

Report n° R18/681

**Evaluation of the VOC emissions of the sample Polyester 25 μ m
(HairPlus) according to ISO 16000-9 after 28 days**

This report should only be reproduced in its entirety

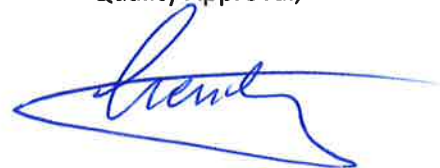
Study for :	ArcelorMittal
Attention of :	Mrs Schouller-Guinet
Customer request nr :	5500074520
Certech request nr:	D18/542
Certech quotation nr :	OP/18/440/TP

Emission date: 9th October 2018

Scientific Approval,



Quality Approval,



1. Study description

1.1 Introduction

This report is related to the request coming from Mme Schouller-Guinet (ArcelorMittal). The study is dedicated to the evaluation of the emissions of VOC from the sample Polyester 25µm (HairPlus). The sample was placed in test chamber on 21st of February 2012. This testing was previously described in test report 12/245 of 19th april 2012. Upon request of ArcelorMittal, the results obtained in 2012 have been reviewed in order to be compared to Agbb evaluation specifications.

Table 1. Sample reference

<i>Customer reference</i>	<i>Certech reference</i>
Polyester 25µm (HairPlus)	202E004

1.2 Methodology

A – Conditioning of the samples

The test was performed in Tedlar bag emission chamber according to ISO16000-9 and -11.

In order to evaluate VOC emissions from materials used indoors, the specific airflow rate is set to be the same in the test chamber as in the model room. When multiplied by the concentration in pollutants, this rate allows to obtain the area specific emission rate according to:

$$q_A = C_x \cdot q \text{ at time } t, \text{ where :}$$

- q_A is the area specific emission rate
- C_x is the VOC concentration
- q specific airflow rate

The specific airflow rate (q , expressed in $m^3/(m^2 \cdot h)$) is related to the air exchange rate (n) and to the product loading factor (L : area of the material tested divided by the chamber volume, expressed in m^2/m^3), following the relation $q = n/L$.

The emissions scenario for walls in the French Directive n° 2011-321 is a q of $0,5 m^3/(m^2 \cdot h)$.

The conditioning step was realised at a constant temperature of 23°C and a relative humidity of 50%.

Samplings were performed the 20^h of March 2012. Blanks were sampled just before starting the test; one blank was considered for each assessment (aldehydes/ketones and VOCs).

Parameters applied for these tests are summarised in table 2.

Table 2. Parameters used for VOC sampling

Sample 202E004	
Parameters	Conditions
Emission test chamber	Tedlar bag
Temperature (°C)	23 ± 2
Relative humidity (%)	50 ± 5
Sample area (m ²)	0,174
Airflow rate (L.min ⁻¹)	1,26
Specific airflow rate (q= n/L) (m ³ .m ⁻² .h ⁻¹)	0,5
Specific airflow rate of the model room for wall scenario (q in m ³ .m ⁻² .h ⁻¹)	0,5 (n=0,5; L=1) *
Start of the test	21/02/2012
Samplings J+28	20/03/2012
Sampling of VOC	Tenax cartridge, 3 L and 300 mL (100 mL.min ⁻¹)
Sampling of aldehydes/ketones	DNPH cartridge, 60 L (1 L. min ⁻¹)

*following specifications of EN16516 for walls

B – Measurement of VOC emissions according to ISO 16000-6

Sampling of volatile organic compounds (VOC) has been performed by adsorption on Tenax[®] sorbent materials (phenyl-phenylene oxide polymers), according to ISO 16000-6. The flow rate was fixed at 100mL/min. Two different volumes have been collected (3L and 0,3L). After collection on sorbent, the chemicals have been desorbed thermally and concentrated on a cryogenic trap prior to the injection. The VOCs have been separated by a capillary column gas chromatograph. Detection, identification, and quantification of organic compounds have been performed by mass spectrometry according to ISO 16000-6. External standards have been used for the calibration. Quantification has been based on the peaks area.

C – Measurement of aldehydes and ketones to ISO 16000-3

“C=O” compounds have been analysed following ISO 16000-3. The sampling line has been connected to a DNPH cartridge. The cartridge content is basically silica impregnated with DNPHydrazine and orthophosphoric acid. Carbonyl bonds react with DNPH to produce the stable hydrazone derivatives. For the sampling, an air volume has been flushed through the cartridge by use of a high precision pump. The flow rate has been fixed at 1 L/min (volume sampling of 60L). Hydrazones have been desorbed with 5 ml acetonitrile and the eluate has been analysed using a HPLC system equipped with UV detection. The external standard method has been used for the quantification. A high purity (99 %) DNPH derivatives standard solution has been used as stock solution to prepare a set of 6 calibration standards in the same range as the expected concentration of the samples. Calibration fit and quantification have been based on the peak area according to ISO 16000-3.

2. Results

Sample and analyses references are listed in table 3.

Table 3. Sample references

Samples	
Your reference	Certech reference
Polyester 25µm	202E004
Blank VOC 202E004 3L	202G051
Blank aldehydes/ketones 202E004 60L	202H023
D=28 VOC 202E004 3L	203G095
D=28 VOC 202E004 0,3L	203G096
D=28 aldehydes/ketones 202E004 60L	203H031

2.1 Measurement of VOC emissions

The results of the Tenax sampling after 28 days of conditioning are summarised in table 4. In this table:

- Column 1 indicates retention times of the compounds
- Column 2 gives the CAS numbers of the identified compounds
- Column 3 gives names of identified compounds. The identification was performed on the retention time, on the MS spectra by comparison to libraries and by manual peak by peak analyses of the MS spectra.
- Column 4 mentions the standard used for the quantification
- Column 5 gives estimated concentration in µg/m³. External standard curves have been used for the quantification in regard to peak area. A careful interpretation of concentrations has to be made (concentration could be estimated in regard to toluene standard for example).
- Column 6 mentions the exposure concentration in the model room taking into account the following:

$$C_{\text{exp}} \times q_{\text{MODEL ROOM}} = C_{\text{TRIAL}} \times q_{\text{TRIAL}} \text{ at 28 days.}$$

Table 4: VOC analysis after 28 days - Sample Polyester 25 µm (202E004)

<i>R.T. (min.)</i>	<i>CAS number</i>	<i>analyte</i>	<i>standard</i>	<i>Measured Concentration C in µg/m³</i>	<i>Exposure Concentration C_{exp} in µg/m³</i>
5.33	75-07-0	acetaldehyde	NA		
15.43	71-43-2	benzene (sim78)	toluene	<0,6	<0,6
17.68		non identifié	toluene	<0,6	<0,6
21.69	108-88-4	toluene	toluene	<0,6	<0,6
22.71	541-05-9	hexamethyl-cyclotrisiloxane	toluene	3,19	3,19
23.82		non identifié	toluene	<0,6	<0,6
26.20	(m-)108-38-3 ou (p-)106-42-3	m(p)-xylene	toluene	<0,6	<0,6
29.13	111-76-2	2-butoxy ethanol	toluene	<0,6	<0,6
30.20	556-67-2	octamethyl- cyclotetrasiloxane	toluene	<0,6	<0,6
31.02		non identifié	toluene	<0,6	<0,6
32.22	95-63-6	1,2,4-trimethylbenzene	toluene	<0,6	<0,6
32.41	100-52-7	benzaldehyde	toluene	<0,6	<0,6
34.36	1120-21-4	n-undecane	toluene	<0,6	<0,6
34.78		non identifié	toluene	<0,6	<0,6
35.29	541-02-6	decamethyl-cyclopentasiloxane	toluene	<0,6	<0,6
35.71	98-86-2	acetophenone	toluene	<0,6	<0,6
35.76	124-19-6	nonanal	toluene	<0,6	<0,6
36.77		non identifié	toluene	<0,6	<0,6
37.95	112-31-2	decanal	toluene	<0,6	<0,6
38.24		non identifié	toluene	<0,6	<0,6
38.78	540-97-6	cyclohexasiloxane, dodecamethyl	toluene	<0,6	<0,6
39.75		non identifié	toluene	<0,6	<0,6
40.31		non identifié	toluene	<0,6	<0,6
41.40		non identifié	toluene	<0,6	<0,6
TVOC (C ₆ -C ₁₆) ⁽¹⁾			toluene	9,5	9,5
TVOC (Agbb) ⁽²⁾			toluene	0	0

NA : not applicable (compounds not quantitatively adsorbed on Tenax® cartridges)

<0,6: below quantification limit (0,6 µg/m³) of GC-MS analysis

(1) According to ISO 16000-6, TVOC are calculated considering the entire surface of the chromatogram between C₆ and C₁₆ after removal of the TVOC from the blank following the same operating mode. Calculation made taking into account the response factor of toluene.

(2) According to Agbb evaluation scheme, TVOC value is the sum of all compounds with concentrations equal or greater than 5 µg/m³ within the retention range C₆-C₁₆

A specific research was made for the 4 CMR compounds: trichloroethylene, benzene, dibutyl phthalate and diethylhexyl phthalate and the results are presented below.

Table 5: CMR analysis after 28 days - Sample 202E004

<i>Compounds</i>	<i>CAS N°</i>	<i>Concentration (µg/m³)</i>
trichloroethylene	79-01-6	ND
benzene	71-43-2	ND
dibutyl phthalate	84-74-2	ND
diethylhexyl phthalate	117-81-7	NA*

ND: not detected (detection limit = 0,2 µg/m³)

NA*: not applicable, our method is not adapted to analyze this compound

2.2 Aldehydes/ketones emissions

Table 6: Carbonyl compounds analysis after 28 days of sample 202E004

<i>Carbonyl compounds</i>	<i>CAS N°</i>	<i>Conc 28 days (µg/m³)</i>	<i>Cexp (µg/m³)</i>
formaldehyde	50-00-0	11,9	11,9
acetaldehyde	75-07-0	1,7	1,7
Limit of detection (µg/m ³)		0,1	

3. Evaluation of the emissions of the sample according to German Agbb evaluation scheme.

The evaluation of the tested sample according to AgBB 2018 is reported in table 8, based on VOC screening analysis after 28 days.

This evaluation takes into account the comparison of the exposure concentrations to the German Lowest Concentration of Interest (LCI) values presented in table 7. The French LCI are given for information.

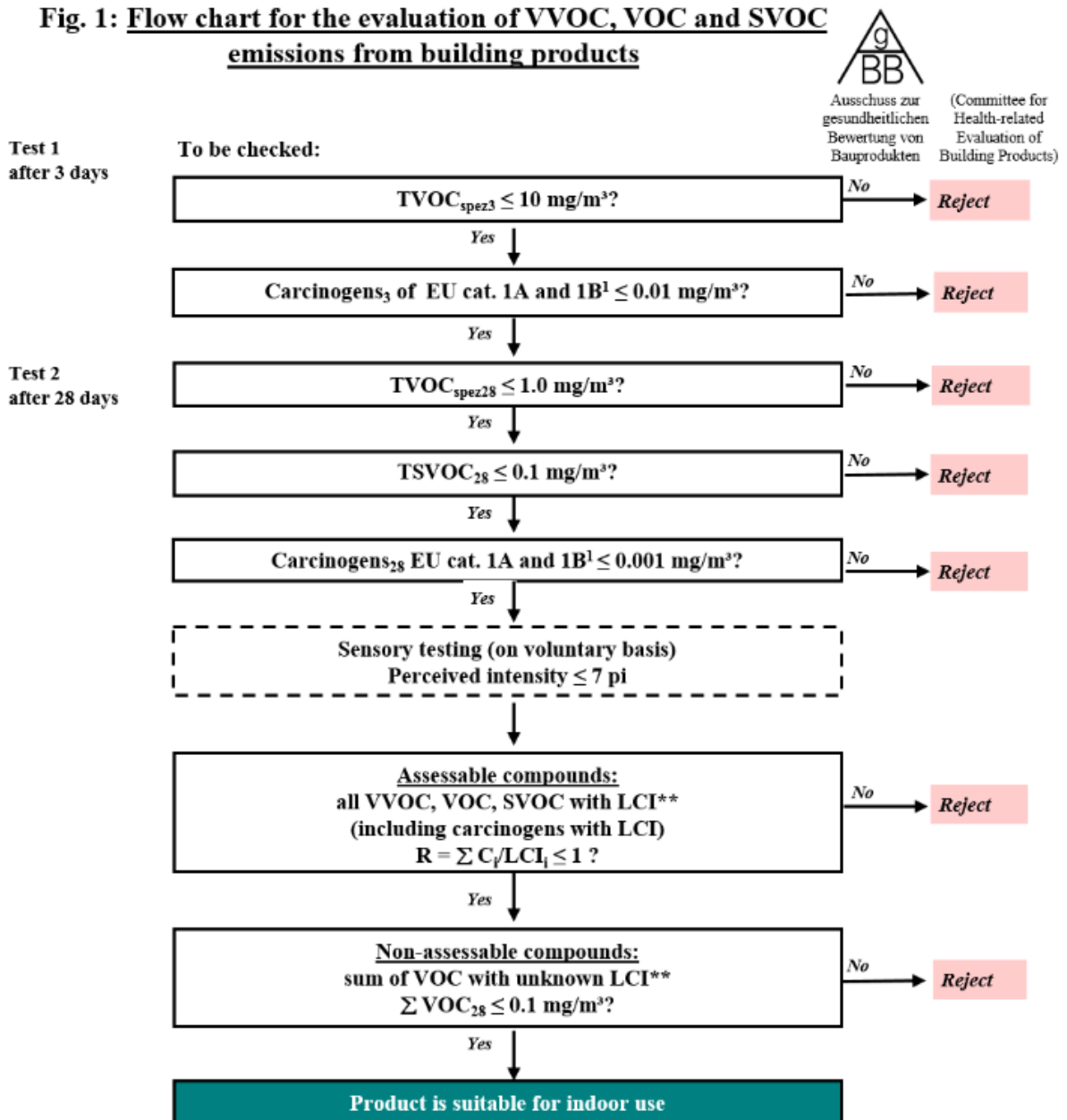
In Agbb scheme, the R calculation takes into account the identified compounds with an exposure concentration above 5 µg/m³.

Table 7. VOC emissions evaluation after 28 days according to AgBB 2018 labelling schemes

CAS number	analyte	Conc. (µg/m ³)	Cexposition (µg/m ³)	French CLI (µg/m ³)	German LCI (µg/m ³)	R AGBB
50-00-0	formaldehyde	11,9	11,9	10	100	0,12
						ΣR AgBB
						<1

Evaluation of the emissions according to AGBB 2018 labeling scheme is the following:

Fig. 1: Flow chart for the evaluation of VVOC, VOC and SVOC emissions from building products



* VVOC: retention range < C₆, VOC, TVOC: retention range C₆ – C₁₆, SVOC: retention range C₁₆ – C₂₂
Emission chamber testing according to EN 16516:2018-01

UBA II 1.3
AgBB 2018

** LCI: Lowest Concentration of Interest (German: NIK)

1 Classification according to Regulation (EC) No 1272/2008 Appendix VI Table 3.1, see notes in the text
<https://www.umweltbundesamt.de/en/topics/health/commissions-working-groups/committee-for-health-related-evaluation-of-building>

As a consequence, sample 202E004 evaluation is summarised in the table 8.

Table 8: Sample 202E004 evaluation according to AGBB 2018 labelling scheme

	Evaluation criteria	Polyester 25µm (HairPlus) 202E004
J+3	TVOC < 10000 µg/m ³	Not evaluated
	[CM ₁₋₂] < 10 µg/m ³	Not evaluated
J+28	TVOC < 1000 µg/m ³	Ok
	∑SVOC < 100 µg/m ³	Not evaluated
	[CM ₁₋₂] < 1 µg/m ³	Ok except for diethylhexyl phtalate (not evaluated)
	Compounds with CLI: R < 1*	OK, R<1
	Compounds without CLI : ∑ Cni < 100 µg/m ³	OK, ∑ Cni < 100 µg/m ³
Sample conformity	Not assessable	

*For individual concentration superior to 5 µg/m³

Annex A: Analytic Conditions

GC-MS

a) Injection by Gerstel TDS-CIS4 cooled system:

The Tenax cartridges were thermo-desorbed and focused on a cryotrap.

b) GC:

HP5973

Column: ZB624

Gas carrier: He 6.0

Method ref: Sensory4longue

HPLC

Equipment

HPLC: Waters Alliance 2690

Column: Waters Symmetry® C18

Detector: Waters PDA 996, $\lambda = 360$ nm

Method: ANA 033