2.2.3 Result of the Formaldehyde Investigation

Table 2.2.1: Result of the Formaldehyde Investigation

Sample description - Description of the variation	Surface-related emission of formaldehyde at 90°C test chamber temperature [mg m^{-2} h^{-1}]			Comments
	Test specimen 1	Test specimen 2	**Mean value** [a] (assessment value)	
"GRABNER-SAUNABOARD" Arolla Pine	**0.38**	**0.39**	**0.39**	**-**
"GRABNER-SAUNABOARD" Western_Red_Cedar	**0.37**	**0.38**	**038**	**-**
"GRABNER-SAUNABOARD" Hemlock	**033**	**0.34**	**0.34**	**-**
"GRABNER-SAUNABOARD" American Nut	**027**	**0.22**	**0.24**	**-**
"GRABNER-SAUNABOARD" Acacia	**035**	**0.40**	**0.37**	**-**
"GRABNER-SAUNABOARD" Birch	**0.34**	**0.34**	**0.34**	**-**
"GRABNER-SAUNABOARD" Spruce	**0.29**	**0.27**	**0.28**	**-**

[a] Arithmetic mean value rounded up to two significant digits

3 EXPERT OPINION

3.1 Assessment Bases for the Investigation of Material Samples for the Emission of Formaldehyde

According to ÖNORM M 6219-1 [1], which defines the requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers, in sauna chambers only solid timbers and layered wood materials may be used, that have a maximum gas analysis value of 0.4 mg m^{-2} h^{-1} formaldehyde according to ÖNORM EN 717-2 (deviating from the ÖNORM, tested at 90°C).

3.2 Assessment Bases for Isocyanates in Wood Samples

There are no known guide values for the emission of isocyanates. If the value is less than the determination limit, it is to be assumed, that the emission is to be regarded as low.

3.3 Assessment Bases for Biocides in Wood Samples

The concentration of pentachlorophenol (PCP) in finished products, that also means in building materials, that are brought into circulation, is restricted by law to 5 mg/kg (ppm) [2]. For wood up to 1 mg/kg can be assumed as basic load. Values up to 1 mg substance/kg indicate a very low load. With values up to 5 mg/kg the load is moderate, with values between 5 - 50 mg/kg the load is considerable. Values between 50 - 500 mg/kg are regarded as high and values above 500 mg/kg are regarded as very high.

If there are no concentration values for PCP in sedimented dust available, the German PCP-directive [3], requires that the PCP-concentrations in possibly treated wood is investigated in further investigations. For this material samples are to be taken from a depth of 0 to 2 mm of the wood in question. If these result in PCP concentrations of over 50 mg PCP/kg wood, in addition to this it is recommended to determine whether the surface area of the treated wood that is in contact with interior air is greater than 0.2 m^2 per m^3 in relation to the room volume. If this is also the case, i.e. both values mentioned are exceeded, it is recommended to determine whether the expected annual average room air load is above 1 µg PCP/m^3 air. If this is the case, then it is recommended in the following, to carry out a renovation of the PCP-burdened room.

[1] ÖNORM M 6219-1 (2010): Requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers Part 1: Planning and operation of saunas and saunas in combination with infrared heat sources - 2010 03 01

[2] PCP-Regulation (1991): Regulation of the Federal Minister for Environment, Youth and Family concerning the ban on Pentachlorophenol (PCP) dated 5.2.1991

[3] PCP-Directive (1996): Directive on the assessment and renovation of Pentachlorophenol (PCP)-burdened building materials and components in buildings. Published by the project group »Pollutants« of the German specialist committee for construction standardization of the working group of the national ministers responsible for the building industry, housing and settlements (ARGEBAU)

3.4 Summarized Assessment

With the assessment values of 0.24 to 0.39 mg m^{-2} h^{-1}, all seven investigated samples, which differ through different top layers, were below the maximum permitted gas analysis value of 0.4 mg m^{-2} h^{-1} and are therefore in conformity with the specifications of ÖNORM M 6219-1. The investigated materials are therefore suitable for sauna construction.

In comparison with lower emitting wood types such as hemlock or linden, the wood types cedar and acacia normally have a relatively higher emission of formaldehyde, when they are tested as solid wood sections at 90°C. In the present investigation the materials veneered with these two more strongly emitting wood types are also below the gas analysis value defined in ÖNORM M 6219-1.

No biocides were proven in the investigated mixed samples, which were obtained from seven "GRABNER-SAUNABOARD" base boards. In the test chamber investigations of two selected "GRABNER-SAUNABOARD" boards no emissions of isocyanates above the determination limit were proven.

Based on all available measurement results it can be assumed, that thin layers of veneer on a (relatively low emitting) "GRABNER-SAUNABOARD"-carrier board do not increase the emission of formaldehyde of the investigated woods above the gas analysis value defined in ÖNORM M 6219-1.

Furthermore it can be assumed with the greatest probability, that no significant increase in formaldehyde emission also occurs with other (not tested) wood types due to a veneer and that therefore all "GRABNER-SAUNABOARD"-boards veneered at works are suitable for sauna construction. This statement is only permitted for "GRABNER-SAUNABOARD" boards veneered at works, that are not bonded with any formaldehyde splitting glue.

General Sworn-in and Court
Certified Appraiser
Dipl. Ing. Peter Tappler

Project management

Dipl. Ing. Bernhard Damberger

3 Expert Opinion

3.1 Assessment Bases

According to ÖNORM M 6219-1 [1], which defines the requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers, in sauna chambers only solid timbers and layered wood materials may be used, that have a maximum gas analysis value of 0.4 mg m^{-2} h^{-1} formaldehyde according to ÖNORM EN 717-2 (deviating from the ÖNORM, tested at 90°C).

3.2 Assessment

For the investigated material with the designation “Grabner-Saunaboard Alder/Hemlock”, at 90°C test chamber temperature the gas analysis value was significantly below the value of 0.4 mg m^{-2} h^{-1} required in ÖNORM M 6219-1 for the formaldehyde emission.

Initial findings

Dipl. Ing. Bernhard Damberger

General Sworn-in and Court Certified Appraiser
Dipl. Ing. Peter Tappler

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[1] ÖNORM M 6219-1 (2010): Requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers Part 1: Planning and operation of saunas and saunas in combination with infrared heat sources - 2010 03 01

3 Expert Opinion

3.1 Assessment Bases

According to ÖNORM M 6219-1 [1], which defines the requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers, in sauna chambers only solid timbers and layered wood materials may be used, that have a maximum gas analysis value of 0.4 mg m^{-2} h^{-1} formaldehyde according to ÖNORM EN 717-2 (deviating from the ÖNORM, tested at 90°C).

3.2 Assessment

For the investigated material with the designation “GRABNER-SONNBOARD”, at 90°C test chamber temperature the gas analysis value was significantly below the value of 0.4 mg m^{-2} h^{-1} required in ÖNORM M 6219-1 for the formaldehyde emission.

Initial findings

Dipl. Ing. Bernhard Damberger

General Sworn-in and Court Certified Appraiser
Dipl. Ing. Peter Tappler

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[1] ÖNORM M 6219-1 (2010): Requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers Part 1: Planning and operation of saunas and saunas in combination with infrared heat sources - 2010 03 01

3 Expert Opinion

3.1 Assessment Bases

According to ÖNORM M 6219-1 [1], which defines the requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers, in sauna chambers only solid timbers and layered wood materials may be used, that have a maximum gas analysis value of 0.4 mg m^{-2} h^{-1} formaldehyde according to ÖNORM EN 717-2 (deviating from the ÖNORM, tested at 90°C).

3.2 Assessment

For the investigated material with the designation Grabner-Saunaboard Structure “Oak Altaussee”, at 90°C test chamber temperature the gas analysis value was significantly below the value of 0.4 mg m^{-2} h^{-1} required in ÖNORM M 6219-1 for the formaldehyde emission.

Initial findings

Dipl. Ing. Bernhard Damberger

General Sworn-in and Court Certified Appraiser
Dipl. Ing. Peter Tappler

[1] ÖNORM M 6219-1 (2010): Requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers Part 1: Planning and operation of saunas and saunas in combination with infrared heat sources - 2010 03 01

3 Expert Opinion

3.1 Assessment Bases

According to ÖNORM M 6219-1 [1], which defines the requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers, in sauna chambers only solid timbers and layered wood materials may be used, that have a maximum gas analysis value of 0.4 mg m^{-2} h^{-1} formaldehyde according to ÖNORM EN 717-2 (deviating from the ÖNORM, tested at 90°C).

3.2 Assessment

For the investigated material with the designation "Grabner-Saunaboard – StoneslikeStones", at 90°C test chamber temperature the gas analysis value was significantly below the value of 0.4 mg m^{-2} h^{-1} required in ÖNORM M 6219-1 for the formaldehyde emission.

Initial findings

Dipl. Ing. Bernhard Damberger

General Sworn-in and Court Certified Appraiser
Dipl. Ing. Peter Tappler

[1] ÖNORM M 6219-1 (2010): Requirements on public and commercial sauna installations, infrared cabins, steam- and other heat chambers Part 1: Planning and operation of saunas and saunas in combination with infrared heat sources - 2010 03 01

3 Expert Opinion

3.1 Evaluation Criteria

According to ÖNORM M 6219-1 [2], which defines the requirements on public and commercial sauna facilities, infrared cabins, steam- and other heat chambers, in sauna chambers only solid woods and wood layer materials may be used, that have a maximal gas analysis value of 0.4 mg m^{-2} h^{-1} formaldehyde according to ÖNORM EN ISO 12460-3 (deviating from the ÖNORM, tested at 90°C).

3.2 Assessment

For the investigated material with the designation "Saunaboard Colour", the formaldehyde emission was below the gas analysis value of 0.4 mg m^{-2} h^{-1} required in ÖNORM M 6219-1 at a test chamber temperature of 90°C. The material is suitable for sauna construction.

Generally sworn and court certified expert
Dipl. Ing. Peter Tappler

Dipl. Ing. Bernhard Damberger

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2 ÖNORM M 6219-1 (2010): Requirements on public and commercial sauna facilities, infrared cabins, steam- and other heat chambers - Part 1: Planning and operation of saunas and saunas in combination with infrared heat source – 2010 03 01

3 Expert Opinion

3.1 Evaluation of the Results

In the above described test chamber conditions, the investigated test specimens "Colour Black – Tulpin Wood" and "Colour Red – Sup Gum" showed an insignificant and material-typical emission of volatile hydrocarbons (VOC). From experience compounds from the classes of aldehydes and the terpenes are emitted from wood and wood materials among others and were therefore to be expected at a test temperature of 90 °C.

The investigation showed no indications of relevant emissions in connection with the colouring agents used. It can be assumed, that even with veneers of a different colour with comparable colouring agents, with great probability no material-atypical emissions will be released by the "JGrabner Saunaboard Colour Kollektion".

Dipl. Ing. Peter Tappler

3 Expert Opinion

3.1 Evaluation Criteria

According to ÖNORM M 6219-1 [2], which defines the requirements on public and commercial sauna facilities, infrared cabins, steam- and other heat chambers, in sauna chambers only solid woods and wood layer materials may be used, that have a maximal gas analysis value of 0.4 mg m^{-2} h^{-1} formaldehyde according to ÖNORM EN ISO 12460-3 (deviating from the ÖNORM, tested at 90°C).

3.2 Assessment

For the investigated materials with the designation Grabner Saunaboard Organoid "Roasnbliatn", "Skelettblattla" and "Safranblüte", the gas analysis value of 0.4 mg m^{-2} h^{-1} for the formaldehyde emission required in ÖNORM M 6219-1 was not exceeded at a test chamber temperature of 90°C.

Dipl. Ing. Peter Tappler

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2 ÖNORM M 6219-1 (2016): Requirements on public and commercial sauna facilities, infrared cabins, steam- and other heat chambers - Part 1: Sauna and sauna in combination with infrared heat sources and sauna chamber with controlled humidity – 2016 11 01.

3 Expert Opinion

3.1 Evaluation Criteria

According to ÖNORM M 6219-1 [2], which defines the requirements on public and commercial sauna facilities, infrared cabins, steam- and other heat chambers, in sauna chambers only solid woods and wood layer materials may be used, that have a maximal gas analysis value of 0.4 mg m^{-2} h^{-1} formaldehyde according to ÖNORM EN ISO 12460-3 (deviating from the ÖNORM, tested at 90°C).

3.2 Assessment

For the investigated material with the designation "Grabner Saunaboard Organoid", the gas analysis value of 0.4 mg m^{-2} h^{-1} for the formaldehyde emission required in ÖNORM M 6219-1 was not exceeded at a test chamber temperature of 90°C.

Generally sworn and court certified expert
Dipl. Ing. Peter Tappler

Findings Report

Dipl. Ing. Bernhard Damberger

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2 ÖNORM M 6219-1 (2010): Requirements on public and commercial sauna facilities, infrared cabins, steam- and other heat chambers - Part 1: Planning and operation of saunas and saunas in combination with infrared heat source – 2010 03 01

TEST REPORT ERROR! REFERENCE SOURCE NOT FOUND. **140476-2** dated 13.06.2014

2 Results

2.1 Type "Wildspitz"

Test specimen: see image
Sampled surface: Decorative layer
Sample No.: 140476-1605-202

Area designation	Internal Sample No.	Allergen content Phl p5 (µg/g)
Type "Wildspitz"	140476-1605-202	< 0.08*

* under the limit of determination

Cologne, dated 13.06.2014

[signature]

Dr. ????. S. Janich-Grün
(Head of testing Biology Lab.)

3 Expert Opinion

3.1 Evaluation Criteria

According to ÖNORM M 6219-1 [2], which defines the requirements on public and commercial sauna facilities, infrared cabins, steam- and other heat chambers, in sauna chambers only solid woods and wood layer materials may be used, that have a maximal gas analysis value of 0.4 mg m^{-2} h^{-1} formaldehyde according to ÖNORM EN ISO 12460-3 (deviating from the ÖNORM, tested at 90°C).

3.2 Assessment

For the investigated materials with the designations "black MDF board" and "Birch plywood board", the gas analysis value of 0.4 mg m^{-2} h^{-1} for the formaldehyde emission required in ÖNORM M 6219-1 was exceeded significantly at a test chamber temperature of 90°C. It is to be expected, that the use of the material in a sauna chamber would lead to an increased concentration of formaldehyde in the room air.

Generally sworn and court
certified expert
Dipl. Ing. Peter Tappler

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2 ÖNORM M 6219-1 (2016): Requirements on public and commercial sauna facilities, infrared cabins, steam- and other heat chambers - Part 1: Sauna and sauna in combination with infrared heat sources and sauna chamber with controlled humidity – 2016 11 01.

Certified Engineer PETER TAPPLER

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ANALYSIS OF MATERIAL SAMPLES FOR THE EMISSION OF VOLATILE ORGANIC COMPOUNDS

FINDINGS AND EXPERT REPORT

Project number: **Y0082**

Client: **J Grabner GmbH**
Peter Mitterbauer Strasse 2
4661 Roitham, Austria

Sample source: Transmitted by the client

Issuer: **Certified Engineer Peter Tappler**
Generally sworn and court-certified expert
Air pollution control – indoor air pollutant exposure
Microbiology – indoor mold exposure
Construction chemistry, building materials – pollutant content of and emissions released by building materials

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Date of issuance: 10 Mar 2020

TABLE OF CONTENTS

1 Task definition

Material samples transmitted by the client are to be analyzed for the emission of Volatile Organic Compounds (VOC). The analysis is to be performed at sauna temperatures (90°C).

2 Findings

2.1 Analysis of material samples for the emission of Volatile Organic Compounds

2.1.1 *Modus operandi* and methodology

The stainless-steel test chamber used for analyzing the emission behavior exhibits a volume of 4.017 liters and is described in Austrian standard ÖNORM EN ISO 12460-3 [1]. Temperature control to +/- 0.5 °C is ensured by a liquid jacket enclosing the chamber. The incoming air was cleaned by way of an activated carbon filter.

The material under analysis was introduced in the cylindrical test chamber in such a way so that the tests specimen could be washed around from all sides. At a defined air-exchange rate in the chamber, the air in the test chamber was analyzed for Volatile Organic Compounds. Sampling was performed by way of adsorption of the substances under analysis to activated carbon, with the air volume conducted through the test chamber being guided entirely via an adsorbent [SKC, Anasorb 747].

The chemical analysis was performed in accordance with Austrian standard ÖNORM M 5700-2. The activated carbon was removed from the adsorption tube and eluted with carbon disulfide (CS_2). The obtained CS_2 extract was directly subjected to quantitative analysis. The individual Volatile Organic Compounds were determined by way of capillary gas chromatography with a coupled mass spectrometer [Shimadzu QP-2010S] by using a capillary column [HP-VOC HEWLETT PACKARD, 50 m] with regard to external and internal standards. The signals obtained from the detector were recorded electronically, with the quantification carried out via the peak surfaces. Measurement inaccuracy is estimated at +/- 20 %.

2.1.2 Calculation of surface-related emission

The measured equilibrium concentration in the test chamber was related to the volume of the supplied air, the sampling time, and the surface of the test item. On this basis, the surface-based emission of volatile substances was calculated in micrograms per square meter and hour [$\mu g\ m^{-2}\ h^{-1}$].

Note: Measurements carried out using the above-described test apparatus result in measured values describing the source strengths of emitting substances under certain boundary conditions

[1] ÖNORM EN ISO 12460-3 (2015): Wood-based panels – Determination of formaldehyde release - Part 3: Gas analysis method (ISO/DIS 12460-3: 2015)

that are exactly defined. Yet the rate of emissions released by a material under practical conditions is impacted by a wide range of factors and may deviate from the indicated values.

2.1.3 Description of samples for the analysis of the emission of Volatile Organic Compounds

The client supplied veneers bearing the designations “Colour Black – Tulpin Wood” and “Colour Red – Sup Gum”. The emission behavior exhibited by the test specimens was tested after a respective conditioning phase of 3 hours in the preheated test chamber. The test chamber had been flushed with purified air before.

Table 2.1.1: Data from the material analysis for Volatile Organic Compounds

	Unit	Data	Image
Sample source		Supplied by the client	
Material description		Colour Black – Tulip Wood	
Date of sample receipt		28 Jan 2020	
Date of analysis		05 Feb 2020	
Start of sampling	[hh.mm]	12:50	
End of sampling	[hh.mm]	13:57	
Surface-related air flow rate	[m³/m²h]	0.91	
Test chamber temperature	[°C]	90	

Table 2.1.2: Data from the material analysis for Volatile Organic Compounds

	Unit	Data	Image
Sample source		Supplied by the client	
Material description		Colour Red – Sup Gum	
Date of sample receipt		28 Jan 2020	
Date of analysis		21 Feb 2020	
Start of sampling	[hh.mm]	13:00	
End of sampling	[hh.mm]	13:40	
Surface-related air flow rate	[m³/m²h]	0.67	
Test chamber temperature	[°C]	90	

2.1.4 Results of the analysis of the emission of Volatile Organic Compounds (VOC)

Table 2.1.3: Results of the emission analysis for Volatile Organic Compounds, surface-related emission indicated in µg/m² h [a]

Sample identification	Colour Black – Tulip Wood		
Date of analysis	05 Feb 2020		
Substance	Unit	Conc.	LOD
Aliphatic and alicyclic compounds			
n-heptane	[µg/m²h]	n.d.	3
n-octane	[µg/m²h]	n.d.	3
n-nonane	[µg/m²h]	n.d.	3
n-decane	[µg/m²h]	n.d.	4
n-undecane	[µg/m²h]	n.d.	4
n-dodecane	[µg/m²h]	n.d.	4
n-tridecane	[µg/m²h]	n.d.	4
n-tetradecane	[µg/m²h]	n.d.	4
n-pentadecane	[µg/m²h]	n.d.	4
n-hexadecane	[µg/m²h]	n.d.	4
Cyclohexane	[µg/m²h]	n.d.	3
Methylcyclohexane	[µg/m²h]	n.d.	3
2.2.4.6.6-pentamethylheptane	[µg/m²h]	n.d.	5
Trimeric isobutene I + II	[µg/m²h]	n.d.	5
4-phenylcyclohexene	[µg/m²h]	n.d.	5
Aromatic compounds			
Benzene	[µg/m²h]	n.d.	3
Toluene	[µg/m²h]	n.d.	2
Ethylbenzene	[µg/m²h]	n.d.	3
m,p-xylene	[µg/m²h]	n.d.	3
o-xylene	[µg/m²h]	n.d.	4
Styrene	[µg/m²h]	n.d.	3
Propylbenzene	[µg/m²h]	n.d.	3
3-ethyltoluene	[µg/m²h]	n.d.	4
2-ethyltoluene	[µg/m²h]	n.d.	4
1,3,5-trimethylbenzene	[µg/m²h]	n.d.	5
1,2,4-trimethylbenzene	[µg/m²h]	n.d.	5
1,2,3-trimethylbenzene	[µg/m²h]	n.d.	4
Chlorinated substances			
Tetrachloroethene (PER)	[µg/m²h]	n.d.	12
Chlorobenzene	[µg/m²h]	n.d.	4

Substance	Unit	Conc.	LOD
Ester			
Ethylacetate	[µg/m²h]	n.d.	3
iso-propylacetate	[µg/m²h]	n.d.	3
iso-butylacetate	[µg/m²h]	n.d.	3
n-butylacetate	[µg/m²h]	n.d.	3
1-methoxy-2-propylacetate (MPA)	[µg/m²h]	n.d.	4
Texanoldiisobutyrate (TXIB)	[µg/m²h]	n.d.	5
Aldehydes			
Pentanal	[µg/m²h]	n.d.	4
Hexanal	[µg/m²h]	9	6
Heptanal	[µg/m²h]	7	6
Octanal	[µg/m²h]	8	6
Nonanal	[µg/m²h]	16	6
Decanal	[µg/m²h]	8	6
Ketones			
4-methyl-2-pentanone (MIBK)	[µg/m²h]	n.d.	3
Cyclohexanone	[µg/m²h]	n.d.	5
Acetophenone	[µg/m²h]	n.d.	6
Benzophenone	[µg/m²h]	n.d.	6
Terpenes			
Alpha-pinene	[µg/m²h]	4	4
Beta-pinene	[µg/m²h]	n.d.	5
3-carene	[µg/m²h]	n.d.	5
Limonene	[µg/m²h]	14	4
Other			
Octamethyltetracyclosiloxane	[µg/m²h]	n.d.	5
Decamethylpentacyclosiloxane	[µg/m²h]	n.d.	5
Sum VOC ident.	**[µg/m²h]**	**66**	

[a] µg/m² h = microgram per square meter and hour (µg m^{-2} h^{-1})
n.d. = below Limit of Determination, na = not evaluable, LOD = Limit of Determination

The “SUM VOC ident.” parameter designates the sum of identified individual compounds.

Table 2.1.4: Results of the emission analysis for Volatile Organic Compounds, surface-related emission indicated in µg/m² h [a]

Sample identification	Colour Red – Sup Gum		
Date of analysis	21 Feb 2020		
Substance	Unit	Conc.	LOD
Aliphatic and alicyclic compounds			
n-heptane	[µg/m²h]	n.d.	3
n-octane	[µg/m²h]	n.d.	3
n-nonane	[µg/m²h]	n.d.	3
n-decane	[µg/m²h]	n.d.	3
n-undecane	[µg/m²h]	n.d.	4
n-dodecane	[µg/m²h]	n.d.	4
n-tridecan	[µg/m²h]	n.d.	4
n-tetradecane	[µg/m²h]	n.d.	4
n-pentadecane	[µg/m²h]	n.d.	4
n-hexadecane	[µg/m²h]	n.d.	4
Cyclohexane	[µg/m²h]	n.d.	3
Methylcyclohexane	[µg/m²h]	n.d.	2
2.2.4.6.6-pentamethylheptane	[µg/m²h]	n.d.	5
Trimeric isobutene I + II	[µg/m²h]	n.d.	5
4-phenylcyclohexene	[µg/m²h]	n.d.	5
Aromatic compounds			
Benzene	[µg/m²h]	n.d.	3
Toluene	[µg/m²h]	n.d.	2
Ethylbenzene	[µg/m²h]	n.d.	3
m,p-xylene	[µg/m²h]	n.d.	3
o-xylene	[µg/m²h]	n.d.	4
Styrene	[µg/m²h]	n.d.	3
Propylbenzene	[µg/m²h]	n.d.	3
3-ethyltoluene	[µg/m²h]	n.d.	4
2-ethyltoluene	[µg/m²h]	n.d.	4
1,3,5-trimethylbenzene	[µg/m²h]	n.d.	5
1,2,4-trimethylbenzene	[µg/m²h]	n.d.	5
1,2,3-trimethylbenzene	[µg/m²h]	n.d.	4
Chlorinated substances			
Tetrachloroethene (PER)	[µg/m²h]	n.d.	12
Chlorobenzene	[µg/m²h]	n.d.	4

Substance	Unit	Conc.	LOD
Ester			
Ethylacetate	[µg/m²h]	n.d.	3
iso-propylacetate	[µg/m²h]	n.d.	3
iso-butylacetate	[µg/m²h]	n.d.	3
n-butylacetate	[µg/m²h]	n.d.	3
1-methoxy-2-propylacetate (MPA)	[µg/m²h]	n.d.	4
Texanoldiisobutyrate (TXIB)	[µg/m²h]	n.d.	5
Aldehydes			
Pentanal	[µg/m²h]	n.d.	4
Hexanal	[µg/m²h]	52	6
Heptanal	[µg/m²h]	13	6
Octanal	[µg/m²h]	17	5
Nonanal	[µg/m²h]	18	6
Decanal	[µg/m²h]	11	6
Ketones			
4-Methyl-2-pentanone (MIBK)	[µg/m²h]	n.d.	3
Cyclohexanone	[µg/m²h]	n.d.	5
Acetophenone	[µg/m²h]	n.d.	6
Benzophenone	[µg/m²h]	n.d.	6
Terpenes			
Alpha-pinene	[µg/m²h]	n.d.	4
Beta-pinene	[µg/m²h]	n.d.	5
3-carene	[µg/m²h]	n.d.	5
Limonene	[µg/m²h]	4	4
Other			
Octamethyltetracyclosiloxane	[µg/m²h]	n.d.	5
Decamethylpentacyclosiloxane	[µg/m²h]	n.d.	5
		,	
Sum VOC ident.	**[µg/m²h]**	**120**	

[a] µg/m² h = microgram per square meter and hour (µg m^{-2} h^{-1})
n.d. = below Limit of Determination, na = not evaluable, LOD = Limit of Determination

The “SUM VOC ident.” parameter designates the sum of identified individual compounds.

3 Expert report

3.1 Evaluation of results

The analyzed test specimens “Colour Black – Tulpin Wood” and “Colour Red – Sup Gum” exhibited a release of volatile organic compounds (VOC) under the test-chamber conditions described above that is inconspicuous and typical of the material. According to experience, compounds falling within the classes of aldehydes and terpenes are released, *inter alia*, by wood and wood-based materials and were thus to be expected at a test temperature of 90 °C.

The analysis did not show any indications of relevant emissions related to the colorants used. It can be assumed in all probability that, also with regard to other colored veneers for which comparable colorants of the “JGrabner Saunaboard Colour Collection” were used, no emissions are released that are atypical of the material.

Certified Engineer Peter Tappler