Indoor Air Chemistry:

Assessment of environmental aerosol generated by Tobacco Heating System 2.2

This appendix to the Philip Morris Products S.A. Technical & Scientific Dossier For the Electrically Heated Tobacco Product (EHTP) as part of the Tobacco Heating System (THS), Version 2.0, dated 27 May 2016, has been reformatted for publication on pmiscience.com.

Indoor Air Chemistry
Assessment of environmental aerosol generated by Tobacco Heating System 2.2.

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Introduction

PMI's heat-not-burn product THS2.2 does not generate side-stream and generates significantly lower levels of harmful and potentially harmful constituents in mainstream aerosol compared to conventional cigarettes smoke.
The objective of this study was to assess the impact of THS2.2 on Indoor Air Chemistry (IAC) based on specific markers of Indoor Air Quality (IAQ) using dedicated room.

Study Design

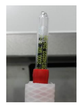
- Four model environmental conditions (EN 15251:2007).

Model Environment	Ventilation [m^3/h]	Air change [L/h]	# of smokers	Cig/pers/h	Cig/h
Office	156	2.16	2	2	4
Hospitality	555	7.68	4	2	8
Residential I/II	121/87	1.68/1.20	2	1.5	3

- Eighteen IAQ markers: Environmental Tobacco Smoke (ETS) markers (e.g. RSP, UVPM-FPM, nicotine), Carbonyls, Volatile Organic Compounds (VOCs), Gases.
- All methods were ISO 17025 accredited.
- Products: Marlboro Gold (MLG), THS2.2, Background (BKG).
- Four hours collection, four trapping systems, on-line measurement for gases.

RSP, UVPM-THBP
FPM-scopoletin
Solanesol

Carbonyles

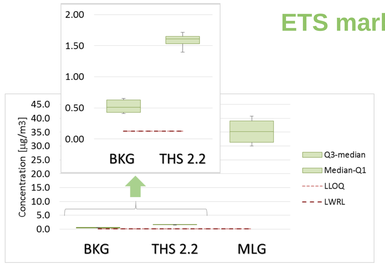


VOCs

3-Ethenylpyridine
Nicotine

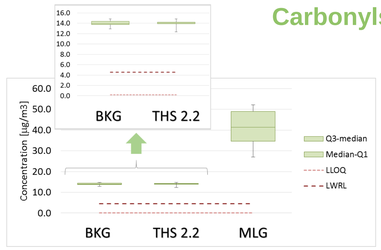
Impact on Indoor Air Quality

Case study: 'Office' environmental conditions



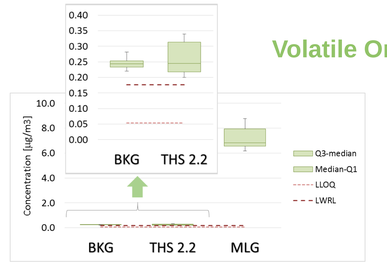
ETS markers: Nicotine

- Statistical increase of nicotine above BKG levels when using THS 2.2
- The median levels of nicotine are substantially lower than in ETS of MLG (THS 2.2: 1.10 µg/m^3; MLG: 34.7 µg/m^3)



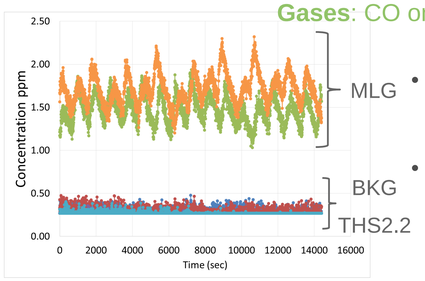
Carbonyls: Formaldehyde

- No statistical increase of formaldehyde above BKG levels when using THS 2.2



Volatile Organic Compounds: Benzene

- No statistical increase of benzene above BKG levels when using THS 2.2



Gases: CO on-line measurement

- BKG and THS2.2: median levels below Limit of Detection (LOD)
- ETS of MLG: several maxima, reflecting the smoking pattern of the panelists

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Analyte		THS2.2$_{adjusted}$ (THS2.2 – BKG) (-): THS2.2 equivalent to BKG			MLG$_{adjusted}$ (MLG – BKG) (*): BKG not subtracted (<LWRL)		
		Residential I/II	Office	Hospitality	Residential I/II	Office	Hospitality
ETS markers	RSP gravimetric [µg/m^3]	-	-	-	236*/268*	204*	147*
	UVPM-THBP [µg/m^3]	-	-	-	39.6*/40.8*	38.5*	18.4*
	FPM-scopoletin [µg/m^3]	-	-	-	8.05*/8.50*	7.88*	4.04*
	Solanesol [µg/m^3]	-	-	-	10.2*/9.84*	10.2*	4.68*
	3-Ethenylpyridine [µg/m^3]	-	-	-	6.02*/7.61*	6.39*	3.94*
	Nicotine [µg/m^3]*	0.69 /1.81	1.10	0.66	29.7/29.1	34.7	34.6
Carbonyls	Acetaldehyde [µg/m^3]	2.66/5.09	3.65	1.40	70.2/83.8	58.8	33.1
	Acrolein [µg/m^3]	-	-	-	6.94*/5.65*	6.42*	3.03*
	Crotonaldehyde [µg/m^3]	-	-	-	2.19*/2.11*	2.04*	0.99*
	Formaldehyde [µg/m^3]	-	-	-	27.1/35.5	28.9	17.5
VOCs	Acrylonitrile [µg/m^3]	-	-	-	2.53*/3.61*	2.61*	1.36*
	Benzene [µg/m^3]	-	-	-	7.09/9.24	6.58	3.40
	1,3-Butadiene [µg/m^3]	-	-	-	13.0*/16.8*	12.6*	5.79*
	Isoprene [µg/m^3]	-	-	-	71.5/99.4	75.9	37.0
	Toluene [µg/m^3]	-	-	-	11.1/26.1	14.9	8.76
Gases	Carbon monoxide [ppm]	-	-	-	1.63*/2.17*	1.59*	<0.92*
	Nitrogen oxide (NO) [ppb]	-	-	-	26.2/35.6	27.0	14.8
	Nitrogen oxides (NOx) [ppb]	-	-	0.52**	29.4/39.7	29.4	15.0

*Mainstream aerosol data (HC Intense): Nicotine: 1.32 mg/stick (THS2.2); 1.61 mg/cig (MLG). Acetaldehyde: 219 µg/stick (THS2.2); 1123 µg/cig (MLG). NOx: 17.3 µg/stick (THS2.2); 345 µg/cig (MLG). **: measured only once (potential contamination from external source)

Irrespective of the environmental conditions applied, only 2 compounds were exceeding BKG levels following the use of THS 2.2: nicotine and acetaldehyde. This increase was only slight for THS 2.2 compared to BKG and 1 or 2 order of magnitude lower than those measured for MLG. The measured indoor air concentrations for nicotine and acetaldehyde after use of THS 2.2 are much lower than maximum exposure levels as defined in existing air quality guidelines.
In light of the above, we can concluded that THS2.2 is not a source of ETS and that using THS 2.2 indoor does not have a negative impact on air quality.

Coming next: Exploratory study on e-cigarettes showed that the IACs were influenced by the amount of consumed e-liquid. Nicotine levels increased above BKG in environmental aerosols of all studied brands. However, the median levels of nicotine were below those obtained for THS2.2, while the spread values (25th and 75th percentile) had comparable range for both products. The carbonyls or other ETS marker were not exceeding background levels.

PMI RESEARCH & DEVELOPMENT

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