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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**
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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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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