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ilac-MRA DANAK TEST Reg.nr. 522

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VOC TEST REPORT
Indoor Air Comfort®

20 October 2015

1 Sample Information

Sample identification	392-2015-00267401
Sample name	Printed Now-Woven Wallcovering
Batch no.	20152212A
Production date	26august 2015
Product type	Wall covering
Sample reception	04/09/2015

2 Brief Evaluation of the Results

Regulation or protocol	Conclusion	Version of regulation or protocol
French VOC Regulation	A+	Regulation of March and April 2011 (DEVL1101903D and DEVL1104875A)
French CMR components	Pass	Regulation of March and April 2011 (DEVL1101903D and DEVL1104875A)
AgBB	Pass	AgBB of February 2015. DIBt of October 2010
Belgian Regulation	Pass	Royal decree of May 2015 (C-2014/24239)
Indoor Air Comfort®	Pass	Indoor Air Comfort 5.3a of March 2015
EN 717-1§	E1	2004

Full details based on the testing and direct comparison with limit values is available in the following pages

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3 Applied Test Methods

3.1 General Test References

Regulation, protocol or standard	Version	Reporting limit VOC [µg/m³]	Calculation of TVOC	Combined uncertainty¤ [RSD(%)]
CEN/TS 16516	October 2013	5	Toluene equivalents	22.5%
ISO 16000 -3 -6 -9 -11	2006-2011 depending on part	2	Toluene equivalents	22.5%
French VOC	Regulation of March and April 2011 (DEVL1101903D and DEVL1104875A)	2	Toluene equivalents	22.5%
AgBB/DIBt	February 2015/October 2010	5	Compound Specific	22.5%
Belgian VOC	Royal decree of May 2015 (C - 2014 / 24239)	5	Toluene equivalents	22.5%
EN 717-1§	2004	-	(Formaldehyde only)	22.5%

3.2 Specific Laboratory Sampling and Analyses

Parameter	External Method	Internal S.O.P.	Quantification limit	Analytical principle	Uncertainty¤ [RSD(%)]
Sample preparation	ISO 16000-11:2006, EN16402:2013, CDPH, AgBB/DIBt, EMICODE	71M549810	-	-	5%
VOC emission chamber testing	ISO 16000-9:2006, CEN/TS 16516:2013	71M549811	-	Chamber and air control	5%
Sampling of VOC	ISO 16000-6:2011, CEN/TS 16516:2013	71M549812	5 L	Tenax TA	5%
Analysis of VOC	ISO 16000-6:2011, CEN/TS 16516:2013	71M542808B	1 µg/m³	ATD-GC/MS	10%
Sampling of aldehydes	ISO 16000-3:2011, CEN/TS 16516:2013	71M549812	35 L	DNPH	5%
Analysis of aldehydes	ISO 16000-3:2011, EN 717-1, CEN/TS 16516:2013	71M548400	3-6 µg/m³	HPLC-UV	10%
Sampling of phthalates	ISO 16200-1, MEL-09, OSHA CSI	71M549812	60 L	XAD-2	5%
Analysis of phthalates*	CPSC-CH-C1001-09.3 (2010)	71M546060	0.6 µg/m³	GC/MS	10%

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4 Test Parameters, Sample Preparation and Deviations

4.1 VOC Emission Chamber Test Parameters

Parameter	Value	Parameter	Value
Chamber volume, V[L]	119	Preconditioning period	-
Air Change rate, n[h^{-1}]	0.5	Test period	09/09/2015 - 07/10/2015
Relative humidity of supply air, RH [%]	50 ± 3	Area specific ventilation rate, q [m/h or $m^3/m^2/h$]	0.5
Temperature, T [°C]	23 ± 1	Loading factor [m^2/m^3]	1

4.2 Preparation of the Test Specimen

Edges and back were covered with aluminium foil and aluminium tape.

4.3 Picture of Sample



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4.4 Deviations from Referenced Protocols and Regulations

No deviations from the referenced test methods were observed except the general deviations.

4.4.1 General Deviations

Method	Deviation details	Impact on results or correction
EN 717-1§	Sampling flow on DNPH was 300 mL/min. The RH% in the supply air to the chamber was 50 ± 3% and not 45 ± 3% during the test. The temperature was 23 ± 1°C and not 23 ± 0.5°C. The air change rate was 0.5/h and not 1/h. The sample was tested without open edges unless elsewise stated under sample preparation.	Formaldehyde concentration can be expected to be slightly overestimated compared to EN 717-1 due to the higher RH% and lower air change rate in ISO 16000-9. The E1 limit value of 120 µg/m³ has been recalculated to SER_A of 120 µg/m²/h and compared with the detected SER_A (in accordance with conclusion presented in CEN TC351 WG2 N174).

5 Results

5.1 VOC Emission Test Results after 3 Days

	CAS No.	Retention time [min]	ID-Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²*h)]	R_D	R_B
VOC with NIK								
1,2-Propandiol (Propylene glycol)	57-55-6	3.55	1	1200	230	580	0.46	0.46
2-Ethyl-1-hexanol	104-76-7	8.91	1	98	72	49	0.33	0.18
2-Ethylhexyl acetate	103-09-3	10.49	1	9.7	8.6	4.8	0.028	0.014
2-Ethylhexyl acrylate	103-11-7	11.41	1	16	14	7.9	0.042	0.042
Texanol *	25265-77-4	12.99	1	13	12	6.3	0.021	0.021
Sum of VOC with NIK				1300	330	640		
VOC without NIK								
None determined								
Sum of VOC without NIK				< 5	< 5	< 3		
TVOC				1300	330	640		
VVOC compounds								
None determined								
TVVOC				< 5	< 5	< 3		
SVOC compounds								
None determined								
TSVOC				< 5	< 5	< 3		
Carcinogens								
Total carcinogens				< 1	< 1	< 1		
Aldehydes								
Formaldehyde	50-00-0		1	< 3	-	< 2		
Acetaldehyde	75-07-0		1	< 3	-	< 2		
Propionaldehyde	123-38-6		1	< 3	-	< 2		
Butyraldehyde	123-72-8		1	< 3	-	< 2		
R-values							0.88	0.72

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5.2 VOC Emission Test Results after 28 Days

	CAS No.	Retention time [min]	ID-Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²*h)]	R_D	R_B
VOC with NIK								
1,2-Propandiol (Propylene glycol)	57-55-6	3.44	1	80	21	40	0.032	0.032
2-Ethyl-1-hexanol	104-76-7	8.89	1	17	13	8.7	0.058	0.032
Sum of VOC with NIK				98	33	49		
VOC without NIK								
None determined								
Sum of VOC without NIK				< 5	< 5	< 3		
TVOC				98	33	49		
VVOC compounds								
None determined								
TVVOC				< 5	< 5	< 3		
SVOC compounds								
None determined								
TSVOC				< 5	< 5	< 3		
Carcinogens								
Total carcinogens				< 1	< 1	< 1		
CMR substances								
Benzene	71-43-2		1	< 1	-	< 1		
Trichloroethylene	79-01-6		1	< 1	-	< 1		
Dibutylphthalate (DBP)*	84-74-2		1	< 1	-	< 1		
Diethylhexylphthalate (DEHP)*	117-81-7		1	< 1	-	< 1		
Aldehydes								
Formaldehyde	50-00-0		1	< 3	-	< 2		
Acetaldehyde	75-07-0		1	< 3	-	< 2		
Propionaldehyde	123-38-6		1	< 3	-	< 2		
Butyraldehyde	123-72-8		1	< 3	-	< 2		
R-values							0.090	0.064

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	CAS No.	Retention time [min]	ID-Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Specific SER [µg/(m²*h)]	R_D	R_B
TVOC (French label)					36			
Toluene	108-88-3			< 2	< 2	< 1		
Tetrachloroethylene	127-18-4			< 2	< 2	< 1		
Ethylbenzene	100-41-4			< 2	< 2	< 1		
Xylene	1330-20-7			< 2	< 2	< 1		
Styrene	100-42-5			< 2	< 2	< 1		
2-Butoxyethanol	111-76-2			< 2	< 2	< 1		
1,2,4-Trimethylbenzene	95-63-6			< 2	< 2	< 1		
1,4-Dichlorobenzene	106-46-7			< 2	< 2	< 1		

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6 Summary and Evaluation of the Results

6.1 Comparison with Limit Values of the French VOC Regulation

	CAS No.	Conc. 28 days µg/m³	 µg/m³	 µg/m³	 µg/m³	 µg/m³
TVOC	-	36	>2000	<2000	<1500	<1000
Formaldehyde	50-00-0	< 3	>120	<120	<60	<10
Acetaldehyde	75-07-0	< 3	>400	<400	<300	<200
Toluene	108-88-3	< 2	>600	<600	<450	<300
Tetrachloroethylene	127-18-4	< 2	>500	<500	<350	<250
Ethylbenzene	100-41-4	< 2	>1500	<1500	<1000	<750
Xylene	1330-20-7	< 2	>400	<400	<300	<200
Styrene	100-42-5	< 2	>500	<500	<350	<250
2-Butoxyethanol	111-76-2	< 2	>2000	<2000	<1500	<1000
1,2,4-Trimethylbenzene	95-63-6	< 2	>2000	<2000	<1500	<1000
1,4-Dichlorobenzene	106-46-7	< 2	>120	<120	<90	<60

The product was assigned a VOC emission class without taking into account the measurement uncertainty associated with the result. As specified in French Decree no. 2011-321 of March 23 2011, correct assignment of the VOC emission class is the sole responsibility of the party responsible for distribution of the product in the French market.

6.2 Comparison with Limit Values of the CMR Components

CMR substances	CAS No.	Conc. 28 days µg/m³	Max. allowed air concentration µg/m³
Benzene	71-43-2	< 1	< 1
Trichloroethylene	79-01-6	< 1	< 1
Dibutylphthalate (DBP)*	84-74-2	< 1	< 1
Diethylhexylphthalate (DEHP)*	117-81-7	< 1	< 1

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6.3 Comparison with Limit Values of AgBB

Parameter	Test after 3 days		Test after 28 days	
	Concentration mg/m³	Limit Value mg/m³	Concentration mg/m³	Limit Value mg/m³
TVOC	1.3	≤ 10	0.098	≤ 1.0
TSVOC	< 0.005	-	< 0.005	≤ 0.1
R-value (dimensionless)	0.88	-	0.090	≤ 1
Sum without NIK	< 0.005	-	< 0.005	≤ 0.1
Formaldehyde	-	-	< 0.003	≤ 0.1
Total carcinogens	< 0.001	≤ 0.01	< 0.001	≤ 0.001

Compliance with the limits alone does not entitle to use the AgBB requirements in conjunction with approval by DIBt. This requires an application, site inspection, and approval. See www.eurofins.com/dibt-procedures.

6.4 Comparison with Limit Values of the Belgian Regulation

Parameter	Test after 28 days	
	Concentration µg/m³	Limit Value µg/m³
TVOC	33	≤ 1000
TSVOC	< 5	≤ 100
R-value (dimensionless)	0.064	≤ 1
Total carcinogens	< 1	≤ 1
Toluene	< 5	≤ 300
Formaldehyde	< 3	≤ 100
Acetaldehyde	< 3	≤ 200

6.5 Comparison with Limit Values of EN 717-1[$]

Parameter	Concentration mg/m³	E2 mg/m³	E1 mg/m³
Formaldehyde 28 days	< 0.003	> 0.10	≤ 0.10

The formaldehyde result is based on chamber testing and DNPH sampling according to ISO 16000. The result is therefore not directly according to the EN 717-1, and there are a few small deviations from EN 717-1 (see section on general deviations). The testing is in accordance with conclusions presented in CEN TC351 WG2 N174 where the difference and compatibility between EN 717-1 and ISO 16000 are empirically and theoretically analysed. For results close to the limit value it is recommended to perform an EN 717-1 test for verification.

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6.6 Comparison with Limit Values of Indoor Air Comfort®

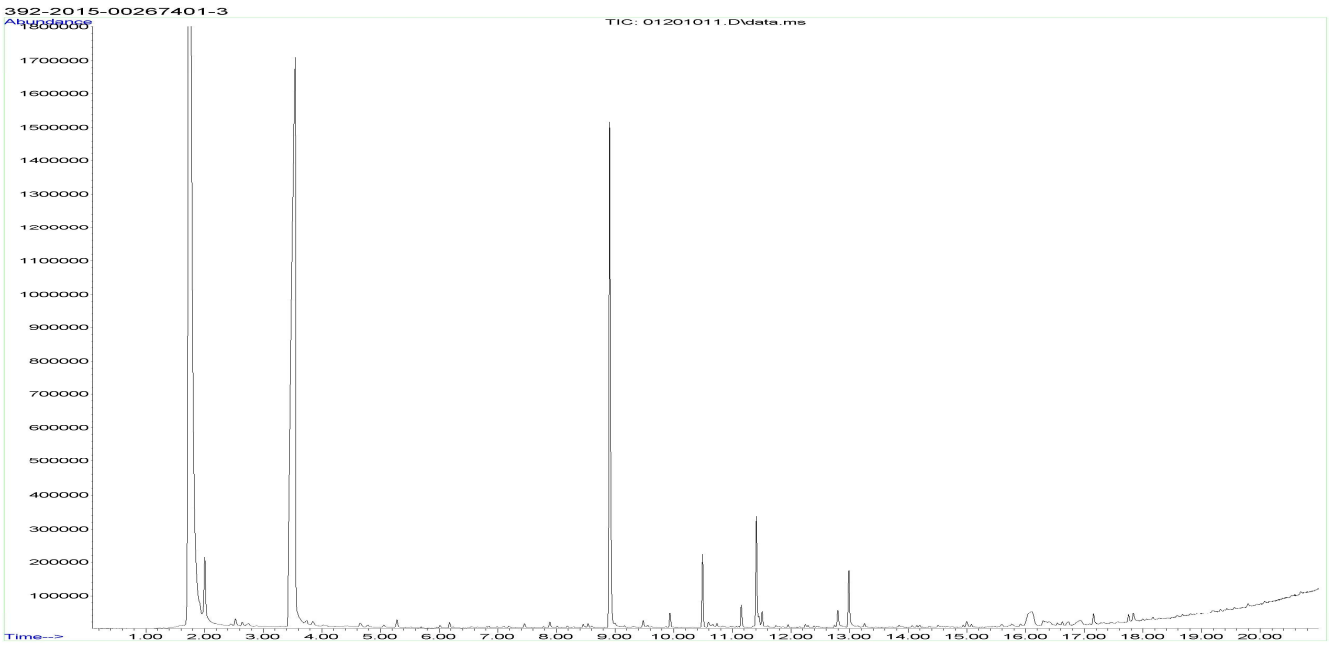
	Test after 3 days		Test after 28 days	
	Concentration µg/m³	**Limit Value** µg/m³	**Concentration** µg/m³	**Limit Value** µg/m³
TVOC (CEN/TS 16516)	330	≤ 10000	33	≤ 1000
TSVOC	< 5	-	< 5	≤ 100
R_D-value (NIK) (dimensionless)	0.88	-	0.090	≤ 1
R_B-value (LCI) (dimensionless)	0.72	-	0.064	≤ 1
TVOC without NIK or LCI	< 5	-	< 5	≤ 100
Total carcinogens	< 1	≤ 10	-	-
Any individual carcinogens	-	-	< 1	≤ 1
CMR substances	-	-	< 1	≤ 1
Formaldehyde	< 3	-	< 3	≤ 60
Acetaldehyde	< 3	-	< 3	≤ 200
French A+/A	-	-	Complies	

Compliance with the limits alone does not entitle to use the Indoor Air Comfort label. This requires an application, site inspection, and approval. See www.eurofins.com/iac-procedures.

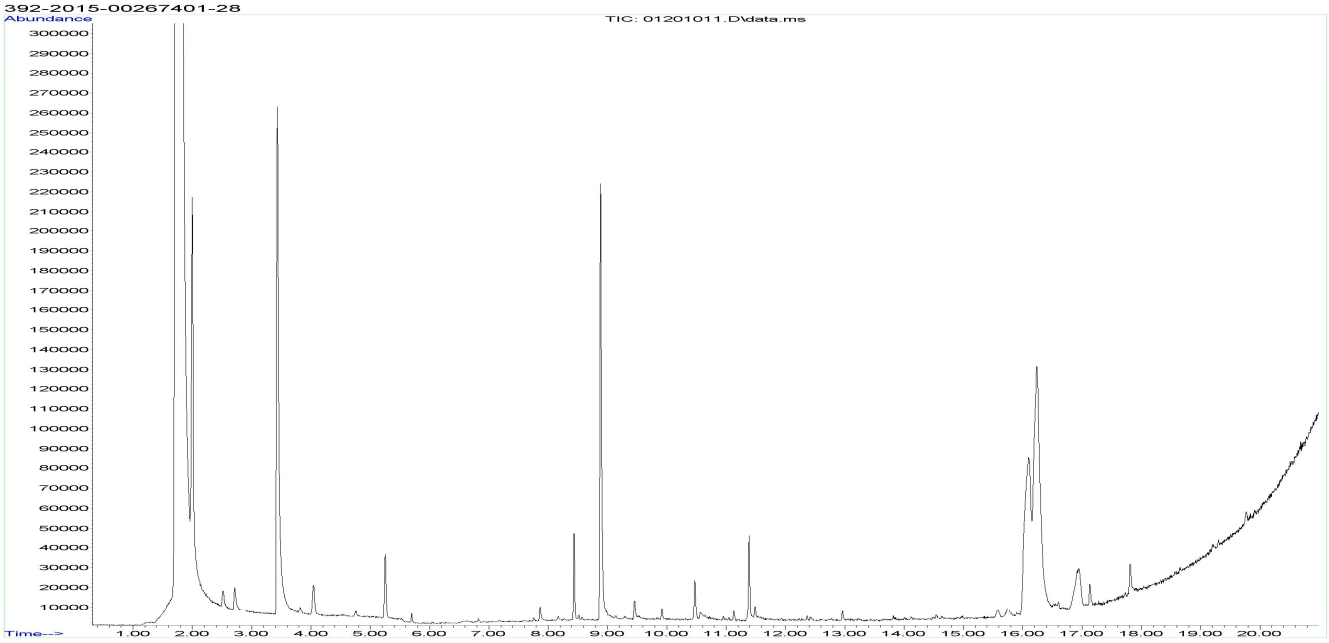
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7 Appendices

7.1 Chromatogram of VOC Emissions after 3 Days



7.2 Chromatogram of VOC Emissions after 28 Days



Please consider the different scales.

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7.3 How to Understand the Results

7.3.1 Acronyms Used in the Report

< Means less than

> Means bigger than (Tube/GC-MS overload)

* Not a part of our accreditation

¤ Um(%) is given as 2x RSD%. Please see section regarding Uncertainty in the Appendices.

§ Deviation from method. Please see deviation section

a The method is not optimal for very volatile compounds. For these substances smaller results and a higher measurement uncertainty cannot be ruled out.

b The component originates from the wooden panels and is thus removed.

c The results have been corrected by the emission from wooden panels.

d Very polar organic compounds are not suitable for reliable quantification using tenax TA adsorbent and HP-5 GC column. A high degree of uncertainty must be expected.

SER Specific emission rate.

7.3.2 Explanation of ID Category

Categories of Identity:

1: Identified and specifically calibrated

2: Identified by comparison with a mass spectrum obtained from library and supported by other information. Calibrated as toluene equivalent.

3: Identified by comparison with a mass spectrum obtained from a library. Calibrated as toluene equivalent.

4: Not identified, calibrated as toluene equivalent.

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7.4 Applied LCI and NIK Values

7.4.1 LCI/NIK Values for Compounds found after 3 Day Measurements

Compound	CAS No.	AgBB 2015 NIK [µg/m³]	Belgian NIK [µg/m³]
1,2-Propandiol (Propylene glycol)	57-55-6	2500	2500
2-Ethyl-1-hexanol	104-76-7	300	540
2-Ethylhexyl acetate	103-09-3	350	690
2-Ethylhexyl acrylate	103-11-7	380	380
Texanol *	25265-77-4	600	600

7.4.2 LCI/NIK Values for Compounds found after 28 Day Measurements

Compound	CAS No.	AgBB 2015 NIK [µg/m³]	Belgian NIK [µg/m³]
1,2-Propandiol (Propylene glycol)	57-55-6	2500	2500
2-Ethyl-1-hexanol	104-76-7	300	540

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7.5 Qualitative Description of VOC Emission Test

7.5.1 Test Chamber

The test chamber is made of stainless steel. A multi-step air clean-up is performed before loading the chamber, and a blank check of the empty chamber is performed.
The chamber operation parameters are as described in the test method section. (CEN/TS 16516, ISO 16000-9, internal method no.: 71M549811).

7.5.2 Expression of the Test Results

All test results are calculated as specific emissions rate, and as extrapolated air concentration in the European Reference Room (CEN/TS 16516, AgBB, EMICODE, M1 and Indoor Air Comfort).

7.5.3 Testing of Carcinogenic VOCs

The emission of carcinogens (EU Categories C1A and C1B, as per European law) is tested by drawing sample air from the test chamber outlet through Tenax TA tubes after the specified duration of storage in the ventilated test chamber. Analysis is performed by ATD-GC/MS (automated thermal desorption coupled with gas chromatography and mass spectroscopy using 30 m HP-5 (slightly polar) column with 0.25 mm ID and 0.25 µm film, Agilent) (CEN/TS 16516, ISO 16000-6, internal methods no.: 71M549812 / 71M542808B).

All identified carcinogenic VOCs are listed; if a carcinogenic VOC is not listed then it has not been detected. Quantification is performed using the TIC signal and authentic response factors, or the relative response factors relative to toluene for the individual compounds.

This test only covers substances that can be adsorbed on Tenax TA and can be thermally desorbed. If other emissions occur, then these substances cannot be detected (or with limited reliability only).

7.5.4 Testing of VOC, SVOC and VVOC

The emissions of volatile organic compounds are tested by drawing sample air from the test chamber outlet through Tenax TA tubes after the specified duration of storage in the ventilated test chamber. Analysis is performed by ATD-GC/MS using HP-5 column (30 m, 0.25mm ID, 0.25µm film) (CEN/TS 16516, ISO 16000-6, internal methods no.: 71M549812 / 712808B).

All single substances that are listed with a LCI/NIK value in the latest publications (hereafter referred to as target compounds) are identified if present. All other appearing VOCs are identified as far as possible. Quantification of target compounds is done using the TIC signal and authentic response factors, or the relative response factors relative to toluene. For certain compound groups, which differ significantly in chemistry from toluene, quantification is performed relative to a representative member of the group for more accurate and precise results. This can include quantification of for example glycols and acids. In addition to that, all results are also expressed in toluene equivalents. All non-target compounds, as well as all non-identified substances, are quantified in toluene equivalents.

The results of the individual substances are calculated in three groups depending on their retention time when analyzing using a non-polar column (HP-1):

- Volatile Organic Compounds (VOC) are defined as: All substances eluting between and including n-hexane (n-C6) and n-hexadecane (n-C16)
- Semi-Volatile Organic Compounds (SVOC) are defined as: All substances eluting after n-hexadecane (n-C16) and before and including n-docosane (n-C22)
- Very Volatile Organic Compounds (VVOC) are defined as: All substances eluting before n-hexane (n-C6).

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Total Volatile Organic Compounds (TVOC) is calculated by summation of all individual VOCs with a concentration ≥ 5 µg/m³. The TVOC can be expressed either in toluene equivalents as defined in CEN/TS 16516 and similar to ISO 16000-6, or as the sum of concentrations using specific or relative response factors. In the case of summation of concentrations using authentic or relative response factors, the toluene equivalent is applied to all non-target and non-identified VOCs before summing up. Compounds regarded as VOC in line with the above definition but elute before n-C6 or after n-C16 on the HP-5 column are treated as VOC, and are thus added to the TVOC.

Total Semi-Volatile Organic Compounds (TSVOC) is calculated by the summation of all individual SVOCs expressed in toluene equivalents with a concentration ≥ 5 µg/m³, as defined in CEN/TS 16516. VOCs that are regarded as VOC in line with the above definition, but elute after n-C16 in this test, are not added to the TSVOC.

Total Very Volatile Organic Compounds (TVVOC) is calculated by the summation of all individual VVOCs with a concentration ≥ 5 µg/m³ and expressed in toluene equivalents. VOCs that are regarded as VOC in line with the above definition, but elute before n-C6 in this test, are not added to the TVVOC.

This test only covers substances which can be adsorbed on Tenax TA and can be thermally desorbed. If emissions of substances outside these specifications occur then these substances cannot be detected (or with limited reliability only).

7.5.5 Calculation of R Values with LCI Lists

The concentrations of detected compounds ≥ 5 µg/m³ are divided by their respective LCI/NIK value (if defined in the given publication). The sum of the quotients gives the R value, which can be mathematically expressed:

$$R = \sum_{i}^{n} \left({}^{c_i}/_{NIK_i} + \ldots + {}^{c_n}/_{NIK_n} \right)$$

This R value is calculated, depending on the purpose of this test, for the European LCI list, for the German LCI/NIK list (R_D), and/or for the Belgian LCI list (R_B).

All VOCs without published LCI/NIK value and concentration ≥ 5 µg/m³ are summed up as sum of VOCs without LCI/NIK if required by the standard or protocol.

7.5.6 Testing of Aldehydes

The presence of aldehydes after the specified duration of storage in the ventilated test chamber is tested by drawing air samples from the test chamber outlet through DNPH-coated silicagel tubes after the specified duration of storage in the ventilated test chamber. Analysis is performed by solvent desorption and subsequently by HPLC and UV-/diode array detection (CEN/TS 16516, ISO 16000-3, VDI 3862 Blatt 3, internal methods no.: 71M549812 / 71M548400).

The absence of formaldehyde and other aldehydes is stated if UV detector response at the specific wavelength is lacking at the specific retention time in the chromatogram. Otherwise it is checked whether the reporting limit is exceeded. In this case the identity is finally checked by comparing full scan sample UV spectra with full scan standard UV spectra.

7.5.7 Testing of Phthalates

The presence of phthalates is tested by drawing air samples from the test chamber outlet through tube with XAD-II adsorbent after the specified duration of storage in the ventilated test chamber. Analysis is performed by solvent desorption and subsequently by GC/MS. Analysis of phthalates is not currently covered by the accreditation (Internal methods no.: 71M549812 / 71M546060).

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7.6 Quality Assurance

Before loading the test chamber, a blank check of the empty chamber is performed and compliance with background concentrations in accordance with CEN/TS 16516 / ISO 16000-9 is determined.

Air sampling at the chamber outlet and subsequent analysis is performed in duplicate. Relative humidity, temperature and air change rate in the chambers is logged every 5 minutes and checked daily. A double determination is performed on random samples at a regular interval and results are registered in a control chart to ensure the uncertainty and reproducibility of the method.

The stability of the analytical system is checked by a general function test of device and column, and by use of control charts for monitoring the response of individual substances prior to each analytical sequence.

7.7 Accreditation

The testing methods described above are accredited on line with EN ISO/IEC 17025 by DANAK (no. 522). This accreditation is valid worldwide due to mutual approvals of the national accreditation bodies (ILAC/IAF, see also www.eurofins.com/galten.aspx#accreditation.

Not all parameters are covered by this accreditation. The accreditation does not cover parameters marked with an asterisk (*), however analysis of these parameters is conducted at the same level of quality as for the accredited parameters.

7.8 Uncertainty of the Test Method

The relative standard deviation of the overall analysis is 22.5%. The expanded uncertainty Um equals 2 x RSD. For further information please visit www.eurofins.dk/uncertainty.

The results are only valid for the tested sample(s).
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