

Beyond Conventional IAQ Metrics: Individual Volatile Organic Compounds in Spanish Dwellings

M. Sacristán-Uña

GI.R. Arquitectura & Energía, Universidad de Valladolid, Spain
Institute of Sustainable Processes, Universidad de Valladolid, Spain

A. Meise, M.S. Montalusa-Mantilla, D. Guerra Díez, Poza-Casado I., R. Muñoz



Universidad
de Valladolid

1

MAIN OBJECTIVE

Characterize the Indoor Air Quality (IAQ) in Spanish dwellings based on alternative pollutants

5

Volatile Organic Compounds

**CONTINENTAL
CLIMATE**

29

Occupied dwellings

**WINTER
PERIOD**

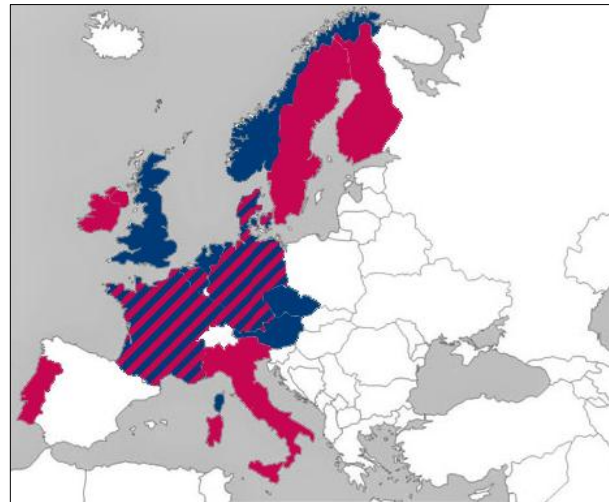


Universidad
de Valladolid

1

2

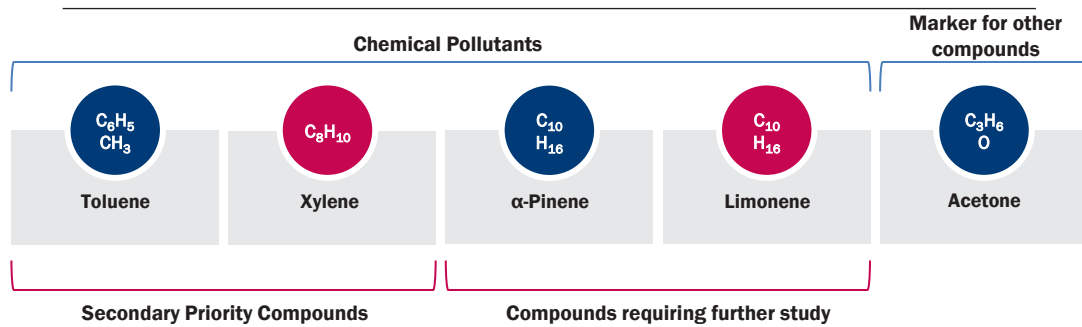
INTRODUCTION



■ ANNEX 68
■ INDEX project

3

INTRODUCTION

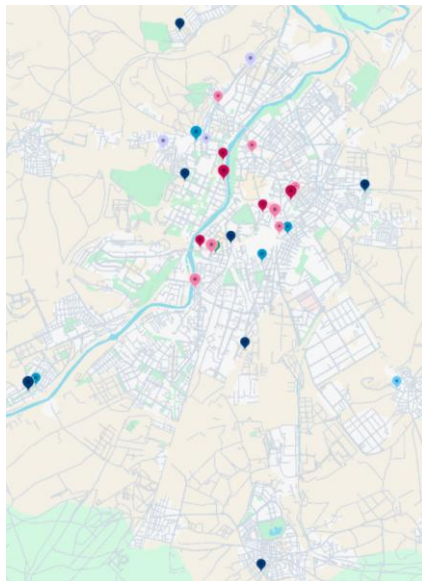


Risks to human health:

- α -Pinene: irritation with neurological symptoms.
- Toluene + Xylene: chronic exposure, effect on the central nervous system and respiratory effects
- Limonene: irritation, headache and dizziness. Generate irritating oxidation products.

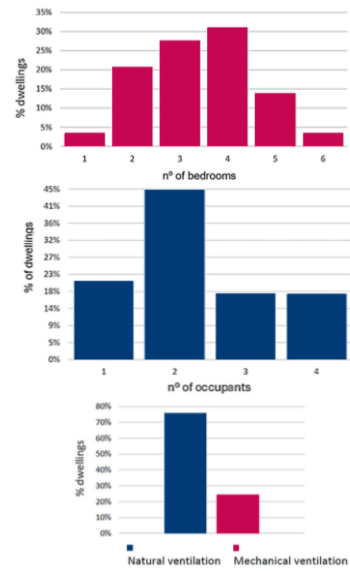
4

INTRODUCTION



Construction period

- 1900-1919
- 1960-1969
- 1970-1979
- 1980-1989
- 1990-1999
- 2000-2010
- 2010-2019
- 2020-2025



5

METHODS



Kitchen



Living room



Master bedroom

3

Rooms per dwelling

**ADSORPTION
TUBES**

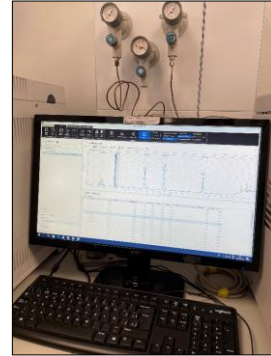
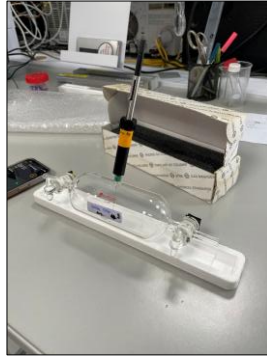
**VACUUM
PUMP**

5

min / room

6

METHODS



Institute of
**Sustainable
Processes**

SPME-GC-FID
techniques

<24 hours
of collection

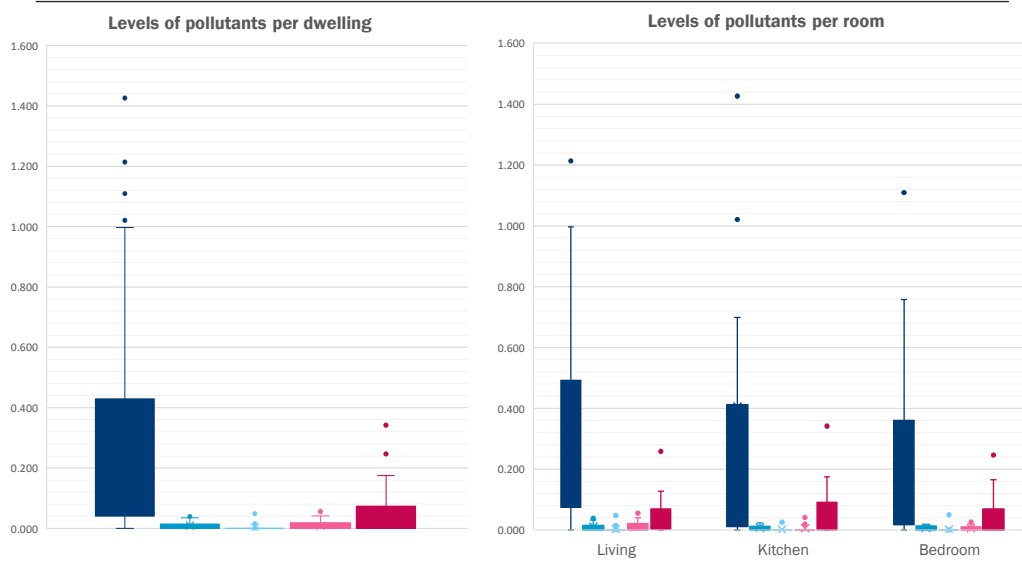


Universidad
de Valladolid

6

7

RESULTS



Universidad
de Valladolid

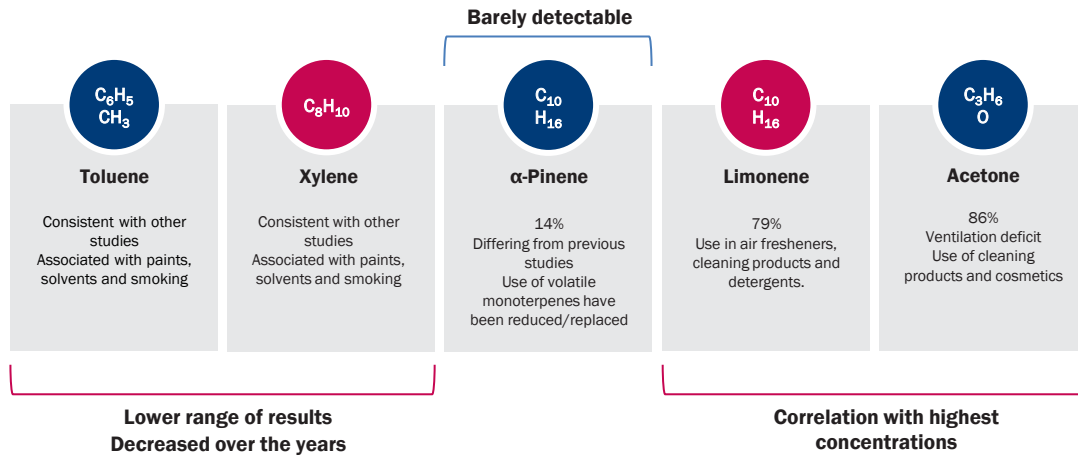
■ Acetone (µg/m³) ■ Toluene (µg/m³) ■ α-Pinene (µg/m³) ■ Xylene (µg/m³) ■ Limonene (µg/m³)

7

8

Results

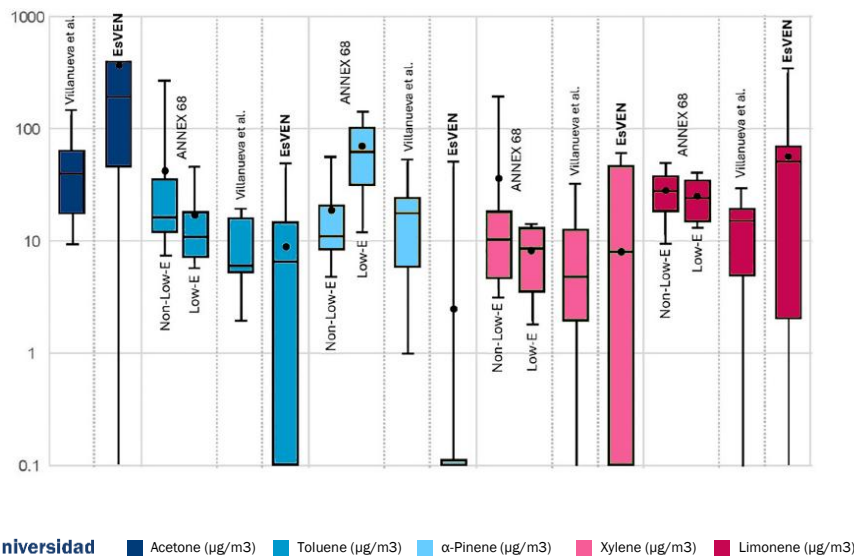
Preliminary analysis



9

RESULTS

Comparative levels of pollutants between projects



10

CONCLUSIONS

Findings of the study

VARIABILITY
DEPENDING
DWELLINGS

DIRECT EMISSION
SOURCES

VENTILATION

Limitations of the study

SAMPLE SIZE

MEASURED
VOCS

LOCATION



Universidad
de Valladolid

10

11

RESEARCH PAPER

Results in Engineering 29 (2026) 110018



Contents lists available at ScienceDirect
Results in Engineering
journal homepage: www.sciencedirect.com/journal/results-in-engineering



Research paper

Assessment of VOCs concentrations in Spanish dwellings: Acetone, toluene, xylene, α -pinene and limonene

A. Meiss^{a,*}, M.S. Montaluisa-Mantilla^b, D. Guerra-Díez^a, I. Poza-Casado^a, R. Muñoz^b

^a G.R. Arquitectura & Energía, Universidad de Valladolid, Spain
^b Institute of Sustainable Processes, Universidad de Valladolid, Spain

ARTICLE INFO

Keywords:
IAQ
Ventilation
Health
Pollutants
Dwellings

ABSTRACT

The presence of certain Volatile Organic Compounds (VOCs) indoors represents a potential concern for occupant health, especially in dwellings with limited ventilation. In this context, the study analyzed the presence of five health-related VOCs (Acetone, Toluene, Xylene, α -Pinene, and Limonene) in Spanish dwellings. This research addresses a significant data gap, as Spain did not participate in similar European indoor air quality campaigns (INDEX or IEA-ERC Annex 60 project). The main objective of the study was to characterize the indoor air quality in these dwellings and compare the findings with comparable data.

The concentrations of these pollutants were measured in different rooms of 29 occupied dwellings located in a continental climate in Spain during the winter period, using solid-phase microextraction coupled with gas chromatography with a flame ionization detector (SPME-GC-FID), under typical winter conditions of reduced ventilation. The results revealed the widespread presence of some compounds in most dwellings, while others were only occasionally detected, associated with specific household activities. The main sources identified were cleaning products, cosmetics, and furnishings. Acetone and Limonene showed the highest concentrations, consistent with their frequent household use, while Toluene and Xylene demonstrated lower levels consistent with the decline in their traditional sources (paints, solvents, tobacco); α -Pinene, meanwhile, was detected at very low levels, possibly due to recent changes in household product formulations. These findings emphasize the importance of ventilation, especially during winter, in reducing VOC accumulation and highlight the need to broaden the regulatory focus on indoor air quality beyond carbon dioxide.

<https://doi.org/10.1016/j.rineng.2026.110018>



Universidad
de Valladolid

11

12

THANK YOU FOR YOUR ATTENTION

marta.sacristan.una@uva.es

Research project "**Ventilación inteligente para una calidad del aire interior saludable en las viviendas españolas (EsVEN)**", PID2022-142104OB-I00, funded by the Ministry of Science and Innovation of the Government of Spain.

I would like to thank the European Social Fund Plus, Programa Operativo Castilla y León, and Junta de Castilla y León, through the Department of Education, for their funding.