

## Investigating the influence of human presence and selected activities on concentrations of airborne constituents

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### Introduction

Studies have suggested that the presence of human beings in an enclosed environment can significantly impact the quality of the air. For example, emissions from exhaled breath and skin influence the concentrations of certain airborne volatile organic compounds (VOC). This influence increases considerably when humans perform different activities of daily living, such as eating and drinking or simply using toiletries. To understand the influence of these parameters on the concentrations of selected airborne constituents, a study was performed under simulated residential conditions (0.5 h<sup>-1</sup>) in an environmentally controlled exposure room (indoor air quality room; IAQ room).

#### Research question:

How do prolonged human presence and certain activities of daily living influence the concentrations of carbonyls, VOCs, total volatile organic compounds (TVOC), CO, NO, and NO<sub>x</sub>?

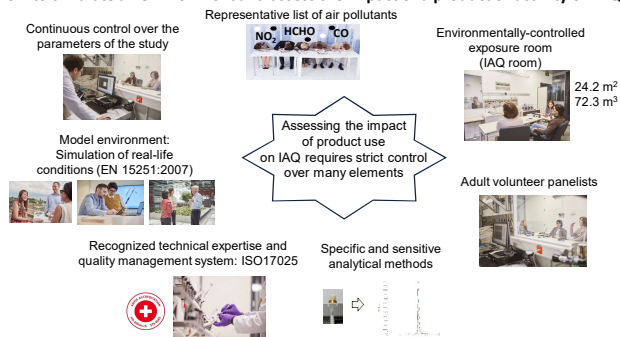
#### Parameters studied:

- Human presence
- Human activities

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### Methods

#### How to simulate an environment and assess the impact of a product or activity on IAQ?



### Results and Discussion

#### Does the presence of people make a difference?

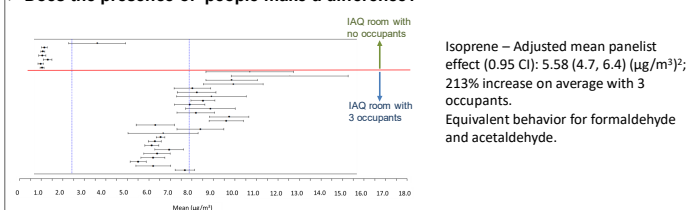


Figure 1: Meta-analysis of isoprene levels in indoor air.

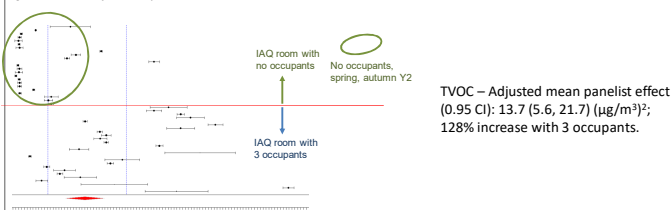


Figure 2: Meta-analysis of TVOC levels in indoor air.

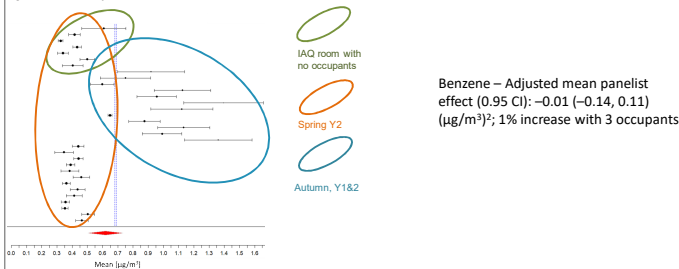
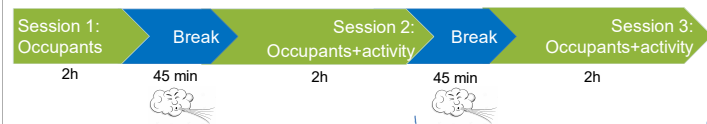


Figure 3: Meta-analysis of benzene levels in indoor air.

#### Do human activities make a difference?



#### Screening: One experiment per activity

> 3 occupants, 2-hour sessions, 0.5 air changes/hour

> Selected activities: drinking wine, sport, using toiletries, and preparing and eating Raclette (melted cheese meal & meat)

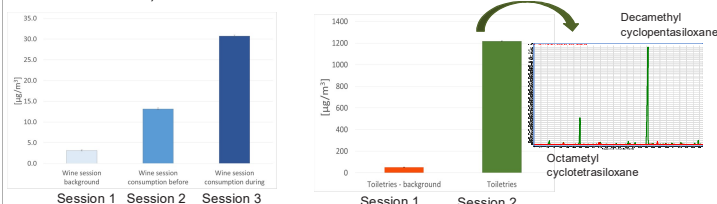


Figure 4: Airborne acetaldehyde concentrations during session with drinking wine.

Figure 5: Airborne TVOC concentrations during session with using toiletries.

Increased concentrations (>300% and >850%) of acetaldehyde; roughly 90% of ethanol is metabolized to acetaldehyde by the human body.

Increased concentrations of acetaldehyde (74%), formaldehyde (20%), and TVOCs (2222%)

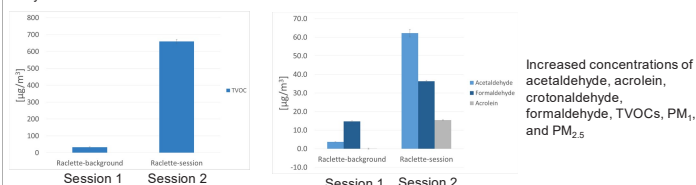


Figure 6: Airborne TVOC, acetaldehyde, formaldehyde, and acrolein concentrations during session with preparing and eating raclette and meat.

Guideline: 140 µg/m<sup>3</sup> for acetaldehyde (OEHA), 0.35 µg/m<sup>3</sup> for acrolein (OEHA), 100 µg/m<sup>3</sup> for formaldehyde (WHO), and 400 µg/m<sup>3</sup> for TVOC (Japan).

#### Impact of common sources on IAQ

Compound	Unit	Three lights	Incense	Cigarettes	THS2.2	Cessation device	MESH	Wine before	Wine during	Sport	Toiletries	Raclette + meat
UWPM-THBP	nm	13.9	32.9	37.7	nm	nm	nm	nm	nm	nm	nm	nm
PM-10	µg/m <sup>3</sup>	3.62	20.4	4.20	1.15	0.32	0.78	nm	nm	nm	nm	nm
Nicotine	nm	nm	49.8	8.60	nm	nm	nm	nm	nm	nm	nm	nm
Acetaldehyde	nm	22.2	122	26.2	3.44	nm	nm	10.0	27.6	2.66	3.69	3.45
Acrolein	nm	0.86	1.57	0.40	nm	nm	nm	1.60	10.5	2.29	21.6	2.06
Formaldehyde	nm	29.0	34.4	9.71	nm	nm	nm	1.60	10.5	2.29	21.6	2.06
Acrylonitrile	nm	0.68	1.21	1.23	nm	nm	nm	nm	nm	nm	nm	nm
Benzene	nm	11.6	17.6	4.17	nm	nm	nm	nm	nm	nm	nm	nm
1,3-Butadiene	nm	9.05	164	39.9	nm	nm	nm	2.54	3.88	nm	1.71	nm
Isoprene	nm	11.6	25.2	5.35	nm	nm	nm	nm	nm	nm	nm	nm
Toluene	nm	32.2	10.2	33.4	nm	nm	nm	41.4	5.18	51.1	43.8	10.2
TVOC	nm	32.2	10.2	33.4	11.3	nm	nm	79.2	nm	nm	nm	nm
Glycerin	nm	nm	30.3	3.2	nm	nm	nm	126	nm	nm	nm	nm
Propylene glycol	nm	nm	60.5	15.1	nm	nm	nm	nm	nm	nm	nm	nm
CO	nm	309	1497	2990	611	nm	nm	37.7	83.7	nm	nm	nm
NO	nm	70.8	13.7	71.8	nm	nm	nm	nm	nm	nm	nm	nm
NO <sub>2</sub>	nm	12.7	21.0	34.5	nm	nm	nm	nm	nm	nm	nm	nm
PM <sub>1</sub>	nm	nm	68.7	12.3	nm	nm	nm	nm	nm	nm	nm	441
PM <sub>2.5</sub>	nm	nm	68.7	12.3	nm	nm	nm	nm	nm	nm	nm	450

Combustible products: 3 tea-lights, 1 incense stick, 12 cigarettes, 2 cigarettes. THS2.2, cessation device, MESH: 12 items per session

### Conclusions

- > Assessing the specific impact of a product or activity requires a controlled environment and strict protocols.
- > Many elements/activities contribute to IAQ. Depending on the activity or product, the influence can be significant.
- > Human presence influences the levels of air pollutants: strong effect for isoprene and TVOCs and mild for formaldehyde and acetaldehyde.
- > Normal recreational or daily living activities, such as cooking, drinking wine, using cosmetics, or using combustible products indoors, lead to an increase in the levels of several harmful airborne constituents.
- > Interpretation of the data and sources of variability is critical for drawing the right conclusions.
- > In a real-life environment, the impact on overall IAQ from the use of smoke-free products as well as any activity performed during the measurements has to be monitored carefully for proper identification of the main source of pollution.

Competing Financial Interest: The research described in this poster was performed by Philip Morris International