

Brödr. Sunde as
Frank Wilhelmsen
P.O. Box 8115 Spjelkavik
NO-6022 ÅLESUND
Norway

Emission measurements after 28 days

(2 appendices)

Object

One sample of a foam insulation was delivered to SP by the client.

Sample name: **Sundolitt S80**
two pieces of 0.5 x 0.6 x 0.05 m, wrapped in aluminium foil and plastic foil

Production date: 2016-02-26

Date of arrival: 2016-03-11

Work requested and method

Emission measurements according to accredited 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) and aldehydes (ISO 16000-3:2011).

The test was started on 2016-03-17. Both samples were used. They were placed back-to-back and edges were sealed with aluminium tape. Total open surface area 0.59 m². The test specimen was stored in a room with controlled climate conditions of 23 ± 2 °C and 50 ± 5 % RH. The specimen was placed in a chamber three days before samplings. The emission samplings were carried out on 2016-04-14.

Test conditions in the chamber:

Chamber volume: 1.0 m³
Temperature: 23 ± 0.5 °C
Relative humidity: 50 ± 5 % RH
Surface area of test specimen: 0.59 m²
Air exchange rate: 0.5 h⁻¹
Area specific air flow rate: 0.85 m³/m² h.
Air velocity at specimen surface: 0.1 – 0.3 m/s

Tenax TA was used as adsorption medium for VOC. The Tenax tubes were thermally desorbed and analysed in accordance to accredited SP method 0601, similar to ISO 16000-6:2011 (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/FID). This means an analysis in a gas chromatograph and detection with a flame ionisation detector

SP Technical Research Institute of Sweden

Postal address
SP
Box 857
SE-501 15 BORÅS
Sweden

Office location
Västeråsen
Brinellgatan 4
SE-504 62 BORÅS

Phone / Fax / E-mail
+46 10 516 50 00
+46 33 13 55 02
info@sp.se

Laboratories are accredited by the Swedish Board for Accreditation and Conformity Assessment (SWEDAC) under the terms of Swedish legislation. This report may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

(FID) and mass selective detector (MS). 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. The emission rate of TVOC is quantified in toluene equivalents and includes all compounds $ca \geq 1 \mu\text{g}/\text{m}^3$ in the chamber. The mass selective detector is used for identification of single compounds, quantified in compound specific amounts when possible, otherwise in toluene equivalents. Quantification limit for carcinogenic substances is $1 \mu\text{g}/\text{m}^2\text{h}$. Minimum triplicate air samples were taken and the results are mean values. Sampled volumes were 1 to 6 L.

The samplings of the aldehydes/ketones formaldehyde, acetaldehyde, acetone and propanal were carried out with DNPH samplers. The samplers were analysed according to accredited SP method 2302, similar to ISO 16000-3:2011 -Indoor air--Part 3:Determination of formaldehyde and other carbonyl compounds – Active sampling method. This means analysis on a liquid chromatograph with absorbance detector. The other aldehydes (butanal, pentanal, hexanal, benzaldehyde, 3-methylbenzaldehyde, 2-methylbenzaldehyde, 4-methylbenzaldehyde and 2,5-dimethylbenzaldehyde) were analyzed on GC-MS/FID by sampling on Tenax TA. Duplicate air samples were taken and the results are mean values. Sampled volumes were 46 and 90 L.

Results

The results in table 1 are expressed as area specific emission rates and as concentrations in a reference room (according to CEN/TS 16516:2013). 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 , ceiling area is 12 m^2 and small surface, like a door, is 1.5 m^2 . **Wall 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 $\mu\text{g}/\text{m}^3$
 E_a = area specific emission rate, in $\mu\text{g}/\text{m}^2\text{h}$
A = surface area of the tested product in reference room, in m^2
n = air exchange rate, in changes per hour, here 0.5 h^{-1}
V = volume of the model room, in m^3 , here 30 m^3

Only the compounds with a concentration in the reference room $> 5 \mu\text{g}/\text{m}^3$ are quantified. The TVOC in the reference room is the sum of all individual substances with concentrations $\geq 5 \mu\text{g}/\text{m}^3$ (in toluene equivalents) within the retention range $C_6 - C_{16}$.

Table 1.
 Emission results of **Sundolitt S80**, after 28 days

Volatile organic compounds	Retention time (min)	CAS number	ID ¹	Emission rate ($\mu\text{g}/\text{m}^2\text{h}$)	Concentration in reference room (wall area) ($\mu\text{g}/\text{m}^3$)
TVOC (C₆ – C₁₆)	6.2 – 37.9	--	B	37	76
Identified substances:					
Ethylbenzene	14.3	100-41-4	A	10	20
Styrene	15.5	100-42-5	A	24	49
Benzaldehyde	18.4	100-52-7	A	5	10
Carcinogenic substances ²					
No substances identified	6.2 – 37.9	--	--	< 1	< 1
Substances outside TVOC:					
VVOC (< C₆) ³	4.5 – 6.2				
Butane, 2-methyl-	4.7	78-78-4	B	570	1 200
Pentane	4.9	109-66-0	B	270	570
Cyclopentane	5.8	287-92-3	B	13	28
SVOC (C₁₆ – C₂₂) ⁴	37.9 - 42.0				
No SVOC substances identified	--	--	--	< 2	< 5
Formaldehyde	--	50-00-0	A	< 1	< 5
Acetaldehyde	--	75-07-0	A	< 1	< 5
Σ Aldehydes ⁵	--	--	A	5	10

¹) ID: A = quantified compound specific, B = quantified as toluene-equivalent

²) VOC-substances, according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B

³) VVOC = very volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)

⁴) SVOC = semi-volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)

⁵) Aldehydes = Aldehydes and ketones according to EN ISO 16000-3:201: formaldehyde, acetaldehyde, acetone, propanal, butanal, pentanal, hexanal, benzaldehyde, 3-methylbenzaldehyde, 2-methylbenzaldehyde, 4-methylbenzaldehyde and 2,5-dimethylbenzaldehyd.

Only VOC-compounds with an emission rate higher than $2 \mu\text{g}/\text{m}^2\text{h}$ are listed in the table (carcinogenic compounds $\geq 1 \mu\text{g}/\text{m}^2\text{h}$). Quantification limit for TVOC is $10 \mu\text{g}/\text{m}^2\text{h}$. Measurement uncertainty for TVOC is 15 % (rel) and for formaldehyde 30 % (rel). Background of TVOC in the empty chamber was $20 \mu\text{g}/\text{m}^3$. The background value is subtracted.

See Appendix 1 for gas chromatogram (FID spectra).

Individual substances can have response factors varying widely from the toluene response factor. The emission for example of benzaldehyde was $5 \mu\text{g}/\text{m}^2\text{h}$. This emission expressed in toluene response factor, like TVOC, is $3 \mu\text{g}/\text{m}^2\text{h}$.

Summary of test results

The emission rate of TVOC was 37 $\mu\text{g}/\text{m}^2\text{h}$ after 28 days and the emission rate of aldehydes were 5 $\mu\text{g}/\text{m}^2\text{h}$. There were no carcinogenic substances detected in the emission.

There was an emission rate of VVOC of 850 $\mu\text{g}/\text{m}^2\text{h}$ (in toluene equivalents).

SP Technical Research Institute of Sweden SP Chemistry, Materials and Surfaces - Chemistry

Performed by

Examined by

Maria Rådemar

Tove Malin

Appendices

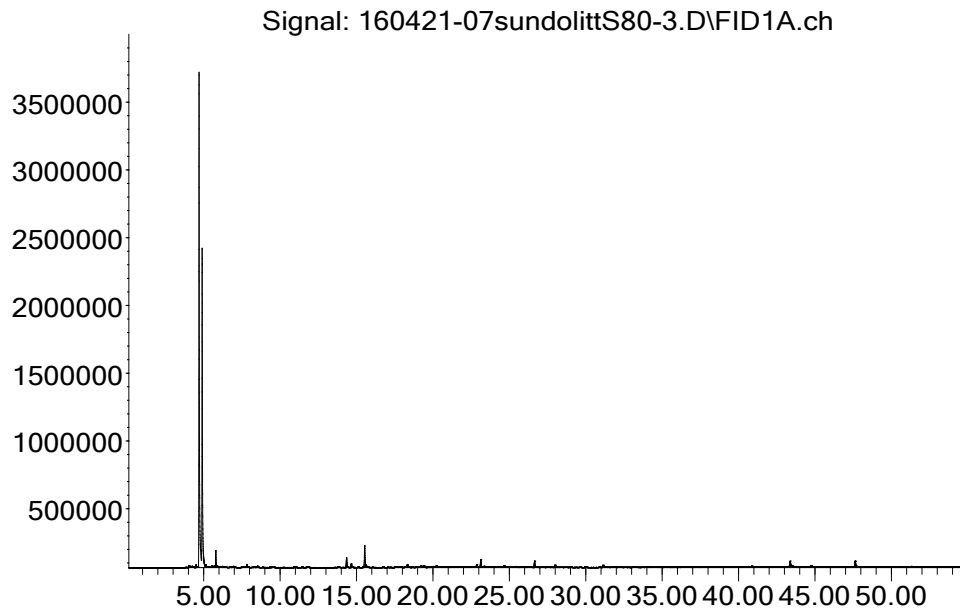
1. Gas Chromatogram
2. Photo of test specimen

Appendix 1

Gas Chromatogram

Sundolitt S80, after 28 days:

Abundance



TVOC between C₆ and C₁₆, means compounds eluting between 6.2 and 37.9 minutes.

Appendix 2

Photo of test specimen



Sundolitt S80