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# VOC TEST REPORT
# EN 13999:2013 BREEAM

19 December 2017

## 1 Sample Information

| | |
|---|---|
| Sample name | Bioclad Two Part Polyurethane Adhesive |
| Batch no. | A: CX00188; B: CX00021 |
| Production date | 18/10/2017 |
| Product type | Pasty fixation |
| Sample reception | 1/11/2017 |

## 2 Brief Evaluation of the Results

| Regulation or protocol | Conclusion | Version of regulation or protocol |
|---|---|---|
| BREEAM UK | Pass | BREEAM: EN 13999-1, -2, -3, -4 (2013) |

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

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# 3 Applied Test Methods

## 3.1 General Test References

| Regulation, protocol or standard | Version | Reporting limit VOC [µg/m³] | Calculation of TVOC | Combined uncertainty¤ [RSD(%)] |
|---|---|---|---|---|
| CEN/TS 16516 | October 2013 | 5 | Toluene equivalents | 22% |
| ISO 16000 -3 -6 -9 -11 | 2006-2011 depending on part | 2 | Toluene equivalents | 22% |
| ASTM D5116 | 2010 | - | - | - |
| BREEAM: EN 13999-1, -2, -3, -4 | 2013 | 2 | Toluene equivalents | 22% |

## 3.2 Specific Laboratory Sampling and Analyses

| Procedure | External Method | Internal S.O.P. | Quantification limit / sampling volume | Analytical principle | Uncertainty¤ [RSD(%)] |
|---|---|---|---|---|---|
| Sample preparation | ISO 16000-11:2006, EN16402:2013, CDPH, AgBB/DIBt, EMICODE | 71M549810 | - | - | - |
| VOC emission chamber testing | ISO 16000-9:2006, CEN/TS 16516:2013 | 71M549811 | - | Chamber and air control | - |
| Sampling of VOC | ISO 16000-6:2011, CEN/TS 16516:2013 | 71M549812 | 5 L | Tenax TA | - |
| Analysis of VOC | ISO 16000-6:2011, CEN/TS 16516:2013 | 71M542808B | 1 µg/m³ | ATD-GC/MS | 10% |
| Sampling of aldehydes | ISO 16000-3:2011, CEN/TS 16516:2013 | 71M549812 | 35 L | DNPH | - |
| Analysis of aldehydes | ISO 16000-3:2011, EN 717-1, CEN/TS 16516:2013 | 71M548400 | 3-6 µg/m³ | HPLC-UV | 10% |
| Sampling of isocyanates | MEL-18 | 71M549812 | 100 L | 2-MP coated filter | - |
| Analysis of isocyanates | ISO 16702:2007 | 71M548418 | 4-6 µg/m$^3$ | HPLC-UV | 10% |

# 4 Test Parameters, Sample Preparation and Deviations

## 4.1 VOC Emission Chamber Test Parameters

| Parameter | Value | Parameter | Value |
|---|---|---|---|
| Chamber volume, V[L] | 119 | Preconditioning period | - |
| Air Change rate, n[$h^{-1}$] | 0.5 | Test period | 13/11/2017 – 23/11/2017 |
| Relative humidity of supply air, RH [%] | 50 ± 3 | Area specific ventilation rate, q [m/h or $m^3/m^2/h$] | 1.25 |
| Temperature of supply air, T [°C] | 23 ± 1 | Loading factor [$m^2/m^3$] | 0.4 |
| | | Loading scenario | Flooring or ceiling |

## 4.2 Preparation of the Test Specimen

The sample was a 2 component sample and was mixed in a ratio A:B = 11:1. The sample was homogenised and applied onto a glass plate.

| Application amount, $g/m^2$ | Trowel |
|---|---|
| 2200 | TKB B12 |

## 4.3 Picture of Sample

## 4.4 Deviations from Referenced Protocols and Regulations

No deviations from the referenced test methods were observed.

# 5 Results

## 5.1 VOC Emission Test Results after 3 Days

| | CAS No. | Retention time [min] | ID-Cat | Specific Conc. [µg/m³] | Toluene eq. [µg/m³] | Specific SER [µg/(m²h)] | Risk Phrases |
|---|---|---|---|---|---|---|---|
| **VOC compounds** | | | | | | | |
| 1,2-Propandiol (Propylene glycol) * | 57-55-6 | 3.21 | 1 | 8.4 | < 2 | 10 | |
| Hexanal | 66-25-1 | 4.45 | 1 | 2.2 | < 2 | 2.7 | H226, H315, H319 |
| Heptanal | 111-71-7 | 6.58 | 1 | 3.9 | 2.2 | 4.8 | H226, H315 |
| Butyrolactone * | 96-48-0 | 6.79 | 1 | 29 | 8.0 | 37 | H302, H318, H336 |
| Pentanoic acid, 4-oxo-, methyl ester * | 624-45-3 | 8.09 | 2 | 110 | 110 | 140 | |
| 2-Butenedioic acid (E)-, dimethyl ester * | 624-49-7 | 8.63 | 2 | 41 | 41 | 51 | H312, H317, H315, H 319, H335 |
| Dimethylsuccinate * | 106-65-0 | 9.07 | 1 | > 21000 | >13000 | >26000 | H319 |
| Butanedioic acid, methyl-, dimethyl ester * | 1604-11-1 | 9.31 | 2 | 120 | 120 | 150 | |
| Not identified * | - | 9.70 | 4 | 3.7 | 3.7 | 4.6 | |
| Dimethyl glutarate * | 1119-40-0 | 10.43 | 1 | >33000 | >20000 | >41000 | |
| Pentanedioic acid, 3-methyl-, dimethyl ester * | 19013-37-7 | 10.67 | 2 | 110 | 110 | 140 | |
| Pentanedioic acid, 2-methyl-, dimethyl ester * | 14035-94-0 | 10.71 | 2 | 140 | 140 | 180 | |
| Benzene, 1-methyl-4-(methylthio)- * | 623-13-2 | 10.88 | 3 | 8.3 | 8.3 | 10 | |
| Not identified * | - | 11.04 | 4 | 15 | 15 | 18 | |
| Not identified * | - | 11.18 | 4 | 4.4 | 4.4 | 5.5 | |
| 2-Hexenedioic acid, dimethyl ester, (Z)- * | 16631-58-6 | 11.27 | 3 | 59 | 59 | 74 | |
| Dimethyl adipate * | 627-93-0 | 11.48 | 1 | >5100 | >3900 | >6400 | |
| **TVOC** | | | | >60000 | >37000 | >75000 | |
| **VVOC compounds** | | | | | | | |
| None determined | | | | | | | |
| **TVVOC** | | | | < 2 | < 2 | < 3 | |

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **SVOC compounds** | | | | | | | |
| None determined | | | | | | | |
| **TSVOC** | | | | < 2 | < 2 | < 3 | |
| **Aldehydes** | | | | | | | |
| Formaldehyde | 50-00-0 | | 1 | < 3 | - | < 4 | C1B, H350, H341 |
| Acetaldehyde | 75-07-0 | | 1 | < 3 | - | < 4 | C2, H351 |
| Propionaldehyde | 123-38-6 | | 1 | < 3 | - | < 4 | |
| Butyraldehyde | 123-72-8 | | 1 | < 3 | - | < 4 | |
| **Diisocyanates** | | | | | | | |
| HDI (hexamethylene diisocyanate) * | 822-06-0 | | 1 | < 4 | | < 5 | H334 |
| 2,6-TDI (2,6-toluene diisocyanate) * | 91-08-7 | | 1 | < 4 | | < 5 | C2, H334, H351 |
| 2,4-TDI (2,4-toluene diisocyanate) * | 584-84-9 | | 1 | < 4 | | < 5 | C2, H334, H351 |
| MDI (4,4-methylene diphenyl diisocyanate) * | 101-68-8 | | 1 | < 4 | | < 5 | C2, H334, H351 |

## 5.2 VOC Emission Test Results after 10 Days

| | CAS No. | Retention time [min] | ID-Cat | Specific Conc. [µg/m³] | Toluene eq. [µg/m³] | Specific SER [µg/(m²h)] | Risk Phrases |
|---|---|---|---|---|---|---|---|
| **VOC compounds** | | | | | | | |
| Butyrolactone * | 96-48-0 | 7.33 | 1 | 8.3 | 2.2 | 10 | H302, H318, H336 |
| Pentanoic acid, 4-oxo-, methyl ester * | 624-45-3 | 8.57 | 2 | 44 | 44 | 55 | |
| 2-Butenedioic acid (E)-, dimethyl ester * | 624-49-7 | 9.10 | 2 | 22 | 22 | 28 | H312, H317, H315, H 319, H335 |
| Dimethylsuccinate * | 106-65-0 | 9.38 | 1 | >9000 | >5600 | >11000 | H319 |
| Butanedioic acid, methyl-, dimethyl ester * | 1604-11-1 | 9.72 | 2 | 30 | 30 | 38 | |
| Not identified * | - | 10.15 | 4 | 2.0 | 2.0 | 2.5 | |
| Dimethyl glutarate * | 1119-40-0 | 10.82 | 1 | >21000 | >13000 | >27000 | |
| Pentanedioic acid, 3-methyl-, dimethyl ester * | 19013-37-7 | 11.06 | 2 | 59 | 59 | 74 | |
| Pentanedioic acid, 2-methyl-, dimethyl ester * | 14035-94-0 | 11.11 | 2 | 82 | 82 | 100 | |
| Not identified * | - | 11.35 | 4 | 8.0 | 8.0 | 9.9 | |
| Not identified * | - | 11.60 | 4 | 3.2 | 3.2 | 4.0 | |
| 2-Hexenedioic acid, dimethyl ester, (Z)- * | 16631-58-6 | 11.71 | 3 | 39 | 39 | 49 | |
| Dimethyl adipate * | 627-93-0 | 11.91 | 1 | >4400 | >3300 | >5400 | |
| **TVOC** | | | | >35000 | >22000 | >44000 | |
| **VVOC compounds** | | | | | | | |
| None determined | | | | | | | |
| **TVVOC** | | | | < 2 | < 2 | < 3 | |
| **SVOC compounds** | | | | | | | |
| None determined | | | | | | | |
| **TSVOC** | | | | < 2 | < 2 | < 3 | |

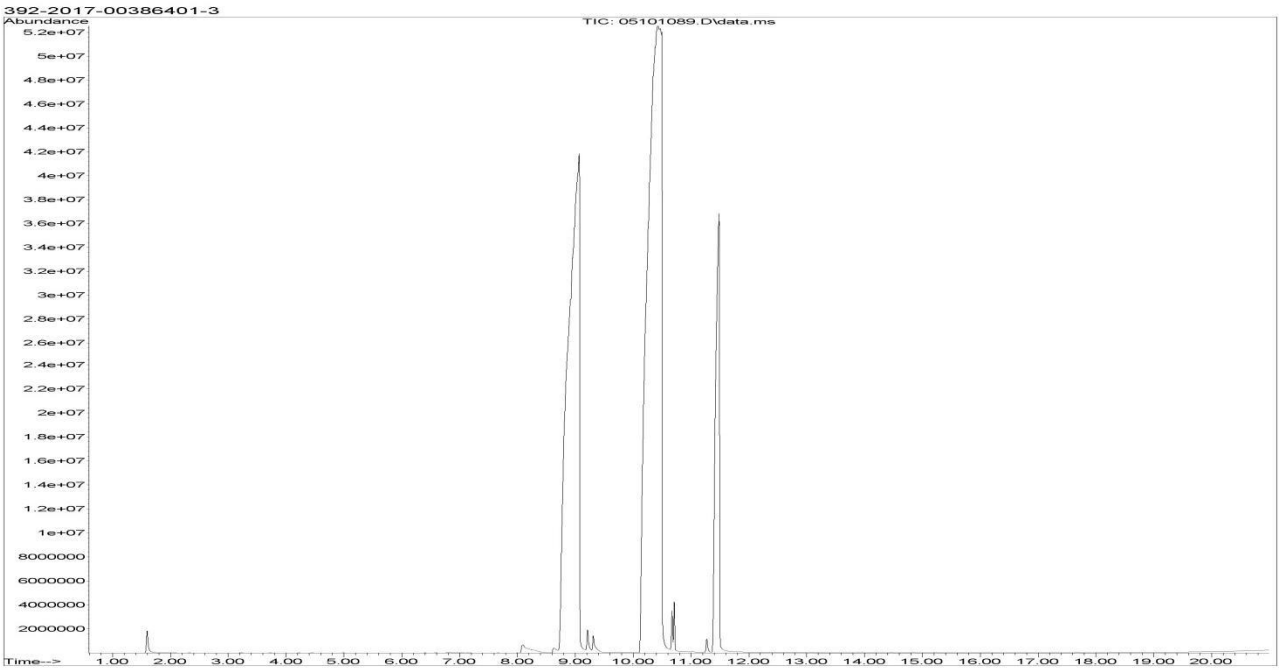
# 6 Summary and Evaluation of the Results

## 6.1 Evaluation of the Results after 3 days according to BREEAM UK

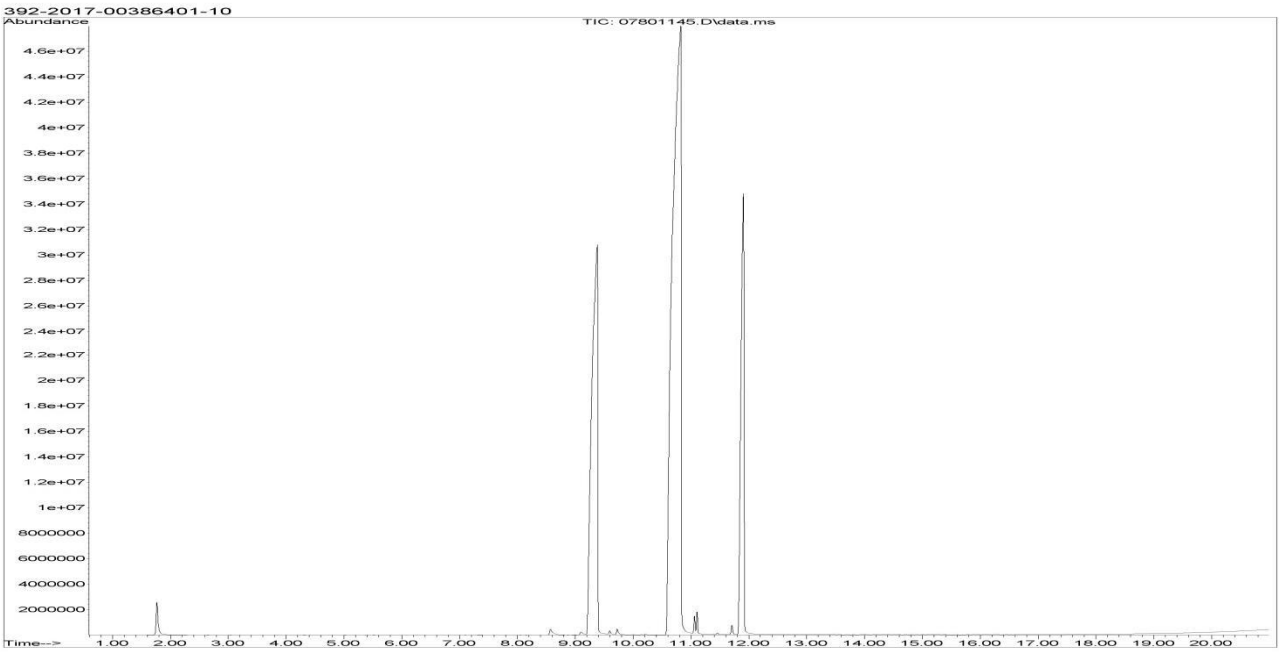
| | CAS No. | Risk Phrases | Concentration [µg/m³] | SER [µg/(m²h)] |
|---|---|---|---|---|
| **Carcinogenic and sensitizing VOCs, VVOCs and SVOCs** | | | | |
| None determined | | | < 2 | < 3 |
| **Carcinogenic and sensitizing volatile aldehydes** | | | | |
| None determined | | | < 10 | < 20 |
| **Carcinogenic and sensitizing volatile Diisocyanates** | | | | |
| None determined | | | < 4 | < 5 |

# 7 Appendices

## 7.1 Chromatogram of VOC Emissions after 3 Days




## 7.2 Chromatogram of VOC Emissions after 10 Days




Please consider the different scales.

## 7.3 How to Understand the Results

### 7.3.1 Acronyms Used in the Report

< Means less than

> Means bigger than (Tube/GC-MS overload)

* Not a part of our accreditation

¤ Um(%) is given as 2x RSD%. 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 wooden panels 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.

SER Specific emission rate.

### 7.3.2 Explanation of ID Category

**Categories of Identity:**

1: Identified and specifically calibrated

2: Identified by comparison with a mass spectrum obtained from library and supported by other information. Calibrated as toluene equivalent.

3: Identified by comparison with a mass spectrum obtained from a library. Calibrated as toluene equivalent.

4: Not identified, calibrated as toluene equivalent.

## 7.4 Qualitative Description of VOC Emission Test

### 7.4.1 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 (CEN/TS 16516, ISO 16000-9, internal method no.: 71M549811).

### 7.4.2 Expression of the Test Results

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

### 7.4.3 Testing of VOCs

The emission of carcinogens (EU Categories C1A and C1B, as per European law) and sensitizing substances 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 (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 µm film, Agilent) (CEN/TS 16516, ISO 16000-6, internal methods no.: 71M549812 / 71M542808B).

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).

### 7.4.4 Testing of Aldehydes

The presence of aldehydes after the specified duration of storage in the ventilated test chamber 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 (CEN/TS 16516, ISO 16000-3, VDI 3862 Blatt 3, internal methods no.: 71M549812 / 71M548400).

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.

## 7.5 Testing of Isocyanates

The presence of carcinogenic or sensitizing diisocyanates was tested by drawing air samples from the chamber outlet through filters coated with methoxy phenyl piperazine. Analysis was performed by HPLC/UV (EN 13999-4, internal method no.: 8418). The absence of the diisocyanates was stated if the specific wavelength UV detector response was lacking at the specific retention time in the chromatogram. Otherwise it was checked whether the detection limit was exceeded. The identity was finally checked by comparing full scan sample UV spectra with full scan standard UV spectra. The legal classification and the associated risk phrases of the identified diisocyanates were looked up.

## 7.6 New names for the Risk Phrases, EN 13999-1: 2007 and 2013

The R-sentences have been updated under REACH (CLP) and the new references are designated as H-sentences. They are directly comparable, and EN 13999:2007 refers to R-sentences whereas EN 13999:2013 refers to H-sentences. For each compound detected, the CAS number was searched in the GESTIS database (database by Institut fuer Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung (IFA)). The following phrases will make the product fail:

Old phrases: C1A, C1B, C2, R40, R42, R45, R46, R49, R60, R61 and R63.

New phrases: C1A, C1B, C2, H350, H350i, H340, H360F, H360D, H351, H341, H361D and H334

## 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 CEN/TS 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 Um equals 2 x RSD. For further information please visit www.eurofins.dk/uncertainty.