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VOC EMISSION TEST REPORT

M1

27 April 2020

1 Sample Information

1.1 Sample for VOC and Aldehyde Emissions

Sample name	Pure
Eurofins reg. number	392-2020-00075002
Batch no.	-
Production date	22/01/2020
Product type	PVC flooring
Sample reception	12/02/2020

1.2 Sample for Sensory Testing and Ammonia

Sample name	Pure
Eurofins reg. number	392-2019-00428601
Batch no.	-
Production date	14/10/2019
Product type	PVC flooring
Sample reception	24/10/2019

2 Brief Evaluation of the Results

Regulation or protocol	Conclusion	Version of regulation or protocol
M1 [§]		M1 Protocol of November 2017
VOC and Aldehyde Emissions	Pass	
Sensory Testing and Ammonia	Pass	

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

[§] Deviation from method. Please see deviation section



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

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3 Applied Test Methods

3.1 General Test References

Regulation, protocol or standard	Version	Reporting limit VOC [$\mu\text{g}/\text{m}^3$]	Calculation of TVOC	Combined uncertainty ^a [RSD(%)]
EN 16516	October 2017	5	Toluene equivalents	22%
ISO 16000 -3 -6 -9 -11	2006-2011 depending on part	2	Toluene equivalents	22%
ASTM D5116-10	2010	-	-	-
M1	M1 Protocol of November 2017	5	Toluene equivalents	22%
EN 15251 ¹ appendix C*	2007	2	Toluene equivalents	22%

3.2 Specific Laboratory Sampling and Analyses

Procedure	External Method	Internal SOP	Quantification limit / sampling volume	Analytical principle	Uncertainty ^a [RSD(%)]
Sample preparation	ISO 16000-11:2006, EN16402:2013, CDPH:2017, AgBB:2018, EMICODE:2019	71M549810	-	-	-
Emission chamber testing	ISO 16000-9:2006, EN 16516:2017	71M549811	-	Chamber and air control	-
Sampling of VOC	ISO 16000-6:2011, EN 16516:2017	71M549812	5 L	Tenax TA	-
Analysis of VOC	ISO 16000-6:2011, EN 16516:2017	71M542808B	1 $\mu\text{g}/\text{m}^3$	ATD-GC/MS	10%
Sampling of aldehydes	ISO 16000-3:2011, EN 16516:2017	71M549812	35 L	DNPH	-
Analysis of aldehydes	ISO 16000-3:2011, EN 717-1:2004, EN 16516:2017	71M548400	3-6 $\mu\text{g}/\text{m}^3$	HPLC-UV	10%
Sampling of Ammonia	NIOSH 6015:1994	71M549812	100 L	H ₂ SO ₄ coated Silicagel	-
Analysis of Ammonia	NIOSH 6015:1994	71M544430	10 $\mu\text{g}/\text{m}^3$	Spectrofotometry	10%
Odour/sensory testing	ISO 16000-28:2012	71M549821, 71M549822	-	Odour panel	10%

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4 Test Parameters, Sample Preparation and Deviations

4.1 VOC Emission Chamber Test Parameters – VOC and Aldehyde Emissions

Parameter	Value	Parameter	Value
Chamber volume, V[L]	119	Preconditioning period	-
Air Change rate, $n[h^{-1}]$	0.5	Test period	09/03/2020 - 06/04/2020
Relative humidity of supply air, RH [%]	50 ± 3	Area specific ventilation rate, $q [m/h \text{ or } m^3/m^2/h]$	1.25
Temperature of supply air, T [°C]	23 ± 1	Loading factor [m^2/m^3]	0.4
		Test scenario	Flooring or ceiling

4.2 VOC Emission Chamber Test Parameters – Sensory Testing and Ammonia

Parameter	Value	Parameter	Value
Chamber volume, V[L]	119	Preconditioning period	-
Air Change rate, $n[h^{-1}]$	0.5	Test period	19/11/2019 - 17/12/2019
Relative humidity of supply air, RH [%]	50 ± 3	Area specific ventilation rate, $q [m/h \text{ or } m^3/m^2/h]$	1.25
Temperature of supply air, T [°C]	23 ± 1	Loading factor [m^2/m^3]	0.4
		Test scenario	Flooring or ceiling

4.3 Preparation of the Test Specimen

Edges and back were covered with aluminium foil and aluminium tape. The samples were arranged with a T-shaped joint.

4.4 Picture of Sample – VOC and Aldehyde Emissions



4.5 Picture of Sample – Sensory Testing and Ammonia



4.6 Deviations from Referenced Protocols and Regulations

This report combines the results from two samples from different batches with different production dates.

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5 Results

5.1 VOC Emission Test Results after 28 Days

	CAS No.	Retention time [min]	ID-Cat	Specific Conc. [µg/m³]	Toluene eq. [µg/m³]	Toluene SER [µg/(m²·h)]	SER [µg/(m²·h)]	EU-LCI [µg/m³]
VOC compounds								
Not identified *		14.27	4	7.0	7.0	8.7		
Butylhydroxy-toluene BHT *	128-37-0	14.47	1	13	17	22		100
Other saturated C11-C13 n-and iso-alcohols *		13.5-14.6	2	99	99	120		
TVOC				120	120	150		
VVOC compounds								
None determined								
TVVOC				< 5	< 5	< 7		
SVOC compounds								
Not identified *		17.36	4	6.8	6.8	8.5		
Not identified *		17.51	4	5.3	5.3	6.6		
TSVOC				12	12	15		
CMR substances								
None determined								
Total CMR				< 1	< 1		< 2	
Aldehydes								
Formaldehyde	50-00-0		1	< 3			< 4	100
Acetaldehyde	75-07-0		1	< 3			< 4	1200
Propionaldehyde	123-38-6		1	< 3			< 4	
Butyraldehyde	123-72-8		1	< 3			< 4	650
Acrolein *	107-02-8		1	< 5			< 7	14
2-Butenal *	123-73-9		1	< 5			< 7	5
Glutaraldehyde *	111-30-8		1	< 5			< 7	
Octanal *	124-13-0		1	< 5			< 7	900
Nonanal *	124-19-6		1	< 5			< 7	900
Decanal *	112-31-2		1	< 5			< 7	900
Add. compounds								
Ammonia	7664-41-7		1	21			26	

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5.2 Sensory Testing

	Acceptance		Acceptance
Participant 1	1	Participant 9	0.4
Participant 2	0.55	Participant 10	-0.5
Participant 3	0.3	Participant 11	0.7
Participant 4	0.2	Participant 12	-0.15
Participant 5	0.95	Participant 13	-0.2
Participant 6	0.5	Participant 14	0.9
Participant 7	0.3	Participant 15	0.8
Participant 8	0.75	Participant 16	0.9
Final Results			
Average assessment	0.5		
90% confidence interval	0.3 - 0.7		
Standard deviation	0.5		

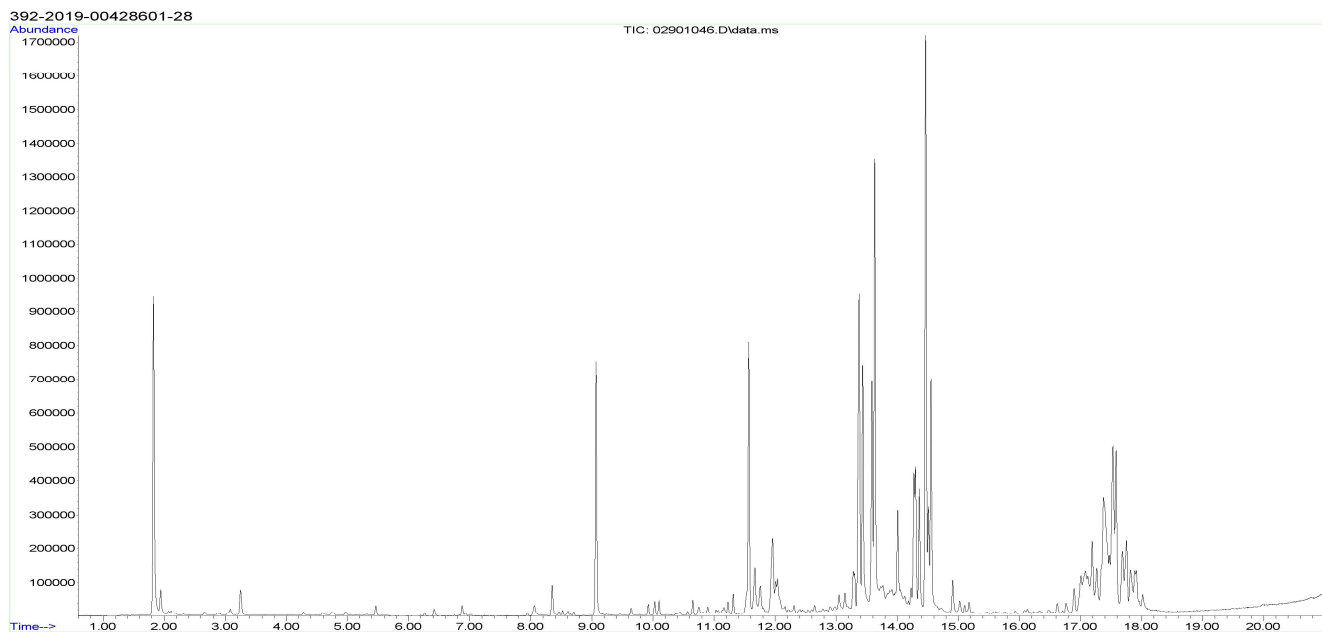
6 Summary and Evaluation of the Results

6.1 Comparison with M1 Limit Values

Parameter	Area specific emission rate mg/(m ² h)	Limit Value mg/(m ² h)
TVOC	0.15	< 0.2
Formaldehyde	< 0.004	< 0.05
Ammonia	0.026	< 0.03
Total CMR [mg/m ³]	< 0.001	< 0.001
Odour (dimensionless)	0.5	≥ 0.0
Single VOCs with EU-LCI	Complies	≤ EU-LCI

7 Appendices

7.1 Chromatogram of VOC Emissions after 28 Days



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7.2 Sampling Report – VOC and Aldehyde Emissions




EN 16516 Sampling Report

Name of applicant: (name, company, phone):	Dries Decuypere BerryAlloc NV +32 56 67 67 78	Producer (if different from company's name at place of sampling):	
Production plant, where sampling takes place	BerryAlloc LVT	Sampler * (Please mark):	
		(name, company, phone):	
Name of the product:	Pure	Type of product	
Model / Program / Series:	Pure Click	Batch N°:	See bottom of plank/label packaging
Article N°:	See label on box.	Date of batch production:	See label on the box
Sample was taken from	<input checked="" type="checkbox"/> ongoing production <input type="checkbox"/> stocks <input type="checkbox"/> retained sample	Date of sampling:	Comes from production, similar as production date.
		Time of sampling:	See production date
Where had the product been stored prior to sampling?	<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:	Production.	Packing material:	Carton box wrapped up in aluminum
Specifics (possible negative influences by air contamination where sample was taken, by petrol emissions, by solvent emissions from production; any other uncertainties, questions, etc).	Our previous report contained a product, reason why we were failing on many aspects of the indoor air comfort gold. There is/could be no contamination hence the fact it is highly impossible to see this component again.		
Cut edges (identification of cut edges when present and identification of new surfaces and surface to be exposed in the emission test):			
Confirmation Herewith the signer 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: 21/02/2020	Signature: Dries Decuypere (Stamp)		

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7.3 Sampling Report – Sensory Testing and Ammonia

Name of applicant: <i>Dries Deuypere</i> <small>(name, company, phone):</small> <i>Berry Alloc NV</i> <i>+32 56 67 67 78</i>		Producer <i>Berry Alloc NV</i> <small>(if different from company's name at place of sampling):</small>	
Production plant, where sampling takes place <i>Berry Alloc NV</i>		Sampler* <small>(Please mark):</small> <small>(name, company, phone):</small>	
Name of the product: <i>Pure</i>		Type of product <i>LVT</i>	
Model / Program / Series: <i>/</i>		Batch N°:	
Article N°:		Date of batch production: <i>2019-10-14</i>	
Sample was taken from <input checked="" type="checkbox"/> ongoing production <input type="checkbox"/> stocks <input type="checkbox"/> retained sample		Date of sampling: <i>2019-10-14</i> Time of sampling:	
Where had the product been stored prior to sampling? <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: <i>No storage, taken from the line</i>		Packing material: <i>carton box</i>	
Specifics (possible negative influences by air contamination where sample was taken, by petrol emissions, by solvent emissions from production; any other uncertainties, questions, etc).		<i>/</i>	
Cut edges (identification of cut edges when present and identification of new surfaces and surface to be exposed in the emission test): <i>/</i>			
Confirmation Herewith the signer 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: <i>20/11/2019</i>		Signature:  <small>(Stamp)</small>	

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7.4 How to Understand the Results

7.4.1 Acronyms Used in the Report

- < Means less than
- > Means bigger than
- * Not a part of our accreditation
- ⌘ 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 substrate 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.
- e The component may be overestimated due to contribution from the system
SER Specific Emission Rate.

7.4.2 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.

7.5 Applied LCI and NIK Values

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

Compound	CAS No.	EU-LCI [$\mu\text{g}/\text{m}^3$]
Butylhydroxytoluene BHT *	128-37-0	100

7.6 Description of VOC Emission Test

7.6.1 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. (EN 16516, ISO 16000-9, internal method no.: 71M549811).

7.6.2 Expression of the Test Results

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

7.6.3 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 μ m film, Agilent) (EN 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).

7.6.4 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, 0.25 μ m film) (EN 16516, ISO 16000-6, internal methods no.: 71M549812 / 71M542808B).

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).

Total Volatile Organic Compounds (TVOC) is calculated by summation of all individual VOCs with a concentration $\geq 5 \mu\text{g}/\text{m}^3$. The TVOC can be expressed either in toluene equivalents as defined in EN 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 $\geq 5 \mu\text{g}/\text{m}^3$, 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).

7.6.5 Testing of Aldehydes

The presence of aldehydes 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.

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.

7.6.6 Testing of Ammonia

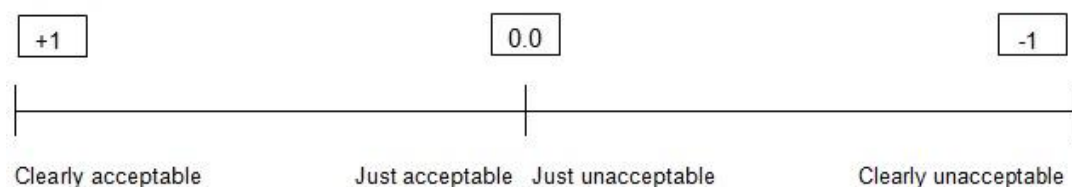
The presence of ammonia was tested by drawing air samples from the chamber outlet through silicagel tubes coated with sulphuric acid after 28 days. Analysis was done by solvent desorption and UV/VIS spectroscopy (internal methods: 71M549812 / 71M544430).

The absence of ammonia was stated if the signal was lacking at the specific wavelength. Otherwise it was checked whether the detection limit was exceeded.

7.6.7 Sensory Testing

The sensory testing was done after 28 days storage under controlled conditions in the testing chamber. The test panel assessed the odour first of the room air and then give the odour rating once for each chamber. The judgement was based on the odour impression after 2-3 inhalations. The odour was rated immediately on a continuous scale with values between +1 (clearly acceptable) and -1 (clearly unacceptable), with just acceptable = +0.1 and just unacceptable = -0.1. The scale was read with an accuracy of ± 0.1 . The result was calculated as the average of the assessments from the odour rating of the panel. Only panel members rating clean moistened air as acceptable (> 0.8) were considered in the calculation.

Sensory Acceptance:



7.7 Quality Assurance

Before loading the test chamber, a blank check of the empty chamber is performed and compliance with background concentrations in accordance with EN 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.

7.8 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.

7.9 Uncertainty of the Test Method

The relative standard deviation of the overall analysis is 22%. The expanded uncertainty U_m equals $2 \times$ RSD. For further information please visit www.eurofins.dk/uncertainty.