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EMISSION MEASUREMENTS

1 Sample Information

Sample name	NOFIRNO MF Sealant
Batch no.	NFN 01 J 01 1322 A
Production date	13.1.2022
Product type	Sealant
Sample reception	19.1.2022

2 Brief Conclusion of the Results

Parameter	Concentration in reference room	Concentration in reference room
	3 d	28 d
TVOC [$\mu\text{g}/\text{m}^3$]	> 1 300 ^d	15
TVVOC [$\mu\text{g}/\text{m}^3$]	< 5	< 5
TSVOC [$\mu\text{g}/\text{m}^3$]	< 5	< 5
Formaldehyde [$\mu\text{g}/\text{m}^3$]	< 2	< 2
Acetaldehyde [$\mu\text{g}/\text{m}^3$]	< 2	< 2
Total CMR [$\mu\text{g}/\text{m}^3$]	< 1	< 1
Single VOCs with EU-LCI [$\mu\text{g}/\text{m}^3$]	\leq EU-LCI	\leq EU-LCI
R-value (based on EU-LCI)	0.06	-

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

Espoo, 6.5.2022

Hanna Kajander
Expert

Distribution Customer



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

1	Sample Information	1
2	Brief Conclusion of the Results	1
3	Applied Test Methods	3
3.1	Specific Laboratory Sampling and Analyses	3
4	Sample Preparation, Test Parameters and Deviations	3
4.1	Sample Information and Preparation of the Test Specimen	3
4.2	Emission Chamber Test Parameters	4
4.3	Deviations from Referenced Protocols and Regulations	4
4.4	Picture of Sample	4
5	Results	5
5.1	Emission Test Results after 3 Days	5
5.2	Emission Test Results after 28 Days	6
6	Evaluation of the results	7
6.1	Comparison with Limit Values of M1 (Finland)	7
6.2	Comparison with Limit Values of BVB Assessment (Sweden)	7
6.3	Comparison with Limit Values of SINTEF Technical Approval (Norway)	7
6.4	Comparison with Limit Values of BREEAM® NOR	8
6.5	Comparison with Limit Values of Danish Indoor Climate Labelling (DICL)	8
7	General Test References	9
8	Appendices	10
8.1	Chromatograms	10
8.2	Sampling Report	11
8.3	Chain of custody report	12
8.4	How to Understand the Results	12
8.5	Description of VOC Emission Test	13

3 Applied Test Methods

3.1 Specific Laboratory Sampling and Analyses

Procedure	External Method	Quantification limit / sampling volume	Analytical principle	Combined Uncertainty [RSD (%)]
Sample preparation	ISO 16000-11 /1/, EN 16516 /2/	-	-	-
Emission chamber testing	EN 16516 /2/, ISO 16000-9 /3/	-	Chamber and air control	-
Sampling of VOC	EN 16516 /2/, ISO 16000-6 /4/	1.5-5 L	Tenax TA	-
Analysis of VOC	EN 16516 /2/, ISO 16000-6 /4, 5/	1 µg/m ³	TD-GC/MS	±25%
Sampling of very volatile carbonyl compounds*	ISO 16000-3 /6/	50-100 L	DNPH cartridge	-
Analysis of very volatile carbonyl compounds*	In-house method KEMIA-TY-011 /7/, ISO 16000-3 /6/	2 µg/m ³	Liquid chromatography/ UV	±23%

*) Not part of our accreditation, analysed at the Institute of Occupational Health, Accredited by FINAS T013

4 Sample Preparation, Test Parameters and Deviations

4.1 Sample Information and Preparation of the Test Specimen

Parameter	Value
Product type	sealant
Product name	NOFIRNO MF Sealant
Batch number	NFN 01 J 01 1322 A
Production date	13.1.2022
Sending date	18.1.2022
Sample received	19.1.2022
Packaging /transport	cartridge 310 ml / transportation company
Sample description	sealant
Test specimen preparation	in a glass profile with depth of 3 mm, width of 10 mm and length of 180 mm
Test period started, date	25.1.2022
Emission sampling, date	28.1.2022 (3d) 22.2.2022 (28d)

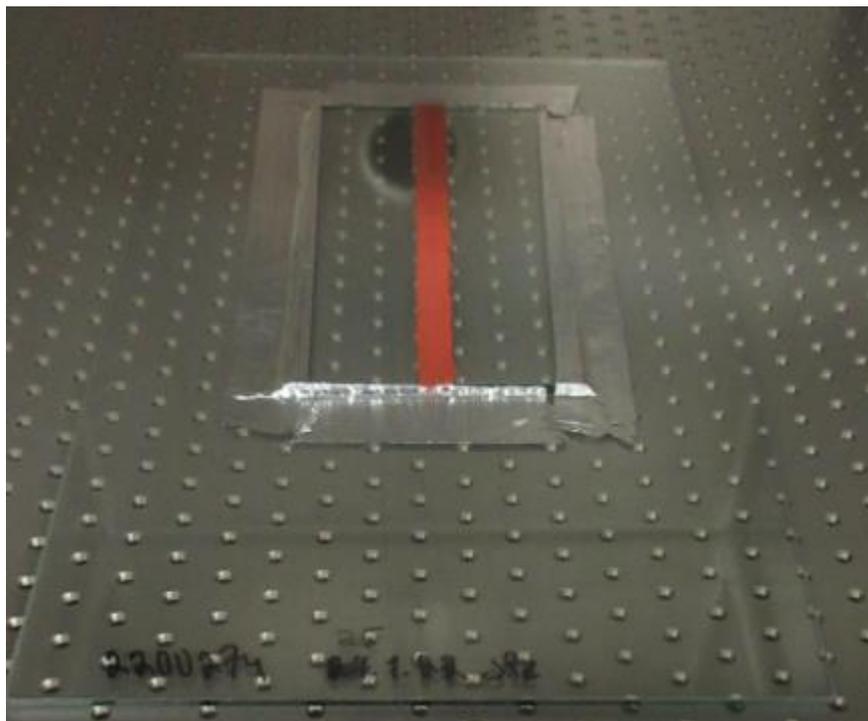
4.2 Emission Chamber Test Parameters

Parameter	Value	Parameter	Value
Chamber volume, V[m ³]	0.25	Test period	25.1.-22.2.2022
Air Change rate, n[h ⁻¹]	0.5	Volume specific ventilation rate, q [m ³ /m ³ h]	70.3
Relative humidity of supply air, RH [%]	50 ± 5	Loading factor [m ³ /m ³]	0.007
Temperature of supply air, T [°C]	23 ± 1	Test scenario	Very small area

4.3 Deviations from Referenced Protocols and Regulations

No deviations from the referenced test methods were observed.

4.4 Picture of Sample



5 Results

5.1 Emission Test Results after 3 Days

	CAS No.	Retention time	ID-Cat	Toluene eq.	Toluene SER	Specific Conc.	Specific SER	EU-LCI	R-value
		[min]		[µg/m ³]	[µg/(m ² ·h)]	[µg/m ³]	[µg/(m ² ·h)]	[µg/m ³]	
VOC compounds									
2-Pentanone	107-87-9	8.15	2	14	1100				
not identified	-	9.72	4	< 5	< 340				
Cyclotrisiloxane, hexamethyl-	541-05-9	13.14	2	11	810				
2-Hexanone oxime ^d	5577-48-0	15.68	2	> 910	> 68000				
Cyclotetrasiloxane, octamethyl-	556-67-2	19.26	1	98	7300	75	5600	1200	0.06
Cyclopentasiloxane, decamethyl-	541-02-6	24.02	2	200	15000				
Cyclohexasiloxane, dodecamethyl-	540-97-6	28.67	2	100	7800				
Cycloheptasiloxane, tetradecamethyl-	107-50-6	32.84	2	11	840				
Sum of compounds with EU-LCI value				98	7300	75	5600		
Sum of compounds without EU-LCI value				> 1300 ^d	> 94000 ^d	< 5	< 340		
TVOC				> 1300 ^d	> 100000 ^d				
VVOC compounds									
None determined									
TVVOC				< 5	< 340				
SVOC compounds									
Cyclooctasiloxane, hexadecamethyl-	556-68-3	36.53	2	< 5	< 340				
TSVOC				< 5	< 340				
CMR substances									
None determined									
Total CMR				< 1	< 38	< 1	< 38		
Very volatile carbonyl compounds									
Formaldehyde	50-00-0		1			< 2	< 120	100	
Acetaldehyde	75-07-0		1			< 2	< 120	300	
Propanal	123-38-6		1			< 2	< 120	650	
Butanal	123-72-8		1			< 2	< 120	650	
Acetone	67-64-1		1			< 2	< 120	120000	
Sum of R-values									0.06

5.2 Emission Test Results after 28 Days

	CAS No.	Retention time	ID-Cat	Toluene eq.	Toluene SER	Specific Conc.	Specific SER	EU-LCI	R value
		[min]		[$\mu\text{g}/\text{m}^3$]	[$\mu\text{g}/(\text{m}^2\cdot\text{h})$]	[$\mu\text{g}/\text{m}^3$]	[$\mu\text{g}/(\text{m}^2\cdot\text{h})$]	[$\mu\text{g}/\text{m}^3$]	
VOC compounds									
Cyclotrisiloxane, hexamethyl-	541-05-9	13.14	2	15	1100				
2-Hexanone oxime	5577-48-0	15.31	2	< 5	< 340				
Cyclotetrasiloxane, octamethyl-	556-67-2	19.25	1	< 5	< 340	< 5	< 340	1200	-
Cyclopentasiloxane, decamethyl-	541-02-6	24.01	2	< 5	< 340	< 5	< 340		
Cyclohexasiloxane, dodecamethyl-	540-97-6	28.67	2	< 5	< 340	< 5	< 340		
Cycloheptasiloxane, tetradecamethyl-	107-50-6	32.83	2	< 5	< 340	< 5	< 340		
Sum of compounds with EU-LCI value				< 5	< 340	< 5	< 340		
Sum of compounds without EU-LCI value				15	1100	< 5	< 340		
TVOC				15	1100				
VVOC compounds									
None determined									
TVVOC				< 5	< 340				
SVOC compounds									
None determined									
TSVOC				< 5	< 340				
CMR substances									
None determined									
Total CMR				< 1	< 38	< 1	< 38		
Very volatile carbonyl compounds									
Formaldehyde	50-00-0		1			< 2	< 120	100	-
Acetaldehyde	75-07-0		1			< 2	< 120	300	-
Propanal	123-38-6		1			< 2	< 120	650	-
Butanal	123-72-8		1			< 2	< 120	650	-
Acetone	67-64-1		1			< 2	< 120	120000	-
Sum of R-values									-

6 Evaluation of the results

6.1 Comparison with Limit Values of M1 (Finland) /8/

Parameter	Concentration mg/m ³	M1, very small area mg/m ³
TVOC 28 days	0.015	≤ 0.02
Single VOCs with EU-LCI 28 days	≤ EU-LCI	≤ EU-LCI
Formaldehyde 28 days	< 0.002	≤ 0.01
Ammonia 28 days	-	≤ 0.01
Total CMR compounds 28 days	< 0.001	≤ 0.001
Odour (dimensionless) 28 days	-	≥ 0.0

Compliance with the limits alone does not entitle to use the M1 Classification label. For the use of a M1 label, a licence has to be applied from the Building Information Foundation RTS sr.

6.2 Comparison with Limit Values of BVB Assessment (Sweden) /9/

Emission reports/certificates concerning emissions to the indoor environment are required for products and material intended for indoor use and that contribute with emissions of volatile organic compounds to the indoor air. The product is classified as recommended if requirements according to one of the following systems are fulfilled: EMICODE EC1 and EC1 PLUS, Blue Angel, M1 (RTS) and/or GUT. Product is classified as accepted if requirements according to one of the following systems are fulfilled: EMICODE EC2, AgBB and/or M2 (RTS). Compliance with the limits alone does not entitle to get an BVBs assessment. The BVBs Assessment has to be applied from Byggarbedömningen.

6.3 Comparison with Limit Values of SINTEF Technical Approval (Norway) /10/

Parameter	Area specific emission rate µg/(m ² ·h)	Limits, very small area µg/(m ² ·h)
TVOC 28 days	1100	7100
Formaldehyde 28 days	< 120	700
Sum of carcinogens 28 days	< 38	70

Compliance with the limits alone does not entitle to get the SINTEF Technical Approval. The SINTEF Technical Approval has to be applied from SINTEF.

6.4 Comparison with Limit Values of BREEAM® NOR /11/

Parameter	Concentration mg/m ³	Basic level mg/m ³	Exemplary level mg/m ³
TVOC 28 days	0.015	≤ 0.3	≤ 0.3
TSVOC 28 days	< 0.005	-	≤ 0.1
Formaldehyde 28 days	< 0.002	≤ 0.06	≤ 0.01
Total CMR compounds 28 days	< 0.001	≤ 0.001	≤ 0.001

6.5 Comparison with Limit Values of Danish Indoor Climate Labelling (DICL) /12/

Parameter	Concentration mg/m ³	Limits mg/m ³
TVOC 3 days	> 1.3	≤ 10
TVOC 28 days	0.015	≤ 1.0
Sum of TVOC and individual SVOCs with LCI (AgBB) 28 days	0.015	≤ 1
Sum of SVOC 28 days	< 0.005	≤ 0.1
R-value (LCI -AgBB) dimensionless	≤ 1	≤ 1
Sum of VOCs without LCI -AgBB	1.1	≤ 0.1
Total CMR compounds 3 days	< 0.001	≤ 0.01
Total CMR compounds 28 days	< 0.001	≤ 0.001
Formaldehyde 28 days	< 0.002	depends on classification ≤ 0.01 / ≤ 0.06 / ≤ 0.1
Odour (dimensionless) 28 days	-	> 0.1

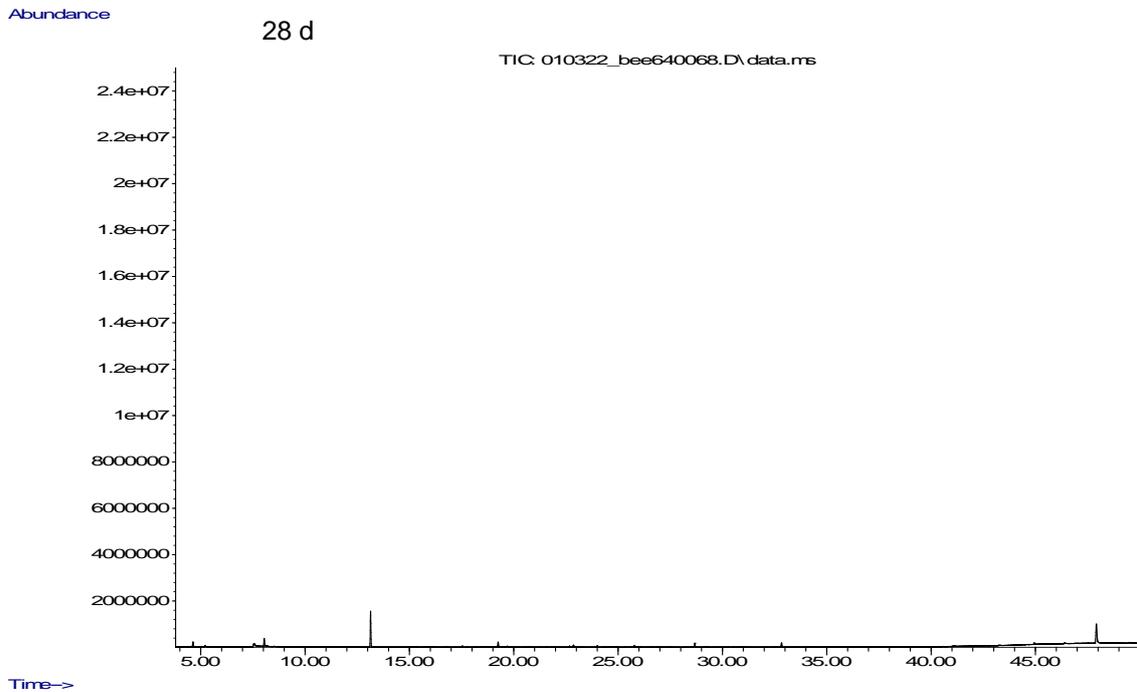
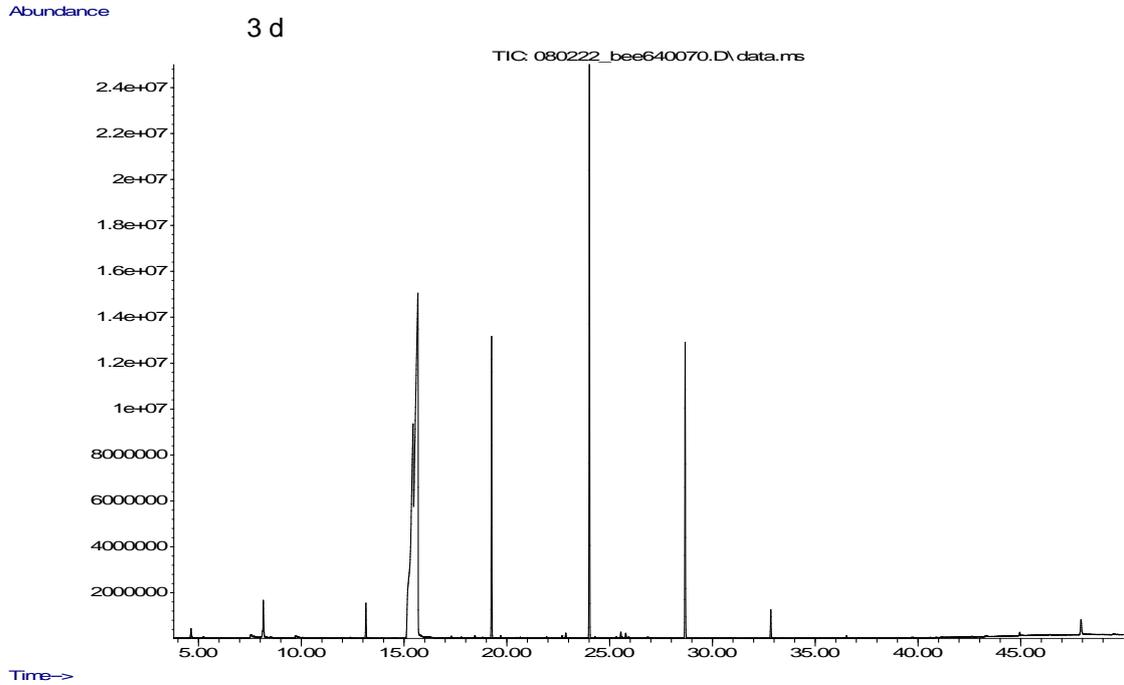
Compliance with the limits alone does not entitle to use the DICL label. For the use of a DICL label, a licence has to be applied from Danish Technological Institute.

7 General Test References

1. ISO 16000-11 Determination of the emission of volatile organic compounds from building products and furnishing. Sampling, storage of samples and preparation of test specimens.
2. EN 16516 Construction products: Assessment of release of dangerous substances. Determination of emissions into indoor air.
3. ISO 16000-9 Determination of the emission of volatile organic compounds from building products and furnishing. Emission test chamber method.
4. ISO 16000-6 Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA ® sorbent, thermal desorption and gas chromatography using MS or MS-FID.
5. EU-LCI VOC-compound emission https://ec.europa.eu/growth/sectors/construction/eu-lci/values_en
6. ISO 16000-3 Determination of formaldehyde and other carbonyl compounds – Active sampling method.
7. In-house method KEMIA-TY-011, Institute of Occupational Health.
8. <https://cer.rts.fi/en/m1-emission-class-for-building-material/m1-criteria-2/>
9. Byggarubedömningen's criteria for chemical content and lifecycle aspects, Version 6.1
10. SINTEF Technical Approval – Health and Environmental Requirements, version 21.01.2021
11. BREEAM-NOR v6.0 New Construction – Technical Manual
12. Danish Indoor Climate Labelling - General test and labelling criteria, 7th Edition, May 2021

8 Appendices

8.1 Chromatograms

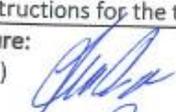


8.2 Sampling Report

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Emission measurements: Sampling report

Notice: This report will be attached to the official test report as an appendix

Testing laboratory / certification body:		Sampler (name, company, telephone): Beele Engineering bv +31 543 461 629	
Name of the manufacturer at the place of sampling (address/stamp): Beele Engineering bv Beunkdijk 11 7122 NZ AALDEN, The Netherlands		Manufacturer (if deviating from company's name at the place of sampling): —	
Name of the product: NOFIRNO MF Sealant		Type of product (e.g. laminate, textile flooring, PVC-flooring): Sealant	
Model/program/series:		Batch No: NFN 01 J 01 1322 A	
Article No: Misc.:		Date of batch production: 13.1.2022	
Sample is taken from	<input checked="" type="checkbox"/> Production <input type="checkbox"/> Store <input type="checkbox"/> Miscellaneous	How had the product been stored prior to sampling?	<input type="checkbox"/> open <input type="checkbox"/> in the stack <input checked="" type="checkbox"/> wrapped up
Place of storage: Room / stock		Packing material: —	
Specifics (possible negative influences by emission at the place of taking the sample, petrol emissions, solvent emissions from production, uncertainties, questions, etc.): —			
Cut edges (identification of cut edges when present and identification of new surfaces and surface to be exposed in the emission test): —			
Confirmation The signer herewith confirms the correctness of the data given above. The sample was selected, drawn and packed personally in accordance with the instructions for the taking of samples.			
Date of sampling: 13.1.2022		Signature: (Stamp)  Jukka Repo Senior Product Engineer	

8.3 Chain of custody report

Emission measurements: Chain of custody report

Customer name Beele Engineering bv		P.O. number	
Address Beunkdijk 11 7122 NZ AALTEN The Netherlands		Sampled by Beele Engineering bv	
Other specifications			
Sample name/ID	sampling date	sampling time	no. of samples
NOFIRING MF SEALANT	13.1.2022	morning batch	1
Date / Time	Released By Name/Title	Received By Name/Title	Conditions
Date 13.1.2022	Name/Title Beele Engineering bv	Name/Title Beele Finland	Sent to Finland on 14.1.2022
Time 18.1.2022	Signature	Signature	
Date 18.1.2022	Name/Title Jukka Repo Senior Product Engineer	Name/Title Hanna Kajander	Sent From Jyväskylä on 18.1.2022
Time 18.1.2022	Signature 	Signature	<i>Tu ES700</i>
Date	Name/Title	Name/Title	
Time	Signature	Signature	

8.4 How to Understand the Results

8.4.1 Acronyms Used in the Report

< Means less than

> Means bigger than

§ 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 results have been corrected by the emission from untreated product specific substrate. Possible secondary emissions from the substrate cannot be excluded.

c 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.

d The component may be underestimated due to exceeding the linear calibration range (contribution from the system) SER Specific Emission Rate.

8.4.2 Explanation of ID Category

Categories of Identity:

- 1: Identified by comparison with a mass spectrum obtained from library and supported by other information and quantified through specific calibration.
- 2: Identified by comparison with a mass spectrum obtained from library and supported by other information. Quantified as toluene equivalent.
- 3: Identified with a lower match by comparison with a mass spectrum obtained from a library. Quantified as toluene equivalent.
- 4: Not identified, quantified as toluene equivalent.

8.5 Description of VOC Emission Test

8.5.1 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. /2,3/

8.5.2 Expression of the Test Results

All test results are calculated as volume specific emission rate, and as extrapolated air concentration in the European Reference Room. /2/

8.5.3 Testing of VOC, SVOC and VVOC

The emissions of volatile organic compounds including volatile CMR substances (EU Class 1A and 1B, as per European law) 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 TD-GC/MS using HP-5 column (50 m, 0.2mm ID, 0.33µm film) /2,4,5/.

All CMR substances and single substances that are listed with a EU-LCI value in the latest publications /5/ (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 can be 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 (CMR substances not included) are calculated in three groups depending on their retention time when analyzing using a non-polar column (HP-5):

- Volatile Organic Compounds (VOC) are defined as: All substances eluting between and including acetic acid, 2,2,4-trimethyl-1,3-pentanediol-di-isobutyrate, 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).

The results of the CMR substances are calculated in their own group.

Total Volatile Organic Compounds (TVOC) is calculated by summation of all individual VOCs between n-hexane and n-hexadecane with a concentration $\geq 5 \mu\text{g}/\text{m}^3$. 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 $\geq 5 \mu\text{g}/\text{m}^3$, as defined in EN 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 $\geq 5 \mu\text{g}/\text{m}^3$ 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).

8.5.4 Testing of Very Volatile Carbonyl Compounds

Very volatile carbonyl compounds were absorbed in dinitrophenyl hydrazine and analysed with liquid chromatography /6,7/. The limit of quantification is $2 \mu\text{g}/\text{m}^3$. The analysis was made at the Institute of Occupational Health.