REPORT

Issued by an Accredited Testing Laboratory

Contact person
Ulrika Johansson
Division Materials and Production
+46 10 516 53 22
ulrika.johansson@ri.se

Date
2023-05-24

Reference
O100785-1185940

Hammerglass AB
Åkagårdsvägen 9
269 71 FÖRSLÖV

Emission measurements after 28 days

(3 appendices)

Test object

A sample of a polycarbonate glass was delivered by the client.

Product name:	**Single 12 mm/Enkelglas 12 mm**
Manufacturer:	Hammerglass AB
Manufacturing date:	2023-02-21
Batch No:	500155
Size of sample:	500 x 1000 mm
Package:	Aluminium and plastic foil, cover sheets
Date of arrival:	2023-03-09
Date of testing:	week 11-18
Place of testing:	Chemistry and Applied Mechanics, Brinellgatan 4, Borås

Assignment

Emission measurements according to ISO 16000-9:2006 (Indoor air – Part 9: Determination of the emission of volatile organic compounds from building products and furnishing – Emission test chamber method) after 28 days regarding volatile organic compounds (VOC and VVOC/SVOC), carcinogenic substances (VOC-substances, EU Regulation No 1272/2008 Annex VI, cat 1A and 1B) formaldehyde and acetaldehyde (ISO 16000-3:2022). Reference room calculations according to EN 16516:2017/A1:2020 (EU-LCI values).

Method

The test was started on March 14, 2023 by unpacking the sample. The test piece was used as received giving an exposed surface area of 1.0 m^2. The test specimen was placed in a separate conditioning container (with air velocity of approx. 0.2 m/s) in a room with controlled climate conditions of 23 ± 2 ºC and 50 ± 5 % RH. The test specimen was placed in the emission chambers five days prior to the air sampling.

Air samplings after 28 days of conditioning were carried out on 2023-04-11.

Conditions of the test in the emission chamber:

Test chamber volume:	1.0 m^3
Area of test specimens:	1.0 m^2
Air exchange rate:	0.5 h^{-1}
Area specific air change rate:	0.5 m^3/m^2 h.
Temperature:	23 ± 1 ºC
Relative humidity:	50 ± 5 % RH
Air velocity at specimen surface:	0.1 – 0.3 m/s

Tenax TA and multisorbent was used as adsorption medium for VOC. The tubes were thermally desorbed and analysed in accordance to ISO 16000-6:2021 (Determination of organic compounds (VVOC, VOC, SVOC) in indoor and test chamber air by active sampling on sorbent tubes, thermal desorption and gas chromatography using MS or MS/FID). This means an analysis in a gas chromatograph and detection with a flame ionisation detector (FID) and mass selective detector (MS). The capillary column used is coated with 5% phenyl/ 95 % methylpolysiloxane. The FID signals are used for compound quantification. The total volatile organic compounds (TVOC) means compounds eluting between and including n-hexane to hexadecane, having boiling points in the range of about 70-260 °C. Minimum duplicate air samples were taken and the results are mean values. Sampled volumes are 4.7 – 6.2 L.

Tenax TA and multisorbent was also used as adsorption medium for testing of volatile carcinogenic compounds according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B), (exclusive formaldehyde), 1 µg/m^3 and above.

The samplings of aldehydes were carried out with DNPH samplers. The samplers were analysed according to ISO 16000-3:2022 (Indoor air - Part 3: Determination of formaldehyde and other carbonyl compounds – Active sampling method). This means analysis on a liquid chromatograph with absorbance detector. Duplicate air samples were taken and the results are mean values. Sampled volumes were 61 L.

Results

The results relate only to the items tested.

The results in Table 1 are expressed as area specific emission rates and as concentrations in a reference room (according to EN 16516:2017/A1:2020, not accredited method). The reference room has a base area of 3 m x 4 m and a height of 2.5 m, with an air exchange rate of 0.5 h^{-1}. The wall area is 31.4 m^2, floor area is 12 m^2, small area, like a door, is 2 m^2 and very small area, like sealant, is 0.2 m^2. Small area is used for the calculation of the concentrations.

Calculation of the concentration from the emission rate:

$$C = \frac{E_a \times A}{n \times V}$$

C = concentration of VOC in the reference room, in µg/m^3
E_a = area specific emission rate, in µg/m^{2}h
A = surface area of product in reference room, in m^2
n = air exchange rate, in changes per hour
V = volume of the reference room, in m^3

Table 1.
Emission results for the product **Single 12 mm/Enkelglas 12 mm** after 28 days

Volatile organic compounds	**CAS number**	**Retention time** (min)	**ID** [1]	**Emission rate** ($\mu g/m^2h$)	**Concentration in reference room** ($\mu g/m^3$)	**LCI_i** ($\mu g/m^3$)	**R_i** (c_i/LCI_i)
TVOC (C_6 – C_{16})	--	10.9 – 43.9	B	< 10	< 5	--	--
Volatile Carcinogens [2]		10.9 – 43.9					
No substances detected	--	--	B	< 1	< 1	--	--
VOC with LCI [3]		10.9 – 43.9					
No substances detected	--	--	A	< 2	< 5	--	--
∑ VOC with LCI	--	--	A	< 2	< 5	--	--
VOC without LCI [4]		10.9 – 43.9					
No substances detected	--	--	B	< 2	< 5	--	--
∑ VOC without LCI	--	--	B	< 2	< 5	--	--
SVOC (C_{16} – C_{22}) [5]		43.9 – 51.3					
No substances detected	--	--	B	< 2	< 5	--	--
∑ SVOC	--	--	B	< 2	< 5	--	--
VVOC (< C_6) [6]		5.0 – 10.9					
Formaldehyde [7]	50-00-0	--	A	< 1	< 1	100	--
Acetaldehyde [7]	75-07-0	--	A	< 1	< 1	300	--
∑ VVOC	--	--	A	< 2	< 5	--	--
R = ∑ C_i / LCI_i [8]	--	--	--	--	--	--	< 0.01

[1)] ID: A = quantified compound specific, B = quantified as toluene-equivalent
[2)] Volatile carcinogens = VOCs according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B
[3)] VOC with LCI = identified VOC-compound with LCI-value according to EU-LCI, Dec 2021
[4)] VOC without LCI = VOC-compound without LCI-value or not identified.
[5)] SVOC = semi-volatile organic compounds, as defined in ISO 16000-6
[6)] VVOC = very volatile organic compounds, as defined in ISO 16000-6
[7)] VVOC-aldehydes measured with DNPH samplers (ISO 16000-3)
[8)] All VVOC, VOC, SVOC and carcinogens with LCI

Only VOC-compounds with an emission rate higher than 2 $\mu g/m^2h$ are listed in Table 1, carcinogenic compounds $\geq$ 1 $\mu g/m^2h$. Only compounds with a concentration in the reference room $\geq$ 5 $\mu g/m^3$ are evaluated based on LCI (= lowest concentration of interest).

TVOC expressed in $\mu g/m^3$ and $\mu g/m^2h$ is the sum of all individual substances with concentrations $\geq$ 5 $\mu g/m^3$ (in toluene equivalents) in the reference room.

Quantification limit for TVOC is 10 µg/m^{2}h. Measurement uncertainty for TVOC is 30 % (rel) and for formaldehyde 36 % (rel). Background of TVOC in the empty chamber was below 10 µg/m^3 and is subtracted.

See Appendix 1 for gas chromatograms (FID spectra). Appendix 2 is a photo of the test specimen and Appendix 3 is the sampling report provided by the client.

Summary of the test results

The test results are summarized in Table 2.

Table 2.
Summary of the emission results after 28 days for the product **Single 12 mm/Enkelglas 12 mm**

Compounds	**Emission rate** (µg/m^{2}h)	**Concentration in reference room** (small area scenario) (µg/m^3)
TVOC	< 10	< 5
∑ Carcinogenic VOCs	< 1	< 1
∑ VOC with LCI	< 2	< 5
∑ VOC without LCI	< 2	< 5
∑ VVOC	< 2	< 5
Formaldehyde	< 1	< 1
∑ SVOC	< 2	< 5
$R = \sum C_i / LCI_i$	< 0.01	

Evaluation of the test results

The emission results can be compared to different Emission Labelling Systems.

Decision rule: When comparing the measured results and requirement level, the average value of the measured results has been compared with the requirement level. No account is taken to the measurement uncertainty.

Byggvarubedömningen (version 7.1, updated 2022-10-01) has criteria regarding Emissions of VOC to indoor environment. The emissions are to be measured according to a standard method such as ISO 16000-9 after 28 days regarding VOC and aldehydes. The requirements for the **Recommended class** are that the test results of TVOC, VOC and aldehydes are in compliance with the requirements of these parameters in one of the following systems: Emicode EC1, Emicode EC1^{PLUS}, Blue Angel, M1 (RTS) or GUT.

The results of the tested sample are compared to **M1** "M1 Emission Classification of Building Materials: Protocol for Chemical and Sensory Testing of Building Materials, ver 15.11.2017", see Table 3.

Table 3.
The test results of the product **Single 12 mm/Enkelglas 12 mm** compared to the relevant requirements in M1

Compounds	**Requirement M1** (mg/m^2h)	**Test Results** (mg/m^2h)	**Pass / Fail**
TVOC	< 0.2	**< 0.010**	**PASS**
Formaldehyde	< 0.05	**< 0.001**	**PASS**
CMR 1A+1B	< 0.001	**< 0.001**	**PASS**
Single VOC ($\mu g/m^3$)	≤ EU-LCI	**≤ EU-LCI**	**PASS**
Ammonia	< 0.03	not measured	--
Odour	≥ 0.0	not measured	--

Conclusion

The test results of TVOC, VOC and aldehydes are in compliance with the requirements of M1 after 28 days and meet the requirements of Byggvarubedömningen for the **Recommended class** regarding Emissions of VOC to the indoor environment.

RISE Research Institutes of Sweden AB
Chemistry and Applied Mechanics - Chemical Product Safety

Performed by

Ulrika Johansson

Examined by

Fredrik Solhage

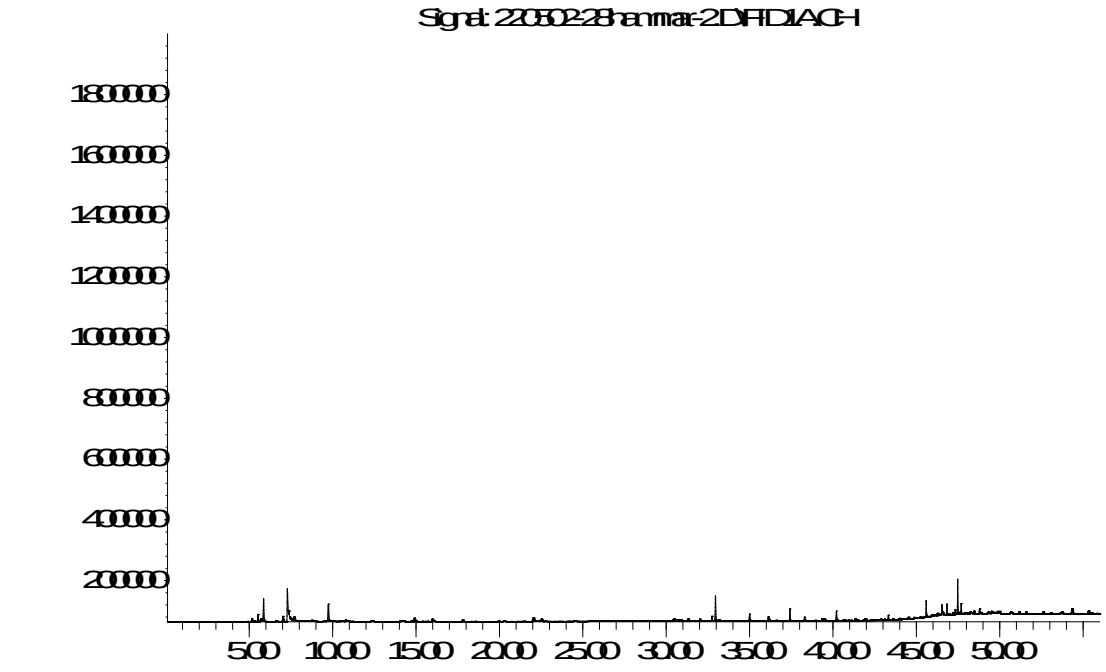
Appendices

1. Gas chromatogram

Appendix 1

Gas chromatogram

Single 12 mm/Enkelglas 12 mm after 28 days



TVOC between C_6 and C_{16}, means compounds eluting between 10.9 and 43.9 minutes.

Appendix 2

Photo of the test specimen

Appendix 3

Sampling Report

Sampler (Name, Company, contact info): Hammerglass AB Peter Hultberg 0726 011230	**Manufacturer of the product** (Company, address): **Åkagårdsvägen 9** **269 71 Förslöv**
Name of product: Single 12mm Enkelglas 12mm	**Type of product:** **Polykarbonat**
Manufacturing Date: 2023-02-21	**Batch No:** **500155**
Date of sampling: 2023-03-03	**Amount/size of material sampled:** **1 st 500mm x 1000mm** **Packing material: Aluminiumfolie, skumplast, Masonitskiva.**
Sample is taken from: Production line ☐ Stock / Storage X Miscellaneous ☐ -where, specify:	**How was the product stored before sampling?** Skivor 2120mm x 3070mm med skyddsfolie på pall, inomhuslager.
If a sub-sample was collected from a larger material amount, describe how the sub-sample was taken: Kapad I plattuppdelningssåg från 2120mm x 3070mm till 500mm x 1000mm.	
Observations and remarks:	
Confirmation I hereby confirm that the sample was selected, taken and packed in accordance with the instructions.	
Date: 2023-03-08	**Signature:**

Verification

Transaction 09222115557493358413

Document

O100785-1185940 Hammerglass, BVB, SINTEF
Main document
8 pages
Initiated on 2023-05-24 14:37:03 CEST (+0200) by Ulrika Johansson (UJ)
Finalised on 2023-05-24 14:39:59 CEST (+0200)

Signing parties

Ulrika Johansson (UJ)
RISE Research Institutes of Sweden AB
Company reg. no. 556464-6874
ulrika.johansson@ri.se
Signed 2023-05-24 14:37:04 CEST (+0200)

Fredrik Solhage (FS)
fredrik.solhage@ri.se
Signed 2023-05-24 14:39:59 CEST (+0200)