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 Norway

Emission measurements according to M1

(3 appendices)

Assignment

At the request of ByggForm AS an emission measurement regarding VOC according to “M1 Emission Classification of Building Materials: Protocol for Chemical and Sensory Testing of Building Materials”, ver 8.4.2014, has been carried out.

The measurements are made after 28 days of conditioning regarding volatile organic compounds, carcinogenic compounds (EU Regulation No 1272/2008 Annex VI, cat 1A and 1B), formaldehyde, ammonia and sensory acceptability.

Product/test specimen

Product type:	Plywood Panel
Product name:	Poplar Plywood BB/CC 2440x1220
Manufacturing date:	2014-04-18
Packaging:	5 pieces of 25 x 1220 x 1000 mm
Arrived at SP:	2014-05-08
Test specimen preparation:	<p>Chemical testing: Two pieces of 0.81 x 0.635 were cut out. They were placed back-to-back and edges were sealed with aluminium tape. Also small parts of front sides were sealed. Total surface area = 1.0 m².</p> <p>Sensory testing: Eight pieces of 0.69 x 0.32 were cut out. They were placed back-to-back and edges were sealed with aluminium tape. Also small parts of front sides were sealed. Total surface area = 1.7 m².</p>
Deviation from protocol:	No deviations
Test period started, date:	2014-05-15
Conditions during ageing:	23 ± 2 °C, 50 ± 5 % RH
Emission samplings, date:	2014-06-11--12

Methods

The specimens were conditioned outside the testing chamber in a controlled climate conditions of 23 ± 2 °C and 50 ± 5 % RH. The specimens were placed in the chambers three days before the measurements.

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Chamber conditions of the test of chemical emissions:

Test chamber volume:	1.0 m ³ , stainless steel
Temperature:	23 ± 1 °C
Relative Humidity:	50 ± 3 % RH
Air exchange rate:	0.5 h ⁻¹
Air velocity at specimen surface:	0.1 – 0.3 m/s
Area of sample:	1.0 m ²
Area specific air flow rate:	0.5 m ³ /m ² h

Chamber conditions of the test of sensory acceptability:

Test chamber volume:	1.0 m ³ , stainless steel
Temperature:	23 ± 1 °C
Relative Humidity:	50 ± 3 % RH
Supply air flow rate:	0.9 l/s = 3.24 m ³ /h
Area of sample:	1.7 m ²

Emission sampling and analytical methods:

Test	Sampling method	Adsorbent	Sampling volume (litre)	Analysis method / Quantification	Detection limit
VOC	SP 1314 ¹	Tenax TA	3 - 6	SP 0601 ² / FID quantification	1 µg/m ³
Formaldehyde	SP 1314 ¹	DNPH	65	SP 2303 ³ / HPLC-UV	0.03 µg/sampler
Ammonia	SP 1314 ¹	Silica gel	240, 340	Liquid chromatograph with conductivity detector ⁴	0.9 µg/sampler
Sensory evaluation	Untrained panel of min 15 persons	--	--	--	--

¹⁾ In accordance with ISO 16000-9:2006, accredited method.

²⁾ In accordance with ISO 16000-6:2011 and M1 protocol, accredited method.

³⁾ In accordance with ISO 16000-3:2001, accredited method.

⁴⁾ The determinations of the sampled silica gel tubes were done by Sahlgrenska Universitetssjukhuset, Miljökemiska laboratoriet, Göteborg, not accredited method.

Tenax TA was used as adsorption medium for VOC. The Tenax tubes were thermally desorbed and analysed in accordance 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), accredited SP method 0601. This means an analysis in a gas chromatograph and detection with a flame ionisation detector (FID) and mass selective detector (MS). The FID signals are used for compound quantification. The TVOC is quantified as toluene equivalents. The mass selective detector is used for identification of compounds. The capillary column used is coated with 5% phenyl/ 95 % methylpolysiloxane.

Tenax TA 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), 0.001 mg/m³ and above. The compound specific response factors were calculated.

The sampling of formaldehyde was carried out with DNPH samplers. The samplers were analysed according to ISO 16000-3 (in accordance to accredited SP method 2302), which means analysis on a liquid chromatograph with absorbance detector.

The sampling of ammonium was carried out with silicagel treated adsorbent tubes and analysis on a liquid chromatograph with conductivity detector.

Three subsequent samples were taken for the VOC determination, two samples for formaldehyde and ammonia respectively.

Results

The results of the chemical testing are expressed as concentrations in the reference room and as area specific emission rates:

A model room has a volume of 30 m³ and an air change rate of 0.5 changes per hour. The concentration of VOC in the model room can be calculated according to this equation:

$$Conc = \frac{SER_A \times A}{n \times V}$$

Conc = concentration of a VOC in the model room, in µg/m³
 SER_a = area specific emission rate, in µg/m²h
 A = area of sample, in m² (12 m² for ceiling)
 n = air exchange rate, in changes per hour
 V = volume of the model room, in m³

Results of the chemical testing of the sample of **Poplar Plywood** after 28 days:

Compound	Concentration in model room mg/m ³	Emission rate mg/m ² h	Criteria M1 mg/m ² h
TVOC	< 0.020	< 0.010	< 0.2
Carcinogens	< 0.002	< 0.001	< 0.005
Formaldehyde	0.058	0.029	< 0.05
Ammonia	< 0.003	< 0.001	< 0.03

Test report from Sahlgrenska Universitetssjukhuset: test report 2014:25 dated 2014-06-25.

See appendix 1 for gas chromatograms from VOC determination.

Results of the sensory evaluation of the sample of **Poplar Plywood** after 28 days:

Evaluator	Sensory evaluation	Criteria M1
1	0.45	$\geq + 0.0$
2	0.75	
3	0.55	
4	0.45	
5	0.55	
6	0.65	
7	0.50	
8	0.90	
9	-0.20	
10	0.15	
11	0.20	
12	0.20	
13	0.80	
14	0.80	
15	0.65	
Arithmetic mean of acceptability:	0.5	

Standard deviation: 0.30

90 % Confidence interval of arithmetic mean: 0.14

The empty sensory test chamber acceptability was determined 2014-06-09. The mean acceptability vote of the empty chamber was > 0.8 .

Interpretation of the results

The tested product **Poplar Plywood** complies with all the requirements of M1 for the tested parameters.

Detailed results

Detailed results (emission rates) of the chemical testing after 28 days:

Sample	TVOC (mg/m ² h) as toluene equivalents between C ₆ -C ₁₆	Formaldehyde (mg/m ² h)	Ammonia (mg/m ² h)	Carcinogens (mg/m ² h) between C ₆ -C ₁₆
1	< 0.010	0.029	< 0.002	< 0.002
2	< 0.010	0.029	< 0.001	< 0.002
3	< 0.010	--	--	< 0.002

Single VOCs above 0.005 mg/m³ in the model room (as toluene equivalents):

Single VOCs	Retention time (min)	CAS number	Emission rate (mg/m ³)		
			Sample 1	Sample 2	Sample 3
Single VOCs C₆-C₁₆: No single VOC detected	5.5 – 36.8 --	--	--	--	--
Single VOC outside C₆ – C₁₆: VVOOC (< C ₆) ⁵ Acetic acid	4.5 – 5.5 5.0	64-19-7	ca 0.020	ca 0.015	ca 0.025
SVOC (C ₁₆ – C ₂₂) ⁶ No single SVOC detected	36.8 - 42.0 --	--	--	--	--

⁵) VVOOC = very volatile organic compounds, as defined in ISO 16000-6 (not accredited)

⁶) SVOC = semi-volatile organic compounds, as defined in ISO 16000-6 (not accredited)

Level of identification of compounds is 100 % for all compounds ≥ 0.005 mg/m³.

Measurements uncertainty

SER_{TVOC}: ± 15 %, SER_{Formaldehyde}: ± 30 %, SER_{NH3}: ± 14 %

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Performed by


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Examined by


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Appendices

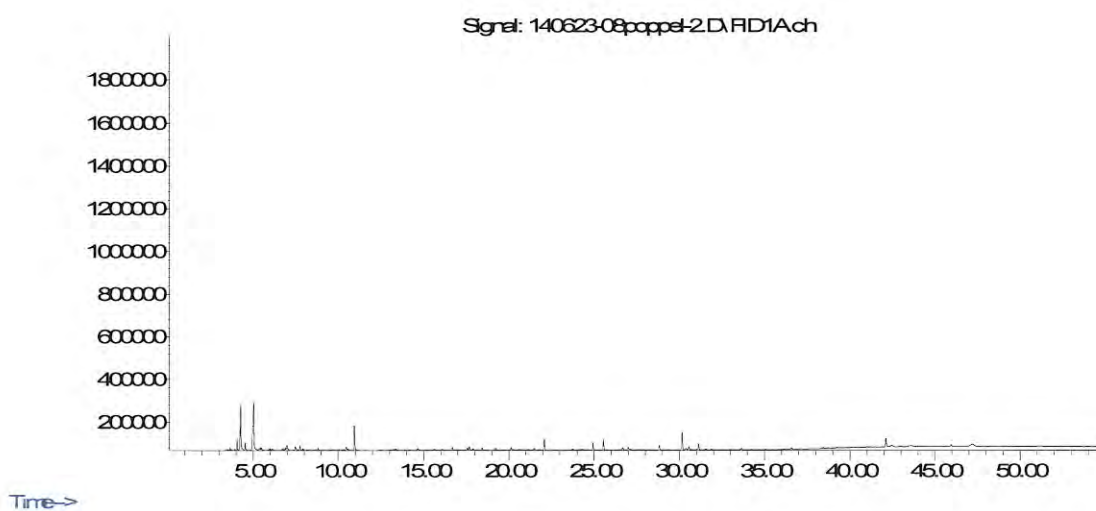
1. Gas Chromatogram
2. Photo of test specimen
3. Sampling report

Appendix 1

Gas chromatogram

Sample: **Poplar Plywood**, after 28 days (sampled volume: 6 litres):

Abundance

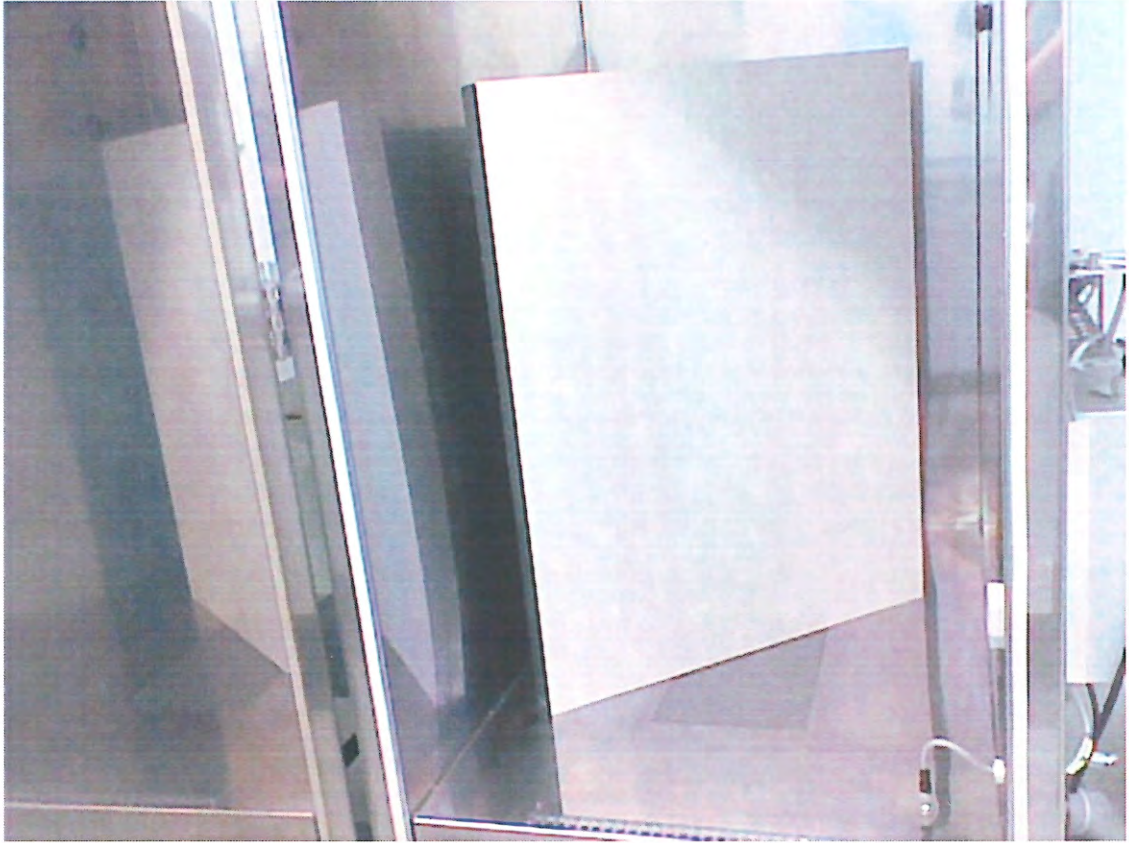


TVOC between C_6 and C_{16} , means compounds eluting between 5.5 and 36.8 minutes.

The compound with retention time 4.3 min is a contamination from the analysis system.

Appendix 2

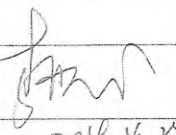
Photo of test specimen



The specimen for the chemical testing.

Appendix 3

Sampling Report

Sampler (Name, Company, contact info) ByggForm AS Eternitveien 8 NO-3470 Siemestad, Norway Att: Herulf Espenæs Phone: +47 91599844 e-mail: herulf@byggform.no	Manufacturer of the product: LINYI QIUZHEN WOOD INDUSTRY CO.,LTD
Name of product POPLAR PLYWOOD BB/CC 2440x1220	Type of product PLYWOOD PANELS, WBP-E1
Manufacturing Date 2014-4-18	Batch No N/A
Date of sampling 2014-4-23	Amount of material sampled 5 pcs * 25x1220x1000mm
Sample is taken from: Production line <input checked="" type="checkbox"/> X Stock / Storage <input type="checkbox"/> Miscellaneous <input type="checkbox"/> -where, specify:	How was the product stored before sampling? After production, the product was cooled down and cut down to samples, before samples were prepared for shipment.
If a sub-sample was collected from a larger material amount, describe how the sub-sample was taken	
Observations and remarks	
Confirmation I hereby confirm that the sample was selected, taken and packed in accordance with M1 testing protocol	
Date 2014-04-24	Signature  2014. 4. 24

M1 2014