LIEN A Co., Ltd.
55/1A Khuong Viet Street Phu Trung
Ward, Tan Phu District
Ho Chi Minh City
Vietnam

# Test Report No. 43981C

**This test report replaces report 43981 B (11th of August 2014).**

| | |
|---|---|
| **Client:** | **LIEN A Co., Ltd.<br>Ho Chi Minh City, Vietnam** |
| **Sample description by client:** | **Natural Latex mattress** |
| Sampling by: | Client |
| Date of arrival of sample: | 24.06.2014 |
| Date of report: | 29.07.2014 |
| Number of pages of report: | 26 |
| Testing parameter: | see table of contents |
| Testing laboratory: | eco-INSTITUT GmbH, Cologne<br>except * subcontracted |
| | # outside accreditation |

Nach DIN EN ISO/IEC 17025 akkreditiertes Prüflabor
DAkkS Deutsche Akkreditierungsstelle D-PL-14117-01-00

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## Content



## Sample view

| Internal Sample-no. | Description by customer | Condition upon delivery | Material composition |
|---|---|---|---|
| A001 | Natural Latex mattress | without objection | Latex Core |

# Test Report

## 1 Emission test

### 1.1 Volatile Organic Compounds (VOC)

**Definition of terms:**

| | |
|---|---|
| VOC<br>(volatile organic compounds) | All individual materials with a concentration ≥ 0,001 mg/m³ in retention range $C_6$ (n-Hexane) to $C_{16}$ (n-Hexadecane)<br>Substances refer to LCI lists / AgBB (DIBt) |
| TVOC<br>(Total volatile organic compounds) | Sum of all individual substances in retention range $C_6$ to $C_{16}$. |
| CMR-VOC<br>(carcinogenic, mutagenic, reproduction-toxic VOC, VVOC and SVOC) | All individual substances with the following categories:<br>Regulation (EC) No. 1272/2008: Category Car.1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B<br>TRGS 905: K1 and K2, M1 and M2, R1 and R2<br>IARC: Group 1 and 2A<br>DFG (MAK lists): Category III1and III2 |
| VVOC<br>(very volatile organic compounds) | All individual substances wit concentration ≥ 0,001 mg/m³ in retention range < $C_6$ |
| TVVOC<br>(Total very volatile organic compounds) | Sum of all VVOC in retention range < $C_6$ |
| SVOC<br>(semi volatile organic compounds) | All individual materials ≥ 0,001 mg/m³ in retention range > $C_{16}$ (n-Hexadecane) to $C_{22}$ (Docosane) |
| TSVOC<br>(Total semi volatile organic compounds) | Sum of all SVOC in retention range > $C_{16}$ to $C_{22}$. |
| Identified and calibrated substances ($c_{id\ sub}$), substance specific calculated | Spectrum and retention time are concordant with the calibrated comparison substance |
| Not identified substances calculated as toluene equivalent ($c_{ni\ tol}$) | Suggestion from the spectrum library with high probability and/or allocation to a group of substances |
| SER | Specific emission rate (see appendix) |
| LCI value | Lowest Concentration of Interest; calculated value for the evaluation of VOC, established by the Committee for Health-related Evaluation of Building Products (Ausschuss zur gesundheitlichen Bewertung von Bauprodukten - AgBB) |
| R value | The quotient of the concentration and the LCI value is generated for every substance which is detected in the test chamber air. The sum of the calculated quotients results in the R value. |

## List of analysed VOCs:

**Aromatic hydrocarbons**
Toluene
Ethylbenzene
p-Xylene
m-Xylene
o-Xylene
Isopropylbenzene
n-Propylbenzene
1,3,5-Trimethylbenzene
1,2,4-Trimethylbenzene
1,2,3-Trimethylbenzene
2-Ethyltoluene
1-Isopropyl-4-methylbenzene
1,2,4,5-Tetramethylbenzene
n-Butylbenzene
1,3-Diisopropylbenzene
1,4-Diisopropylbenzene
Phenyl octane
1-Phenyl decane[2]
1-Phenyl undecane[2]
4-Phenylcyclohexene
Styrene
Phenyl acetylene
2-Phenyl propene
Vinyl toluene
Naphthalene
Indene
Benzene
Cresol

**Saturated aliphatic substances**
Hydrocarbons
2-Methyl pentane[1]
3-Methyl pentane[1]
n-Hexane
Cyclohexane
Methylcyclohexane
n-Heptane
n-Octane
n-Nonane
n-Decane
n-Undecane
n-Dodecane
n-Tridecane
n-Tetradecane
n-Pentadecane
n-Hexadecane
Methylcyclopentane
1,4-Dimethylcyclohexane

**Terpenes**
δ-3-Caren
α-Pinene
β-Pinene
Limonene
Longifolene
Caryophyllene
Isolongifolene
alpha-Phellandrene
Myrcene
Camphene
alpha-Terpinend
Longipinene
beta-Caryophyllene
beta-Farnesen
alpha-Bisabolen

**Aliphatic alcohols and ether**
1-Propanol[1]
2-Propanol[1]
tert-Butanol
2-Methyl-1-propanol
1-Butanol
1-Pentanol
1-Hexanol
Cyclohexanol
2-Ethyl-1-hexanol
1-Octanol
4-Hydroxy-4-methyl-pentan-2-one
1-Heptanol
1-Nonanol
1-Decanol

**Aromatic alcohols (phenols)**
Phenol
BHT (2,6-di-tert-butyl-4-methylphenol)
Benzylalcohol

**Glycols, Glycol ether, Glycol ester**
Propylenglycol (1,2-Dihydroxypropane)
Ethylene glycol (Ethandiol)
Ethylene glycol monobutyl ether
Diethylene glycol
Diethylene glycol-monobutyl ether
2-Phenoxyethanol
Ethylene carbonate
1-Methoxy-2-propanol
Glycolic acid butyl ester
Texanol
Butyldiglycol acetate
Dipropylenglycol mono-methyl ether
2-Methoxyethanol
2-Ethoxyethanol
2-Propoxyethanol
2-Methylethoxyethanol
2-Hexoxyethanol
1,2-Dimethoxyethane
1,2-Diethoxyethane
2-Methoxyethyl acetate
2-Ethoxyethyl acetate
2-Butoxyethyl acetate
2-(2-Hexoxyethoxy)-ethanol
1-Methoxy-2-(2-methoxy-ethoxy)-ethane
Propylene glycol di-acetate
Dipropylene glycol
Dipropylene glycol monomethylether acetate
Dipropylene glycol mono-n-propylether
1,4-Butanediol
Tripropyleneglycolmonomethyl ether
Triethylene glycol dimethyl ether
1,2-Propylene glycol dimethyl ether
TXIB
Ethyldiglycol
Dipropylene glycol-dimethyl ether
Propylene carbonate
Hexylene glycol
3-Methyl-1-butanol
1,2-Propylene glycol n-propyl ether
1,2-Propylene glycol n-butyl ether
Diethylglycol phenyl ether
Neopentyl glycol

**Aldehydes**
Butanal[1,3]
Pentanal[3]
Hexanal
Heptanal
2-Ethylhexanal
Octanal
Nonanal
Decanal
2-Butenal[3]
2-Pentenal[3]
2-Hexenal
2-Heptenal
2-Octenal
2-Nonenal
2-Decenal
2-Undecenal
Furfural
Glutaraldehyde
Benzaldehyde
Acetaldehyde[1,3]
Propanal[1,3]
Propenal[1,3]
Isobutenal
3-Methyl-2-propanol
Methylisobutylketone
Cyclopentanone
Cyclohexanone

**Ketones**
Ethylmethylketone[3]
3-Methyl-2-propanol
Methylisobutylketone
Cyclopentanone
Cyclohexanone
Acetone[1,3]
2-Methylcyclopentanone
2-Methylcyclohexanone
Acetophenone
1-Hydroxyacetone

**Acids**
Acetic acid
Propionic acid
Isobutyric acid
Butyric acid
Pivalic acid
n-Valeric acid
n-Hexanoic acid
n-Heptanoic acid
n-Octanoic acid
2-Ethylhexanoic acid

**Esters and Lactones**
Methylacetate[1]
Ethyl acetate[1]
Vinyl acetate[1]
Isopropyl acetate
Propyl acetate
2-Methoxy-1-methylethyl acetate
n-Butyl formate
Methylmethacrylate
Isobutylacetate
1-Butyl acetate
2-Ethylhexyl acetate
Methyl acrylate
Ethyl acrylate
n-Butyl acrylate
2-Ethylhexyl acrylate
Adipic acid dimethyl ester
Fumaric acid dibutyl ester
Succinic acid dimethyl ester
Hexandioldiacrylate
Maleic acid dibutyl ester
Butyrolactone
Dibutyl glutarate
Dibutyl succinate
Dimethylphthalate
Texanol
Dipropylene glycol diacrylate

**Chlorinated hydrocarbons**
Tetrachlorethene
1,1,1-Trichlorethane
Trichlorethene
1,4-Dichlorbenzene

**Others**
1,4-Dioxane
Caprolactam
N-Methyl-2-pyrrolidone
Octamethylcyclotetrasiloxane
Methenamine
2-Butanonoxime
Triethyl phosphate
5-Chlor-2-methyl-4-isothiazolin-3-one
2-Methyl-4-isothiazolin-3-one (MIT)
Triethylamine
Decamethylcyclopentasiloxane
Dodecamethylcyclopentasiloxane
Tetrahydrofuran (THF)
1-Decene
1-Octene
2-Pentylfuran
Tetramethyl succinonitrile
Propylencarbonate
Isophorone
Dimethylformamide (DMF)
Tributyl phosphate

1 VVOC
2 SVOC
3 Analysis according to DIN ISO 16000-3

## Explanation of the Specific Emission Rate SER

Emission measurements are accomplished in test chambers under defined physical conditions (temperature, relative humidity, room loading, air change rate etc.).

Test chamber measurement results are directly comparable only if the investigations were accomplished under the same basic conditions.

If the differences of the physical conditions refer only to the change of air rate and/or the loading, the "SER" or "specific emission rate" can be used for comparability of the measurement results. The SER indicates how many volatile organic compounds (VOC) are released by the sample for each material unit and hour (h).

The SER can be calculated using the formula below for each proven individual component of the VOC from the data in the test report.

As material units the following are applicable:

| | |
|---|---|
| l = unit of length (m) | relation between emission and length |
| a = unit area ($m^2$) | relation between emission and surface |
| v = unit volume ($m^3$) | relation between emission and volume |
| u = piece unit (unit = piece) | relation between emission and complete unit |

From this the different dimensions for SER result:

| | | |
|---|---|---|
| length-specific | $SER_l$ | in µg/m h |
| surface-specific | $SER_a$ | in µg/$m^2$ h |
| volume-specific | $SER_v$ | in µg/$m^3$ h |
| unit specific | $SER_u$ | in µg/u h |

SER thus represents a product specific rate, which describes the mass of the volatile organic compound, which is emitted by the product per time unit at a certain time after beginning of the examination.

$$SER = q \bullet C$$

q specific air flow rate (quotient from change of air rate and loading)
C Concentration of the measured substance(s)

The result can be indicated in milligrams (mg) in place of micro grams (µg), whereby 1 mg = 1000 µg.

**Test method**

| | | |
|---|---|---|
| Preparation of test sample: | Date: | 01.07.2014 |
| | Pre-treatment: | not applicable |
| | Masking of backside: | not applicable |
| | Masking of edges: | not applicable |
| | Relationship of unmasked edges to surface: | not applicable |
| | Charging: | related to area |
| | Dimensions: | 28.3 cm x 28.3 cm x 14.5 cm |
| Test chamber conditions:: | | |
| | Chamber volume: | 0.25 $m^3$ |
| | Temperature: | 23 °C |
| | Relative humidity: | 50 % |
| | Air pressure: | normal |
| | Air: | cleaned |
| | Air change rate: | 1 $h^{-1}$ |
| | Air velocity: | 0.3 m/s |
| | Loading: | 1.3 $m^2/m^3$ |
| | Specific air flow rate: | 0.769 $m^3/m^2 \cdot h$ |
| | Air sampling: | 2 and 7 days after test chamber loading |
| Analytics: | DIN ISO 16000-3 | |
| | DIN ISO 16000-6 | |
| | Limit of determination: | 1 µg/$m^3$ |

# Measurement time 2 days after test chamber loading

## 1.1.1 CMR-VOC$_{2d}$

**Test parameter:**

Carcinogenic, mutagenic and reproduction-toxic volatile organic compounds (CMR VOC), test chamber, air sampling 2 days after test chamber loading

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| No. | Substance | CAS No. | Concentration (Test chamber air) [µg/m³] | CMR classification*) |
|---|---|---|---|---|
| **VOC$_{2d}$: Identified and calibrated substances in accordance with LCI list/AgBB, substance specific calculated (c$_{id\ sub}$)** | | | | |
| - | - | - | - | n.d. |
| **VOC$_{2d}$: Further identified and calibrated CMR substances in addition to LCI list/AgBB, substance specific calculated(c$_{id\ sub}$)** | | | | |
| - | - | - | - | n.d. |
| **VOC$_{2d}$: Further identified, not calibrated CMR substances, calculated as toluene equivalent (c$_{ni\ tol}$)** | | | | |
| - | - | - | - | n.d. |

*) Classification acc. to Regulation (EC) No. 1272/2008: Category Carc. 1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B, TRGS 905: K1 and K2, M1 and M2, R1 and R2, IARC: Group 1 and 2A, DFG (MAK list): Category III1 and III2

| | Concentration (Test chamber air) [µg/m³] | SER$_a$ [µg/m²h] |
|---|---|---|
| **Sum of VOC** with the following categorisations:<br>Regulation (EC) No. 1272/2008: Category Carc. 1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B<br>TRGS 905: K1 and K2, M1 and M2, R1 and R2<br>IARC: Group 1 and 2A<br>DFG (MAK list): Category III1 and III2 | **n.d.** | **n.d.** |

n.d. = not detectable

## 1.1.2 VOC / TVOC $_{2d}$

**Test parameter:**
Volatile organic compounds (VOC), test chamber, air sampling 2 days after test chamber loading

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| No. | Substance | CAS No. | Concentration (Test chamber air) [µg/m³] |
|---|---|---|---|
| **$VOC_{2d}$: Identified and calibrated substances in accordance with LCI list/AgBB, substance specific calculated ($c_{id\ sub}$)** | | | |
| **1** | **Aromatic hydrocarbons** | | |
| 1-1 | Toluene | 108-88-3 | 5 |
| 1-2 | Ethylbenzene | 100-41-4 | 2 |
| 1-4 | p-Xylene | 106-42-3 | 14 |
| 1-5 | m-Xylene | 108-38-3 | |
| 1-6 | o-Xylene | 95-47-6 | 7 |
| 1-7 | Isopropylbenzene | 98-82-8 | 2 |
| 1-8 | n-Propylbenzene | 103-65-1 | 11 |
| 1-10 | 1,3,5-Trimethylbenzene | 108-67-8 | 23 |
| 1-11 | 1,2,4-Trimethylbenzene | 95-63-6 | 70 |
| 1-12 | 1,2,3-Trimethylbenzene | 526-73-8 | 14 |
| 1-13 | 2-Ethyltoluene | 611-14-3 | 15 |
| **2** | **Saturated aliphatic hydrocarbons** | | |
| 2-9.1 | n-Octane | 111-65-9 | 1 |
| 2-10.1 | n-Nonane | 111-84-2 | 8 |
| 2-10.2 | n-Decane | 124-18-5 | 19 |
| 2-10.3 | n-Undecane | 1120-21-4 | 7 |
| 2-10.4 | n-Dodecane | 112-40-3 | 1 |
| **7** | **Aldehydes** | | |
| 7-3 | Hexanal | 66-25-1 | 4 |
| 7-7 | Nonanal | 124-19-6 | 2 |
| **$VOC_{2d}$: Further identified and calibrated substances in addition with LCI list/AgBB, substance specific calculated ($c_{id\ sub}$)** | | | |
| **12** | **Others** | | |
| | Benzothiazol | 95-16-9 | 2 |
| | 2-Methylfuran | 534-22-5 | 2 |
| **$VOC_{2d}$: Not calibrated substances calculated as toluene equivalent ($c_{ni\ tol}$)** | | | |
| | Isoalkan, C9-C10 | - | 3 |
| | Isoalkan, C9-C10 | - | 4 |
| | Alkylbenzol | - | 47 |

| | | | |
|---|---|---|---|
| | Alkylbenzol | - | 21 |
| | Isoalkan, C10-C11 | - | 5 |
| | Cycloalkan | - | 2 |
| | Div. Alkylbenzole | - | 17 |

| **Total volatile organic compounds** | **Concentration (test chamber air) [µg/m³]** | **$SER_a$ [µg/m²h]** |
|---|---|---|
| **$TVOC_{2d}$** | **308** | **237** |

| **Further VOC sums** | **Concentration (test chamber air) [µg/m³]** | **$SER_a$ [µg/m²h]** |
|---|---|---|
| **Sum VOC without LCI** | **103** | **79** |
| **Sum of bicyclic terpenes** | **n.d.** | **n.d.** |
| **Sum of sensitising materials** with the following categorisations:<br>DFG (MAK lists): Category IV<br>German Federal Institute for Risk Assessment lists: Cat A<br>TRGS 907 | **n.d.** | **n.d.** |
| **Sum of VOC** with the following categorisations:<br>Regulation (EC) No. 1272/2008: Category Carc. 2, Muta. 2, Repr. 2<br>TRGS 905: K3, M3, R3<br>IARC: Group 2B<br>DFG (MAK list): Category III3 | **7** | **5** |
| **$C_9$ - $C_{14}$ - Alkanes / Isoalkanes** | **45** | **35** |
| **Sum $C_4$-$C_{11}$ Aldehydes, acyclic, aliphatic** | **6** | **5** |
| **Sum $C_9$-$C_{15}$ Alkyl benzenes** | **135** | **104** |
| **Sum Cresols** | **n.d.** | **n.d.** |

| **R-Value (without dimension)$_{2d}$** | **0.16** |
|---|---|

n.d. = not detectable

### 1.1.3 $SVOC_{2d}$

**Test parameter:**
Semivolatile organic compounds (SVOC), test chamber, air sampling 2 days after test chamber loading

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| No. | Substance | CAS No. | Concentration (test chamber air) [µg/m³] |
|---|---|---|---|
| **$SVOC_{2d}$: Identified and calibrated substances in accordance with LCI list/AgBB, substance specific calculated($c_{id\ sub}$)** | | | |
| - | - | - | n.d. |
| **$SVOC_{2d}$: Further identified and calibrated substances in addition to LCI list/AgBB, substance specific calculated($c_{id\ sub}$)** | | | |
| - | - | - | n.d. |
| **$SVOC_{2d}$: Not calibrated substances calculated as toluene equivalent ($c_{ni\ tol}$)** | | | |
| - | - | - | n.d. |

| Total semivolatile organic compounds | Concentration (test chamber air) [µg/m³] | $SER_a$ [µg/m²h] |
|---|---|---|
| **$TSVOC_{2d}$** | **n.d.** | **n.d.** |

n.d. = not detectable

### 1.1.4 $VVOC_{2d}$

**Test Parameter:**
Very volatile organic compounds (VVOC), test chamber, air sampling 2 days after test chamber loading

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| No. | Substance | CAS-No. | Concentration (test chamber air) [µg/m³] |
|---|---|---|---|
| **$VVOC_{2d}$: Identified and calibrated substances in accordance with LCI list/AgBB, substance specific calculated($c_{id\ sub}$)** | | | |
| **2** | **Saturated aliphatic hydrocarbons** | | |
| 2-1 | 3-Methylpentane | 96-14-0 | 3 |
| **4** | **Aliphatic alcohols and ethers** | | |
| 4-3 | 2-Propanol | 67-63-0 | 1 |
| **10** | **Esters und Lactones** | | |
| 10-1 | Methylacetate | 79-20-9 | 1 |
| **$VVOC_{2d}$: Further identified and calibrated substances in addition to LCI list/AgBB, substance specific calculated($c_{id\ sub}$)** | | | |
| - | - | - | n.d. |
| **$VVOC_{2d}$: Not calibrated, identified substances calculated as toluene equivalent ($c_{ni\ tol}$)** | | | |
| - | - | - | n.d. |

| Total very volatile organic compounds | Concentration (test chamber air) [µg/m³] | $SER_a$ [µg/m²h] |
|---|---|---|
| **$TVVOC_{2d}$** | **5** | **4** |

n.d. = not detectable

### 1.1.4.1 Formaldehyde$_{2d}$ and Acetaldehyde$_{2d}$

**Test parameter:**

Formaldehyde and Acetaldehyde, test chamber, air sampling 2 days after test chamber loading

**Test method:**

| | |
|---|---|
| Preparation of test sample and Test chamber conditions: | see Volatile organic compounds |
| Analytics: | DIN ISO 16000-3 |
| Limit of determination: | 2 µg/m³ ≈ 0,002 ppm |

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| **Substance** | **Concentration** (Test chamber air) **[µg/m³]** | **Concentration** (Test chamber air) **[ppm]** |
|---|---|---|
| Formaldehyde | 2 | 0.002 |
| Acetaldehyde | < 2 | < 0.002 |

# Measurement time 7 days after test chamber loading

## 1.1.5 CMR-VOC$_{7d}$

**Test parameter:**

Carcinogenic, mutagenic and reproduction-toxic volatile organic compounds (CMR VOC), test chamber, air sampling 7 days after test chamber loading

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| No. | Substance | CAS No. | Concentration (Test chamber air) [µg/m³] | CMR classification*) |
|---|---|---|---|---|
| **VOC$_{7d}$: Identified and calibrated substances in accordance with LCI list/AgBB, substance specific calculated ($c_{id\ sub}$)** | | | | |
| - | - | - | - | n.d. |
| **VOC$_{7d}$: Further identified and calibrated CMR substances in addition to LCI list/AgBB, substance specific calculated($c_{id\ sub}$)** | | | | |
| - | - | - | - | n.d. |
| **VOC$_{7d}$: Further identified, not calibrated CMR substances, calculated as toluene equivalent ($c_{ni\ tol}$)** | | | | |
| - | - | - | - | n.d. |

*) Classification acc. to Regulation (EC) No. 1272/2008: Category Carc. 1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B, TRGS 905: K1 and K2, M1 and M2, R1 and R2, IARC: Group 1 and 2A, DFG (MAK list): Category III1 and III2

| | Concentration (Test chamber air) [µg/m³] | SER$_a$ [µg/m²h] |
|---|---|---|
| **Sum of VOC** with the following categorisations:<br>Regulation (EC) No. 1272/2008: Category Carc. 1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B<br>TRGS 905: K1 and K2, M1 and M2, R1 and R2<br>IARC: Group 1 and 2A<br>DFG (MAK list): Category III1 and III2 | **n.d.** | **n.d.** |

n.d. = not detectable

## 1.1.6 VOC / TVOC $_{7d}$

**Test parameter:**
Volatile organic compounds (VOC), test chamber, air sampling 7 days after test chamber loading

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| No. | Substance | CAS No. | Concentration (Test chamber air) [µg/m³] |
|---|---|---|---|
| **$VOC_{7d}$: Identified and calibrated substances in accordance with LCI list/AgBB, substance specific calculated ($c_{id\ sub}$)** | | | |
| **1** | **Aromatic hydrocarbons** | | |
| 1-1 | Toluene | 108-88-3 | 4 |
| 1-4 | p-Xylene | 106-42-3 | 2 |
| 1-5 | m-Xylene | 108-38-3 | |
| 1-6 | o-Xylene | 95-47-6 | 2 |
| 1-8 | n-Propylbenzene | 103-65-1 | 4 |
| 1-10 | 1,3,5-Trimethylbenzene | 108-67-8 | 10 |
| 1-11 | 1,2,4-Trimethylbenzene | 95-63-6 | 32 |
| 1-12 | 1,2,3-Trimethylbenzene | 526-73-8 | 7 |
| 1-13 | 2-Ethyltoluene | 611-14-3 | 6 |
| **2** | **Saturated aliphatic hydrocarbons** | | |
| 2-10.1 | n-Nonane | 111-84-2 | 2 |
| 2-10.2 | n-Decane | 124-18-5 | 9 |
| 2-10.3 | n-Undecane | 1120-21-4 | 4 |
| **$VOC_{7d}$: Further identified and calibrated substances in addition with LCI list/AgBB, substance specific calculated ($c_{id\ sub}$)** | | | |
| **12** | **Others** | | |
| | Benzothiazol | 95-16-9 | 1 |
| | 2-Methylfuran | 534-22-5 | 1 |
| **$VOC_{7d}$: Not calibrated substances calculated as toluene equivalent ($c_{ni\ tol}$)** | | | |
| | Isoalkan, C9-C10 | - | 1 |
| | Isoalkan, C9-C10 | - | 1 |
| | Alkylbenzol | - | 18 |
| | Alkylbenzol | - | 8 |
| | Isoalkan, C10-C11 | - | 2 |
| | Cycloalkan | - | 1 |
| | Div. Alkylbenzole | - | 10 |

| **Total volatile organic compounds** | **Concentration (test chamber air) [µg/m³]** | **$SER_a$ [µg/m²h]** |
|---|---|---|
| **$TVOC_{7d}$** | **125** | **96** |

| **Further VOC sums** | **Concentration (test chamber air) [µg/m³]** | **$SER_a$ [µg/m²h]** |
|---|---|---|
| **Sum VOC without LCI** | **43** | **33** |
| **Sum of bicyclic terpenes** | **n.d.** | **n.d.** |
| **Sum of sensitising materials** with the following categorisations:<br>DFG (MAK lists): Category IV<br>German Federal Institute for Risk Assessment lists: Cat A<br>TRGS 907 | **n.d.** | **n.d.** |
| **Sum of VOC** with the following categorisations:<br>Regulation (EC) No. 1272/2008: Category Carc. 2, Muta. 2, Repr. 2<br>TRGS 905: K3, M3, R3<br>IARC: Group 2B<br>DFG (MAK list): Category III3 | **4** | **3** |
| **$C_9$ - $C_{14}$ - Alkanes / Isoalkanes** | **15** | **12** |
| **Sum $C_4$-$C_{11}$ Aldehydes, acyclic, aliphatic** | **n.d.** | **n.d.** |
| **Sum $C_9$-$C_{15}$ Alkyl benzenes** | **59** | **45** |
| **Sum Cresols** | **n.d.** | **n.d.** |

| **R-Value (without dimension)$_{7d}$** | **0.07** |
|---|---|

n.d. = not detectable

### 1.1.7 $SVOC_{7d}$

**Test parameter:**
Semivolatile organic compounds (SVOC), test chamber, air sampling 7 days after test chamber loading

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| No. | Substance | CAS No. | Concentration (test chamber air) [µg/m³] |
|---|---|---|---|
| **$SVOC_{7d}$: Identified and calibrated substances in accordance with LCI list/AgBB, substance specific calculated($c_{id\ sub}$)** | | | |
| - | - | - | n.d. |
| **$SVOC_{7d}$: Further identified and calibrated substances in addition to LCI list/AgBB, substance specific calculated($c_{id\ sub}$)** | | | |
| - | - | - | n.d. |
| **$SVOC_{7d}$: Not calibrated substances calculated as toluene equivalent ($c_{ni\ tol}$)** | | | |
| - | - | - | n.d. |

| Total semivolatile organic compounds | Concentration (test chamber air) [µg/m³] | $SER_a$ [µg/m²h] |
|---|---|---|
| **$TSVOC_{7d}$** | **n.d.** | **n.d.** |

n.d. = not detectable

### 1.1.8 $VVOC_{7d}$

**Test Parameter:**
Very volatile organic compounds (VVOC), test chamber, air sampling 7 days after test chamber loading

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| No. | Substance | CAS-No. | Concentration (test chamber air) [µg/m³] |
|---|---|---|---|
| **$VVOC_{7d}$: Identified and calibrated substances in accordance with LCI list/AgBB, substance specific calculated($c_{id\ sub}$)** | | | |
| **10** | **Esters und Lactones** | | |
| 10-1 | Methylacetate | 79-20-9 | 1 |
| **$VVOC_{7d}$: Further identified and calibrated substances in addition to LCI list/AgBB, substance specific calculated($c_{id\ sub}$)** | | | |
| - | - | - | n.d. |
| **$VVOC_{7d}$: Not calibrated, identified substances calculated as toluene equivalent ($c_{ni\ tol}$)** | | | |
| - | - | - | n.d. |

| Total very volatile organic compounds | Concentration (test chamber air) [µg/m³] | $SER_a$ [µg/m²h] |
|---|---|---|
| **$TVVOC_{7d}$** | **1** | **1** |

n.d. = not detectable

### 1.1.8.1 Formaldehyde$_{7d}$ and Acetaldehyde$_{7d}$

**Test parameter:**

Formaldehyde and Acetaldehyde, test chamber, air sampling 7 days after test chamber loading

**Test method:**

| | |
|---|---|
| Preparation of test sample and Test chamber conditions: | see Volatile organic compounds |
| Analytics: | DIN ISO 16000-3 |
| Limit of determination: | 2 µg/m³ ≈ 0.002 ppm |

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| **Substance** | **Concentration (Test chamber air) [µg/m³]** | **Concentration (Test chamber air) [ppm]** |
|---|---|---|
| Formaldehyde | 2 | 0.002 |
| Acetaldehyde | < 2 | < 0.002 |

## 1.2 Carbon disulfide ($CS_2$, test chamber)

**Test parameter:**
Carbon disulfide ($CS_2$)

**Test method:**

| | |
|---|---|
| Analytics: | DIN ISO 16000-6 |
| Limit of determination: | 1 µg/m³ |

**Test result:**

| Sample-no.: | Parameter | Measurement time [days] | Concentration (test chamber) [µg/m³] |
|---|---|---|---|
| A001 | Carbon disulfide $CS_2$ | 2 | 45 |

## 1.3 Nitrosamines (test chamber) *

**Test parameter:**
Nitrosamines

**Test method:**

| | |
|---|---|
| Analytics: | BGI 505-23 |
| Limit of determination: | 100 ng/m³ |

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| **Parameter** | **Concentration (Test chamber air) after days [ng/m³]** |
|---|---|
| N-Nitrosodimethylamine | n.n |
| N-Nitrosomethylethylamine | n.n |
| N-Nitrosodiethylamine | n.n |
| N-Nitrosodiisopropylamine | n.n |
| N-Nitrosodipropylamine | n.n |
| N-Nitrosodibutylamine | n.n |
| N-Nitrosopiperidine | n.n |
| N-Nitrosopyrrolidine | n.n |
| N-Nitrosomorpholine | n.n |

## 2 Odour

**Test parameter:**

Odour, testing collective, odour testing, 24 hours after loading of desiccator

**Test method:**

| | | |
|---|---|---|
| Manufacture of test specimen: | see 1.1 volatile organic compounds<br>Sizes: | 5 cm x 5 cm x 6 cm |
| Conditions of dessicator: | Temperature:<br>Relative air humidity:<br>Loading:<br>Air sampling: | 40 °C<br>50%<br>See 1.1 volatile organic compounds<br>24 hours after loading of dessicator |
| Analytics: | following VDA-recommendation 270 | |
| Ratings: | 1 not perceptible<br>2 perceptible, not bothering<br>3 clearly perceptible, not bothering<br>4 bothering<br>5 strongly bothering<br>6 unbearable | |

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| Intensity of odour |
|---|
| 2 |

## 3 Ash Content*

**Test parameter:**
Ash content

**Test method:**

| | |
|---|---|
| Analytics: | Thermogravimetric Analysis (TGA) |

**Test result:**

| | |
|---|---|
| Sample: | A001: Natural Latex mattress |

| **Filler** | **[weight/%]** |
|---|---|
| Ash content (incl. zinc oxide), with reference to the sample | 3.0 |
| Filler content, with reference to the sample [1)] | 0 |
| Polymer content, with reference to the sample | 97.0 |

Remark:
[1)] The amount of filler is calculated as difference between the amount of ash and zinc oxide, assuming that the maximum of zinc oxide is 5 % of the total latex foam.

## 4 Polymer content#*

**Test parameter:**

Relation between natural rubber (NR) and synthetic rubber (SBR)

**Test method:**

| | |
|---|---|
| Analytics: | PIR/GC-MS |

**Test result:**

| | |
|---|---|
| Sample-no.: | A001 |

| **Polymer content** | **[weight/%]** |
|---|---|
| NR, with reference to the polymer content [1)] | 100 |
| SBR, with reference to the polymer content | 0 |

[1)] If NR-content is below 5 %, the result will be 100 % SBR. Usually there will be no use of NR below 5 % in a mixture of NR and SBR.

Cologne, 11.08.2014

Dr. rer.-nat. Hans-Ulrich Krieg
(Technical Manager)

# Evaluation

The product **Natural Latex mattress** was submitted to laboratory tests on behalf of LIEN A Co., Ltd. for an ecological product examination according to the eco-INSTITUT-Label test criteria “mattresses” (status: May 2013).

The results documented in the test report were evaluated as follows.

| **P11 Complete mattress** | | | |
|---|---|---|---|
| **Test parameter** | **Result / Emission** | **Limit value** | **Within limits [yes/no]** |
| **Emission test** | | | |
| **Measurement time: 2 days after test chamber loading** | | | |
| TVOC (total volatile organic compounds) | 308 µg/m³ | ≤ 400 µg/m³ | yes |
| VOC (incl. VVOC and SVOC) with the following categorisations: Regulation (EC) No. 1272/2008: Category Carc. 1A and 1B, Muta. 1A and 1B, Repr. 1A and 1B; TRGS 905: K1, K2, M1, M2, R1, R2; IARC: Group 1 and 2A; DFG (MAK list): Categories III1, III2 | < 1 µg/m³ | ≤ 2 µg/m³ | yes |
| Formaldehyd | 2 µg/m³ | ≤ 24 µg/m³ | yes |
| Acetaldehyd | < 2 µg/m³ | ≤ 24 µg/m³ | yes |
| Disulphide (only latex products) | 45 µg/m³ | ≤ 50 µg/m³ | yes |
| **Measurement time: 7 days after test chamber loading** | | | |
| TVOC (total volatile organic compounds) | 125 µg/m³ | ≤ 200 µg/m³ | yes |
| VOC (sum) without NIK | 43 µg/m³ | ≤ 100 µg/m³ | yes |
| VOC (individual values): | | | |
| Sum bicyclic Terpenes | < 1 µg/m³ | ≤ 200 µg/m³ | yes |
| Sum of sensitising materials with the following categorisations: DFG (MAK list): Category IV, German Federal Institute for Risk Assessment lists: Cat A, TRGS 907 | < 1 µg/m³ | ≤ 100 µg/m³ | yes |
| Sum of VOC (incl. VVOC and SVOC) with the following categorisations: Regulation (EC) No. 1272/2008: Category Carc. 2, Muta. 2, Repr. 2; TRGS 905: K3; IARC: Group 2B; DFG (MAK list): Category III3 | 4 µg/m³ | ≤ 50 µg/m³ | yes |
| Sum C9 – C14: Alkanes / Isoalkanes | 15 µg/m³ | ≤ 100 µg/m³ | yes |
| Sum C4-C11 Aldehydes, acyclic, aliphatic | < 1 µg/m³ | ≤ 100 µg/m³ | yes |
| Sum C9 - C15 Alkylbenzenes | 59 µg/m³ | ≤ 100 µg/m³ | yes |
| Sum Cresols | < 1 µg/m³ | ≤ 5 µg/m³ | yes |
| VOC (individual substances): | | | |
| Styrene | < 1 µg/m³ | ≤ 10 µg/m³ | yes |
| Methylisothiazolinon (MIT) | < 1 µg/m³ | ≤ 1µg/m³ | yes |
| Benzaldehyde | < 1 µg/m³ | ≤ 20 µg/m³ | yes |
| 2-Ethyl-1-hexanol | < 1 µg/m³ | ≤ 100 µg/m³ | yes |
| Ethylenglycolmonobutylether | < 1 µg/m³ | ≤ 100 µg/m³ | yes |

| | | | |
|---|---|---|---|
| 2-Hexoxyethanol | < 1 µg/m³ | ≤ 100 µg/m³ | yes |
| Methylisobutylketon | < 1 µg/m³ | ≤ 100 µg/m³ | yes |
| 2-Butoxyethylacetate | < 1 µg/m³ | ≤ 200 µg/m³ | yes |
| TSVOC (total semi-volatile organic compounds) | < 1 µg/m³ | ≤ 40 µg/m³ | yes |
| R-value | 0.07 | ≤ 1.0 | yes |
| Nitrosamines (only latex products) | < 100 ng/m³ | ≤ 300 ng/m³ | yes |
| Odour | 2 | ≤ Grade 3 (24 hours after loading of desiccator) | yes |

n.d.: not detectable

| **P31 Upholstery / padding materials: Latex** | | | |
|---|---|---|---|
| **Test parameter** | **Result** | **Limit Value** | **Within Limits [yes/no]** |
| Filler content | 0 % | ≤ 5 % | yes |
| Polymer content (NR: natural rubber) | 100 % NR | not applicable | not applicable |

n.d.: not detectable

# Summary evaluation

The product **Natural Latex mattress** was submitted to an ecological product examination on behalf of LIEN A Co., Ltd. for the acquisition of the eco-INSTITUT-Label.
The eco-INSTITUT-Label criteria were successfully fulfilled.

As a result of the successful ecological product examination the

## eco-INSTITUT-Label

is awarded for the product/s:
**Latex core for natural latex mattresses**
for a period of two years.

| | |
|---|---|
| Certification number | ID 0310 – 12246 - 001 |
| Test report Number | 43981 |
| Validity | 07 / 2016 |

After expiration of two years it is possible to acquire the eco-INSTITUT-Label for another two year period. For this a laboratory test will be accomplished according to the latest eco-INSTITUT-Label test criteria.

Cologne, 11.08.2014

Vanessa Laumann
(Project manager)