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BIOCIDES EXPOSURE ASSESSMENT – MEASUREMENT STRATEGY FOR NANOMATERIALS UNDER BIOCIDAL PRODUCTS REGULATION (BPR)

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PLATE-FORME NANO SÉCURITÉ

OUTLINE

- Context
  - Biocides-European definition
  - Biocidal Products application
  - European regulatory for nanomaterials in biocides
- Exposure assessment
  - Experimental rooms description
  - Aeraulic study of experimental rooms
  - Nanoparticles exposure assessment
- Conclusion

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Context

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Nanomaterials under Biocidal Products Regulation

BIOCIDAL PRODUCT' MEANS

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regulation (EU) No 528/2012

- Any substance or mixture, in the form in which it is supplied to the user, consisting of, containing or generating one or more active substances, with the intention of destroying, deterring, rendering harmless, preventing the action of, or otherwise exerting a controlling effect on, any harmful organism by any means other than mere physical or mechanical action,

- any substance or mixture, generated from substances or mixtures which do not themselves fall under the first indent, to be used with the intention of destroying, deterring, rendering harmless, preventing the action of, or otherwise exerting a controlling effect on, any harmful organism by any means other than mere physical or mechanical action.

- A treated article that has a primary biocidal

APPLICATION OF BIOCIDAL PRODUCTS

Farming

- Poultry
- Swine
- Feed / Storage
- Hatchery
- Incubator

APPLICATION OF BIOCIDAL PRODUCTS

Process and supply chain

- Bakeries
- Meat industry
- Dairy products
- Beverages
- Prepared
- storage
- Transport
- Distribution

BIOCIDAL PRODUCT AND NANOMATERIAL

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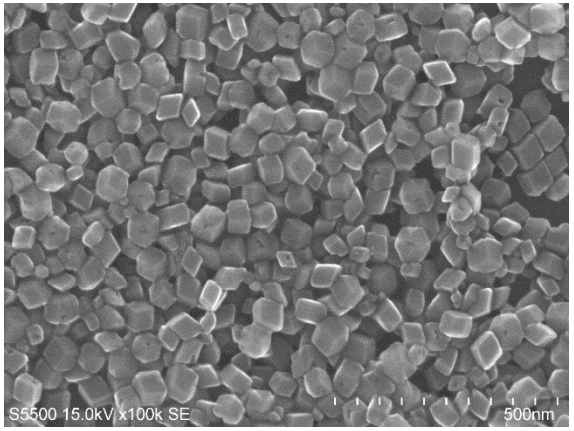
- ‘nanomaterial’ means a natural or manufactured active substance or non-active substance containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1-100 nm



- A dedicated risk assessment is needed when the nanoform of the active and non-active substances are used in a biocidal product. The label of the biocidal product must show the name of each nanomaterial followed by the word "nano" in brackets. Products containing nanomaterials are excluded from the simplified authorisation procedure and need complementary tests

RISK ASSESSMENT FOR BIOCIDAL PRODUCT

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- When test methods are applied to nanomaterials, an explanation shall be provided of their scientific appropriateness for nanomaterials, and, where applicable, of the technical adaptations/adjustments that have been made in order to respond to the specific characteristics of these materials

LCB food safety
The Vital Link

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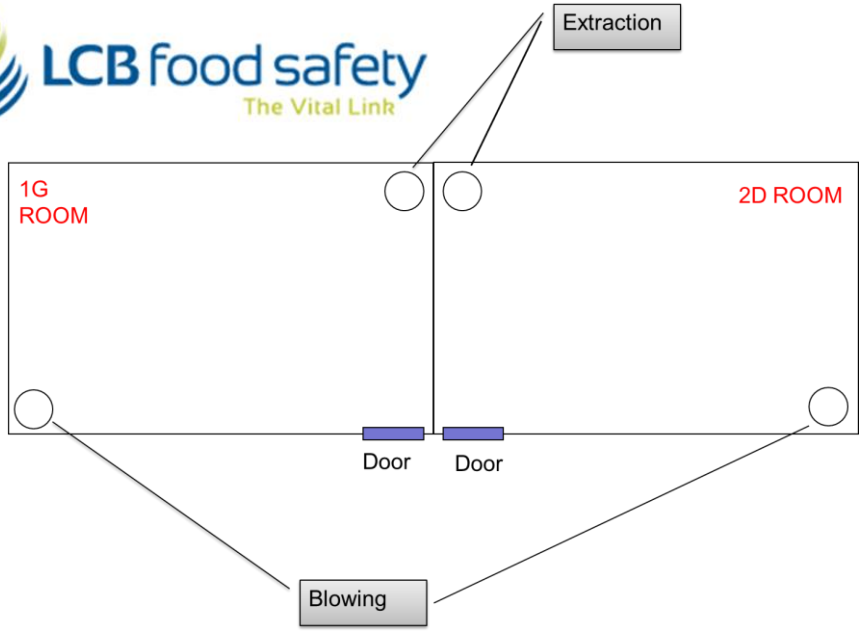
Exposure assessment

The two steps of evaluation

- Evaluation was realized in two experimental rooms of LCB food safety

The volume of each experimental room is 67 m^3
The air renewal is around 5 - 6

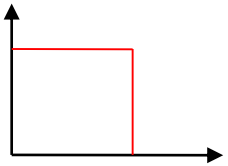


- First step – aeraulic study of experimental rooms
- Second step – nanoparticles exposure assessment

Residence time principle

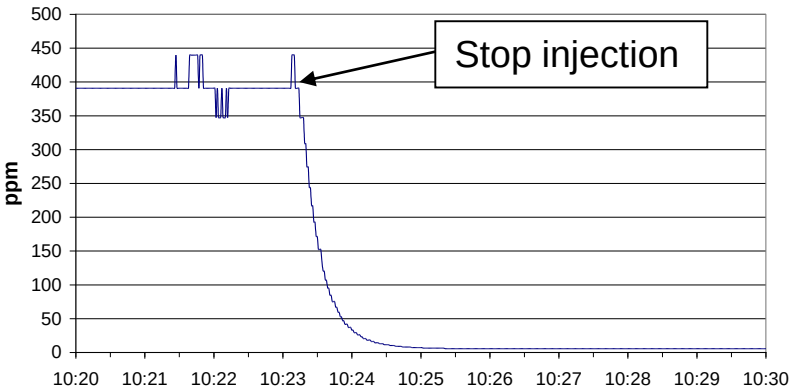
- Study of response function of inverse step experiments

Injection: gas → ROOM →



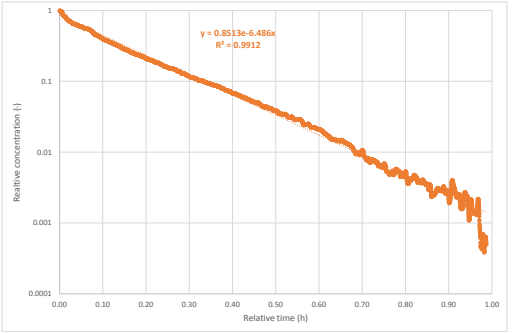
Inverse step experiments

Response curve



Exploitation

$$\ln\left(\frac{C(t)}{C^*}\right) = -\frac{1}{\tau}.t = -R.t$$

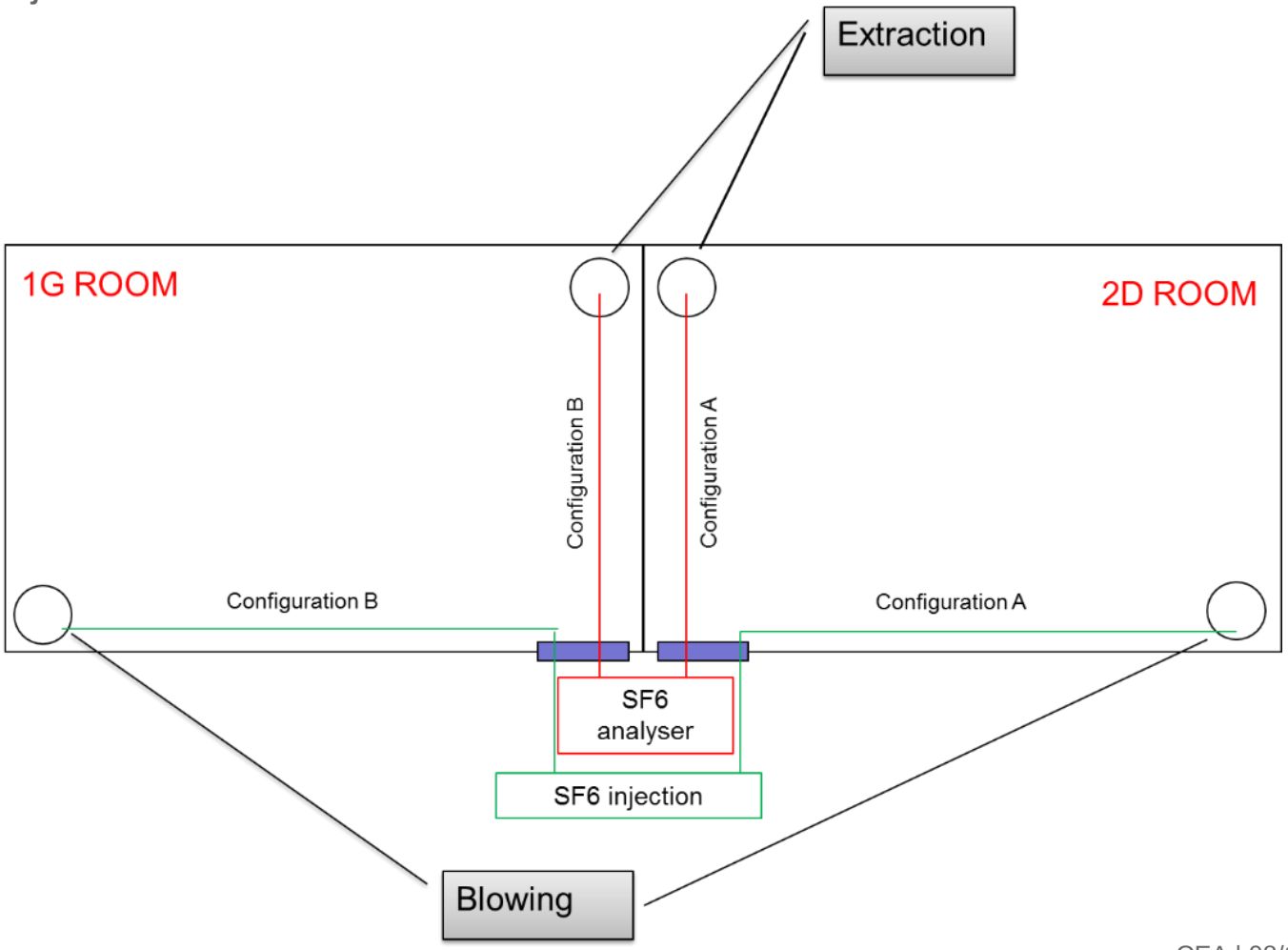


One slope : homogeneous renewal

Two slope : inhomogeneous renewal
use of an two-area model

Gaseous tracing configurations in the experimental rooms

- SF6 injection and measurement



Devices

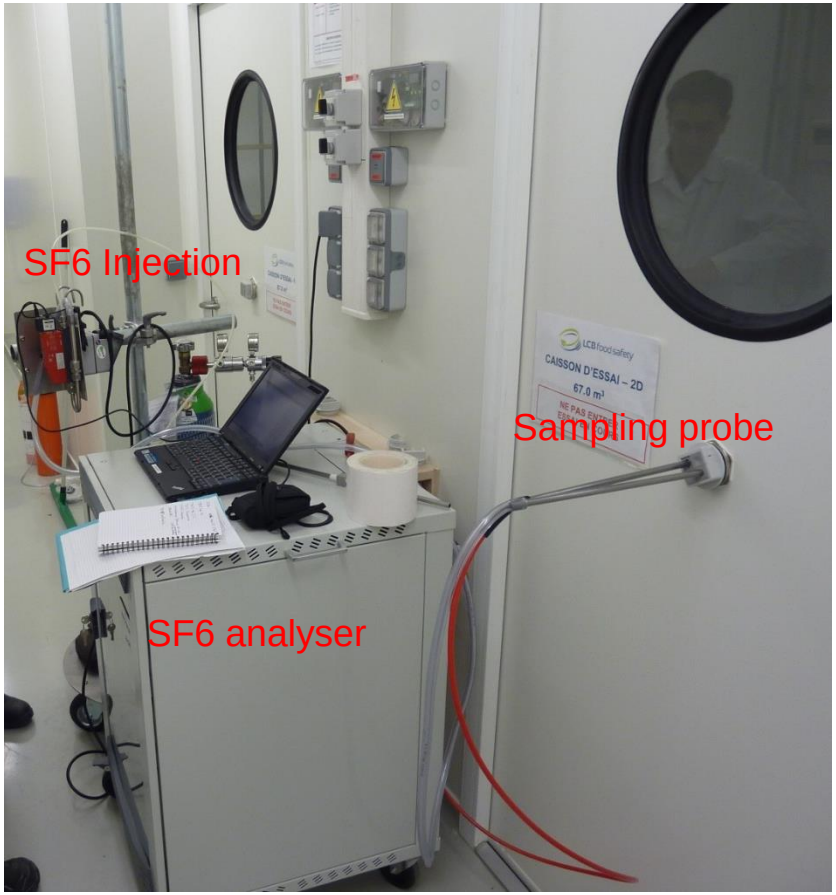
- SF6 injection and measurement

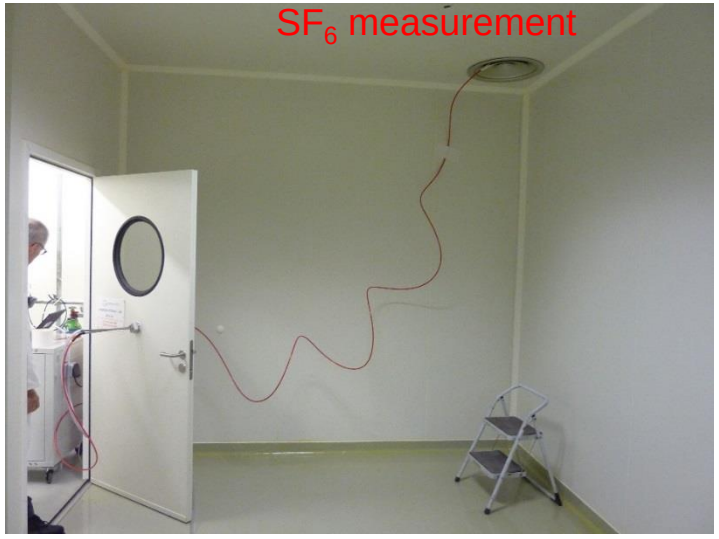
Mass flow meter
Description: Thermal mass flow meters
Make: Vögtlin
Injection range: 0.1 L/min to 5 L/min
For this study the injection flow was 1 L/min of SF_6 at 10 % in nitrogen

Gaseous analyser
Description: SF6 X-STREAM Analyser
Make: EMERSON
Measurement method: Infrared
Measuring range: 10 ppb – 20 ppm of SF_6
Sampling rate: 0.9 L/min

Gaseous tracing configurations in the experimental rooms

- SF6 injection and measurement

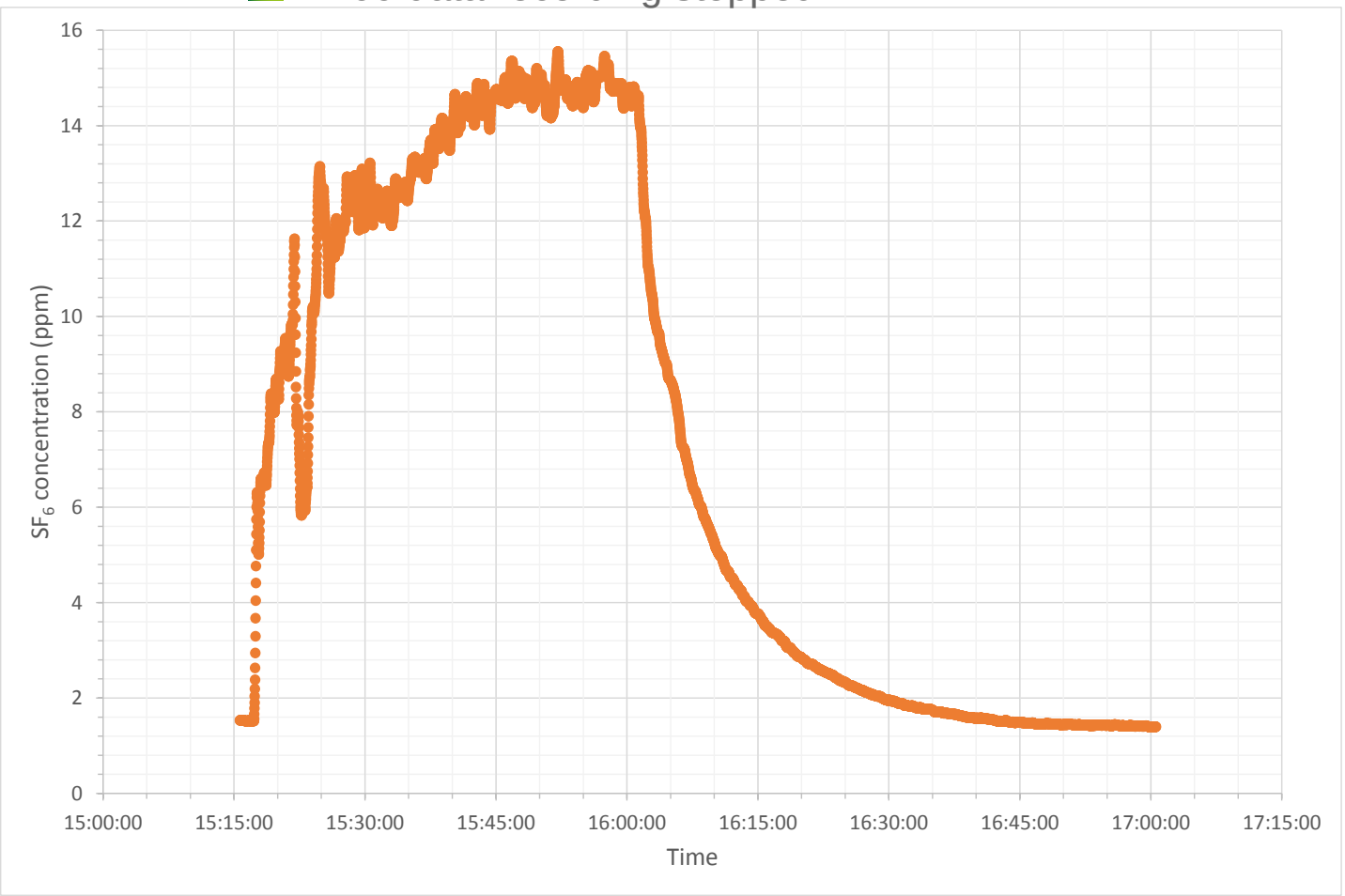




RESIDENCE TIME

SF_6 concentration evolution in experimental room 1G

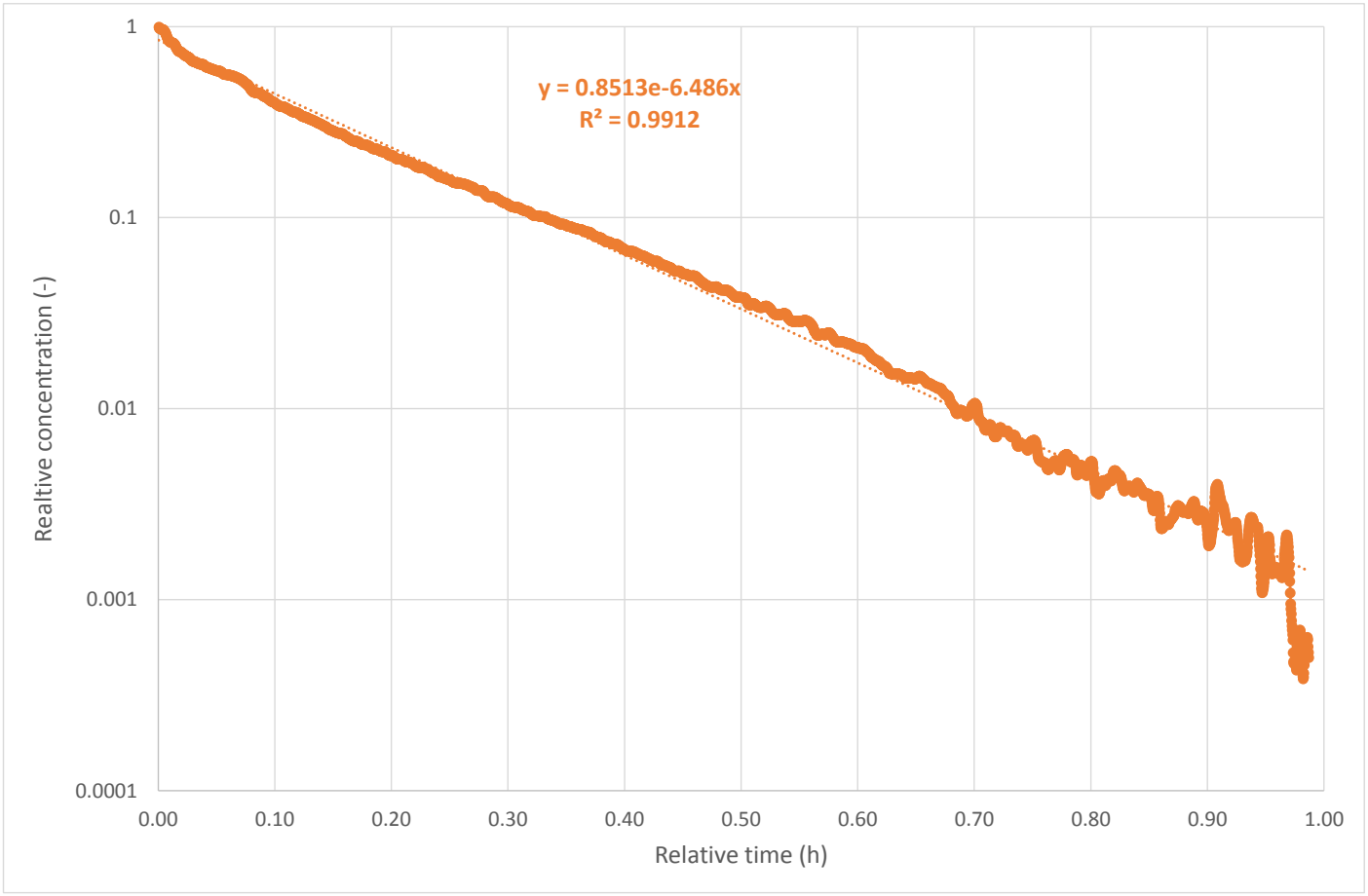
- The significant events are:
  - from 15:16 to 16:00 injection of SF6,
  - 16:00 SF6 injection stopped,
  - 17:00 data recording stopped



RESIDENCE TIME

Gaseous relative concentration as function of time – 1G experimental room

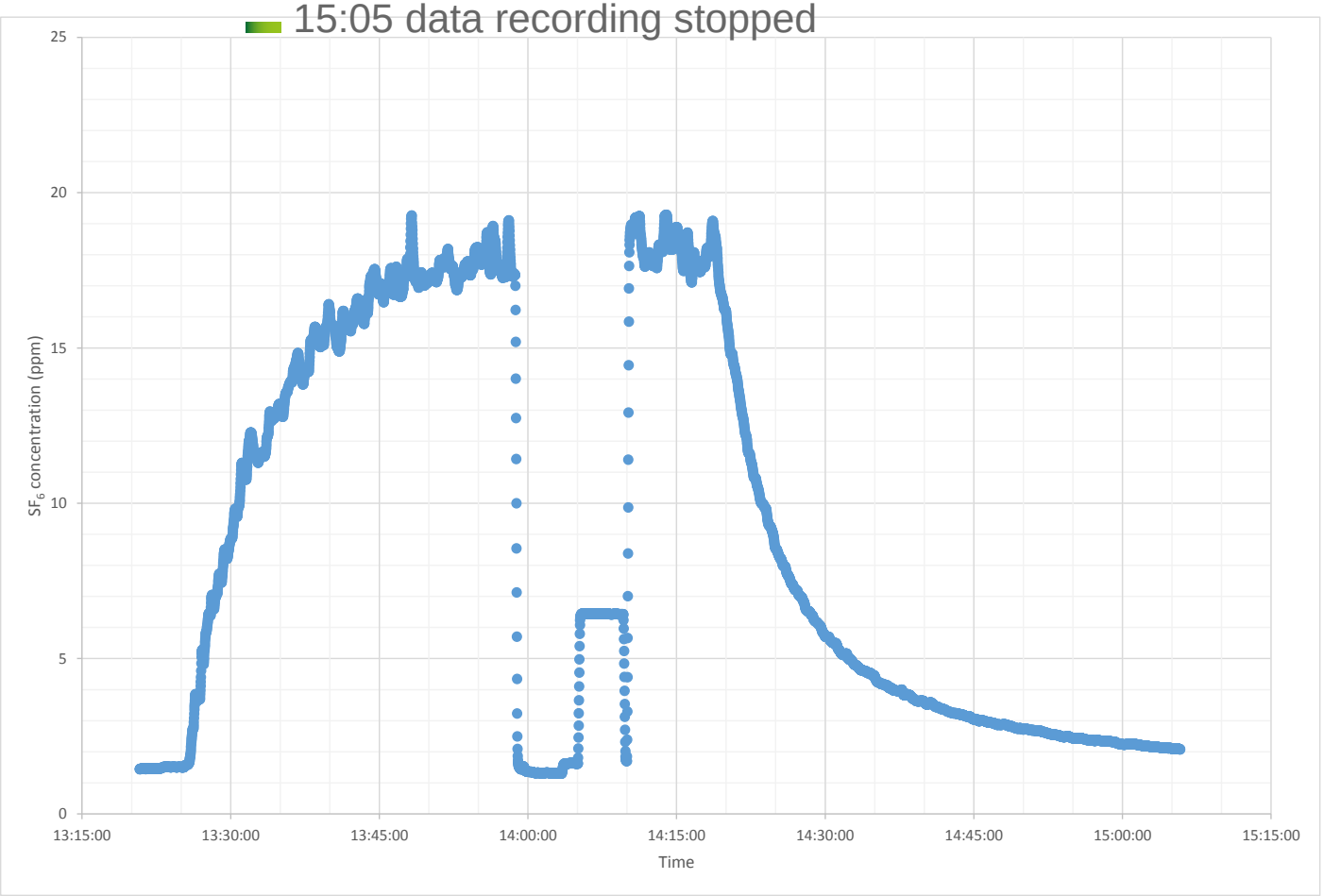
- The figure shows only one slope that corresponds to a homogeneous renewal of the 1G experimental room. The slope of the curve gives a renewal rate of 6.5 h^{-1}.



RESIDENCE TIME

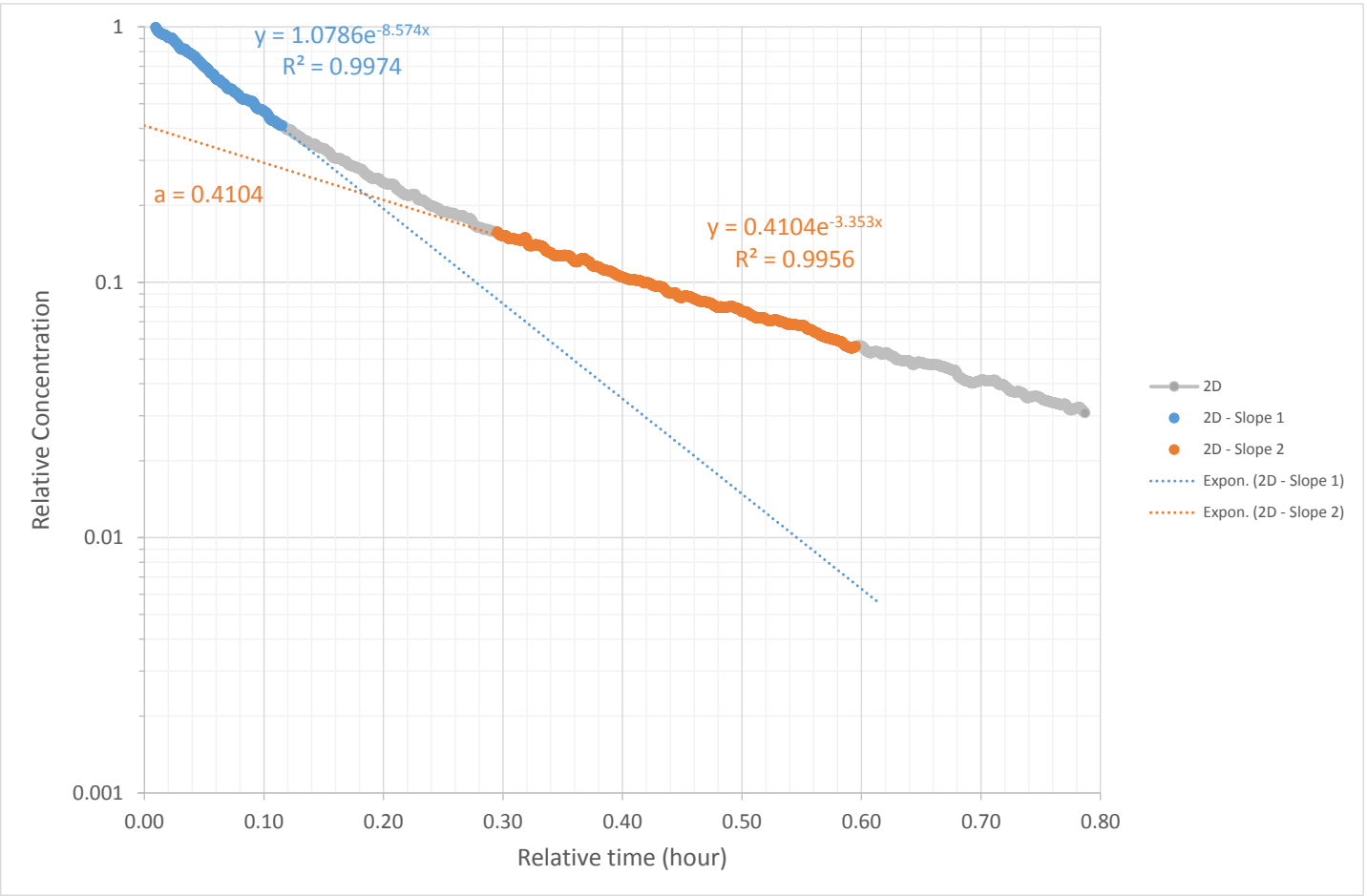
SF_6 concentration evolution in experimental room 2D

- The significant events are:
  - from 13:23 to 14:17 injection of SF_6,
  - 13:57 SF_6 calibration of analyser,
  - 14:17 SF_6 injection stopped,
  - 15:05 data recording stopped



Gaseous relative concentration as function of time – 2D experimental room

- The slope of the first curve,P1, is 8.6 and the slope of the second curve is 3.4. The application of the RTD theory for a two areas model gives:



R=5.9
H= 30 %

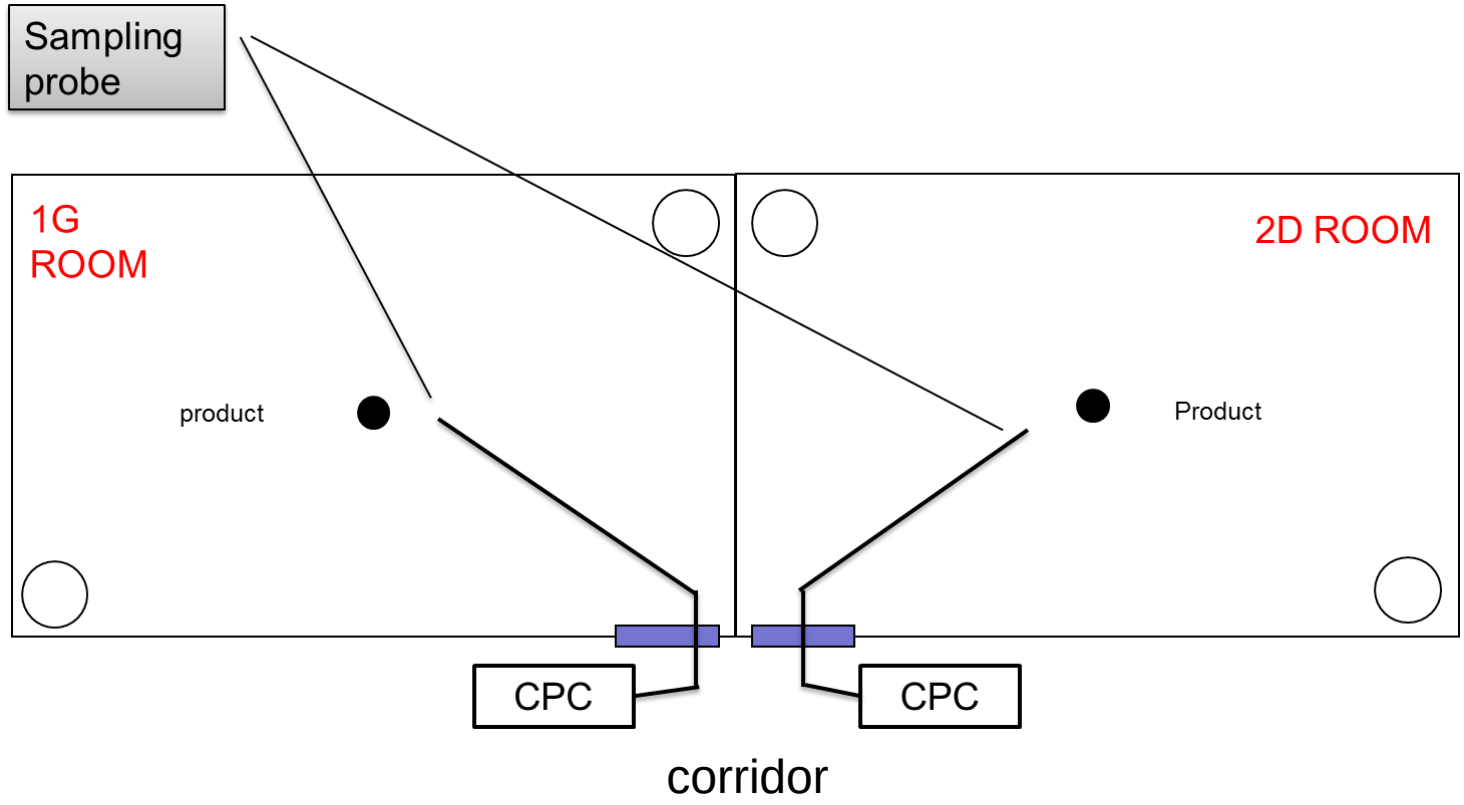
RESIDENCE TIME

Comparison of renewal rate of 1G and 2D experimental rooms

- Difference in ventilation network create a difference in the pressure losses and consequently the operating point of each experimental room are not the same.

Nanoparticles measurement in the experimental rooms

- Biocide products and measurements



Devices

- Nanoparticles measurement

Two biocidal products FUMICIDE DM studied

Description: Condensation Particle Counter (CPC GRIMM 5416)

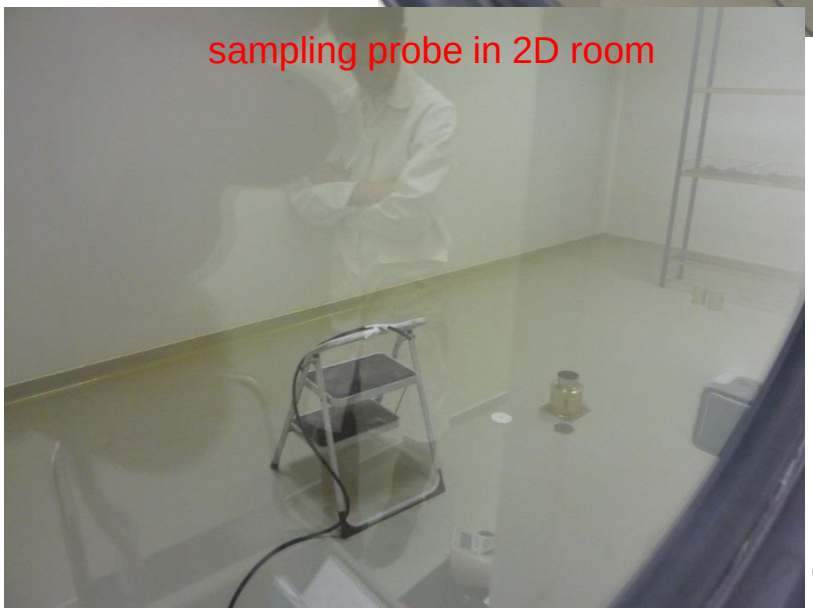
Make: GRIMM
Quantity: 2
Counting method: condensation nucleus
Measuring range:
Concentration: ca. 0 to 10^7 p/cm^3
Size: 5 to 3,000 nm Sampling rate: 0.3 L/min

NANOPARTICLES EXPOSURE ASSESSMENT

Nanoparticles measurement configurations in the experimental rooms

Nanoparticles measurement


sampling probe in 1G room


sampling probe in 2D room

NANOPARTICLES RESIDENCE TIME

Nanoparticles concentration evolution in experimental room 1G and 2D

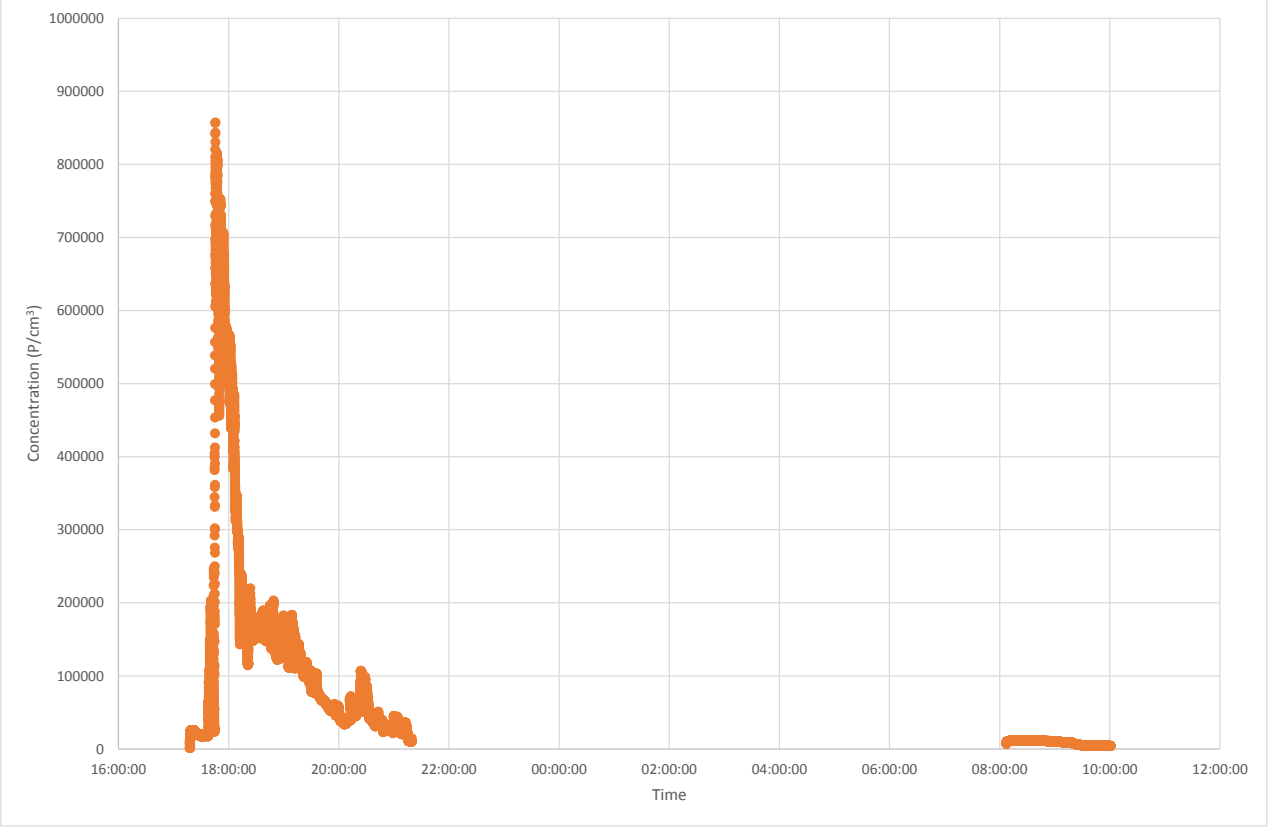
- The significant events are:

- June 23, 2016
  - 15 min background measurement in experimental room with ventilation,
  - 15 min background measurement in experimental room without ventilation,
  - after generation of product

- June 24, 2016
  - After 16 hours ventilation turned on,
  - 45 min background measurement.

RESIDENCE TIME

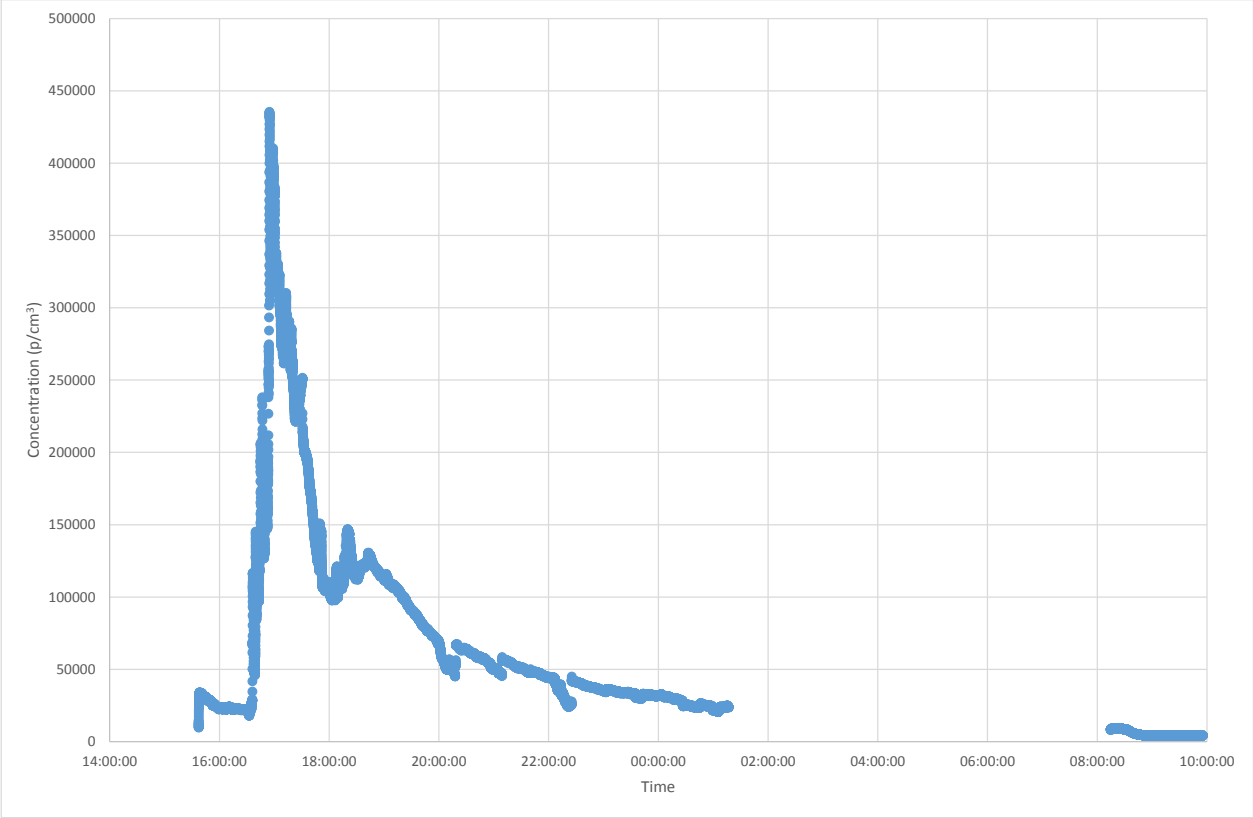
Nanoparticles concentration evolution in experimental room 1G



- The maximum concentration is 857 000 p/cm^3 after 9 min
- The time to return to the background level is 3 h 45 min
- Time for a complete renewal of the particles background inside the experimental room after the ventilation was turn on is 45 min

RESIDENCE TIME

Nanoparticles concentration evolution in experimental room 2D



- The maximum concentration is 435 500 p/cm^3 after 14 min
- The Time to return at background level is 8 h 25 min
- Time for a complete renewal of the particles background inside the experimental room after the ventilation was turn on is 45 min

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CONCLUSION - OUTLOOKS

CONCLUSION

Aeraulic study

- 1G experimental room the air renewal is homogeneous
- 2D experimental room the air renewal is inhomogeneous
- the room is significantly different between 1G and 2D experimental rooms

Nanoparticles exposure assessment

- Maximum of concentration of product in air is around 10 min after the activation of product
- It needs several hours without ventilation to decrease to the nanoparticles background level after the generation of products
- 45 min is necessary to have a complete renewal of the particles background concentration in the experimental room that correspond to4 air renewal
- A person can penetrate safely in a room after 4 air renewal if the ventilation is homogeneous
- upper bound approach

- Caution:
  - *Due to the chemical composition of biocidal products the particles number counted by CPC could be a mixing of particle aerosols, droplet aerosols or volatile compound like VOC that may condense in the measurement chamber*

Thank you for your attention

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