane)
- C4** n-butane = C4
Acetylene
trans-2-butène
1-butene
1,3-Butadiene
cis-2-butène
Iso-pentane (2-methyl butane)
- C5** n-pentane =C5
1-pentene
2-methylpentane = I Hexane
- C6** n-hexane =C6
isoprene

Analyzed by airmoVOC C6 to C12

- C6** Benzene
- C7** n-heptane = C7
Toluene
- C8** 2,2,4-trimethylpentane
= Iso Octane
n-octane =C8
Ethylbenzene
m-xylene
p-xylene
o-xylene
- C9** 1,3,5 trimethylbenzene
1,2,4 trimethylbenzene
1,2,3 trimethylbenzene

Analyzed by airmoHCHO

Formaldehyde

Analyzed by ChromaTHC

Total non-methane
hydrocarbon



Many other VOCs can be added to this list and monitored with the same system



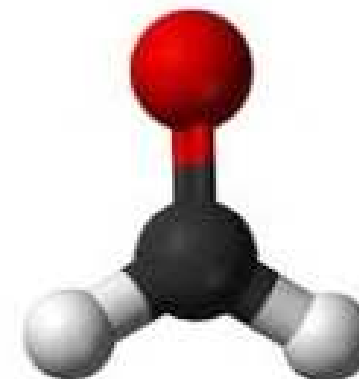
microF

Portable Formaldehyde Analyzer

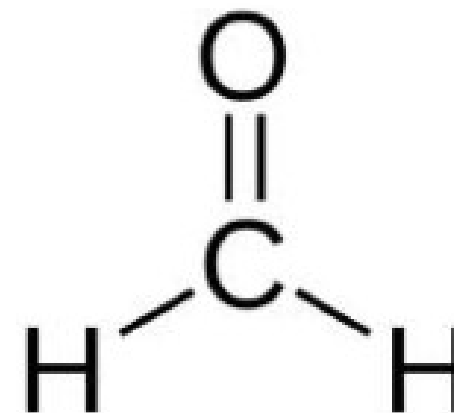


Why analyze formaldehyde ?

- Formaldehyde is present in :
 - Chemical, pharmaceutical, funeral industries
 - Paper plants
 - Indoor air (paintings, coatings)



- Formaldehyde effects :
 - Irritating, breathing issues (<500 ppb)
 - Carcinogenic (>500 ppb)
 - Risk of death (> 20 ppm)



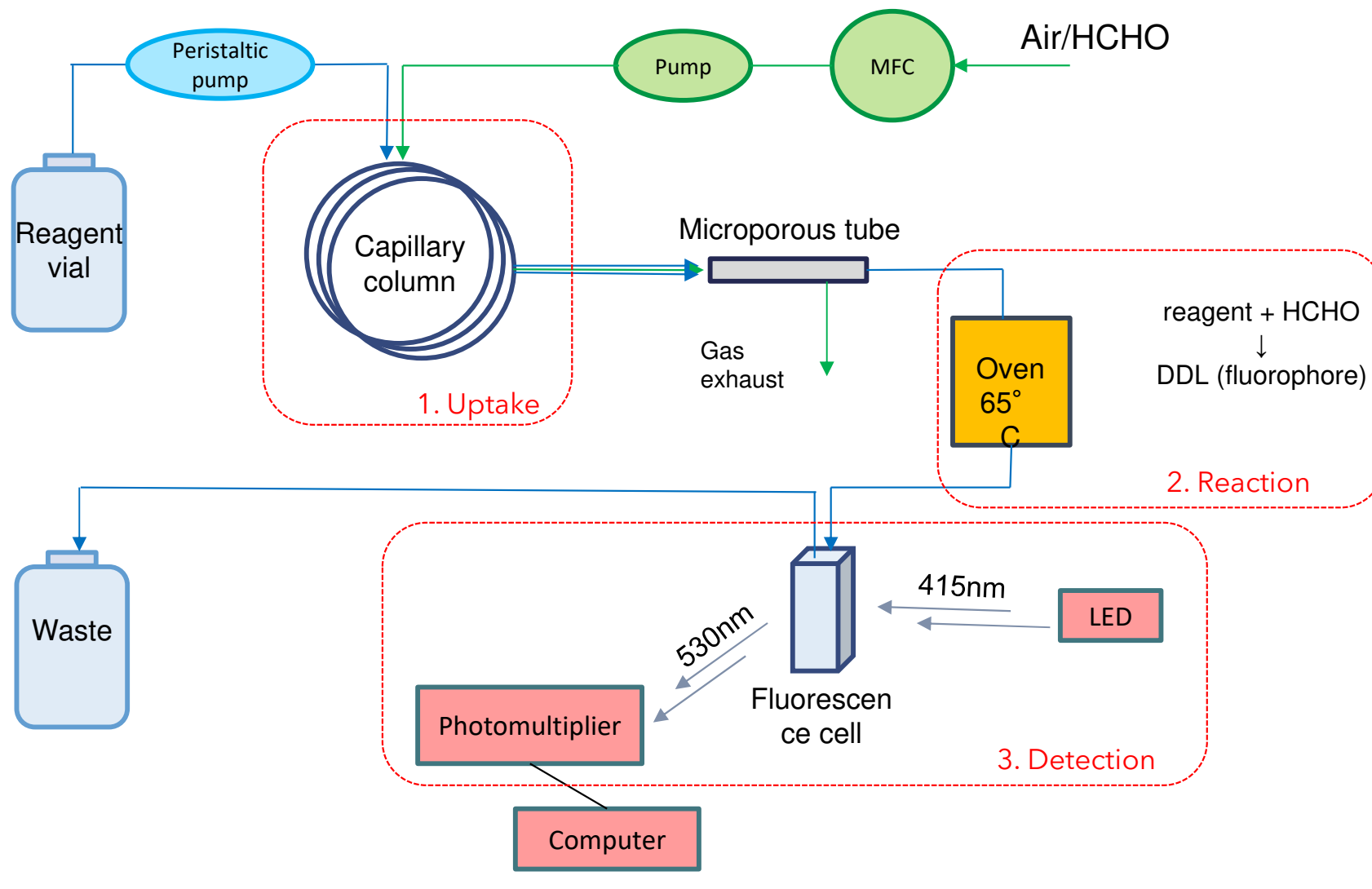
New portable micro Formaldehyde analyzer

Dimension	32 cm × 28 cm × 15 cm
Weight	6,5kg
Limit of detection	1 µg/m ³
Linearity range	0 – 400 µg/m ³
Trapping type	Microfluidic annular flow
Derivitization reagent	Fluoral-P (acetylacetone)
Detection type	Fluorescence

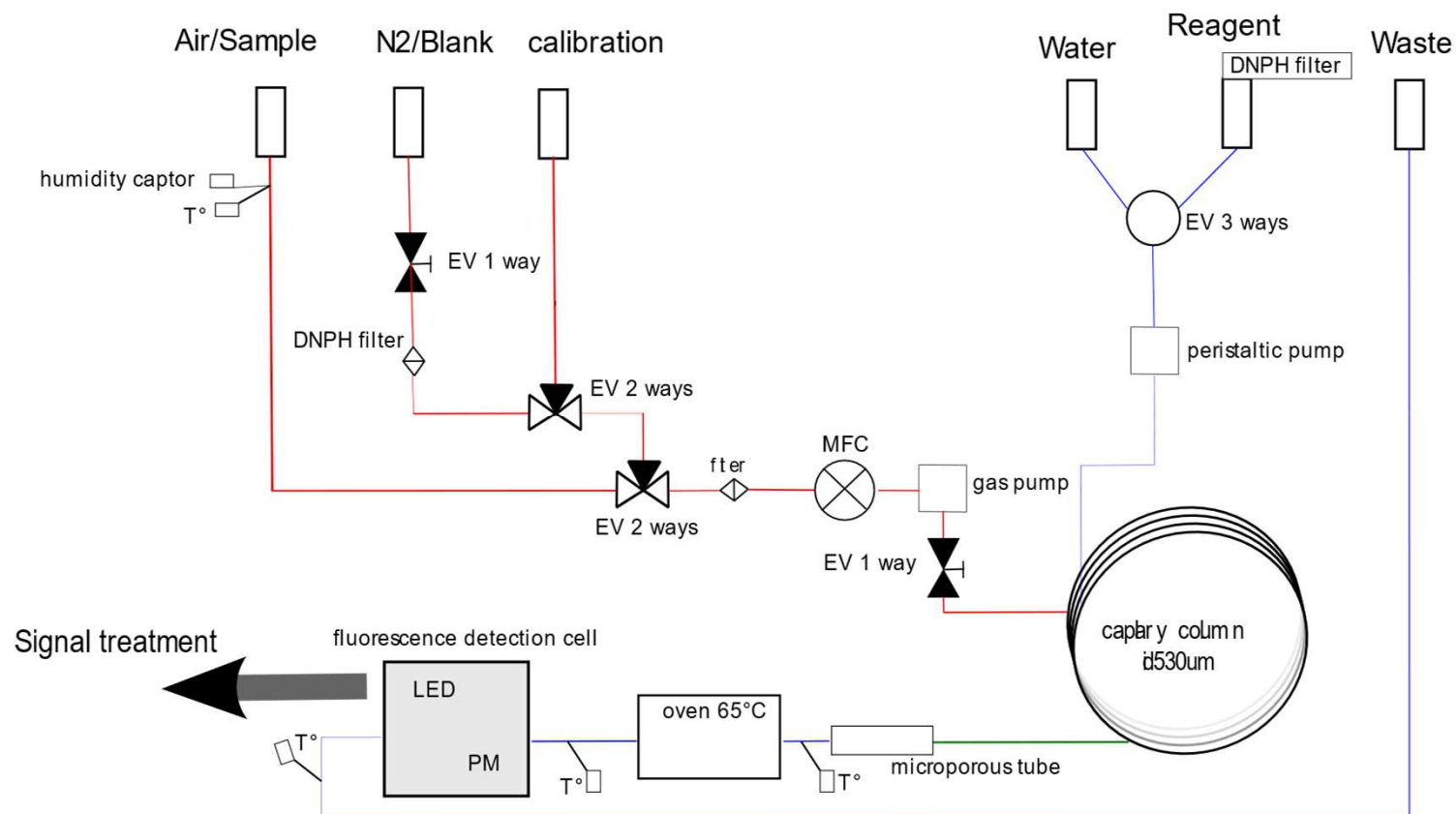


Developped in collaboration with CNRS French Research Center

Principle Scheme

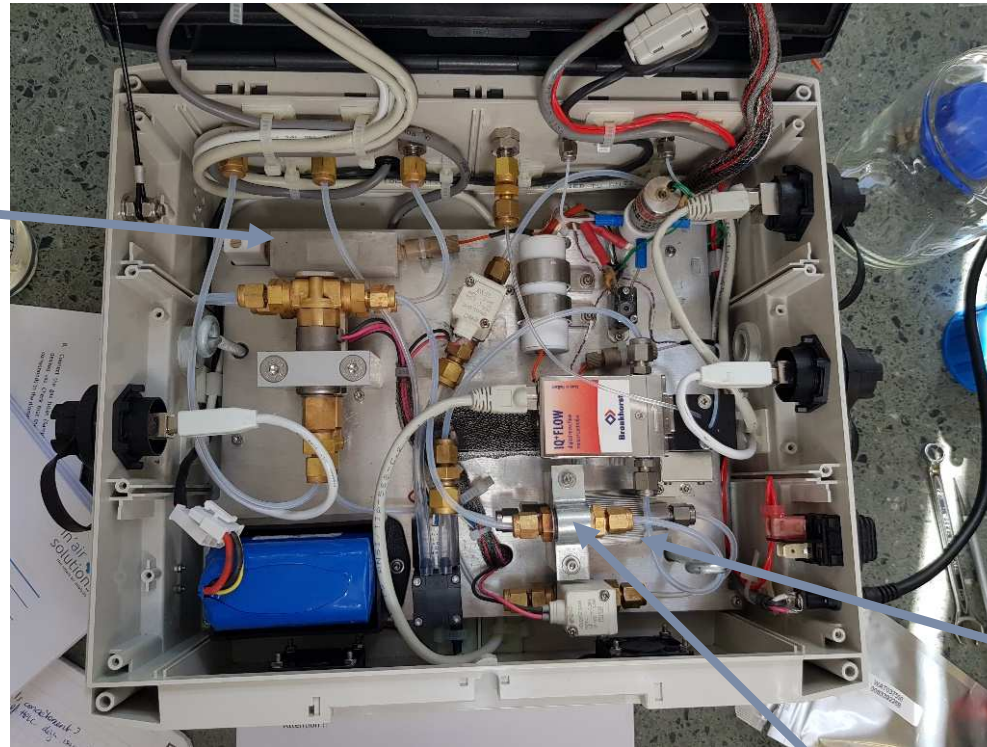


Full scheme



Internal view

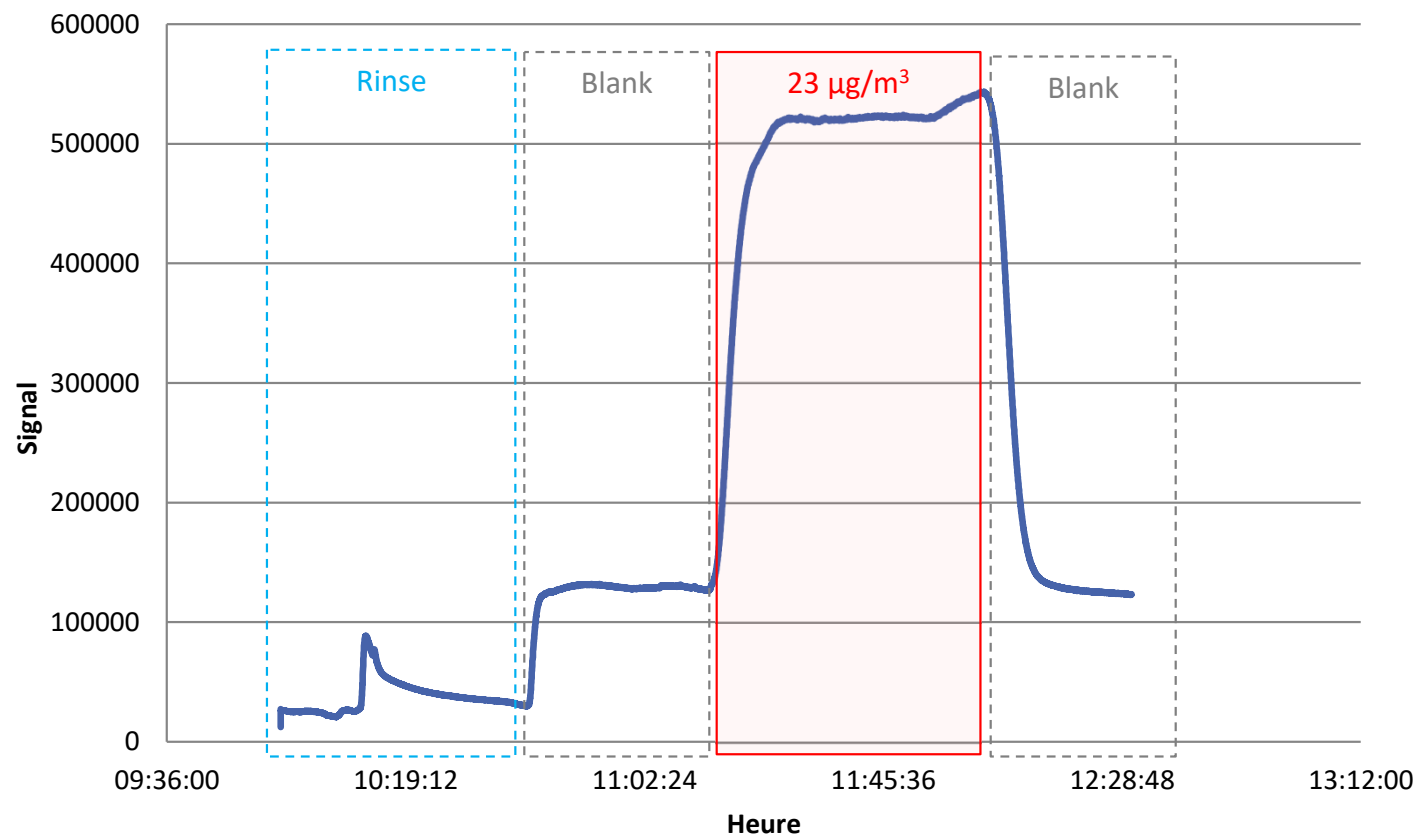
Microporous tube



DNPH cartridge

Particle filter

Principle Typical curve



Test parameters :

- **Liquid flow rate** : 17 µL/min
- **Gas flow rate** : 250 mL/min
- **Concentration** : 23 µg/m³
- **Tube length** : 10 cm

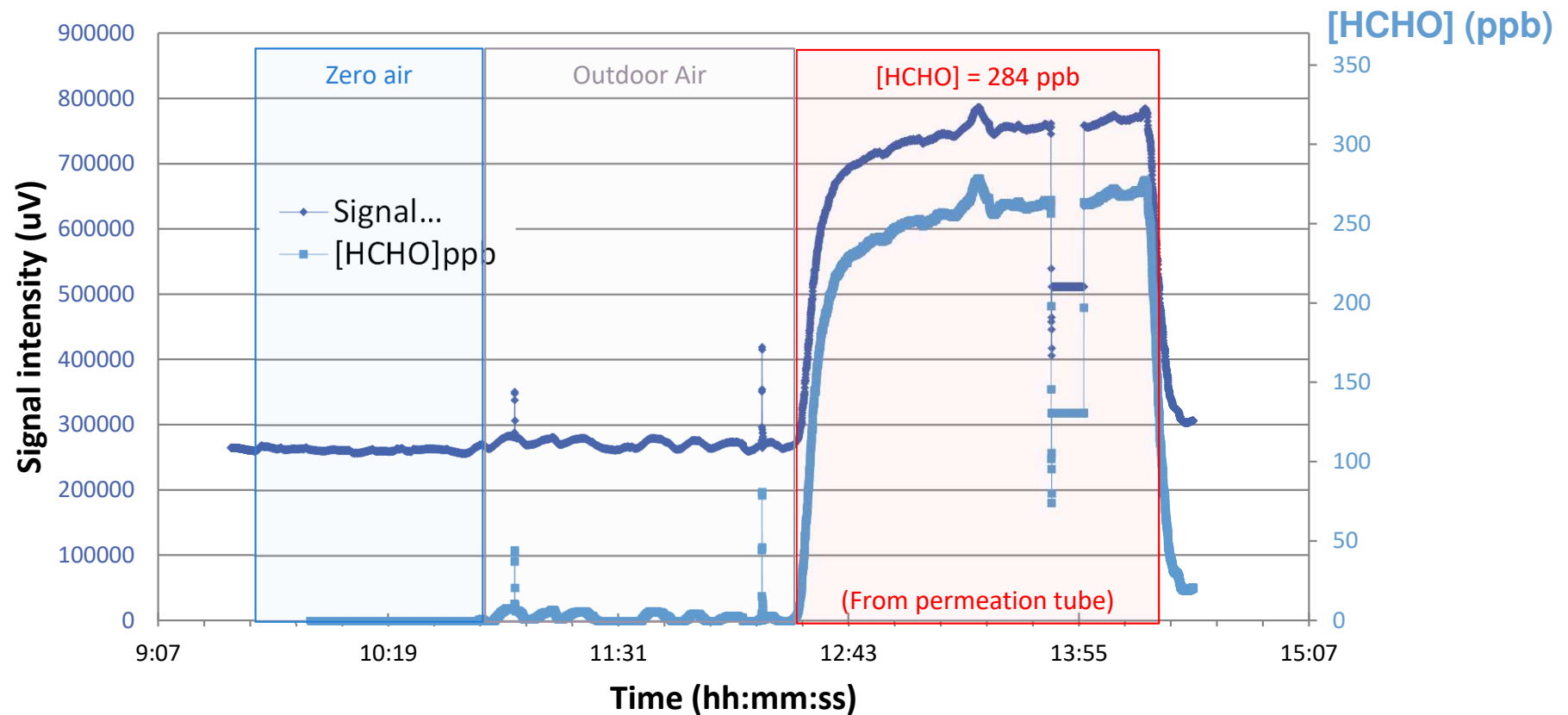
Anaïs Becker's work

The **intensity of the signal** is **proportional to the concentration** of formaldehyde

PrincipleTypical curve

- Intensity curve
- Concentration curve ($\mu\text{g}/\text{m}^3$ or ppb)

$\mu\text{F-1}$ sampling tests



- Strainer for particle filter (pore diameter 7 μm) : to change every month
- DNPH tubes and rings : to change every month
 - One for reagent bottle preservation
 - One inside the analyser to filter outdoor air to do blank measurementsStorage at 5° C, away from the light
- Microporous tube (10 cm) : to change every month
- Reagent : 100 mL for 80h with analysis caps
Storage at 5° C
- Distilled water : 100 mL for 80h
(Waste bottle to empty after each use)

Detection range : 0-400 ppb

Detection limit : 1 ppb (1.2 µg/m³)

Response time : 10 min

Time resolution : Few seconds to 120 s

Reagent consumption : 1.2mL per 60 minutes

Conditions :

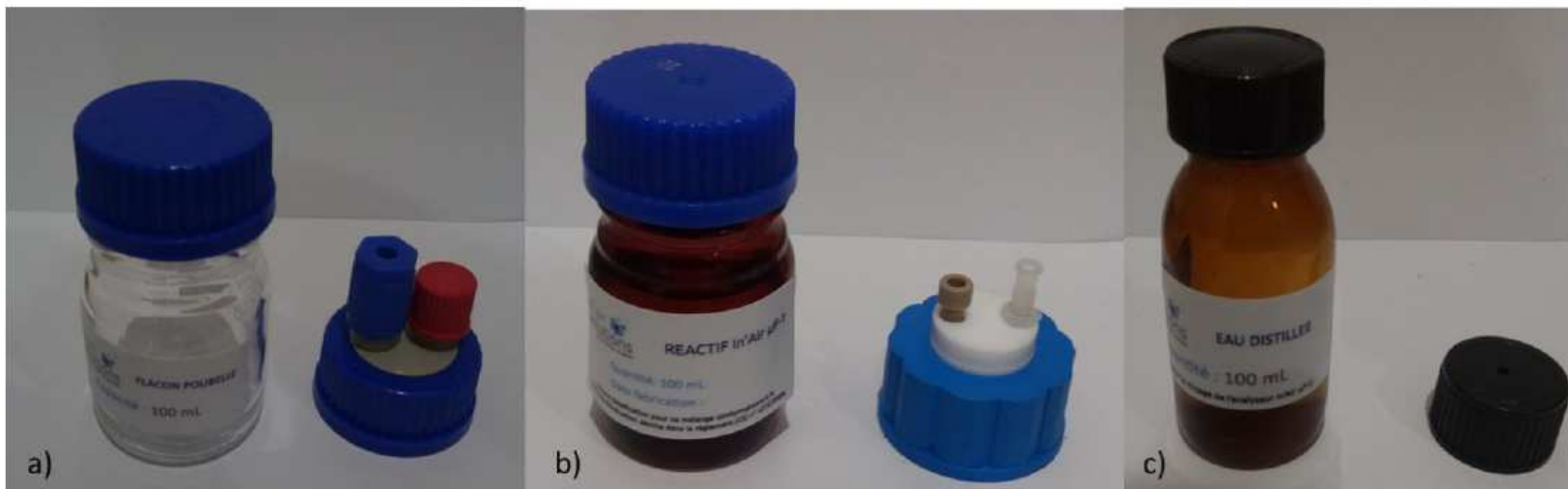
Gas T° : 5 - 40° C;

Gas Relative humidity : 20 - 80%

Atmospheric pressure

Altitude max : 2000m

Launching and using the device Set-up



Set-up



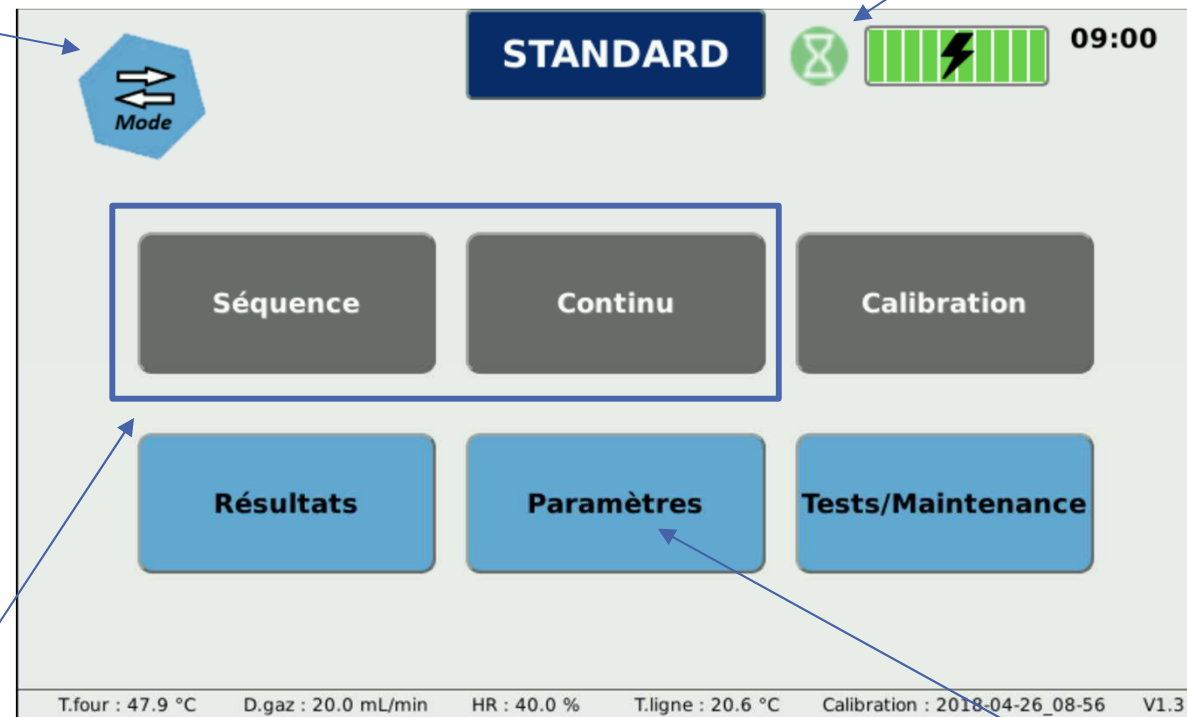
Analyser on a flat surface
Caps for liquid and gas connexion removed
Bottles with specific caps in place
Gas at atmospheric pressure
Then turn on the analyser

Analysis

User mode
and expert
mode

Stabilisation

Analysis



Sequence : Programmable sequence
Continuous : Manual change of modes

General parameters and
analysis parameters

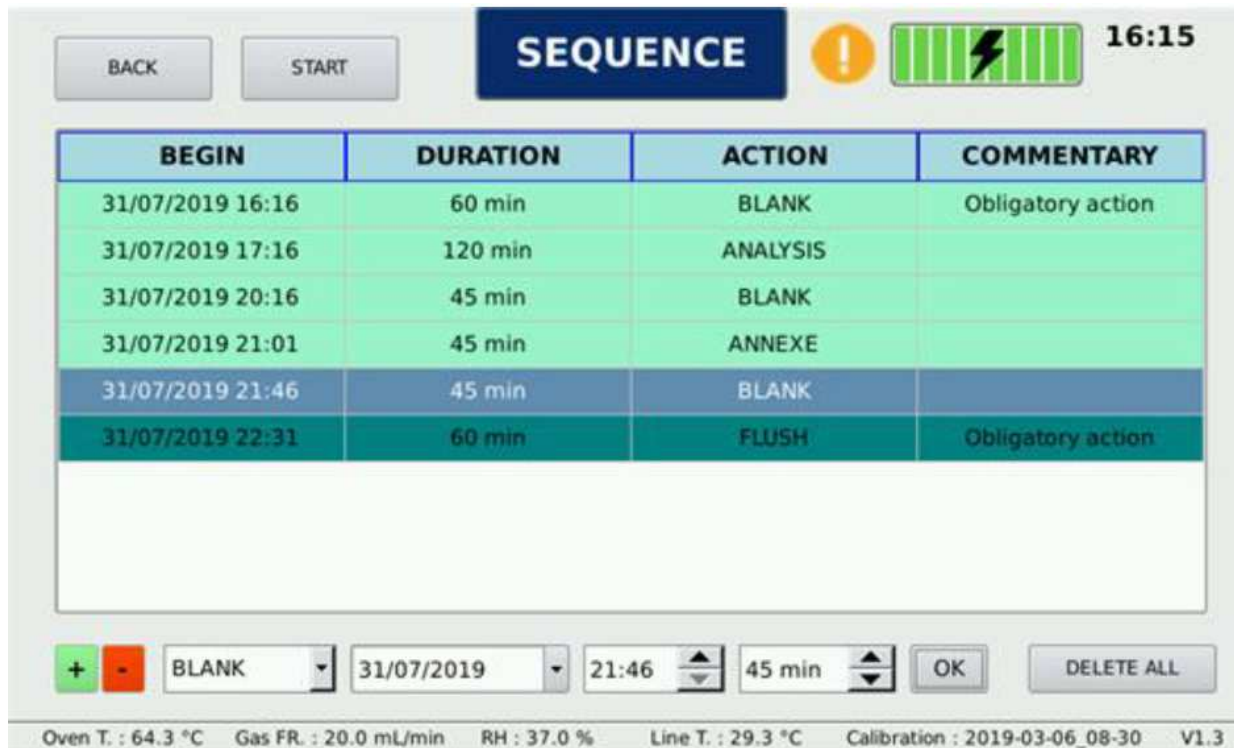
Before a run, check that the analyser is calibrated
(minimum every 3 months)

- Continuous measurement :

Manual blank, measure, rinsing steps 10min delay when switching from one mode to an other.



- Sequence programming



The screenshot shows a software interface for sequence programming. At the top, there are buttons for 'BACK' and 'START', a central 'SEQUENCE' title bar, a warning icon, a battery status indicator, and a clock showing '16:15'. Below this is a table with four columns: 'BEGIN', 'DURATION', 'ACTION', and 'COMMENTARY'. The table contains six rows of data, with the last row highlighted in dark blue. At the bottom of the interface, there is a form for adding a new sequence step, including fields for a plus/minus button, a dropdown menu (currently set to 'BLANK'), a date field (31/07/2019), a time field (21:46), a duration field (45 min), and 'OK' and 'DELETE ALL' buttons. A status bar at the very bottom displays various system parameters: Oven T. : 64.3 °C, Gas FR. : 20.0 mL/min, RH : 37.0 %, Line T. : 29.3 °C, Calibration : 2019-03-06_08-30, and V1.3.

BEGIN	DURATION	ACTION	COMMENTARY
31/07/2019 16:16	60 min	BLANK	Obligatory action
31/07/2019 17:16	120 min	ANALYSIS	
31/07/2019 20:16	45 min	BLANK	
31/07/2019 21:01	45 min	ANNEXE	
31/07/2019 21:46	45 min	BLANK	
31/07/2019 22:31	60 min	FLUSH	Obligatory action

+ - BLANK 31/07/2019 21:46 45 min OK DELETE ALL

Oven T. : 64.3 °C Gas FR. : 20.0 mL/min RH : 37.0 % Line T. : 29.3 °C Calibration : 2019-03-06_08-30 V1.3

Results



Typical blank baseline : 100,000-150,000 µV
Signal saturation : 2,000,000

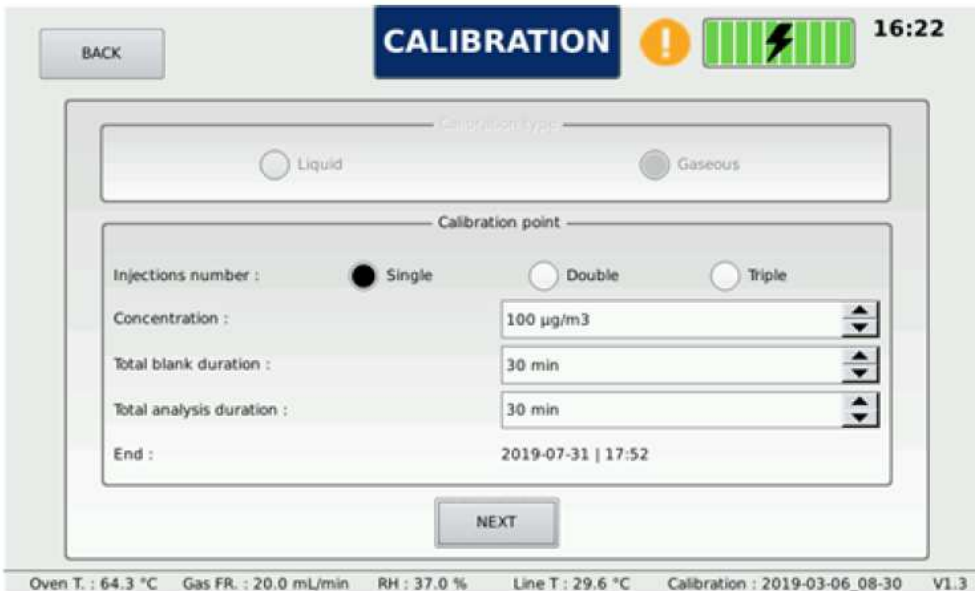
Results



- Direct visualisation
- Exportation as excel file (via USB key)

Calibration

1. Connect calibration HCHO to calibration port
2. Program and launch
3. Check before saving



BACK CALIBRATION ! 16:22

Calibration type: ☐ Liquid ☐ Gaseous

Calibration point:

Injection number: ☒ Single ☐ Double ☐ Triple

Concentration: 100 µg/m³

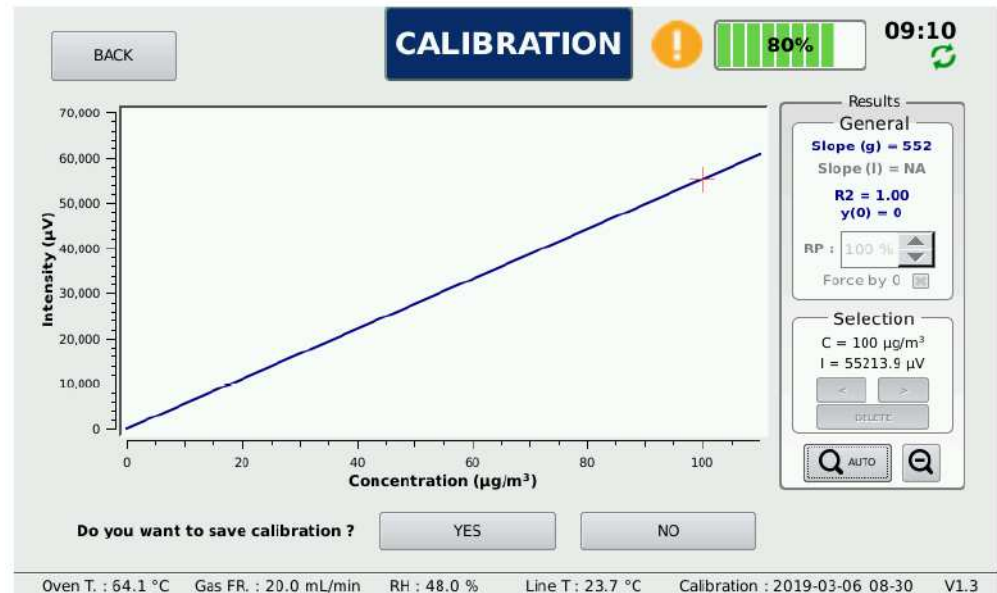
Total blank duration: 30 min

Total analysis duration: 30 min

End: 2019-07-31 | 17:52

NEXT

Oven T.: 64.3 °C Gas FR.: 20.0 mL/min RH: 37.0 % Line T.: 29.6 °C Calibration: 2019-03-06_08-30 V1.3



For liquid calibration, connect calibration solution to water port.

The steps are the same as for the gaseous calibration, only the end of calibration screen is different : uptake yield can be changed (gaseous slope vs liquid slope)

Tests/Maintenance

BACK

TESTS/MAINTENANCE





16:04

Tests

Maintenance

Pumps

Liquid : 60 %  

Probes Temp. (°C) : 41.5 / 42.6 / 40.0

Gas : 1000 Hz 55 %  

Oven

Setpoint : 65 °C  

Measure (°C) : 64.5

Detection

PM : Sig. Visu. PM 

DEL : 167 mA 

Electrovalves

EVg3 N°1 : 227 mA 

EVg3 N°2 : ? mA 

Non return EV (gas) : 222 mA 

Non return EV (liquid) : 218 mA 

EV Reagent/Water : 191 mA 

MFC

Setpoint : 20 mL/min  

Measure (mL/min) : 20.0

Ventilators

Ventilator 1 :  Ventilator 2 : 

Oven T. : 64.5 °C Gas FR. : 20.0 mL/min HR : 41.0 % Line T. : 28.5 °C Calibration : 2019-03-06_08-30 V1.3

Tests/Maintenance



The screenshot shows a control interface for a gas and liquid analyzer. At the top, there is a 'BACK' button, a 'TESTS/MAINTENANCE' title bar, a warning icon, a battery status indicator, and the time '16:04'. Below the title bar, there are two tabs: 'Tests' and 'Maintenance'. The 'Tests' tab is active, showing two main sections: 'Expendables' and 'Defaults'. The 'Expendables' section lists various consumables with their remaining time and a 'CLEAR' button for each. The 'Defaults' section lists various system parameters with their current status. At the bottom, there is a status bar showing various operational parameters.

Expendables	
Reagent : 15 h 2 min	CLEAR
DNPH Reagent : 10 d 23 h 42 min	CLEAR
Water : 5 h 6 min	CLEAR
μPorous Tube : 18 h 58 min	CLEAR
DNPH Blank : 8 d 5 h 40 min	CLEAR
PAF : 10 d 23 h 42 min	CLEAR

Defaults	
Level 1 : CALIB	RH/T REAGENT WATER PAF DNPH Blank DNPH Reagent μPOROUS
Level 2 : OVEN	MFC EV PM DEL PMP GAS PMP LIQ

Status Bar: Oven T. : 64.5 °C Gas FR. : 20.0 mL/min HR : 41.0 % Line T. : 28.5 °C Calibration : 2019-03-06_08-30 V1.3

Level 1 issue :
Device continues to operate

Level 2 issue :
The analyser stops immediately : problem has to be solved and the system has to be restarted

Keep track of the duration of use of each consumable and reset when changed

- MERMAID project

« Near Real-Time Monitoring of Formaldehyde in a Low-Energy School Building ». *Atmosphere* 10, n° 12 (décembre 2019): 763.

<https://doi.org/10.3390/atmos10120763>.

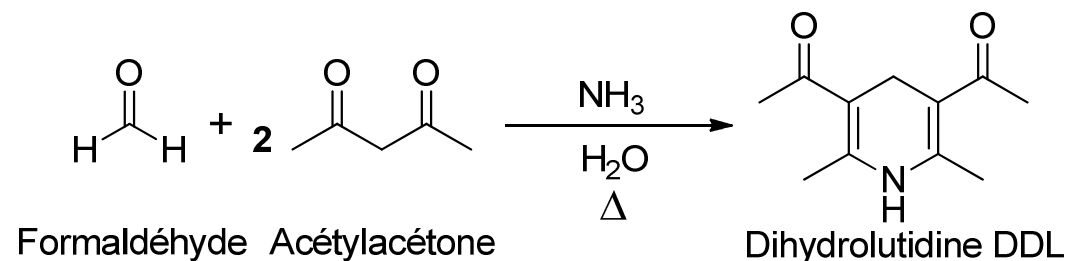
- IMPACT'AIR

**Miniaturized analyzer based on microfluidic technology
dedicated to quantification of indoor air pollution**

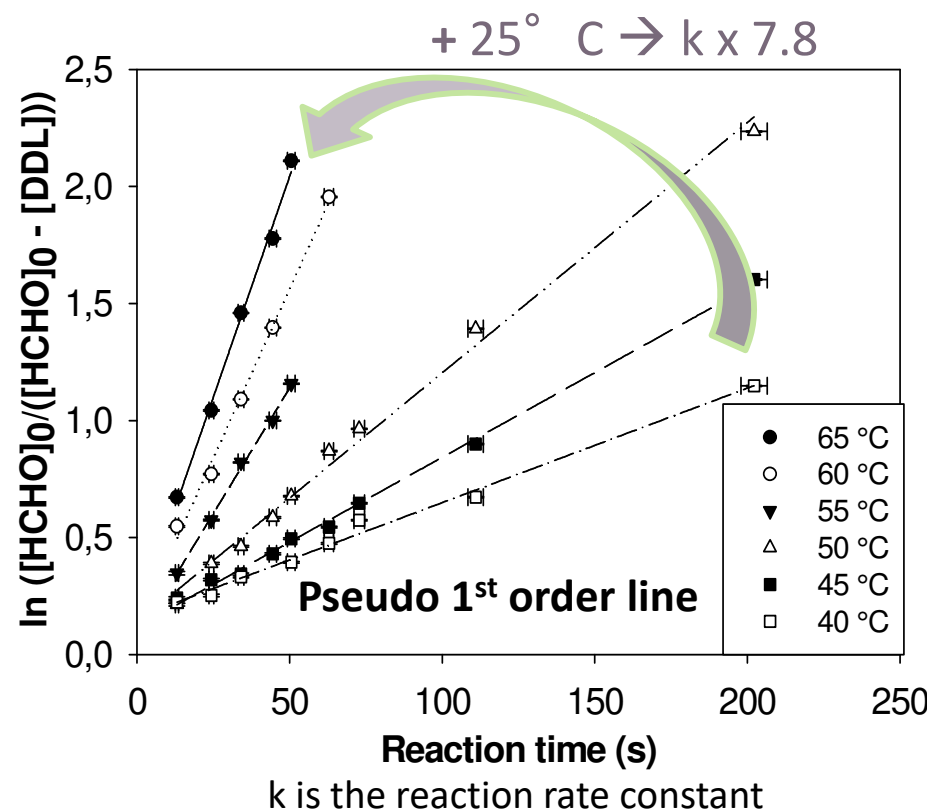
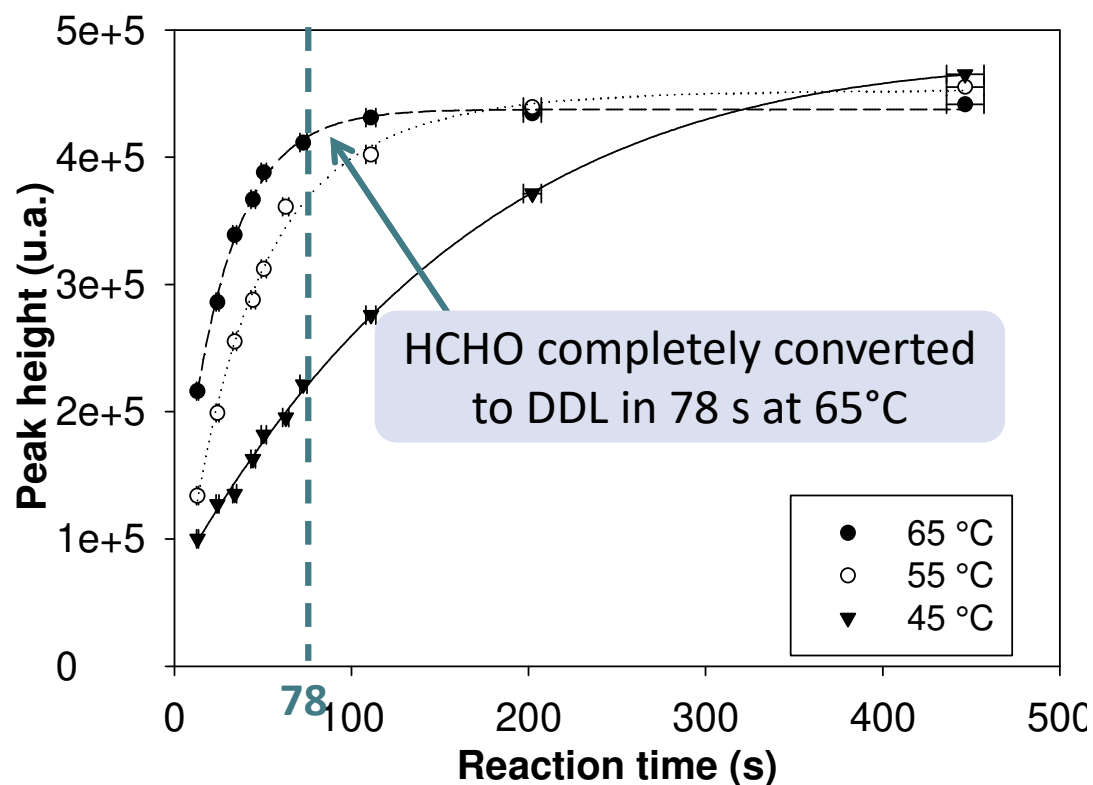
Strasbourg University – 5/6 june 2019

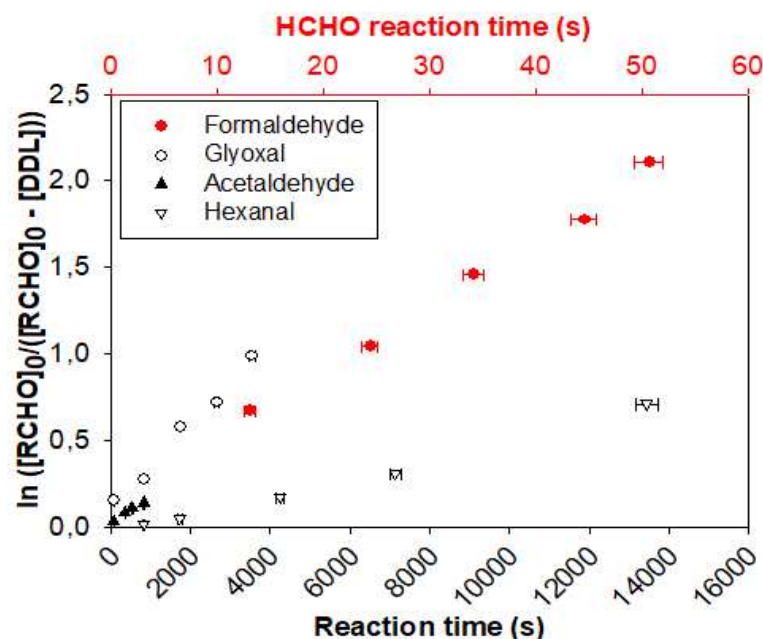
Reaction and kinetic study

Hantzsch mechanism



Kinetic study (Pseudo 1st order reactions)



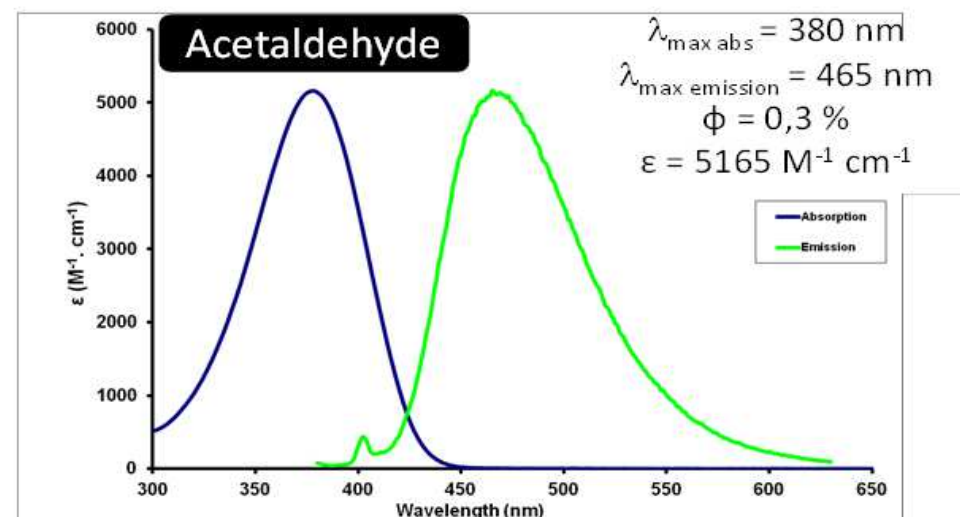


Aldehyde	$10^3 \times k (\pm \Delta k)$ ($L^2 \text{ mol}^{-2} \text{ s}^{-1}$) at 65°C
Formaldehyde	94000 ± 5000
Glyoxal	31.3 ± 1.6
Acetaldehyde	15.6 ± 0.8
Hexanal	8.7 ± 0.4

$k_{\text{HCHO}} \gg k_{\text{others aldehydes}}$

Formaldehyde

$\phi = 1,5 \%$
 $\epsilon = 6600 \text{ M}^{-1} \text{ cm}^{-1}$



Acetaldehyde, Hexanal, Glyoxal

- Low water solubility
- Low fluorescence quantum efficiency
- Low rate reaction constant

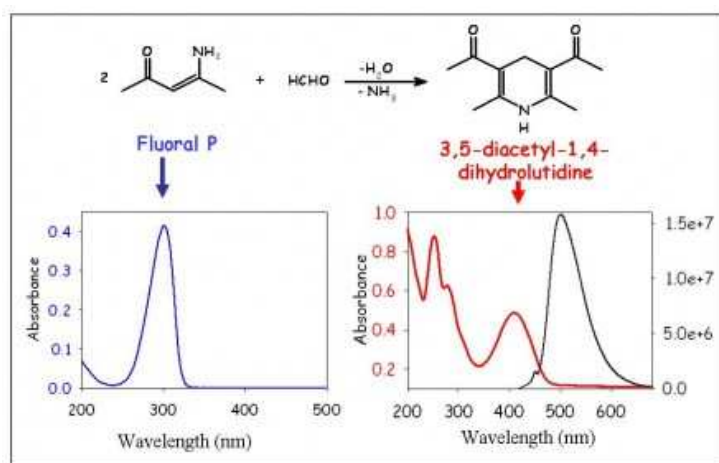
No possible interference between these aldehydes and acetylacetone reagent

Acetaldehyde, Hexanal, Glyoxal

- Low water solubility
- Low fluorescence quantum efficiency
- Low rate reaction constant

**No possible interference between
these aldehydes and acetylacetone
reagent**

Absorption and fluorescence emission spectra of DDL



http://www-lfp.cea.fr/ast_visu.php?num=450&lang=ang

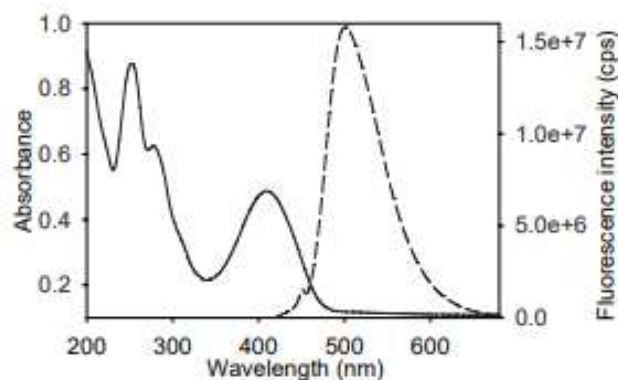


Fig. 4. Absorption and fluorescence spectra of 3,5-diacetyl-1,4-dihydrolutidine in the porous matrix.

Sensors & Transducers
Journal, Vol.82, Issue 8,
August 2007, pp. 1423-1430

Flow rates optimisation to obtain an annular flow

- Guglielmino, Maud, Pierre Bernhardt, Claire Trocquet, Christophe A. Serra, et Stéphane Le Calvé.
« On-Line Gaseous Formaldehyde Detection by a Microfluidic Analytical Method Based on Simultaneous Uptake and Derivatization in a Temperature Controlled Annular Flow ». *Talanta* 172 (1 septembre 2017): 102-8.
<https://doi.org/10.1016/j.talanta.2017.05.038>

Best Features

- Continuous and near real-time measurements
vs Standard method (ISO: NF ISO 16000-3) : Successive sampling on DNPH cartridge and HPLC analysis – Time consuming and bulky equipment
- Temporal resolution of a few seconds
- High formaldehyde selectivity
Fluorescence detection excitation and emission wavelength specific to DDL
- No known interference
- LOD 1 ppb
- Portable
- Gaseous or liquid calibration possible

Technology comparison

Specification	Reference method DNPH	aerolaser	Chromatotec airmoHCHO	Chromatotec microF
Detection principle	Derivitization method with DNPH Spectrometer	Thermal desorption and fluorimetric detection (Hantzsch reaction)	GC with FID and methanizer	Derivitization method with DNPH Fluorescence Detector
LDL	Around 10ppb	Around 0,1ppb	Less than 1 ppb in automatic	About 1ppb
Linearity		Linear from 0,1 to 3000ppb with $R^2 > 0,999$	Linear on peak area $R^2 > 0.995$ for each compound at ppb or ppm	Linear on 0 – 400 $\mu\text{g}/\text{m}^3$ range
Long term stability			RSD on 48 hours $< 2\%$ at 2 ppm for all compounds	N/A
Interferences	Other aldehydes	Other aldehydes	Not sensitive to humidity and hydrocarbons.	Specific to Formaldehyde
Compounds measured	Formaldehyde	Formaldehyde	Formaldehyde Methanol Acetaldheyde	Formaldehyde

Feedback from scientific researchers confirm that other solutions are not able to continuously monitor formaldehyde at low ppb (0-30ppb) range accurately

- Service study, control laboratory for campaign and **HSE departments**
- Indoor air (paintings, coatings) & Clean rooms
- Ambient air monitoring in urban and rural areas
- Industrial fence line monitoring
- Chemical, pharmaceutical, funeral industries
- Paper plants

User profiles



Online Gas and Liquid Analyzer Experts

- Service companies (ex: Bureau Veritas)
- Governmental agencies (EPA, INERIS)
- Meteorological institutes
- Universities and Research centers
- Industrial consortia
- Petrochemical groups

Some reference customer

- La Rochelle University
 - Research studies
- CSTB (Construction Scientific and technical center)
 - Indoor air control

Diapositive 37

cc21

chromatotec chromatotec; 22/06/2021

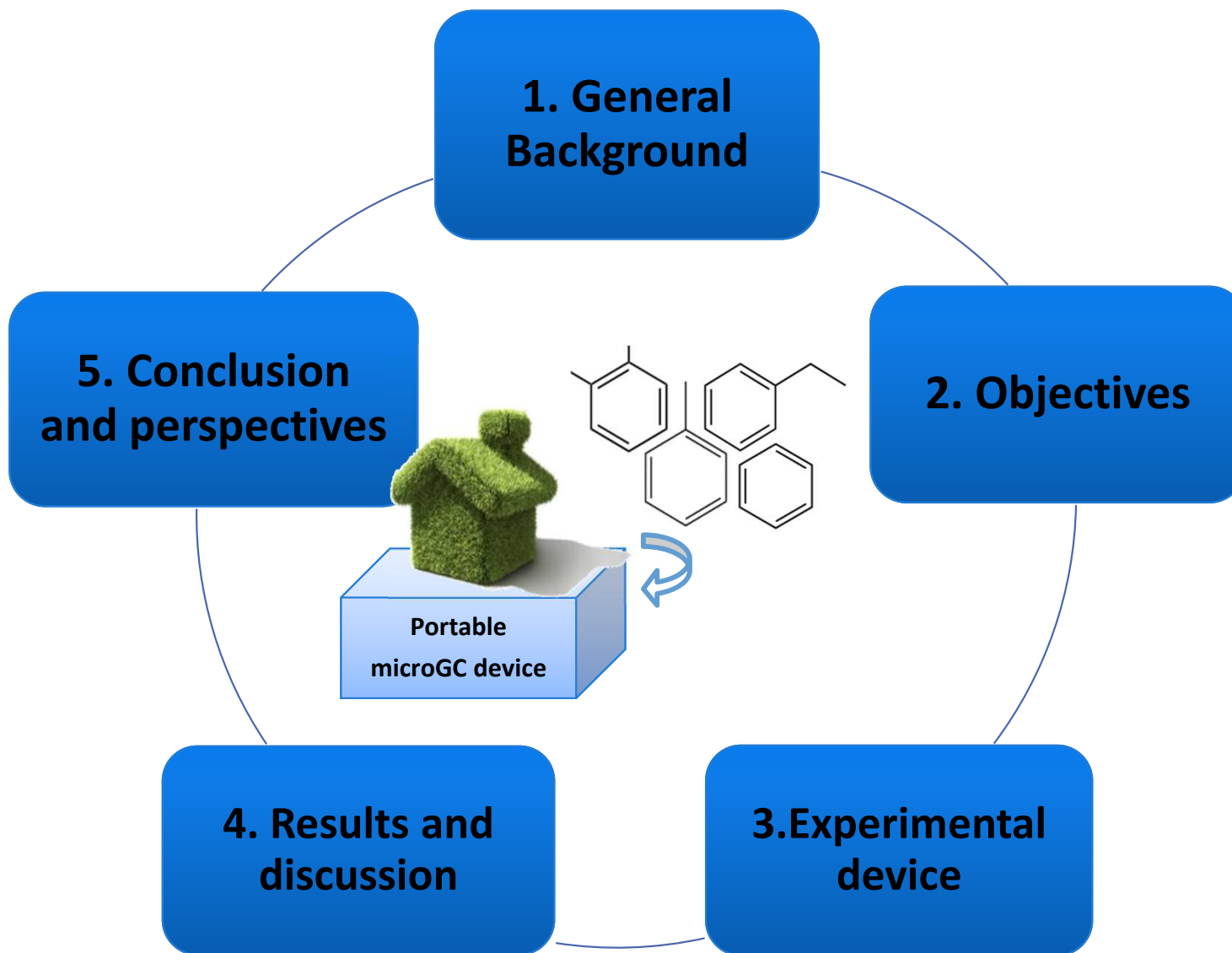


MicroGC & microBTEx

Portable Gas Chromatograph Analyzer

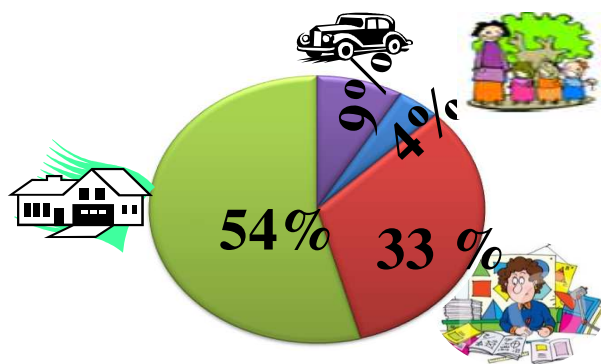


Developped in collaboration with CNRS French Research Center



General background

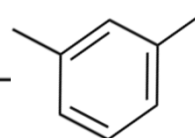
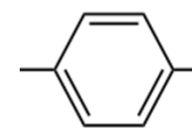
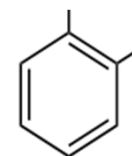
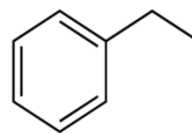
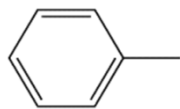
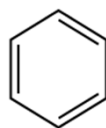
Time spent in enclosed environment can reach **90%**



Indoor air quality (IAQ) is responsible of more than 4 millions of premature deaths per year*

Indoor Air is contaminated by a wide variety of Volatile organic compounds (VOCs)

BTEX: Benzene, Toluene, Ethyl Benzene and Xylenes



* World Health Organization

BTEX emission sources in indoor air

General background

BTEX effects on health and regulations

Compound	Effect*
Benzene	Human carcinogenic class A (leukaemia)
Toluene	Harmful to Nervous central system
Ethylbenzene	Pneumonitis
Xylenes	Liver and kidney disorder



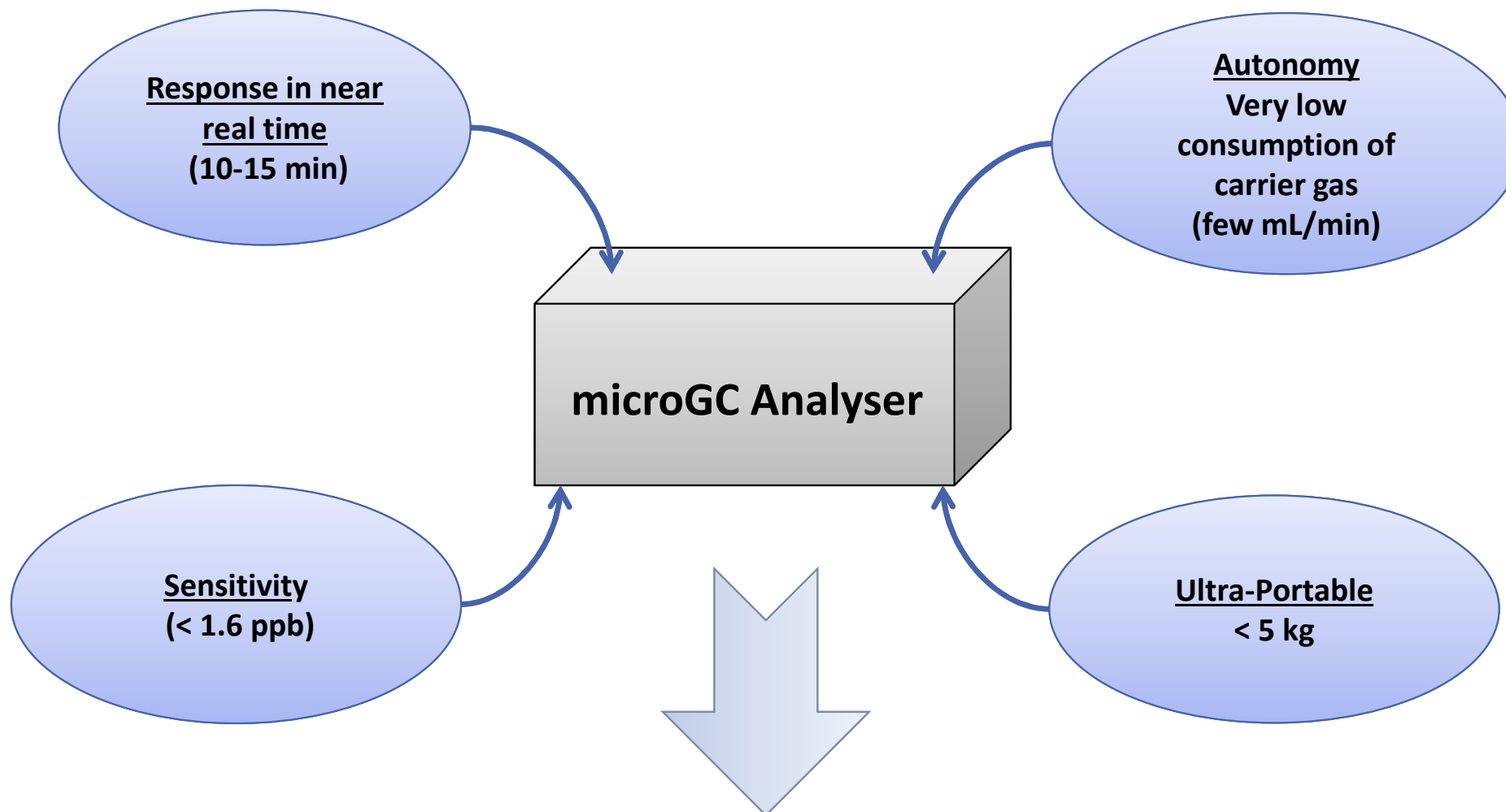
European Union has fixed a threshold value of **1.6 ppb** (**5 $\mu\text{g}/\text{m}^3$**) in public building since 2013**

In France this threshold value decreased to **0.6 ppb** (**2 $\mu\text{g}/\text{m}^3$**) in 2016

This new regulation makes necessary the development of **portable and sensitive instruments** for BTEX and VOCs monitoring in public buildings

* World Health Organisation ** Decret n° 2011-1728 of December 2011 for Indoor air monitoring-French government

Objectives



BTEX & VOCs monitoring in public indoor air starting 2018

Experimental device:

Prototype evaluation

Laboratory prototype 1



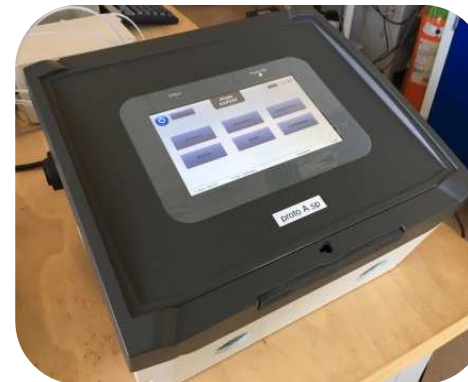
Laboratory prototype 2



Commercial instrument



Industrial prototype
(5 kg including battery)

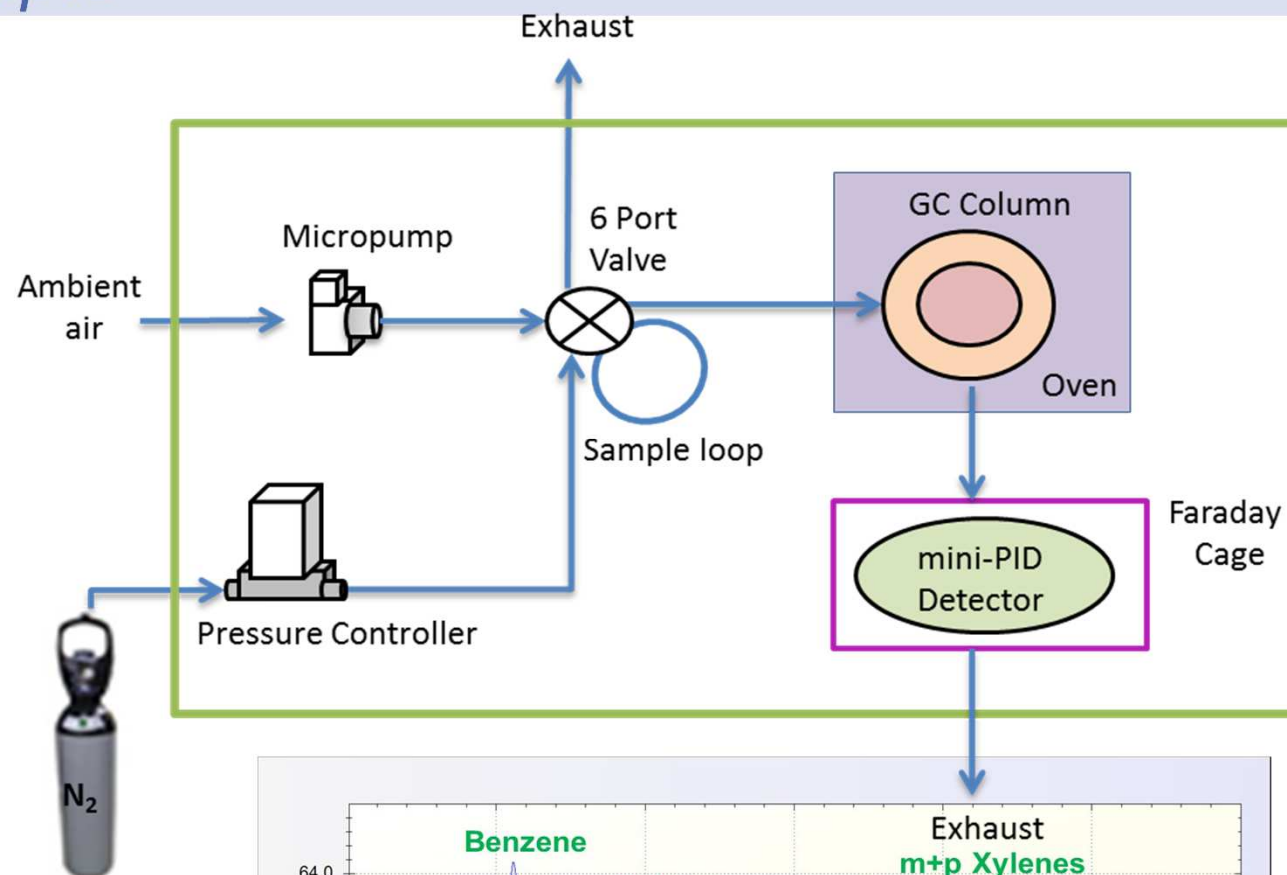


Experimental device:

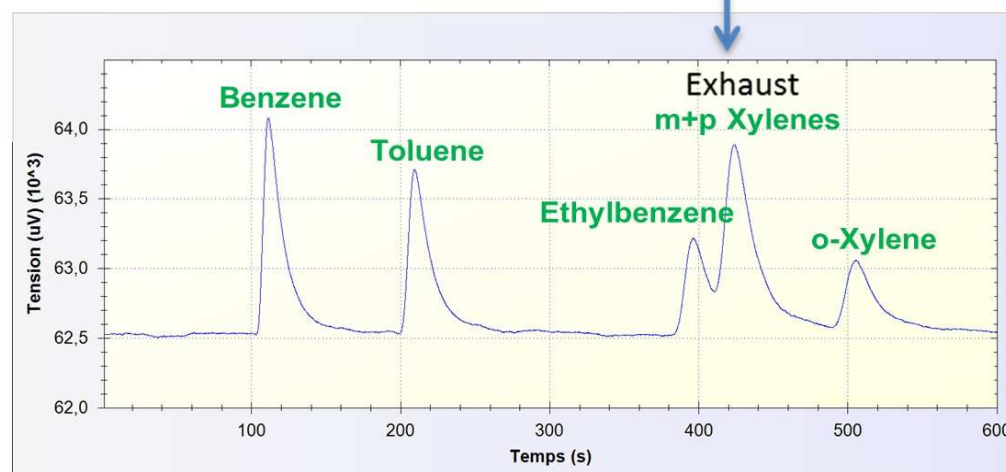
Operating principle

Three steps analysis:

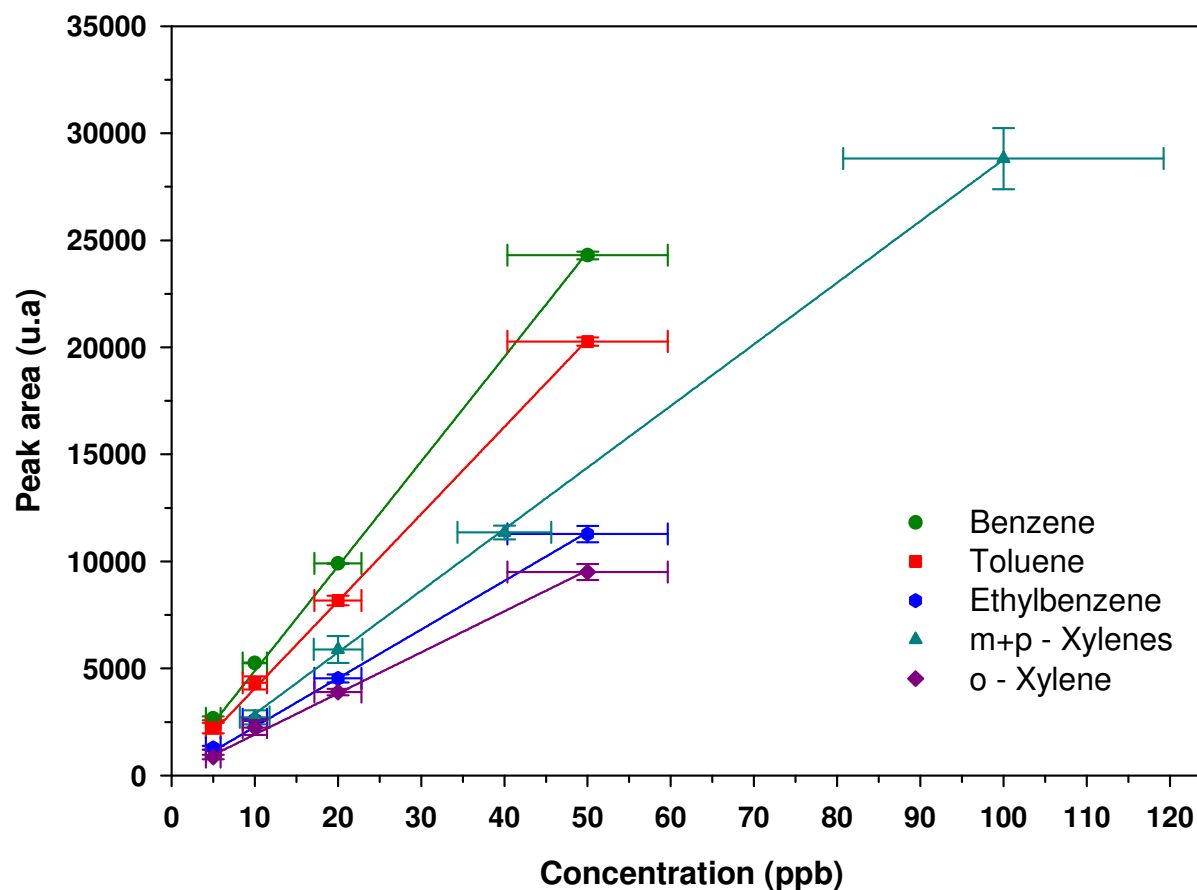
1. Air Sampling
2. Separation
3. Detection



Temperature: 65° C
Carrier gas flow: N₂ at 2.5 mL/min
Time of analysis: 10 min



Results and discussion: *Linear range and detection limits*



Compound	LOD (ppb) (S/N=3)
Benzene	1
Toluene	1.6
Ethylbenzene	3.5
m+p - Xylenes	6.7
o-Xylene	6.6

Results and discussion:

Field campaign MERMAID

- Carried out in a junior high school recently built respecting the thermal regulation of 2005 and equipped with a **modern ventilation**.
- **BTEX concentrations** were continuously **measured** using our new micro-device and a commercial analyzer for **two weeks**, both operating with a **time resolution of 10 minutes**.



classroom



Results and discussion:

Field campaign MERMAID

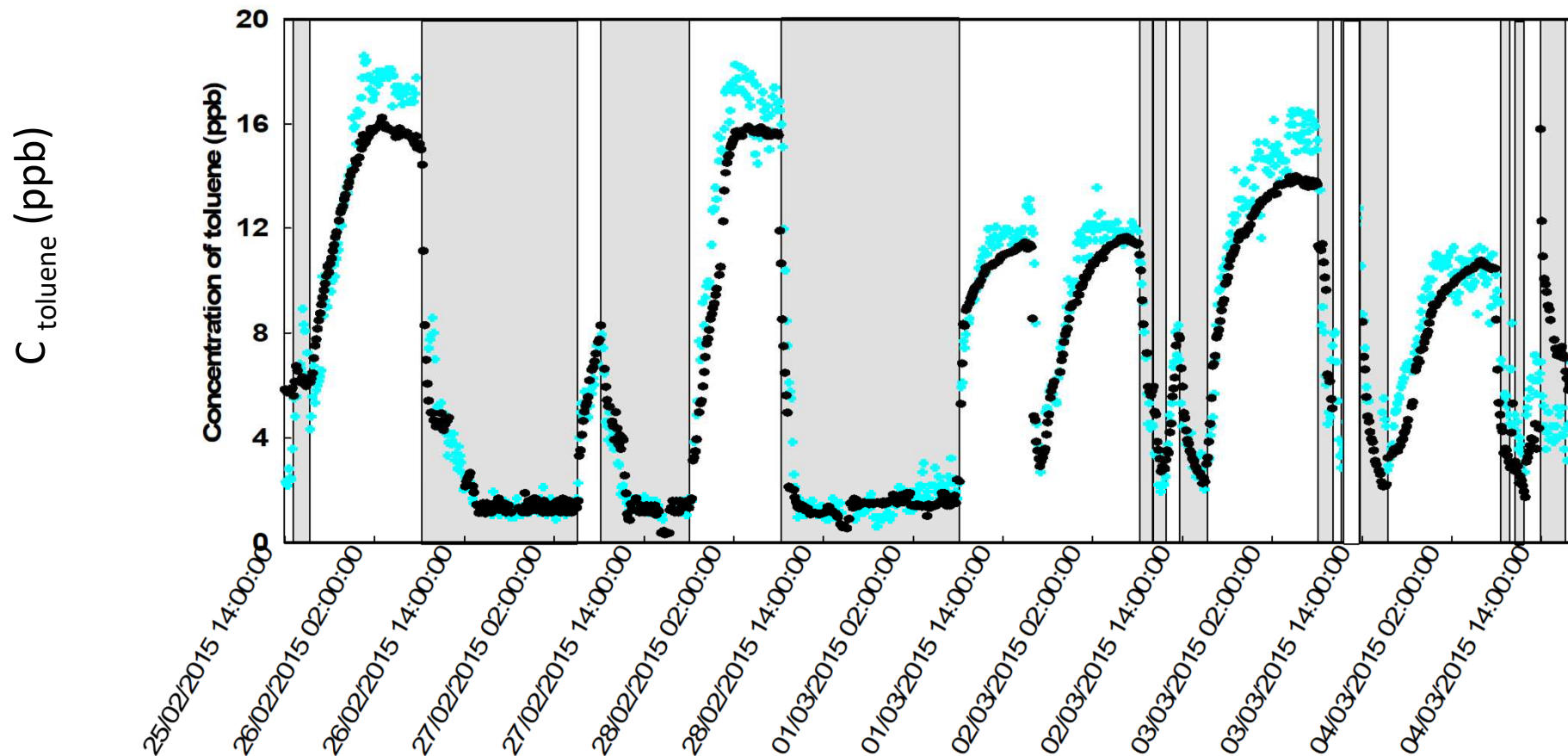


Toluene: major VOC in this classroom
(floor emissions)

■ Ventillation ON

CHROMATOTEC microBTX

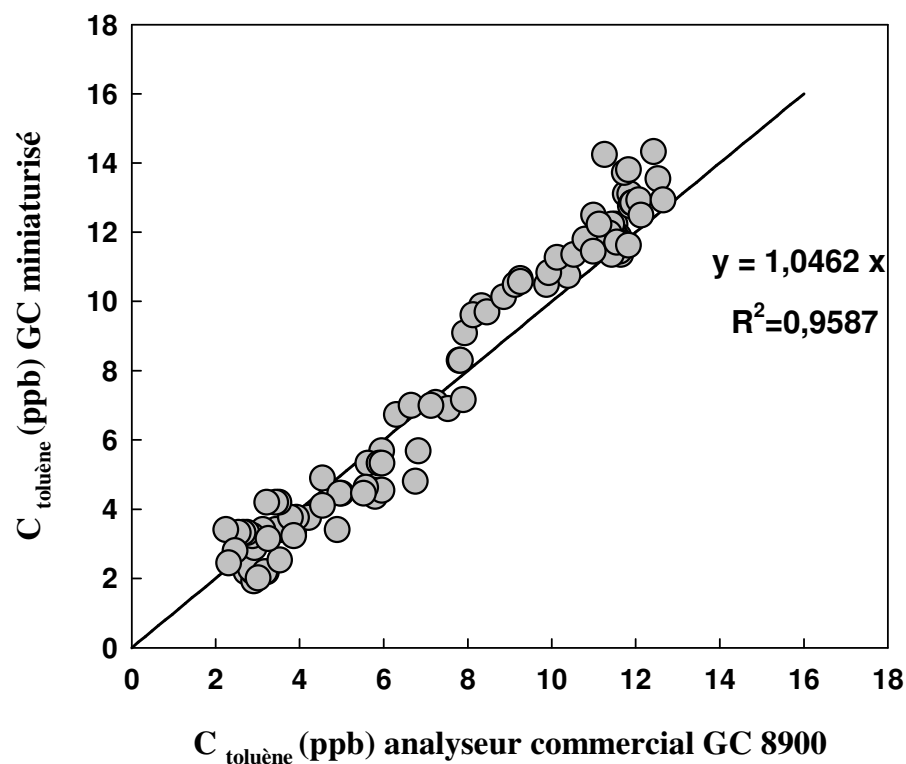
BASELINE MOCON GCPID 8900



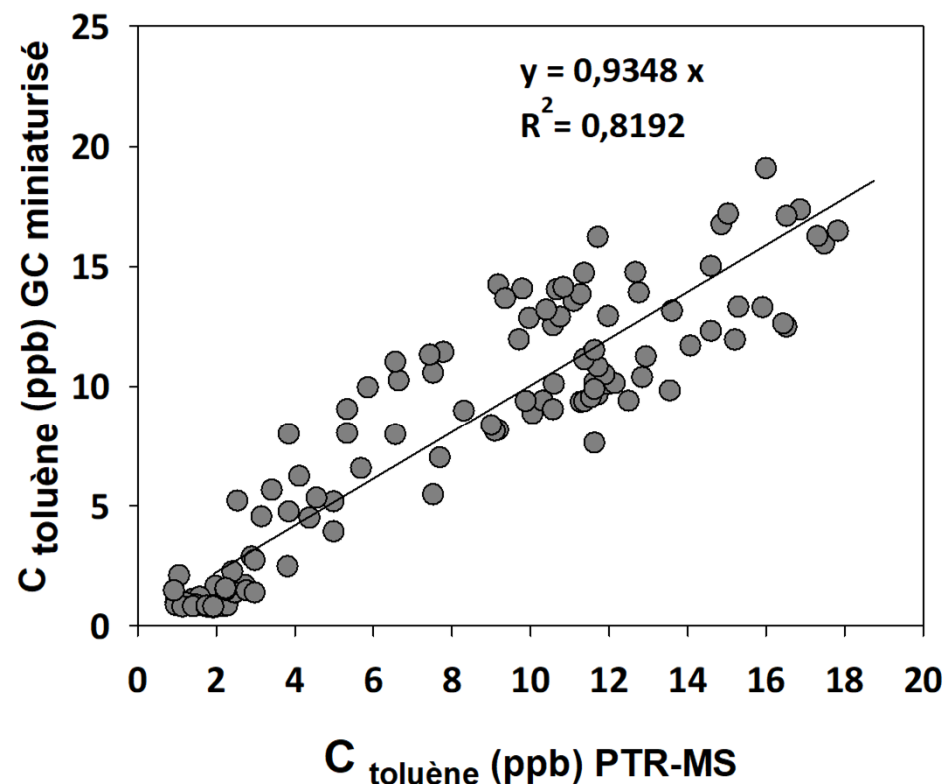
Results and discussion:

Field campaign MERMAID

Inter-comparaison with other on-line techniques



Deviation: 4.5%



Deviation: 6.5 %

Results and discussion:

Field campaign IMPACT'AIR

IMPACT'AIR project aims at improving the **indoor air quality in schools**

This project was carried out in two primary schools of La Rochelle (France) for 5 weeks

Main objectives:

- **Monitoring** of regulated **pollutants** (formaldehyde, benzene and CO₂)
- Identification of pollutants **emission sources**



Results and discussion:

Field campaign IMPACT'AIR



Online Gas and Liquid Analyzer Experts

	School	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	m+p Xylenes (ppb)	o-Xylene (ppb)
Empty Class Week 1	Lavoisier	--	--	--	--	--
	Grandes Varennes	--	--	--	--	--
Furnished Class Week 2	Lavoisier	--	--	--	--	--
	Grandes Varennes	--	--	--	--	--
Normal school activity Weeks 3, 4 and 5	Lavoisier	--	0 – 3.5	0 – 4.4	0 – 10.4	0 – 6.6
	Grandes Varennes	0 – 12.1	0 – 29.5	--	0 – 10.9	0 – 10.5

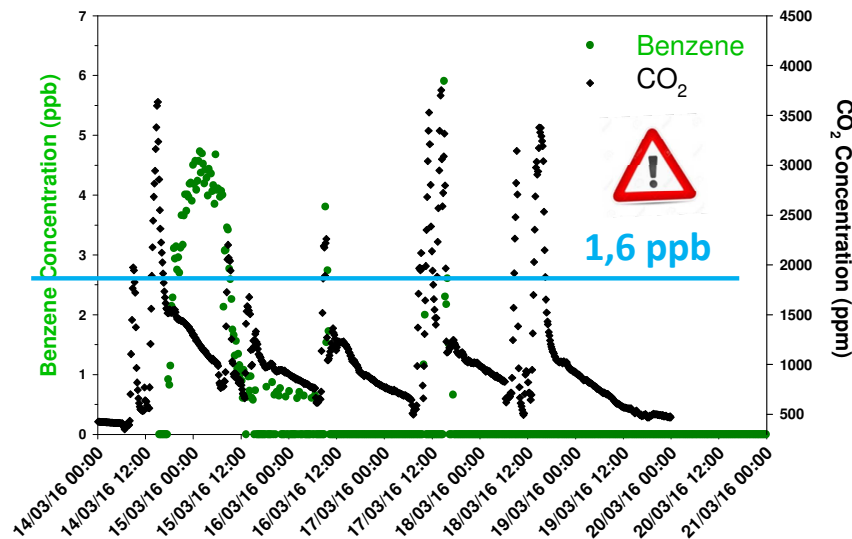
- ➡ Buildings materials and furniture did not emit any BTEX
- ➡ All BTEX were detected in the three weeks of normal activity in the classroom
- ➡ The major pollutant found in both classrooms was toluene

Results and discussion:

Field campaign MERMAID

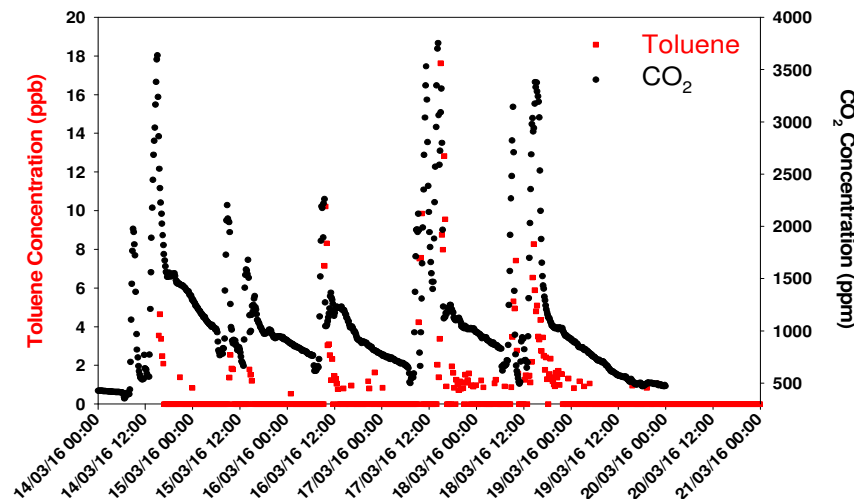
Les Grandes Varennes – 5th week

Benzene



➔ Concentrations of **benzene** and **CO₂** (confinement indicator) are not **correlated**

➔ **Benzene** comes from **outside** (e.g. traffic, industries)

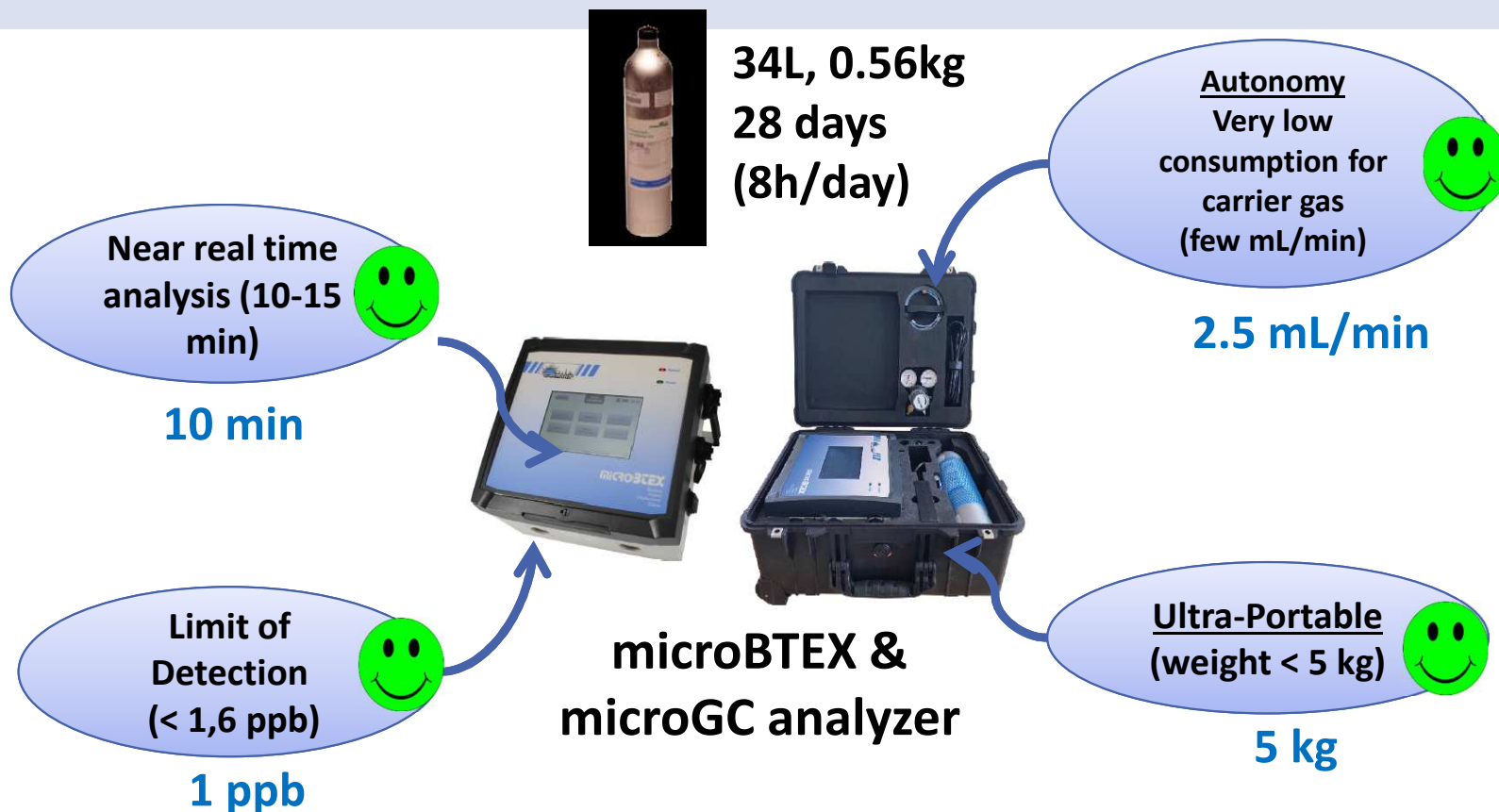


Toluene

➔ Concentrations of **toluene** and **CO₂** are **correlated**

➔ toluene comes from **inside** the classroom (e.g. children's activities)

Conclusions and perspectives



- ➡ Sensitive, rapid and portable instrument is fully adapted to field measurements for monitoring spatial and time concentrations changes
- ➡ Other applications on demand for special compounds and or concentrations
- ➡ In the future, addition of a **miniaturized preconcentrator (trap)** to improve the sensitivity by a factor 10 – 50

Best features microBTEx & microGC



- Compact size and low weight (<5kg)
- Easy to use with colored touchscreen display
- Deployment in less than 5 minutes
- Powered by mains or battery (>4h)
- Minimal carrier gas consumption
- Rapid calibration with gaseous BTEX mixture or only Benzene

Advantage of this solution

- Short cycle time (15 min) compared to ISO 16000-3:2011
- Automatic solution
- No interferences with chromatography
- Visualization of data

Technology comparison

BTEX detection methods

		Methods	Detection limit	Analytical time	Portability	Gas consumption
OFFLINE	 <p>ATD-GC-FID</p>	(Laboratory GC) coupled to different detectors <u>MS/FID/PID</u>	0,22-85 ppt	1 h	No (bulky)	200 mL/min
		PTR-MS	12 ppt	10 min	No (bulky)	50 mL/min
ONLINE		Transportable Analyzer	10 ppt	10-30 min	Transportable (15 kg)	5-10 mL/min



major default: the need of big gas cylinder due to their high gas consumption



Design of a new instrument based on gas chromatography device

- Replacement of Perkin Elmer PhotoVAC Voyager
- Industrial fence line monitoring
- Transportable version for onsite BTEX and VOCs monitoring
- Chemical, pharmaceutical
- Paper plants
- Indoor air (paintings, coatings) & Clean rooms



- Customers profiles
 - Governmental agencies (EPA, INERIS)
 - Meteorological institutes
 - Universities and Research centers
 - Industrial consortia
 - Petrochemical groups



μ airTOXIC

**Compact and standalone carrier gas
free autoGC**



- Wall mounted box μairTOXIC in compliance with mCERTS
- Compact and standalone carrier gas free autoGC for remote air monitoring
- Upcoming product for end of 2021
- Developed thanks to our 30 years experience in autoGC





DET H2O

Portable Moisture Analyzer

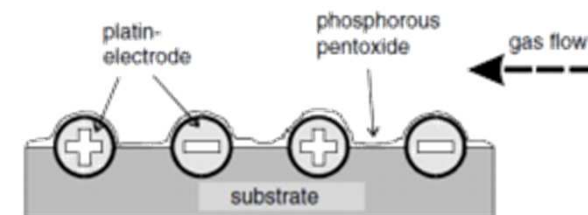
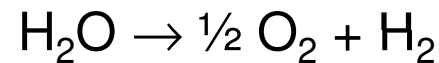
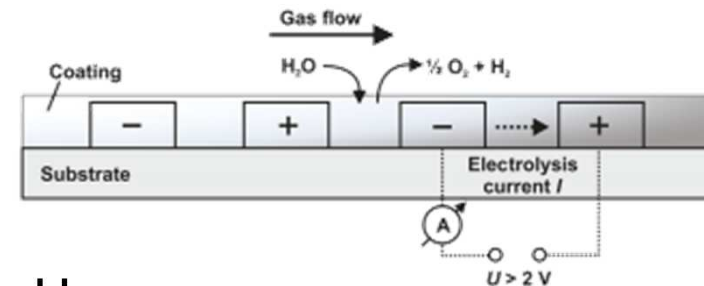
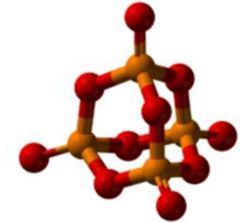


**BATTERY OPERATED
PORTABLE MOISTURE MONITOR**

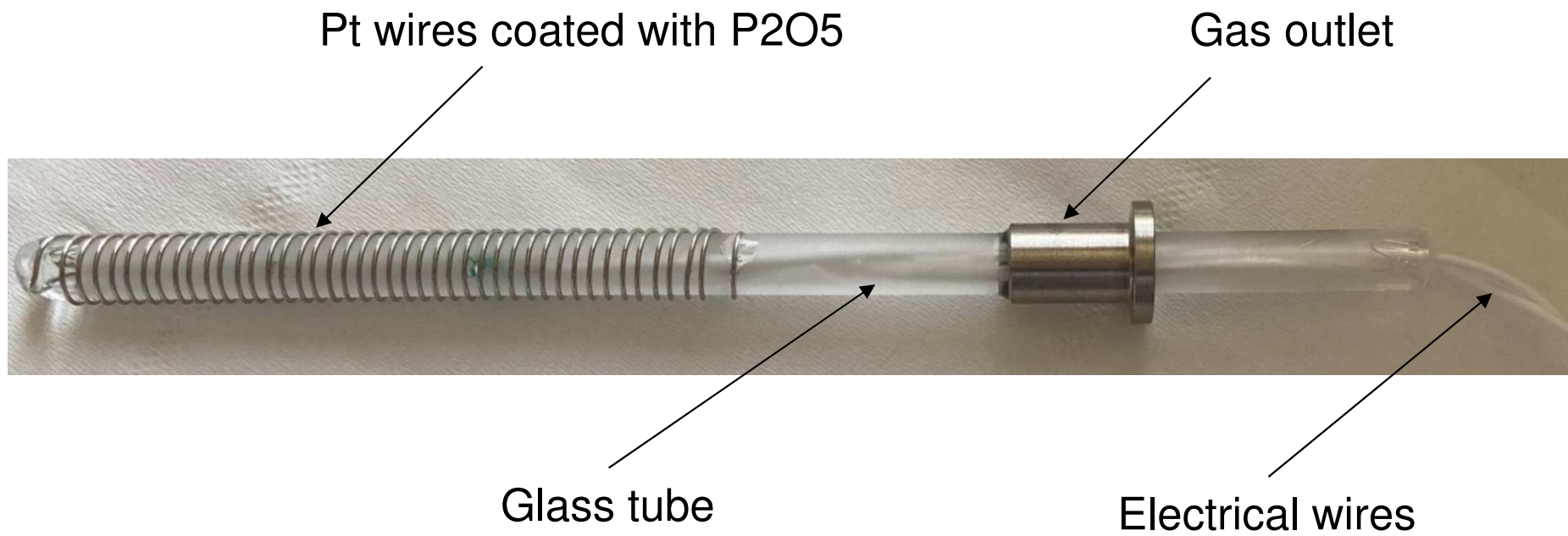
Technology Principle

Electrolyte Probe

- Method described by Keidel in 1959 : Method for the measurement of H₂O in gases
- Technology based on water electrolyze adsorbed by P₂O₅
- 2 Pt wires rolled around a glass tube and coated with P₂O₅
- When electrical current is applied, water present in gas is electrolyzed



Probe

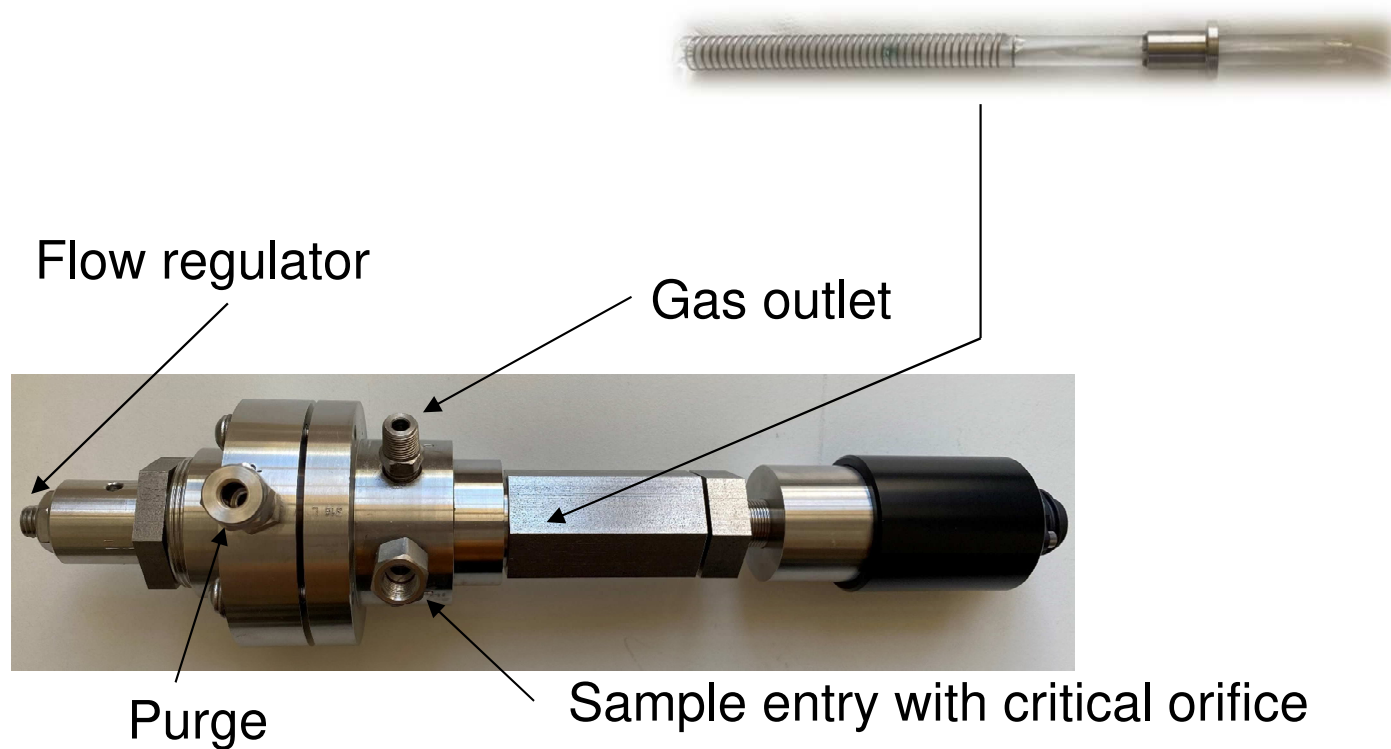


PORTABLE HYGROMETER :

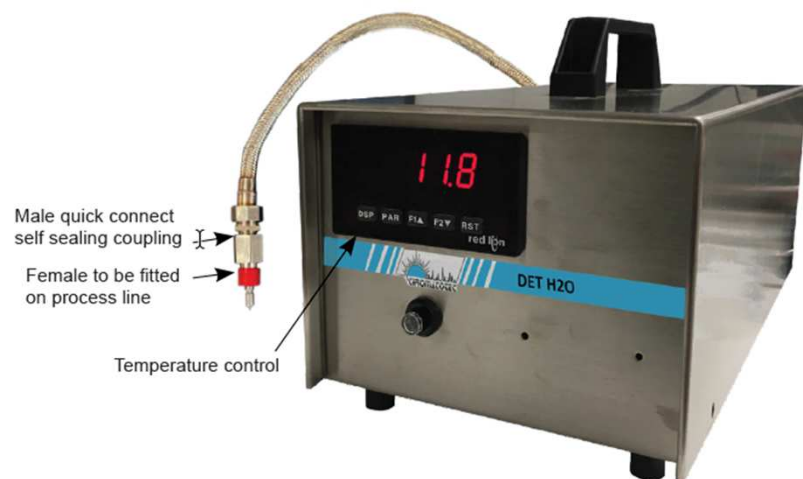
Probe holder

Pressure and flow regulation systems

Probe inside probe holder



Instrument



Male quick connect
self sealing coupling

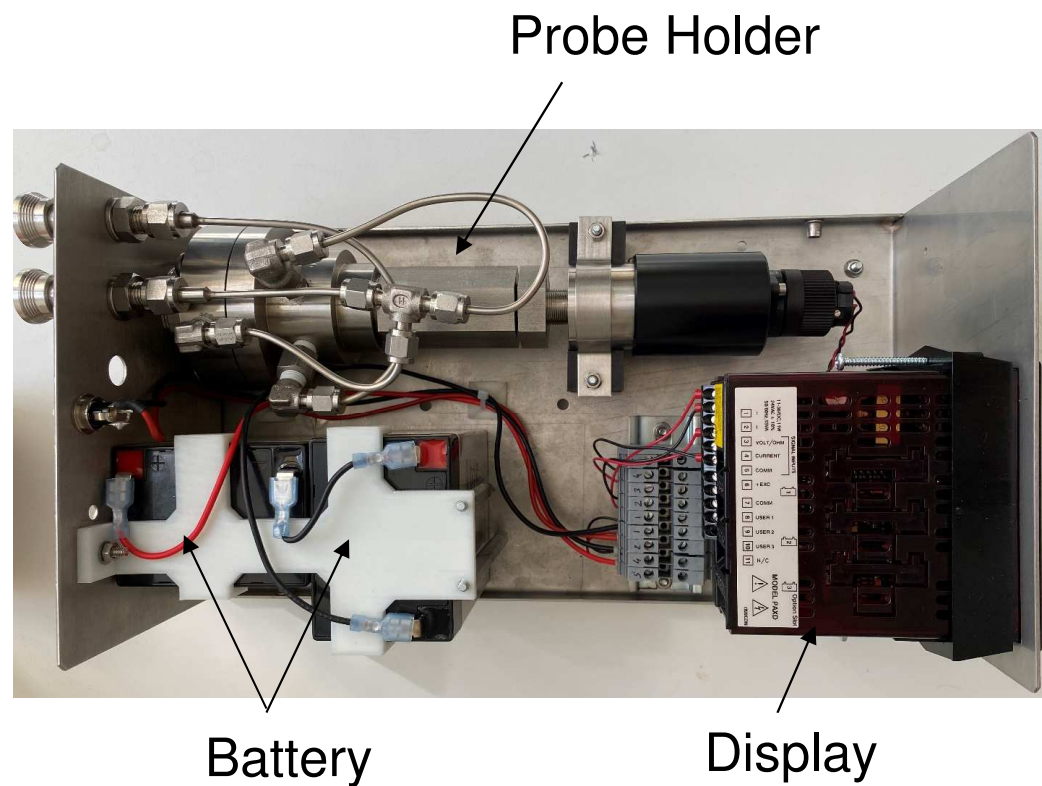
Female to be fitted
on process line

Temperature control

**BATTERY OPERATED
PORTABLE MOISTURE MONITOR**

Sample in

Vent



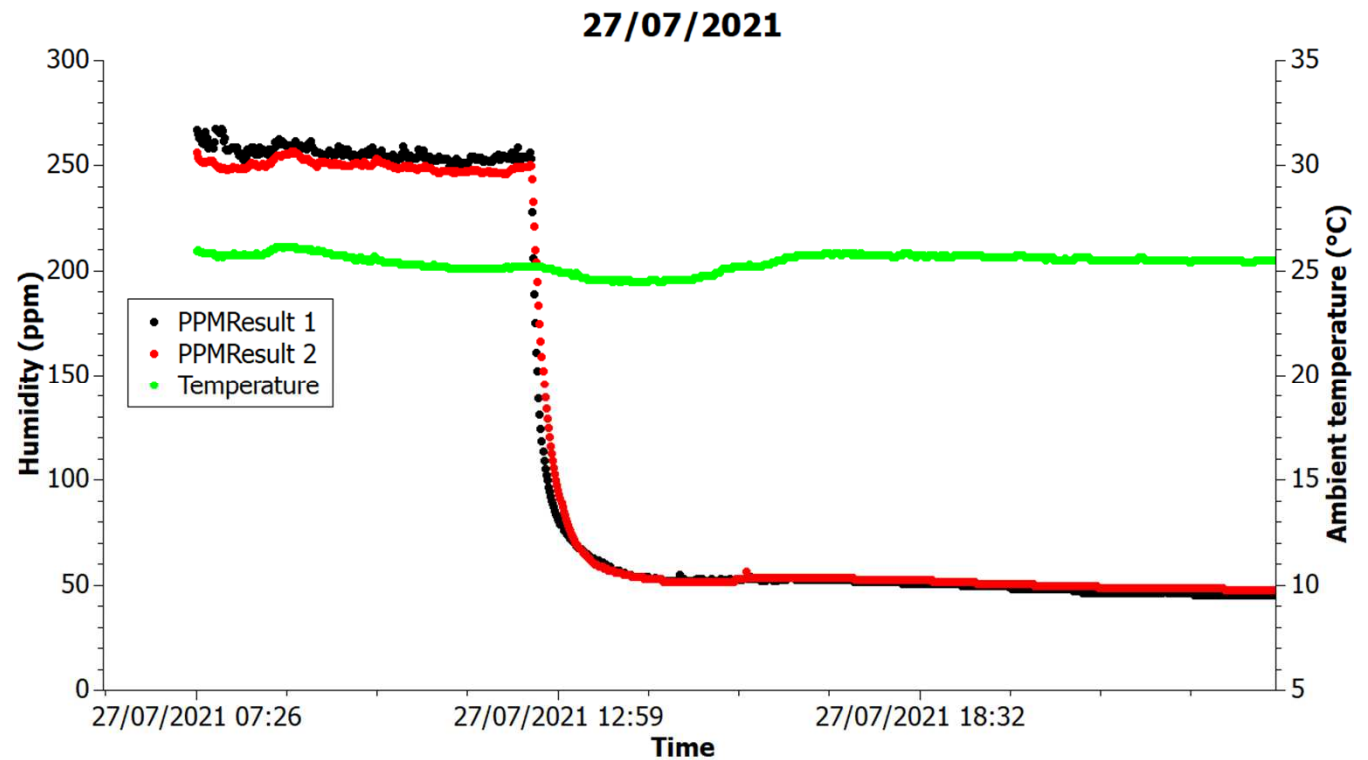
Probe Holder

Battery

Display

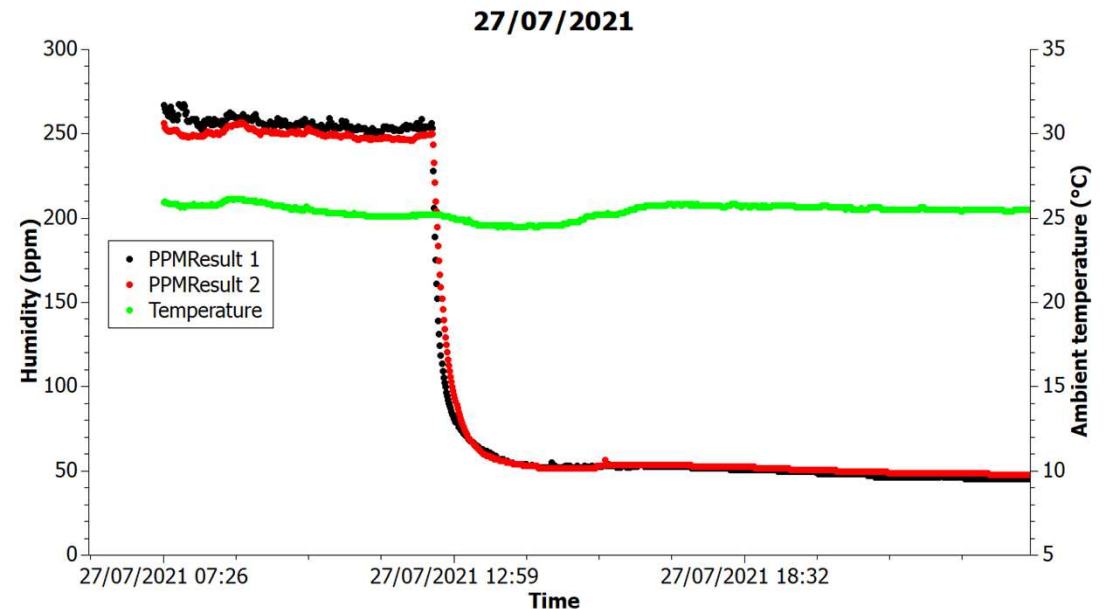
Calibration

- 2 calibration points
 - Highest point (humid)
 - Lowest point (dry)



Sensor response time characterisation

- T90 : Time when 90% of the final value is reached
- 1) Probe humidification with moisture generator
 - 2) Drying process with dry gas until stabilization of the signal

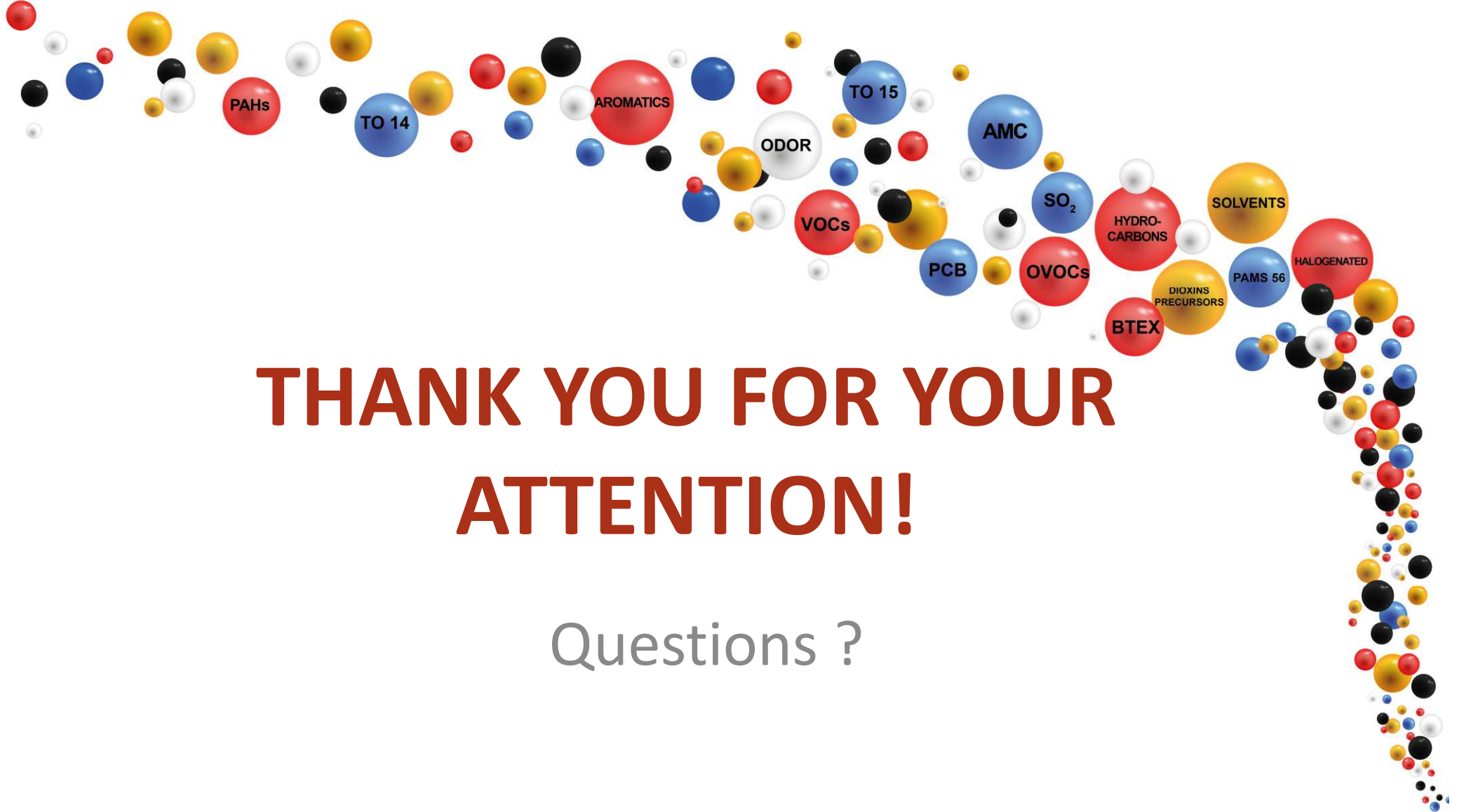


- Medical – moisture analysis in pure gases like O₂
- Industry with corrosive gases
- Chemical, pharmaceutical

- Technology principle exists since more than 60 years
- Water trapped by P_2O_5 is then electrolyzed and allow a measurement in real time
- Very sensitive technology for multiple gaz analysis
- Moisture in corrosive gases like Cl_2 , HCl , H_2 ... can be analyzed by this technology

- Stationary or portable hygrometer
- Extended measurement range – from 30ppb to 5000ppm(v) H₂O
- Capable to measure samples at pressure from 1,4 to 20 barg with pressure reducer – up to 200 barg on request
- ATEX version available





**THANK YOU FOR YOUR
ATTENTION!**

Questions ?