

New AirmoVOC C₂C₆ expert

Chromatotec[®]

General introduction

Ambient air quality monitoring (outdoor)

The distinguishing feature of the environmental market is that its emergence and growth has been largely driven by government intervention, via regulation and pricing policies.

→ Component EU Directive ozone precursor mixture : PAMS 56 cylinder, 31 COV cylinder...



The challenges:

- Analyze precisely ambient air composition in different locations (town, mountains...)
- More and more compounds
- Lower limit of quantification

objective of the study

- Optimal volume of trapping determination : breakthrough volume
- Linearity study
- Product developed by the laboratory research and development :
 - new FID detector 10 more sensitive**
 - New BS : around 40000 instead of 4000
- validation and new FID detector parameters determination.

Outline

- I. Operating principle of the C_2C_6 analyseur
- II. Breakthrough volume study
- III. Linearity study
- IV. Classical FID with expert FID comparison
- V. Conclusion

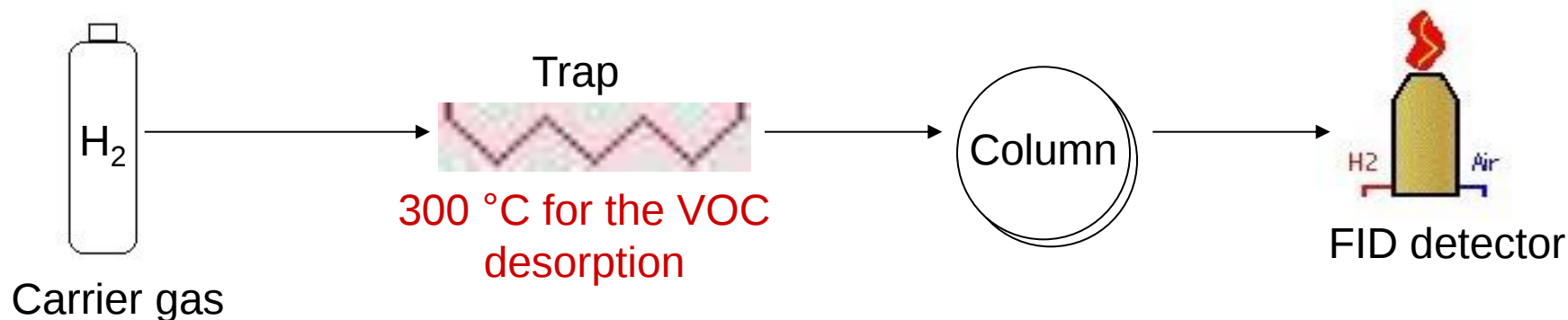


I. Operating principle of the C₂C₆ analyseur

• First stage : Sampling step



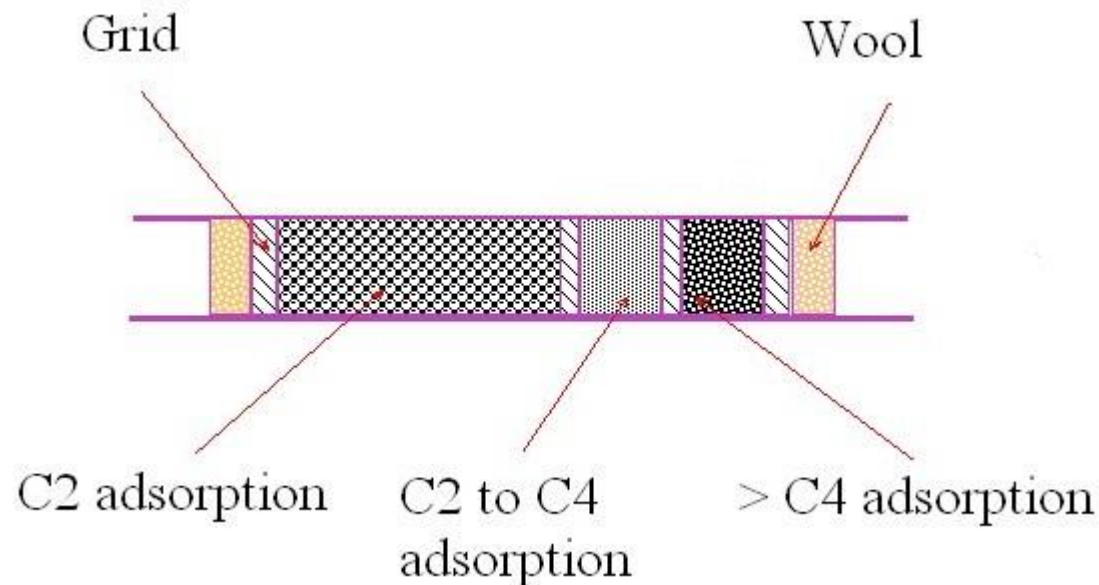
• Second stage : Injection step



II. Breakthrough volume study

The breakthrough volume is the trapped sample volume for which the compounds are no longer trapped quantitatively → **Trapped volume for which there is loss mass**

$$\text{Trapped volume (ml)} = \text{sample flow (ml/min)} * \text{sampling time (min)}$$



Schematic diagram of the three phases trap

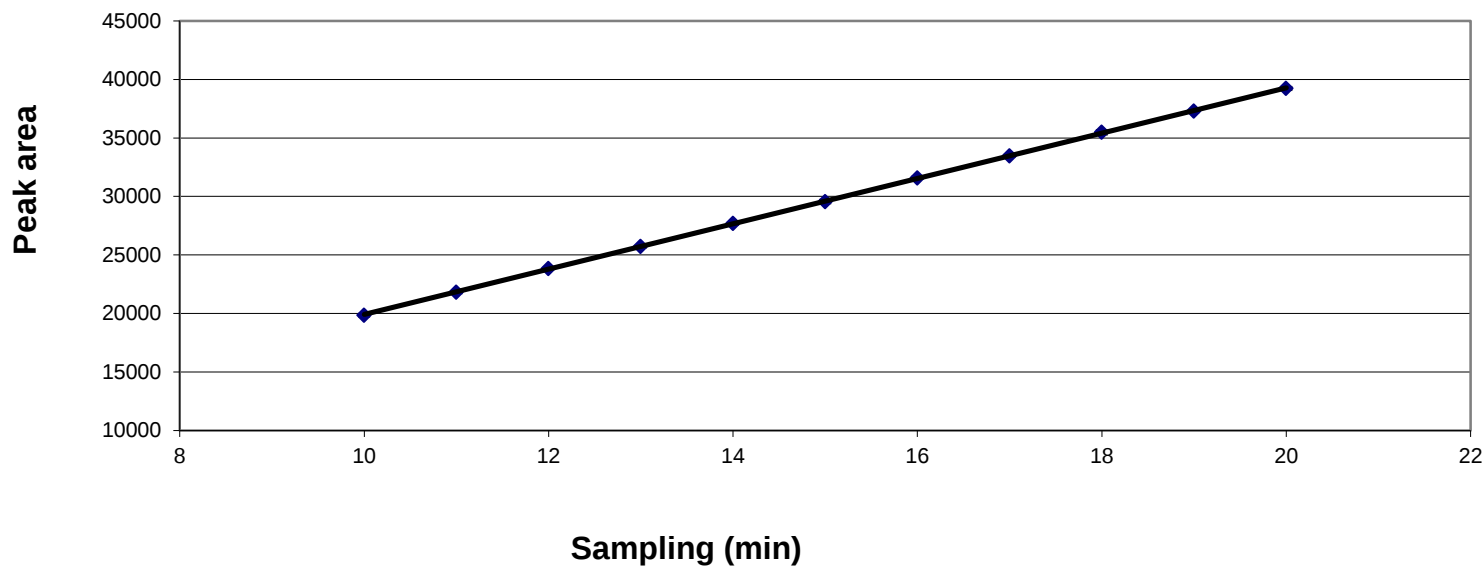


Results

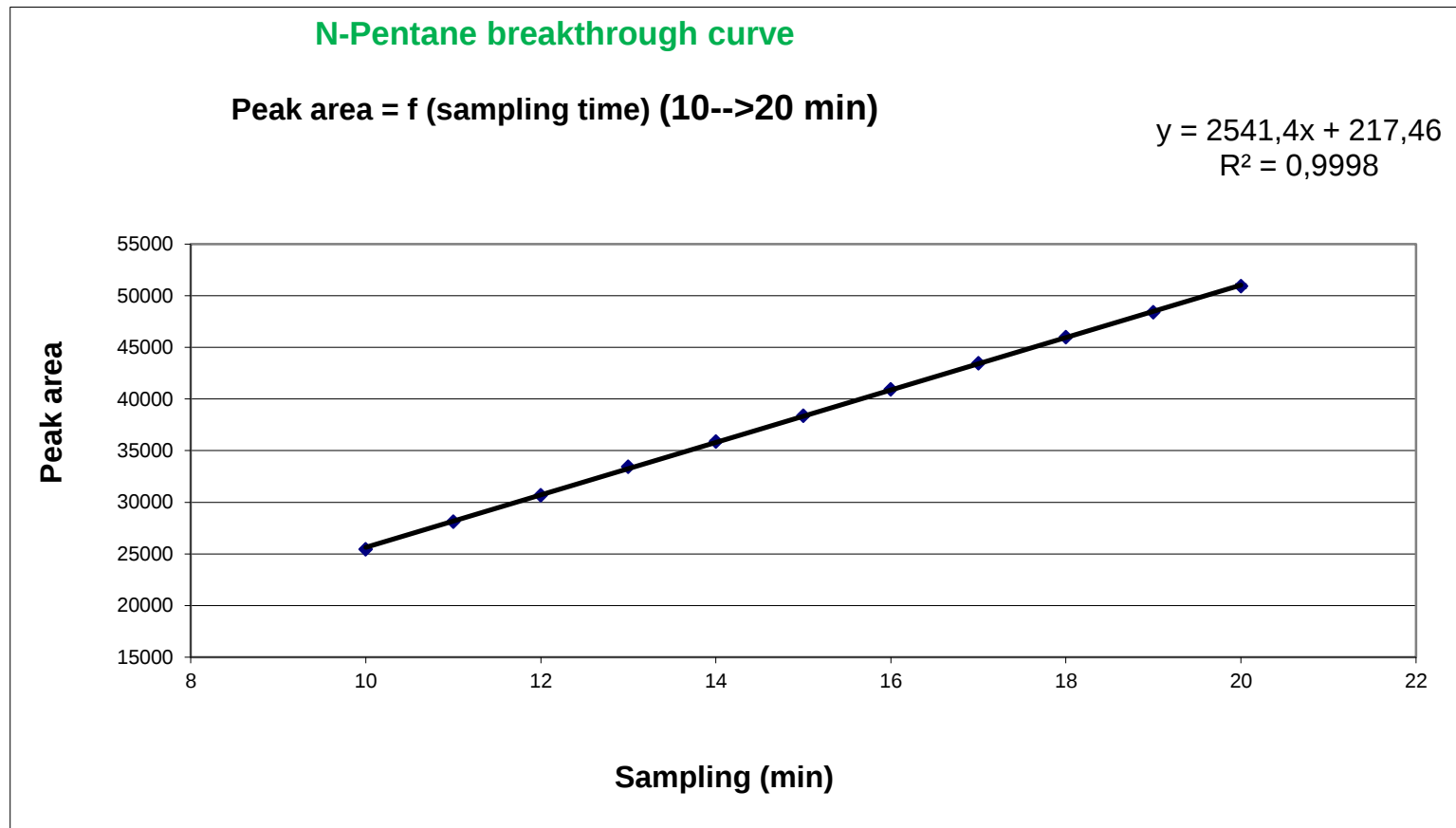
N-Butane breakthrough curve

Peak area = f (sampling time) (10-->20 min)

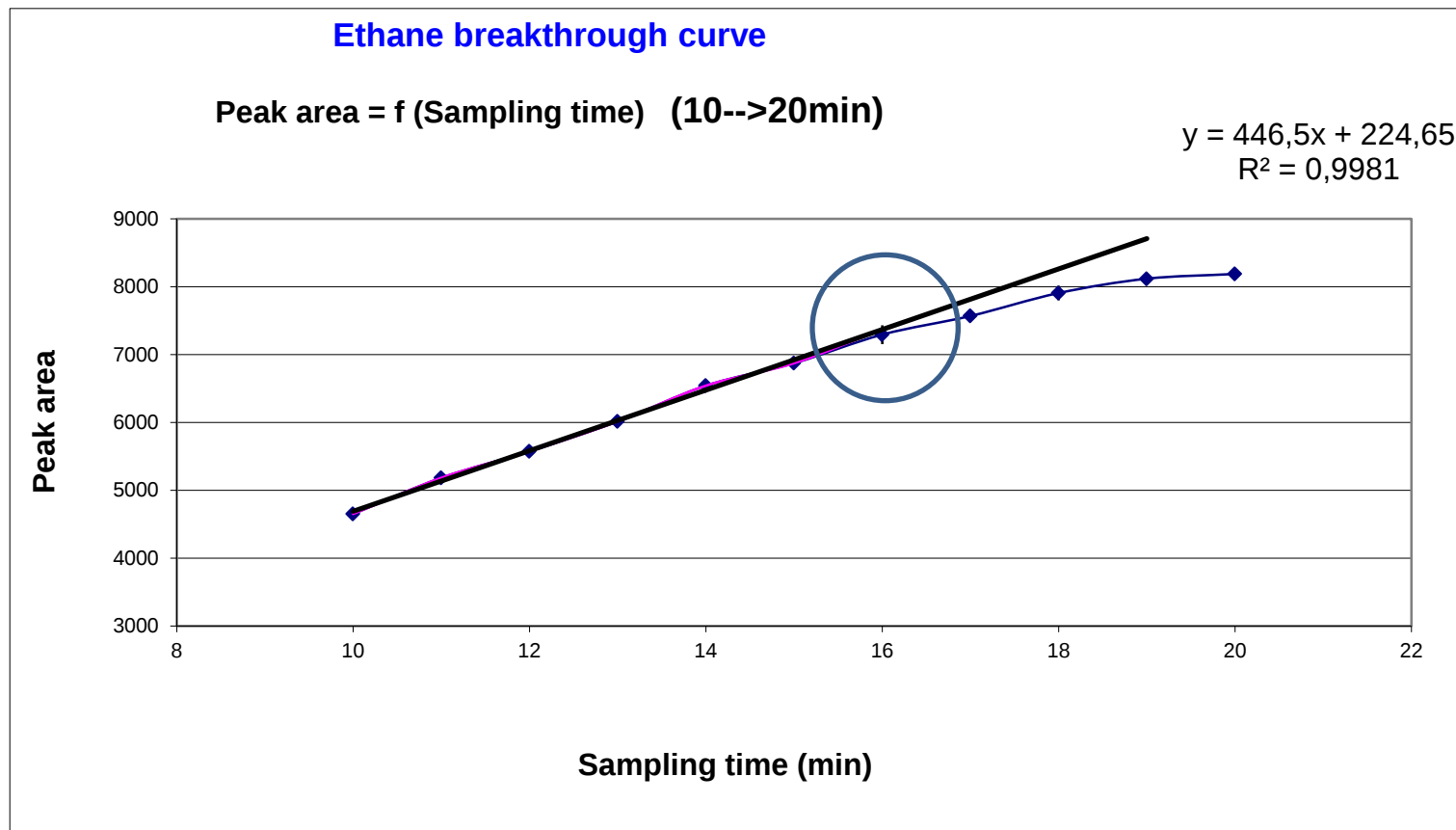
$$y = 1937,8x + 527,42$$
$$R^2 = 0,9999$$



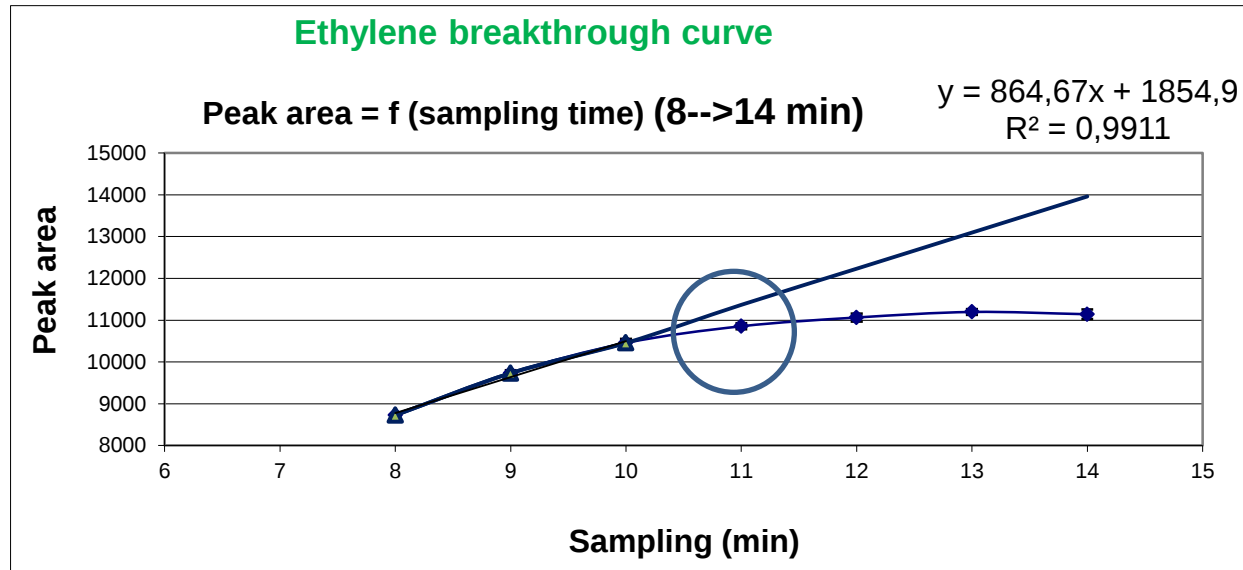
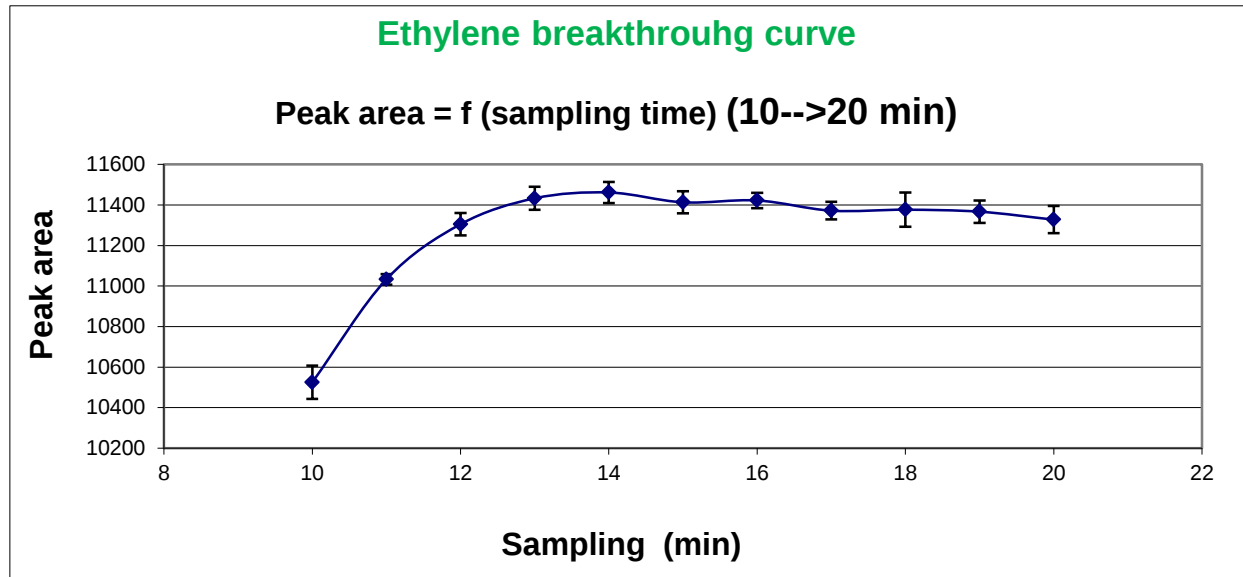
→ N-Butane is trapped without loss mass until 20 min sampling



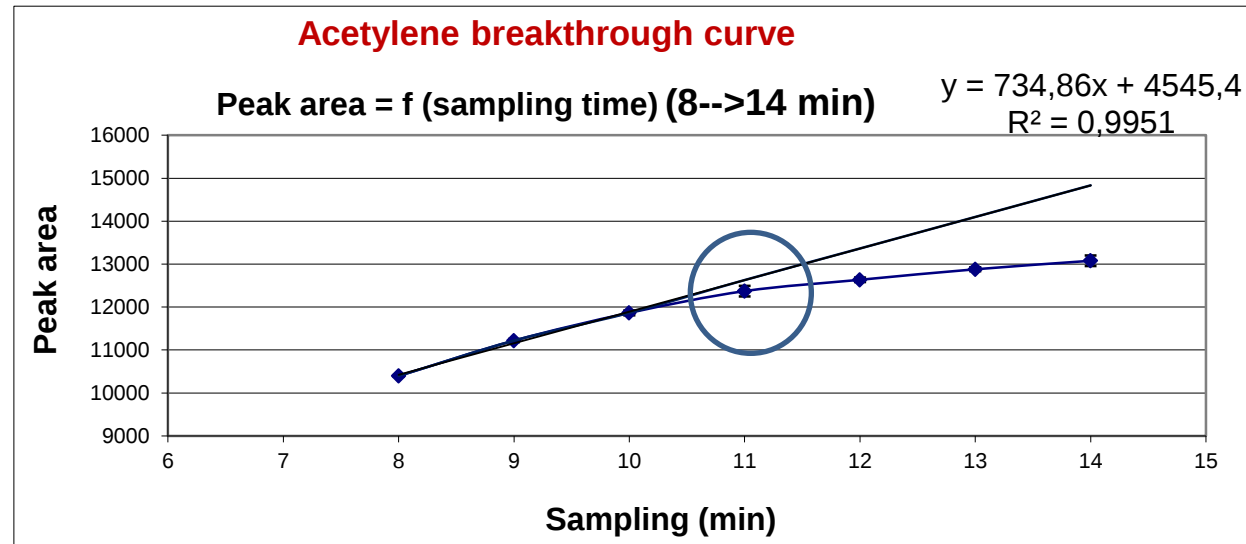
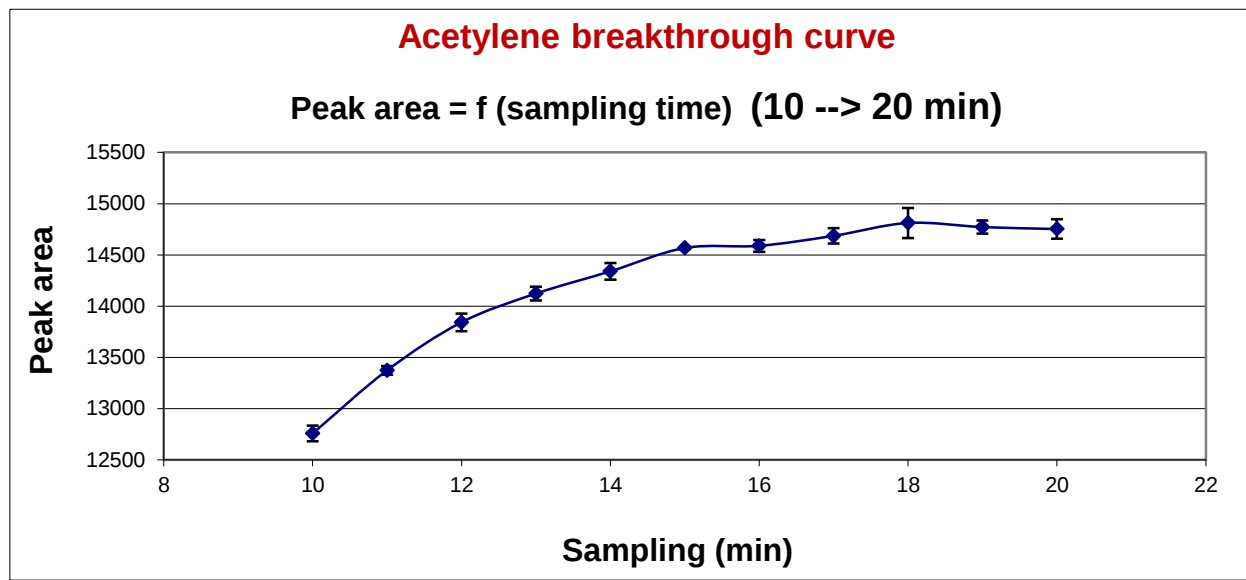
→ N-Pentane is trapped without loss mass until 20 min sampling



→ Ethane is trapped without loss mass until 16 min sampling



→ Ethylene is trapped without loss mass until 11 min sampling



→ Acetylene is trapped without loss mass until 11 min sampling

VOC	Breakthrough volume (ml)	Sampling time (min)
Ethane (C ₂)	176.26 ± 0.01	16
Ethene and acetylene (C ₂)	121.20 ± 0.14	11
C ₃ until C ₆	until 219.76 ± 0.03	until 20

Breakthrough volume study

- With a 11 ml/min sampling flow, a 10 min sampling time allows a quantitative VOC trapping from C₂ to C₆
- With a 11 ml/min sampling flow, a 20 min sampling time allows a quantitative VOC trapping from C₃ to C₆

III. Linearity study

Linearity : Capacity (in a given range) to get dosing results directly proportional to the concentration or amount of sample analyte

Method used :

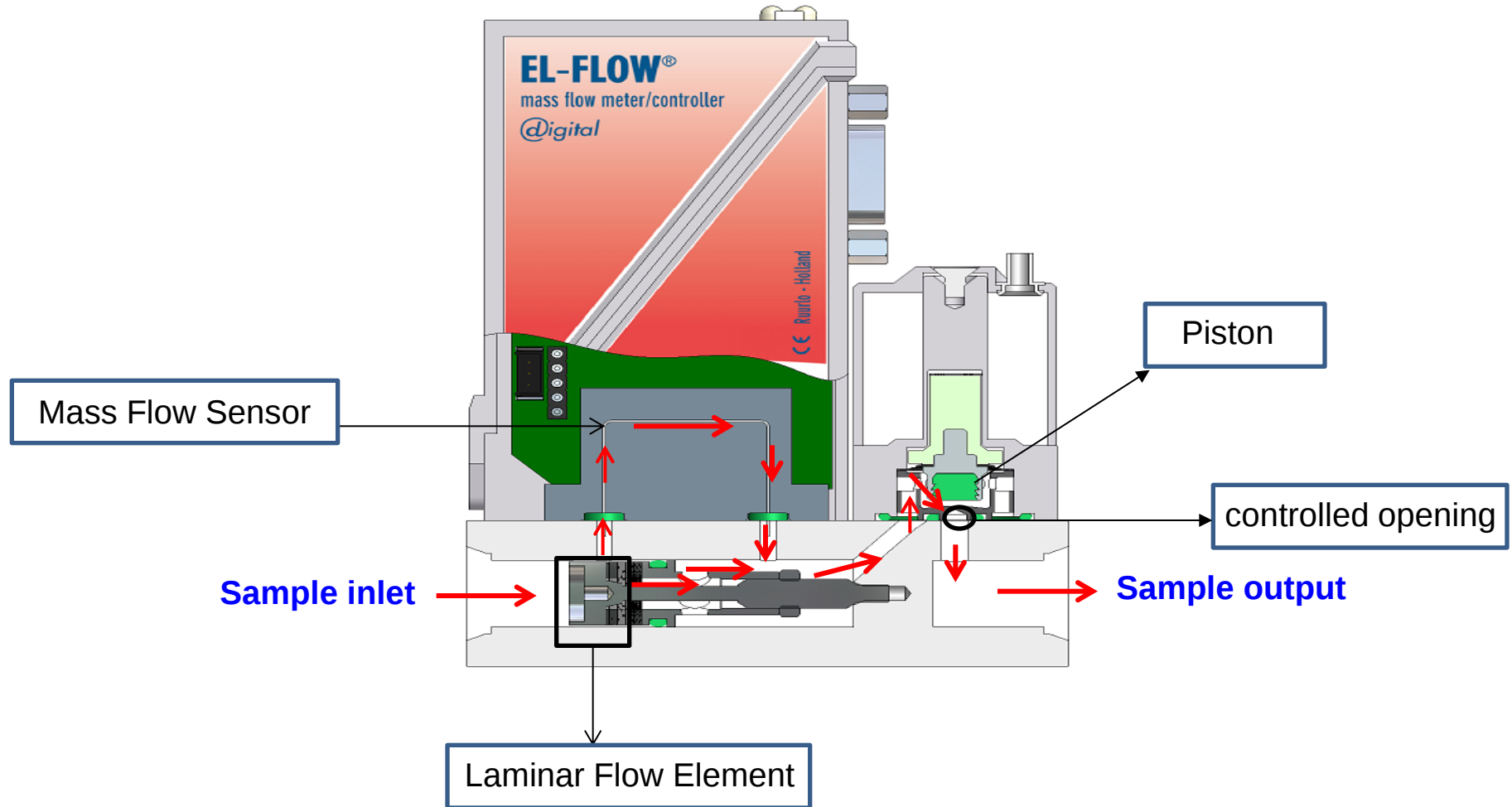
- Sample flow around **11 ml/min**
- Sampling time : **10 min**



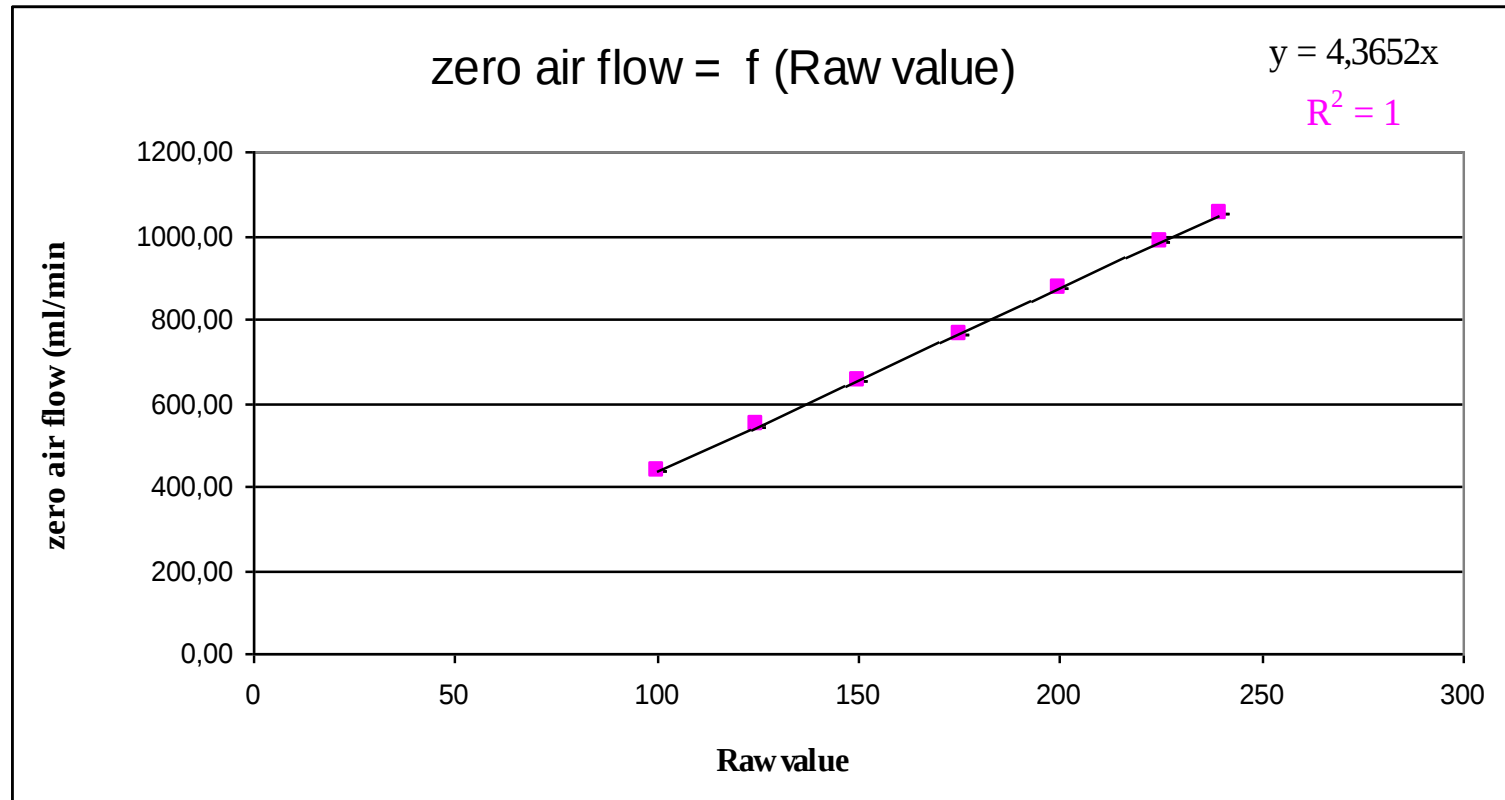
$$V_{\text{sampling}} = (110.30 \pm 0.17) \text{ ml}$$

- 5 concentration levels for each compound studied → two Mass Flow Controller used for the 31 COV cylinder dilutions in the zero air
- Analysis repeated 6 times at each level

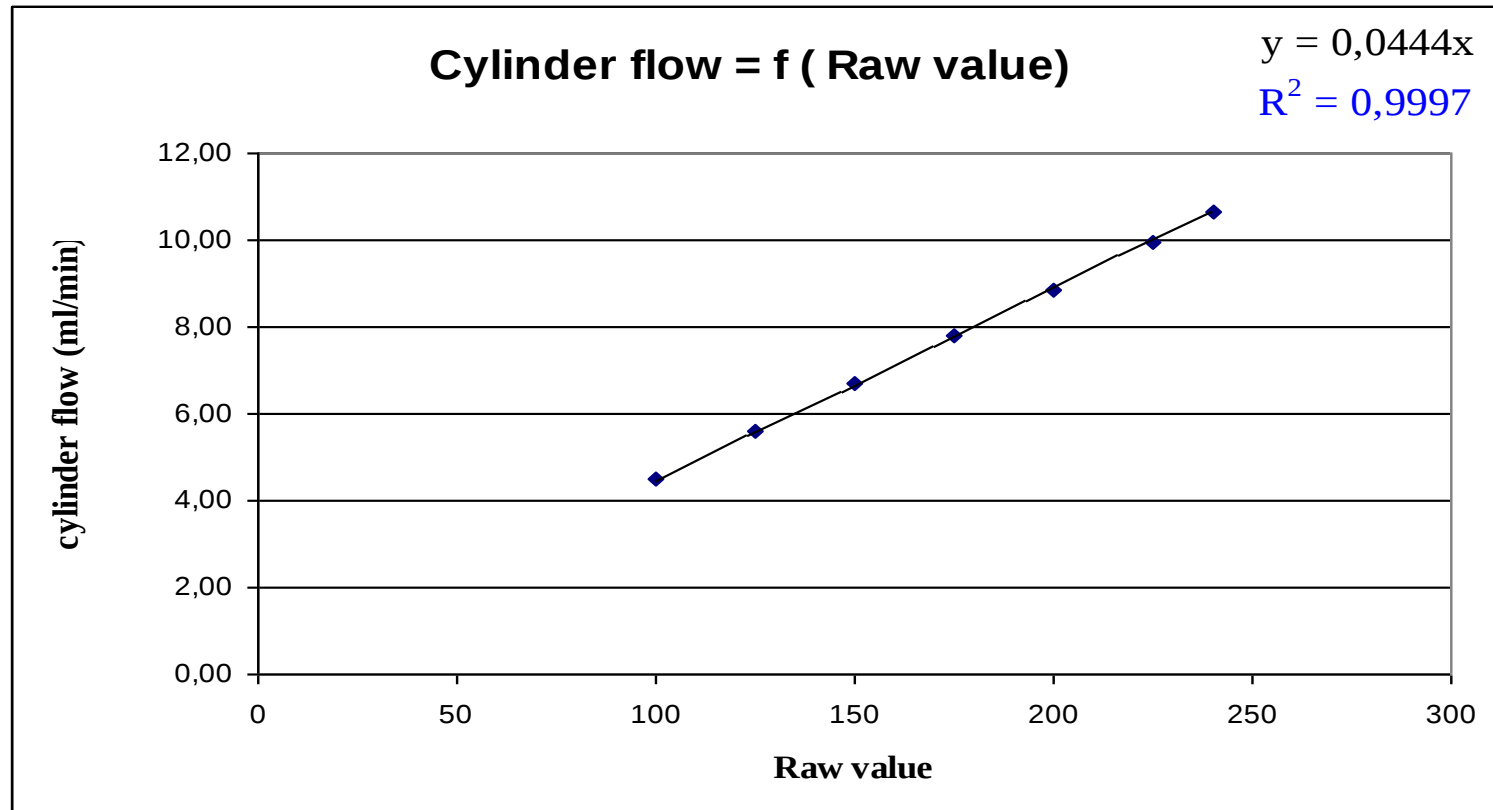
➤ Operating principle of the MFC



➤ MFC calibration



➤ MFC calibration



➔ The MFC are perfectly linear in their flow range



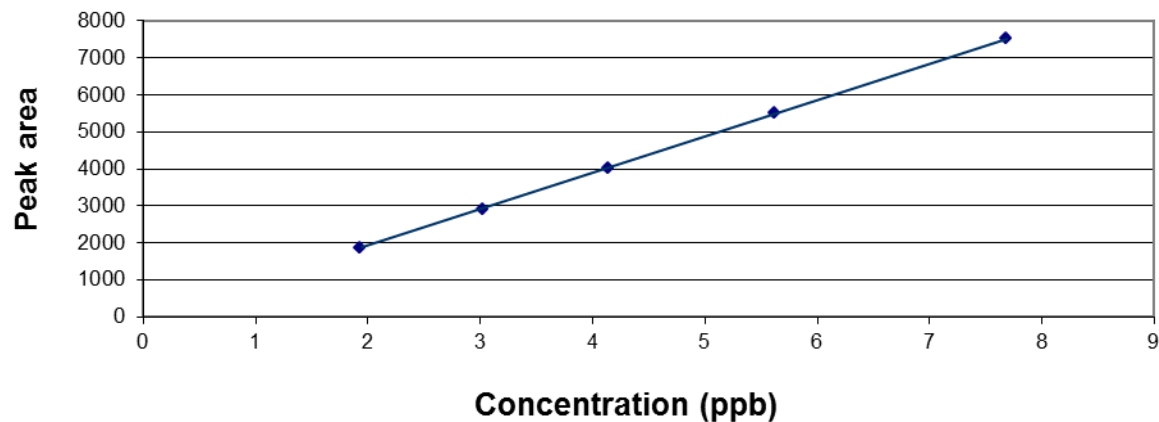
Results

Peak area = f (Concentration)

Ethane

$$y = 976,8x$$

$$R^2 = 0,9997$$

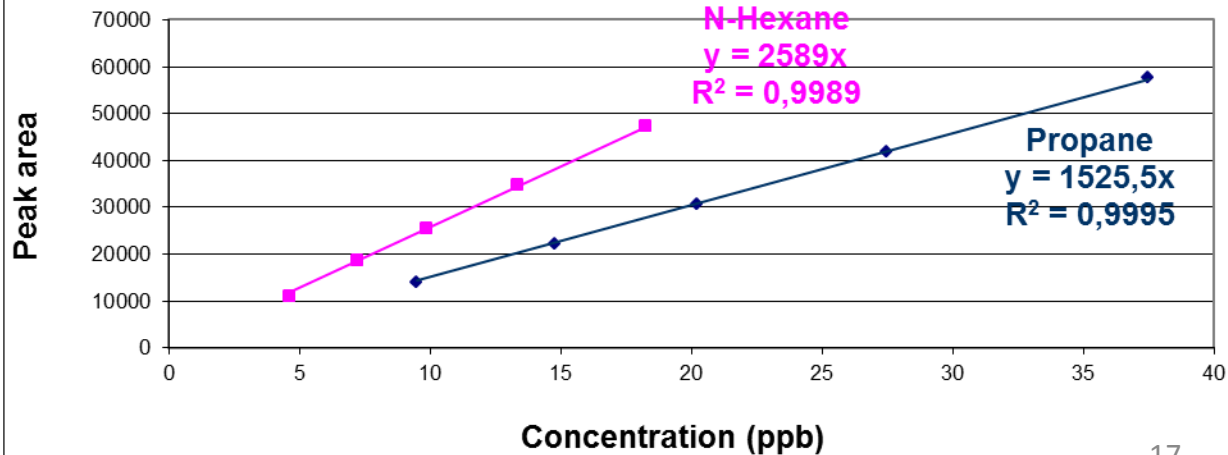


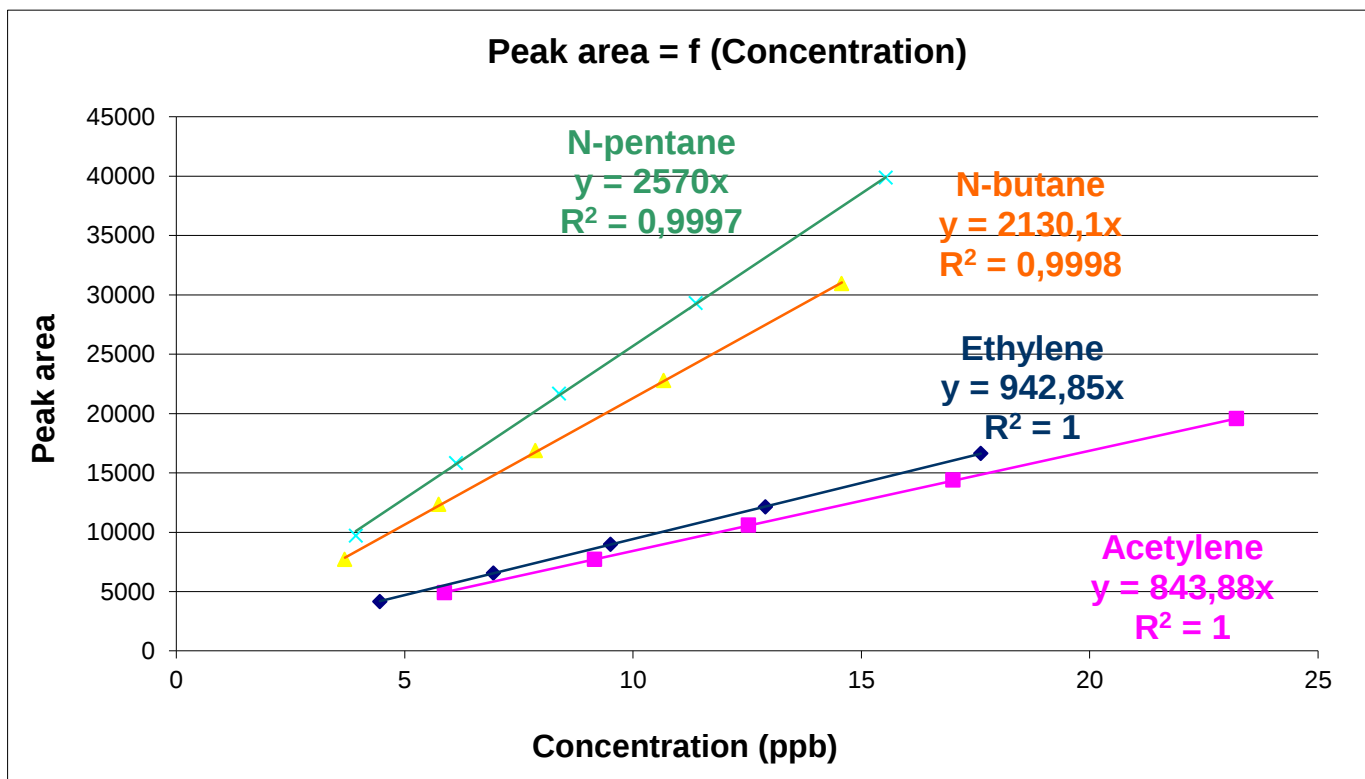
Peak area = f (Concentration)

N-Hexane

$$y = 2589x$$

$$R^2 = 0,9989$$





→ $R^2 > 0,997$ for all the compounds studied → The linearity test is validated in the ranges of the study.

IV. Classical FID with expert FID comparison

- New detection system : **the expert FID**
- Theoretically expected sensibility gain : 10

Validity criteria :

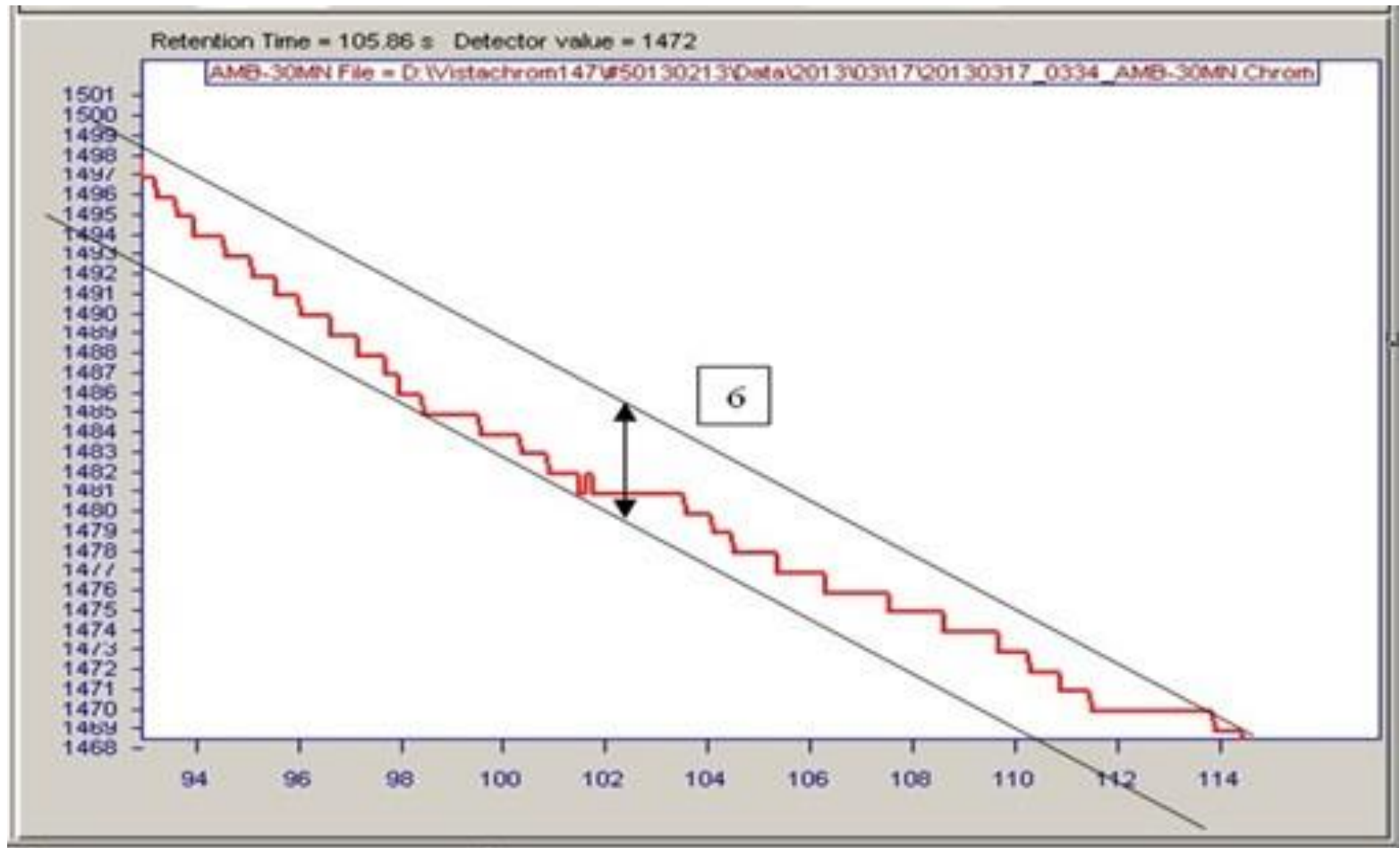
- The short-term noise must not be increased
- The baseline shape needs to enable integration

→ Limit of quantification calculation :

$$\text{LOQ (ppt)} = \frac{\text{Minimum area} * \text{N-Butane concentration (ppt)}}{\text{N-Butane peak area}}$$

$$\text{LOQ (ng/m}^3\text{)} = \frac{\text{LOQ (ppt)} * \text{M (g/mol)}}{V_m \text{ (24.04 l/mol at 20}^\circ\text{C)}}$$

➤ Short-term noise

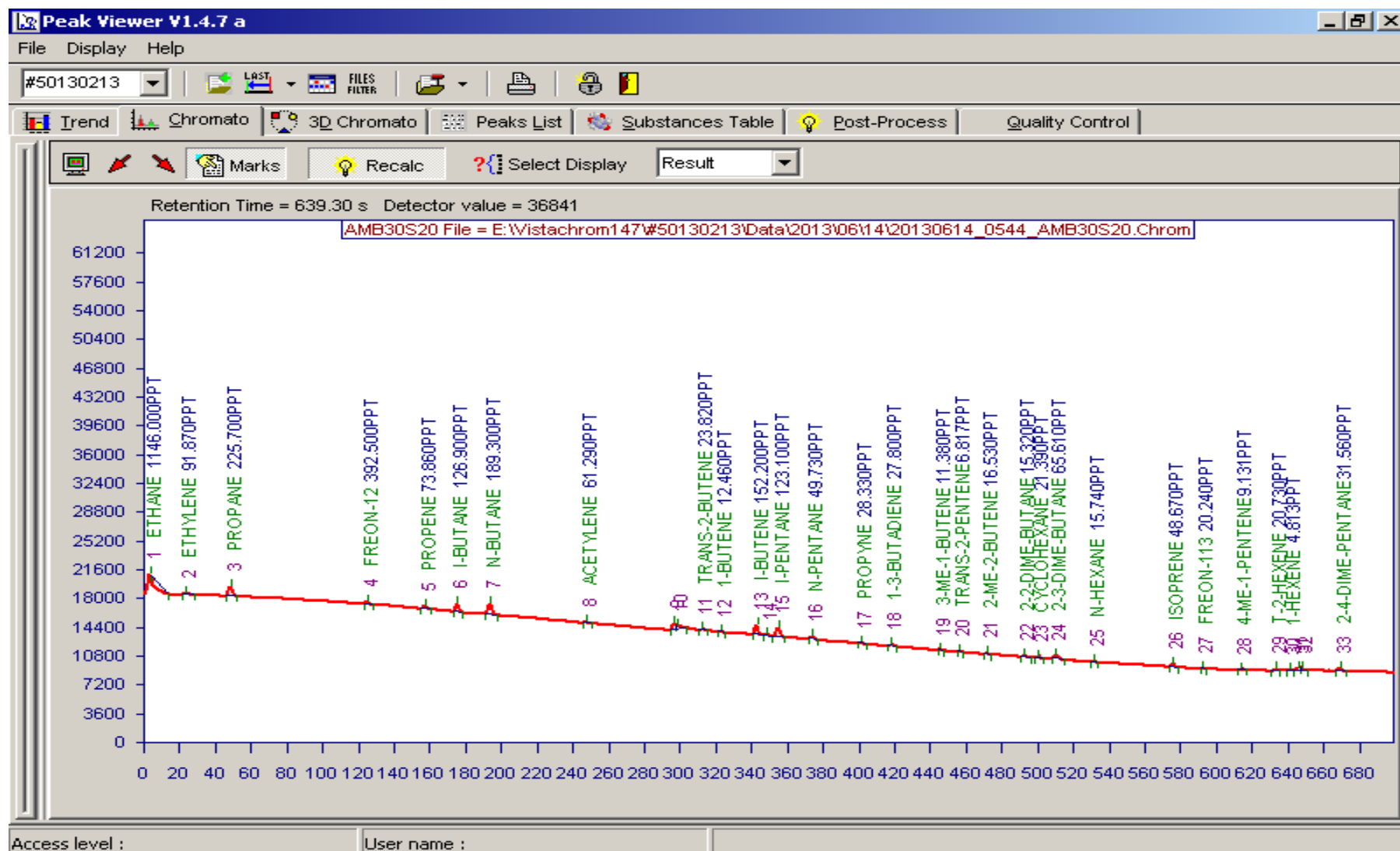


Detection system :	Classical FID	Expert FID
BS (N-Butane) Amplification 3	3870	37407
Short-term noise	5,8	6
Minimum area	25	25
LOQ (ng/m ³)	60,4	6,1
LOQ (ppt) N-Butane	24,99	2,54

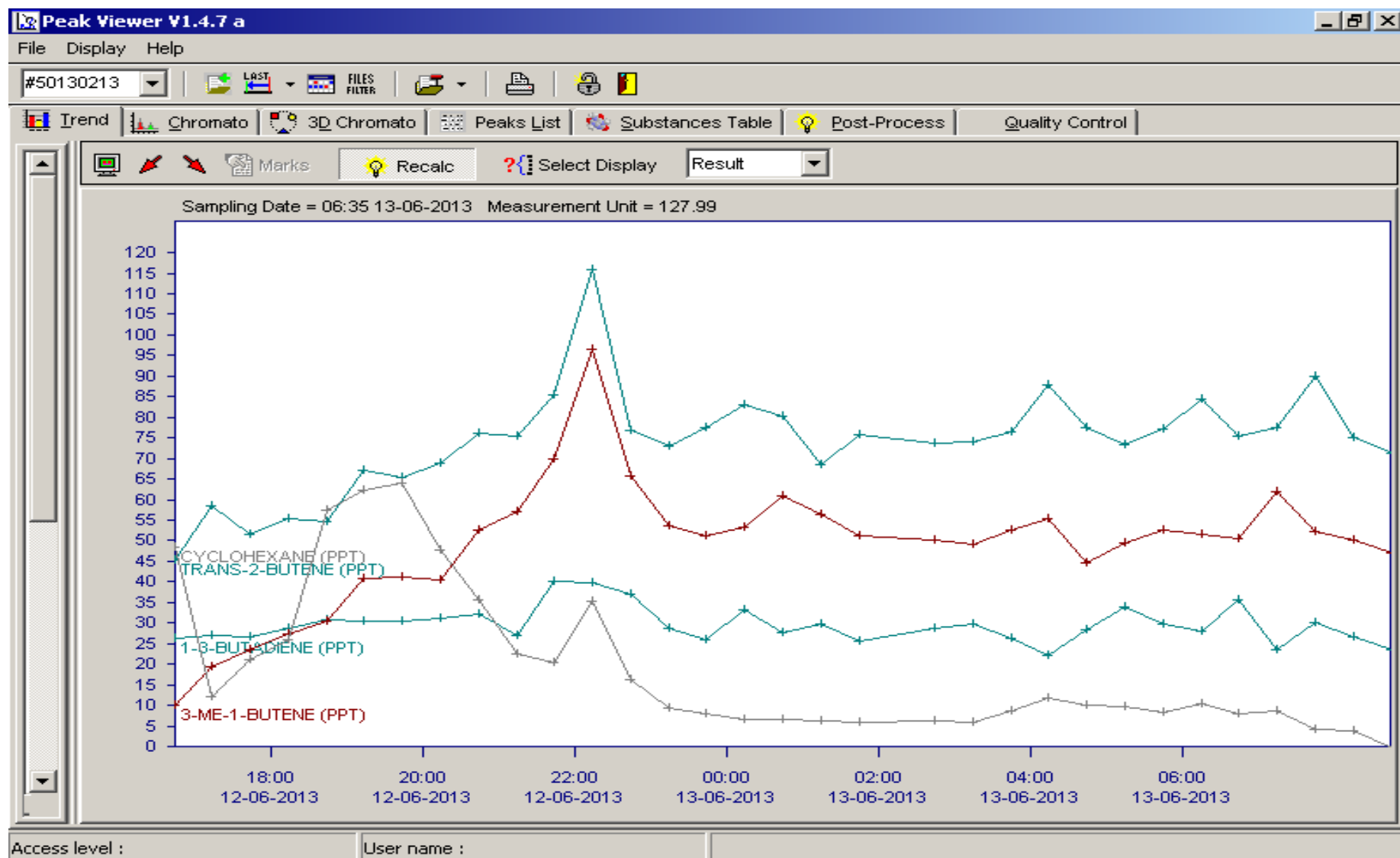
*Classical FID with expert FID comparison
(sample flow : 11ml/min ; sampling time : 10 min)*

→ Sensibility gain approximately equal to 10 without short-term noise damage

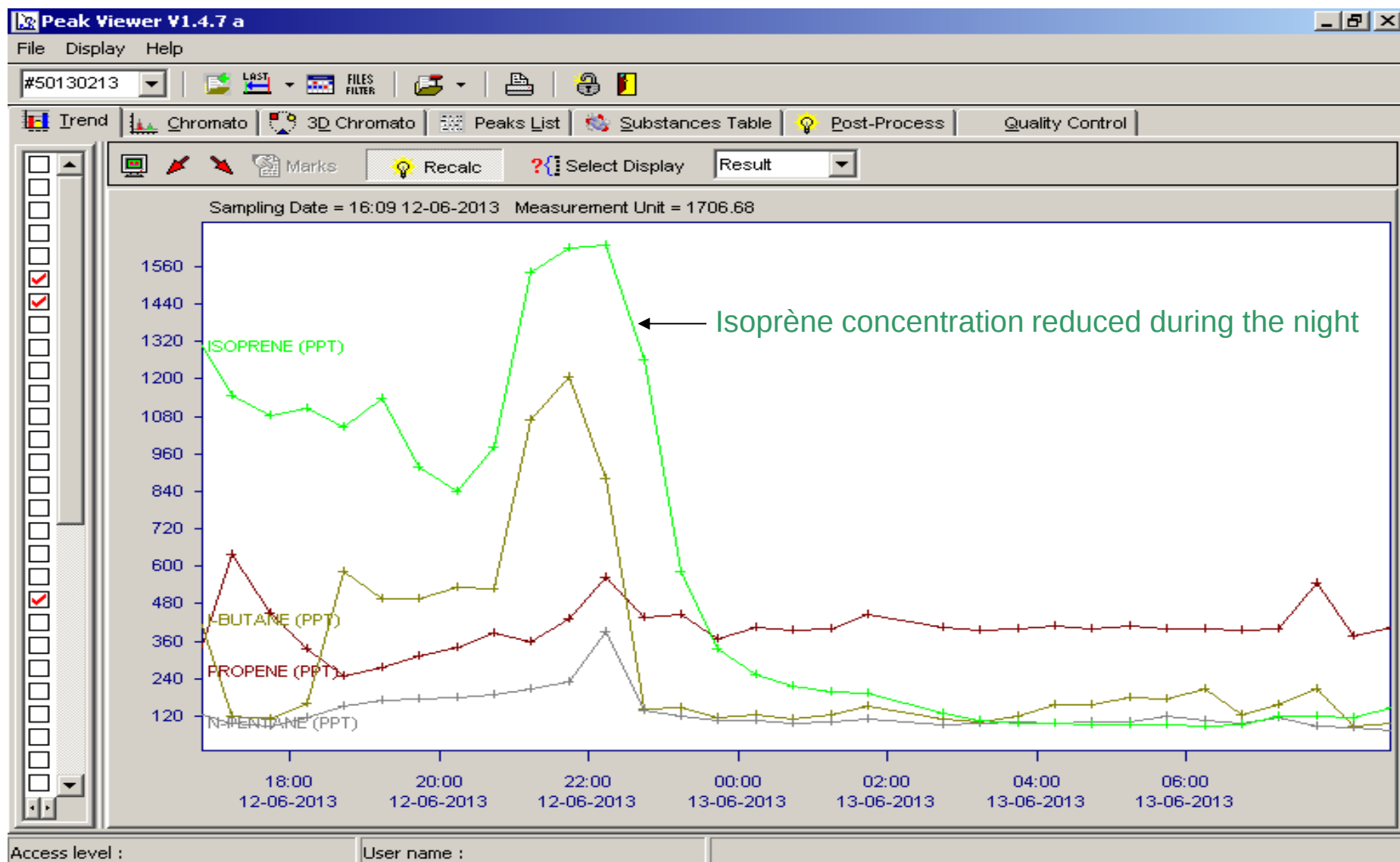
➤ Chromatogram example



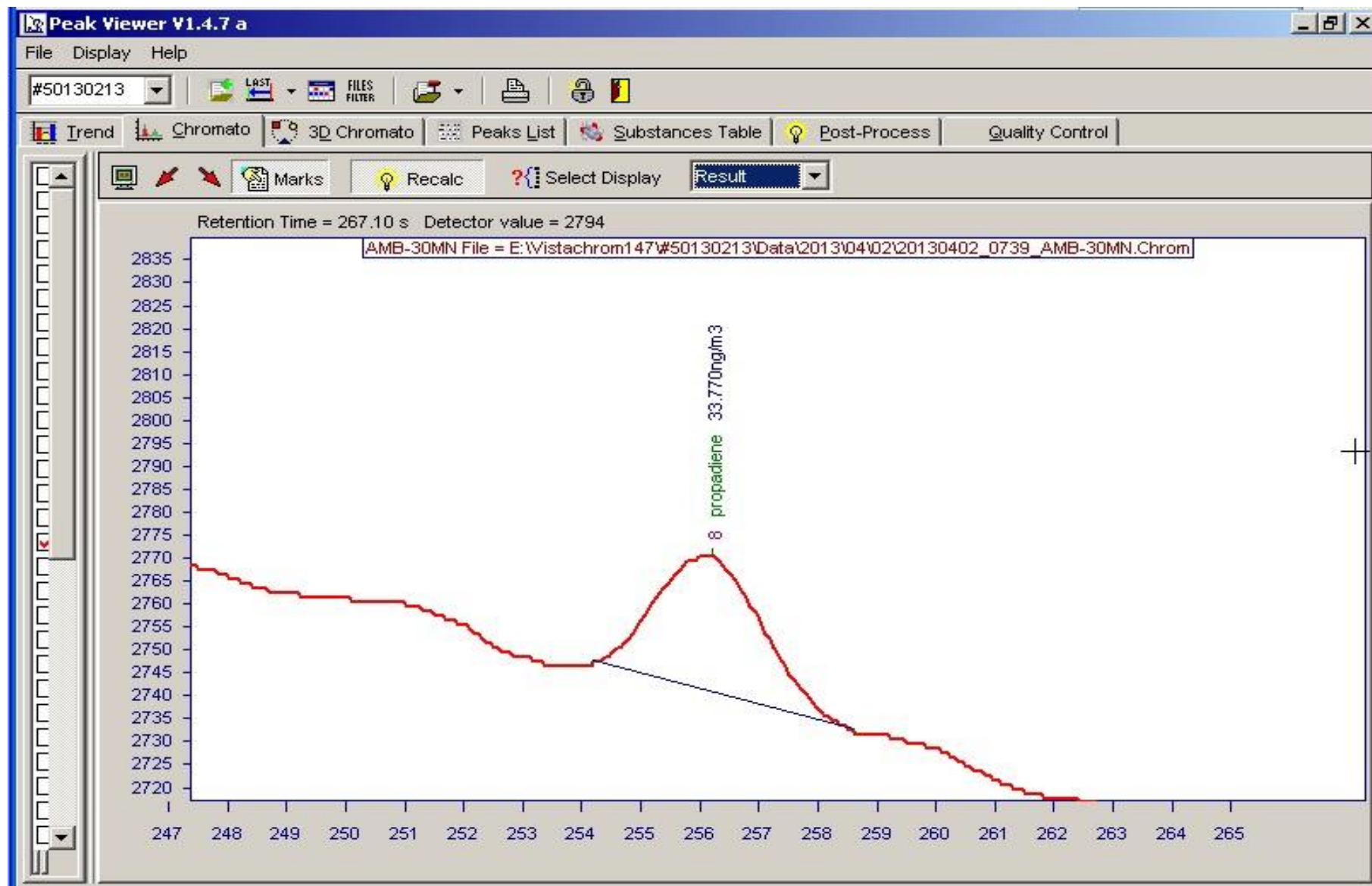
➤ Trend for low chemical concentrations



➤ Application example



➤ New substance



V. Conclusion

Sample flow (ml/min)	Optimum sampling time (min) for c_2 to c_6 compounds	FID expert LOQ (ng/m ³)
11	10	6.1 (= 2,54 ppt)

- FID expert sensibility gain equal to 10: validated
 - without short-term noise damage
 - Linearity verified
- **C₃ to C₆** compounds : possibility of trapping until 20 min → LOQ lowering factor 2
→ **LOQ = 3.05 ng/m³**



Thank you for your attention !