Vitrulan Textilglas GmbH
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Bernecker Str. 8
95509 Marktschorgast

Test report no. 50643-001-002

Client:	**Vitrulan Textilglas GmbH Marktschorgast**
Sample description by client	**Test commission no. 405** **M754 control sample** **M755 finished clean air product**
Sample provision:	Commissioning client
Sample receipt:	01.10.2015
Date of report:	24.11.2015
Number of pages:	10
Test objectives:	see Table of Contents
Test laboratories:	eco-INSTITUT Germany GmbH, Cologne

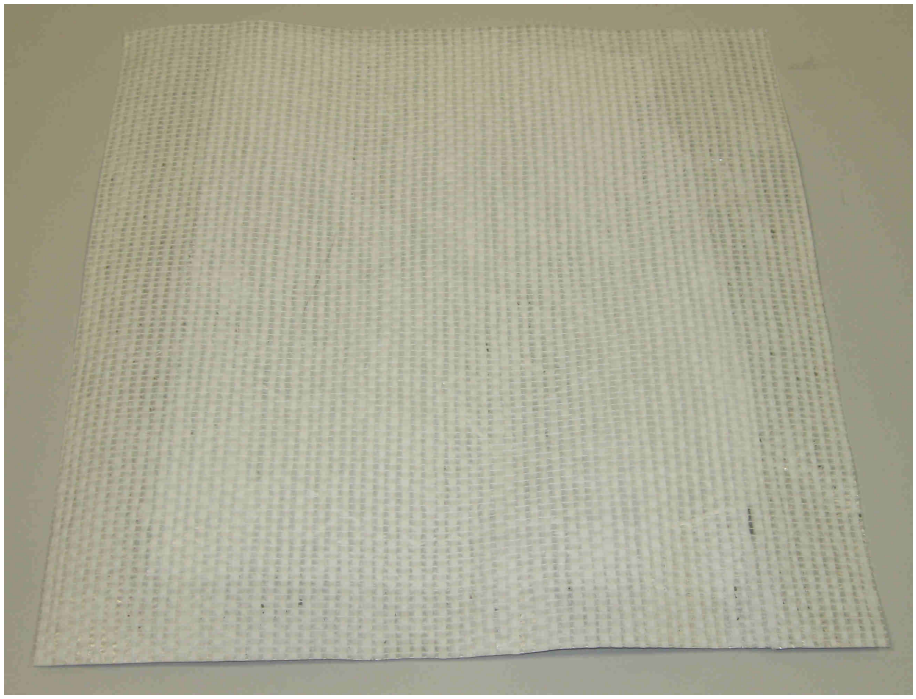
Table of Contents

Overview of samples

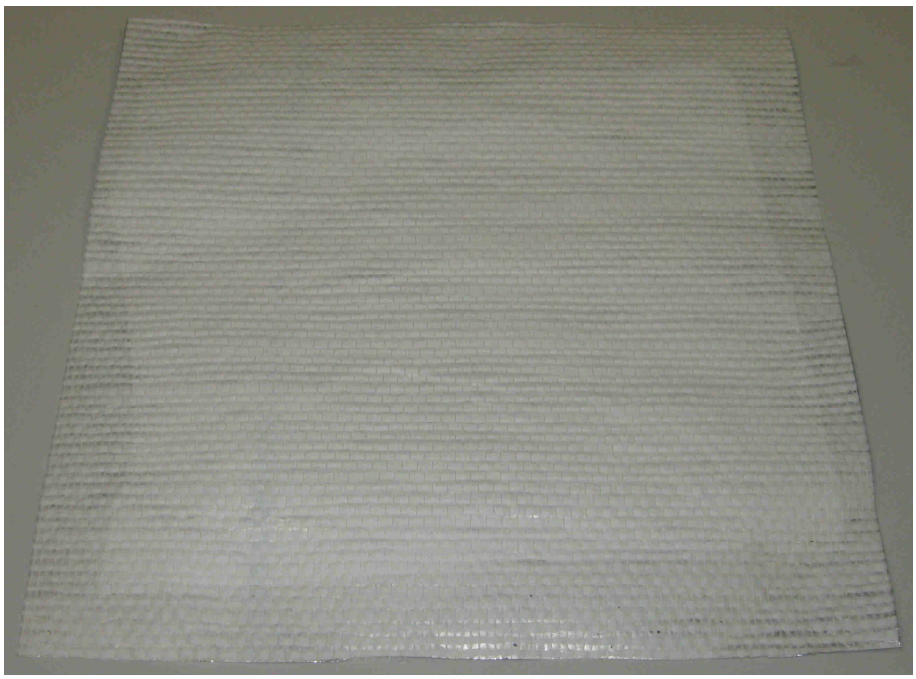
eco sample number	Sample description	Sample condition upon receipt	Type of sample	Test method
A001	M754 control sample	without objection	untreated textile glass	sorption
B001	M754 control sample	without objection	untreated textile glass	re-emission
A002	M755 finished clean air product	without objection	finished textile glass	sorption
B002	M755 finished clean air product	without objection	finished textile glass	re-emission

Photos

Sample A001: M754 control sample



Sample A002: M755 finished clean air product



Test report

1 Method Description

Performance test for evaluating the reduction in the concentration of formaldehyde by sorptive building materials according to DIN ISO 16000-23

The performance test on the reduction of formaldehyde concentrations was conducted according to DIN ISO 16000-23.

This part of ISO 16000 specifies a general laboratory test method for evaluating the reduction in formaldehyde concentrations by sorptive building materials. This method can be used for panels, wallpaper, carpets, varnished products and other building materials. The method is based on the test chamber method specified in DIN EN ISO16000-9. Air sampling and the analytical method for the determination of formaldehyde are covered in DIN ISO 16000-3, which constitutes part of the full method.

Pursuant to this, the performance of the material being tested for the reduction in formaldehyde concentrations was measured based on the drop in formaldehyde concentrations in a test chamber containing the test sample. The method specified in ISO 16000-23 used supply air that had been spiked with formaldehyde, which was fed into the test chamber containing the material that was being tested. The concentration of formaldehyde in the spiked air was set so that the concentration measured in the test chambers without the samples equated to about that of the WHO benchmark value, or just below it, and thus corresponded to an actual situation inside a building. The performance in relation to reduction was determined by monitoring the difference in formaldehyde concentration between the incoming and outgoing ports of the test chamber.

The test was conducted by placing the unchanged materials that had been supplied, the untreated and finished textile glass, in test chambers that were run in parallel pursuant to DIN ISO 16000-9.

The test samples were always placed on the floor of the test chamber.

The test consists of two sequential test cycles, on sorption and re-emission.

Sorption constitutes the part of the test in which the incoming air in the chamber is spiked with formaldehyde. The comparison of the test samples (untreated and finished samples) tested under these conditions provides information on the performance of the product in relation to reduce the formaldehyde concentration in the indoor air.
The formaldehyde concentration was measured at the specified points in time when the air spiked with formaldehyde was fed through the incoming port and at the outgoing port of the chamber.

Re-emission constitutes the part of the test in which the incoming air in the chamber is no longer spiked with formaldehyde. During this process, the test samples (untreated and finished samples) are left in the chambers unchanged. Only the supply of formaldehyde is stopped. The air change remains constant, but is now uncontaminated. The comparison of the test samples, tested under these conditions, provides information on the performance of the product in relation to fixing the formaldehyde that has previously been sorbed on the test sample. The formaldehyde concentration was measured at the specified points in time at the outgoing port of the chamber.

Test chamber measurements based on the following parameters:

Preparation of the test specimens:	Date:	09.10.2015
	Pre-treatment:	test sample production
	Masking of backside:	100 % (aluminium foil)
	Masking of edges:	no
	Ratio of to unmasked edges to surface:	n/a
	Loading:	in relation to area
	Dimensions:	35.3 cm x 35.4 cm
Test chamber conditions:	according to DIN ISO 16000-9	
	Chamber material:	glass
	Chamber volume:	0.125 m^3
	Temperature:	23 °C
	Relative humidity:	50 %
	Air pressure:	normal
	Air:	purified
	Air change rate:	0.5 h^{-1}
	Air velocity:	0.3 m/s
	Loading:	1.0 m^2/m^3
	Specific air flow rate:	0.5 m^3/m^2 h
	Sample geometry:	horizontal on floor of chamber
	Formaldehyde spiking:	heatable permeation tube containing paraformaldehyde
	Air sampling:	see Table
Analysis:	DIN ISO 16000-3	
	Limit of determination:	2 µg/m^3

2 Sorption

Test objective:

Evaluation of the reduction in the concentrations of formaldehyde – comparison between finished and untreated material.

Test method:

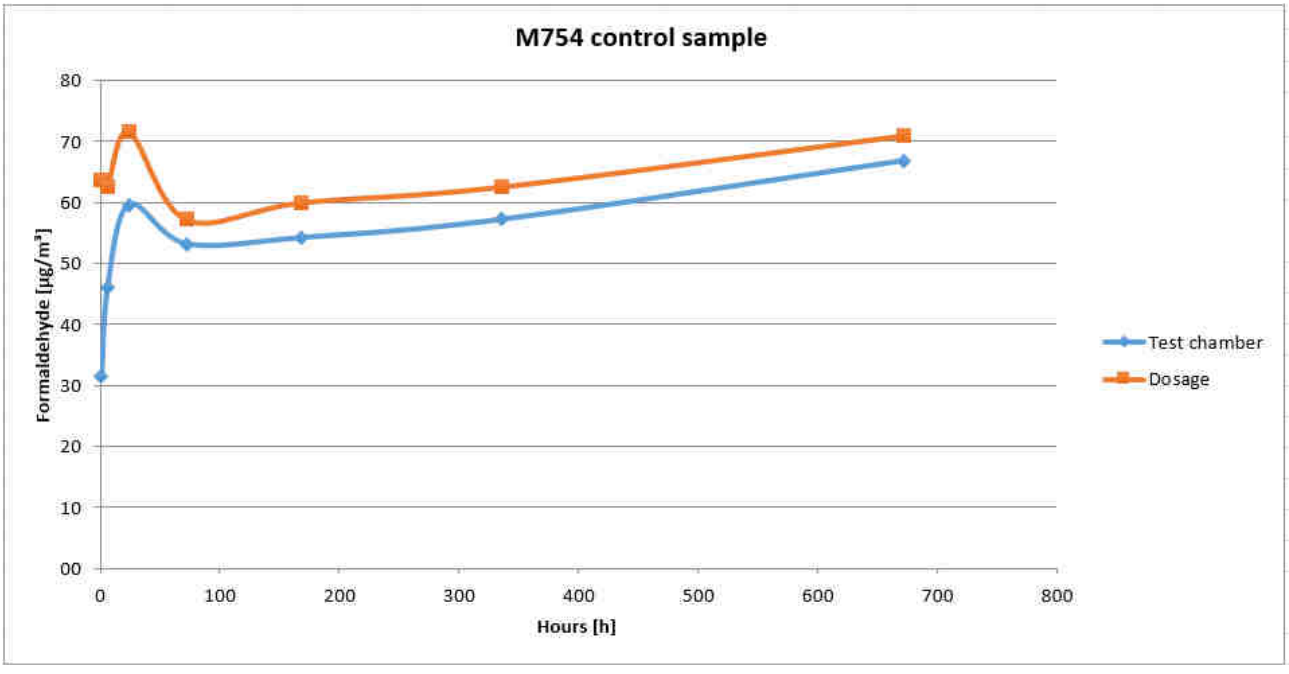
Analysis:	DIN ISO 16000-23 DIN ISO 16000-3 (DNPH method)
Limit of determination:	2 µg/m³

Test result:

Sample A001: M754 control sample

Table 1

Time of measurement [hours]	Test chamber [µg/m³]	Test chamber [ppm]	Dosage [µg/m³]	Dosage [ppm]	Recovery [%]
1	31.4	0.026	63.7	0.053	49.3
6	46.0	0.038	62.6	0.052	73.5
24	59.6	0.050	71.6	0.060	83.2
72	53.2	0.044	57.2	0.048	93.0
168	54.2	0.045	60.0	0.050	90.3
336	57.2	0.048	62.6	0.052	91.4
672	66.8	0.056	71.0	0.059	94.1

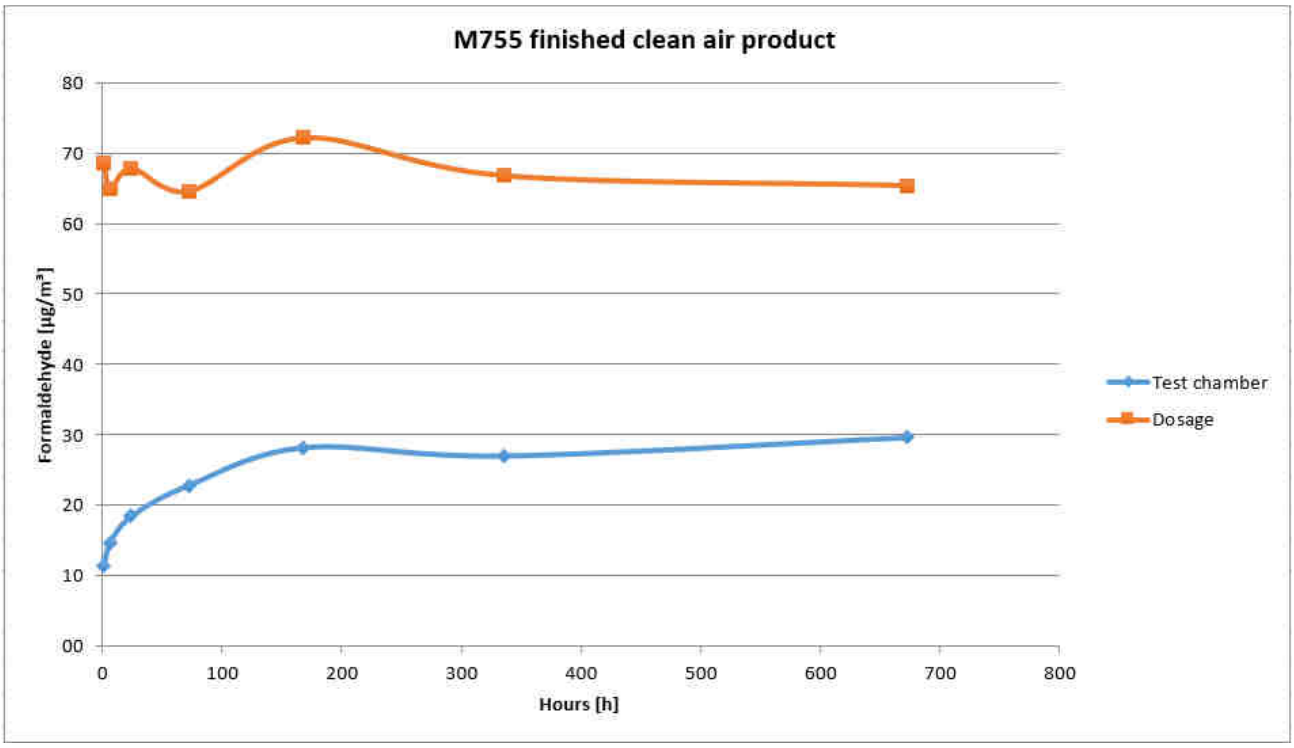


Test result:

Sample A002: M755 finished clean air product

Table 2

Time of measurement [hours]	Test chamber [µg/m³]	Test chamber [ppm]	Dosage [µg/m³]	Dosage [ppm]	Recovery [%]
1	11.4	0.010	68.6	0.057	16.6
6	14.6	0.012	65.0	0.054	22.5
24	18.4	0.015	67.8	0.057	27.1
72	22.8	0.019	64.6	0.054	35.3
168	28.2	0.024	72.2	0.060	39.1
336	27.0	0.023	66.8	0.056	40.4
672	29.6	0.025	65.4	0.055	45.3



Calculation of mean sorption flux between 168 hours (7 days) and 672 hours (28 days):

$$F_m = \frac{\left(\rho_{\text{in},t_e} - \rho_{\text{out},t_e}\right) q_c}{A}$$

where

ρ_{in, t_e} is the concentration of formaldehyde at the incoming port of the test chamber at the time t_e;

ρ_{out, t_e} is the concentration in the test chamber at the time t_e;

q_c the volume of air flow in the test chamber;

A the surface of the test sample. ·

The mean concentration of incoming air is ρ_{in} = 68 µg/m³ during this period
The concentration in the test chamber (=concentration of outgoing air) is ρ_{out} = 28 µg/m³.
The volume of air flow over the entire period is 0.0625 m³/h

Therefore, the mean sorption flux for the period between 168 hours (7 days) and 672 hours (28 days) is:

F_m = (68-28) * 0.0625 / 0.125 = 20 µg/(m² * h)

This value means that, in the presence of a material with this mean capacity for formaldehyde uptake, material occupying the same surface area that emits formaldehyde at the same level in a fictitious interior room would compensate for this and effectively result in a neutral formaldehyde balance.

3 Re-emission

Test target objective:

Evaluation of the re-emission of formaldehyde after previous spiking – comparison between finished and untreated material.

Test method:

Analysis:	DIN ISO 16000-23 DIN ISO 16000-3 (DNPH method)
Limit of determination:	2 µg/m³

Test result:

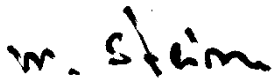
Sample B001: M754 control sample

Time of measurement [hours]	Test chamber [µg/m³]	Test chamber [ppm]
24	8.4	0.007
168	3.5	0.003

Sample B002: M755 finished clean air product

Time of measurement [hours]	Test chamber [µg/m³]	Test chamber [ppm]
24	11.5	0.010
168	5.4	0.005

Cologne, 24.11.2015



Michael Stein, Dipl.-Chem.
(Deputy Technical Head Manager)

Evaluation

The materials **M754 control sample** and **M755 finished clean air product** were subjected to tests to establish their performance in reducing the formaldehyde concentrations pursuant to DIN ISO 16000-23. The tests on the untreated and finished materials were conducted in two parallel test chambers pursuant to DIN EN ISO 16000-9. The incoming and outgoing air in the chambers operated in this manner was tested for formaldehyde content pursuant to DIN ISO 16000-3. Based on the difference in the courses of concentration in the parallel chamber experiments, the following conclusions can be drawn on the performance of the material that has been submitted.

The courses of the formaldehyde concentration curves in the test chamber air differ significantly between the untreated and finished material during the sorption test phase. While there are only minor differences in the two courses of concentration in the incoming air spiked with formaldehyde and in the outgoing air from the chamber for the untreated material (see Table 1) and the curves are almost identical, the values for the outgoing air from the test chamber in the parallel experiment with the finished material are very different from the those for the incoming air spiked with formaldehyde (see Table 2). Recovery for the finished material amounts to about 40-42% of the quantity of formaldehyde used to spike the air between the measurements after 168 hours (7 days) and after 672 hours (28 days) after the test chamber was loaded (start of measurement). The mean concentration in the incoming air is = 68 µg/m³ during this period, with the concentration in the test chamber only amounting to 28 µg/m³. In comparison, the untreated material exhibits practically no formaldehyde-reducing effect, which is documented by the recovery of almost 100 %.

There is thus clear evidence for the formaldehyde-reducing effect of the finished material over this period.

The slight rise in the course of the curve for the formaldehyde concentration in the test chamber is characteristic for such finished materials and indicates that the capacity of the finished material drops off over time.

In the subsequent test on re-emission, the finished material exhibits slightly higher re-emission at the start of the series of measurements when compared with the untreated material. After seven days, the formaldehyde concentrations in both materials are in a similar low range of about 3-5 µg/m³ and there is no significant difference between them. This is presumably formaldehyde that is superficially adsorbed and is not permanently bound to the material. This allows us to deduce that the finished material also binds the sorbed quantity of formaldehyde over a longer period of above 28 days.

Cologne, 24.11.2015

Dr. Frank Kuebart, Dipl.-Chem.
(Head of Test Centre)