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**Staatlich akkreditierte Prüf- und Überwachungsstelle  
Bescheid GZ BMWA-92.714/0131-I/12/2005 v. 12.4.2005**

## TEST REPORT

regarding

**olfactometric measurements on biowaste compost windrows  
with and without coverage at the composting plant Krems  
on the 21.8., 24.8., 31.8., 7.9. and 15.11. 2006**

Customer	POLYFELT GmbH
Address of the customer	A-4020 Linz, Schachermeyerstraße 18
Order date / order number	04.07.2006 SD / Wb

Reference number	A-1662-1/2-06
Technical responsible	Dr. A. Amann

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## A Issue

The Polyfelt GmbH authorised the NUA Umweltanalytik GmbH with tests regarding the reduction of odorant emissions by covering compost windrows with textiles.

The tests were conducted at the biological waste composting plant of the NUA Abfallwirtschaft GmbH in Krems-Gneixendorf.

## B Measurement program

### B1 Measurement of odorous compounds

The emission rates were quantified by sampling with a surface emission measurement hood covering a fixed surface area 1 m<sup>2</sup> in accordance with VDI-guideline 3790 part 2 "Environmental meteorology – Emissions of gases, odours and dusts from diffuse sources – Landfills". The hood is sunk to a depth of about 3 centimetres in order to avoid sampling ambient air. A probe is located in the hood to extract samples for subsequent olfactometric analysis.

### Odour threshold determination

Device	Olfactometer ECOMA TO8-S System Mannebeck
Fabrication number	EO.8016
Year of manufacture; last service	2002; before every measurement
Dilution principle	Gas jet dilution with 2 gas jet pumps
Range of dilution	0 - 65000 GE (without predilution)
Sampling bag / sample inlet	Nalophan bag (volume 8 l)
Conditioning of neutral air	Pressurized ambient air, dried with silica-gel, purified with activated carbon
Sample outlet	4 nose masks, glass 70*60 mm
Sample gas flow / neutral air flow	1,27 m <sup>3</sup> /h / 1,30 m <sup>3</sup> /h
Flush time	5 seconds
Measurement cycle	Four steps at 2,2 seconds each, the cycle is repeated until all panelists gave two positive responses during the „diluted sample“ step. Inhalation step reference air – exhalation step – inhalation step diluted sample gas – exhalation step – etc.
Break time	20 seconds between two runs (three runs per sample) Three minutes between two samples 15 minutes after five samples No panelist analyzes more than 12 samples per day.
Blank samples	20 %, equally distributed
Sampling	The samples were taken by a emission measurement hood (1m <sup>2</sup> ) with a built-in fan (250 l/min). After an equilibration time of two minutes the Nalophan bag was connected and (over the course of two minutes) filled with sample air. The samples were not additionally diluted or conditioned in any way.
Sample transport and storage	The samples were transported in an air-conditioned car and analyzed within 24 hours.
Laboratory, measuring location	Odour laboratory of NUA-Umweltanalytik GmbH
Method	Method of limits; Yes/No-method
Software	ECOMA Software for TO8 Version 1.0
Panelists	4 panelists from panel of NUA-Umweltanalytik GmbH; Odour threshold test with n-Butanol
Documentation	Form 26 (Form for sampling), log
Guideline	ÖNORM EN 13725 / Documentation see QM-System
Detection limit	6 GE/m <sup>3</sup>
Interlaboratory comparison test	July 2005; international Interlaboratory comparison test organized by OLFATEC, Germany. The NUA Umweltanalytik fulfilled all tests within the required limits.

## B2 Gas analysis

The determination of the gas composition (methane, carbon dioxide and oxygen) was made with a portable waste gas analyser and a piercing sampling probe in the vicinity of the measurement hood sampling points. Overall 12 points were tested (4 on each covered windrow) with a piercing depth of 1 m.

### Methane, carbon dioxide, oxygen

Device	GA 45 portable waste gas analyser
QS-number	GE 2104
Description	Gas analyser for methane, carbon dioxide and oxygen
Manufacturer	Geotechnical Instruments Ltd.
Year of manufacture	2004
Sampling	Direct sampling by negative pressure through pump; 600 ml/min
Operating principle	Methane, carbon dioxide: NDIR Oxygen: elektrochemical
Scale	Methane: 0 – 100 % Carbon dioxide: 0 – 50 % Oxygen: 0 – 21 %
Detection limit	Methane: 1,8 % Carbon dioxide: 1,0 % Oxygen: 1,8 %
Measurement uncertainty	CH <sub>4</sub> : 1,8 – 5 % ± 0,5 %; 5 – 15 % ± 1 %; 15 – Full Scale ± 3 % CO <sub>2</sub> : 1,0 – 5 % ± 0,5 %; 5 – 15 % ± 1 %; 15 – Full Scale ± 3 % O <sub>2</sub> : 1,8 – 5 % ± 0,5 %; 5 – 15 % ± 0,5 %; 15 – Full Scale ± 1 %
Calibration gases	60 Vol.% Methane with 40 Vol.% carbon dioxide by SIAD; Filled 17.07.2003, guaranteed stability of 60 months 21 Vol.% Oxygen (Air)

## C Description of used materials and plant

The input material included communal biowaste mixed with shrub prunings. During the first piling the windrows were scattered with stone meal (several kilograms per 30 m-windrow). The windrows were piled in June 2006. The windrows were turned immediately preceding the start of the tests on 21.8.

Composting time: approx. 6 months

Textile cover: Ten Cate Nicolon bv Compost cover 25 x 4,8m, Prod.unit: K322319005 (Abbr. T)

Fleece: Polyfelt Kompostschutz Top Tex 5 x 40 m, Fl.GW 200 g/m<sup>2</sup> Art. A1372 Lot 20036401 (Abbr. P)



Turning of the windrows before the start of measurements on 21.8.2006



Covered windrows, left side Ten Cate Nicolon, right side Polyfelt

## D Measurement results

### D1 Measurement on 21.8.2006

The measurement started 1.5 hours after the turning process.

Turning frequency: once in 14 days

Measurement date 21.8.2006, time 13.00 to 14.30 MESZ

Weather conditions: 18 °C, wind 2-4 m/s west, cloud cover [%] 70-100

Legend:            T<sub>1</sub>            Test area TenCate Plane  
                       P<sub>1</sub>            Test area Polyfelt Top Tex  
                       O<sub>1</sub>            Test area with no cover  
                       Air            Ambient odorant concentration

\* The odour units were determined from a composite sample (1 to 4).

Sample	T [°C]	CH4 [%]	CO2 [%]	O2 [%]	Odour units/[m <sup>3</sup> ]*
T <sub>1</sub>	58	0,1	22,1	0	2170
T <sub>2</sub>	58,5	0	14,3	4,3	
T <sub>3</sub>	58,5	0	21,6	0	
T <sub>4</sub>	60	0	14	3,9	
P <sub>1</sub>	56	0,2	20,5	0	1290
P <sub>2</sub>	62	0,6	24,3	0	
P <sub>3</sub>	61	0,2	20	0	
P <sub>4</sub>	60,5	0,9	24,9	0	
O <sub>1</sub>	60	0,3	19,5	0	5160
O <sub>2</sub>	61	0	1,6	17,7	
O <sub>3</sub>	63	0,1	15,5	3,4	
O <sub>4</sub>	60,5	0,2	21,5	0	
Air					910

## D2 Measurement on 24.8.2006

The measurement took place 3 days after the turning process.

Temperature [°C] 21-24

Air pressure [hPa] 974

Wind velocity [m/s] 0,5

Precipitation (+/-) -

Cloud cover [%] 20-30

Legend: T<sub>1</sub> Test area TenCate Plane  
 P<sub>1</sub> Test area Polyfelt Top Tex  
 O<sub>1</sub> Test area with no cover  
 Air Ambient odorant concentration  
 \* The odour units were determined from a composite sample (1 to 4).

Sample	T [°C]	CH4 [%]	CO2 [%]	O2 [%]	Odour units/[m <sup>3</sup> ]*
T <sub>1</sub>	70	1,6	19,8	0,7	970
T <sub>2</sub>	74	0,5	16,4	1,3	
T <sub>3</sub>	72	0,5	19	0	
T <sub>4</sub>	80	0,3	12,2	6,1	
P <sub>1</sub>	78	0,2	16,9	1,5	600
P <sub>2</sub>	71	3,4	21,7	0	
P <sub>3</sub>	69	3,8	20,7	0	
P <sub>4</sub>	60	10,8	25,3	0	
O <sub>1</sub>	66	1,1	20	0	2300
O <sub>2</sub>	80	0,6	18	0	
O <sub>3</sub>	68	0,7	17,4	1,3	
O <sub>4</sub>	72	0,2	10,5	7,6	
Air					230

## D3 Measurement on 31.8.2006

The measurement took place 10 days after the turning process.

Temperature [°C] 18

Air pressure [hPa] 984

Wind velocity [m/s] 4,08 to 5,42

Precipitation (+/-) -

Legend: T<sub>1</sub> Test area TenCate Plane  
 P<sub>1</sub> Test area Polyfelt Top Tex  
 O<sub>1</sub> Test area with no cover  
 Air Ambient odorant concentration

\* The odour units were determined from a composite sample (1 to 4).

Sample	T [°C]	CH4 [%]	CO2 [%]	O2 [%]	Odour units/[m <sup>3</sup> ]*
T1	75	0	1,9	18,5	45
T2	68	0	1,4	18,5	
T3	59	0	0,1	20,1	
T4	61	0	1,4	18,8	
P1	70	0	5,4	13,3	45
P2	77	0,6	12,8	5,2	
P3	76	0	6,4	12	
P4	76	0	12,2	3,5	
O1	70	0	11,1	7	33
O2	51	0	0,1	19,7	
O3	70	0	2,1	16,1	
O4	76	0	4,5	12,7	
Air	18	0	0	20,5	32

Odour units after subtraction of the ambient air value: T: 13  
 P: 13  
 Open windrow 1







Due to strong wind interfering with the windrow's surface emission rate the measurement results from 31.8 were not included.

The measurements showed that the coverage of a triangular windrow results in a significant reduction of odour emissions. A direct comparison between the two tested cover materials shows no distinct difference in their ability to reduce odour emissions.

Rough estimation of the range of the odour plume after reduced emissions:

Assumptions:

- Dispersion calculation: GIEBEL (mean values over 20 minutes). The results were multiplied by 10 to cover short peaks in odour concentration.
- Assumed plant capacity: 5000 Mg/a biowaste input
- Assumed odour freight without coverage: 18 Mio OU/h = 5000 OU/sec
- Assumed reduction of odour emissions: 80%

Range of the odour plume (including short-time peaks) at different air velocities:

Cover	no		yes	
Wind velocity	1 m/s	2 m/s	1 m/s	2 m/s
Range of odour plume	550 m	350 m	200 m	130 m

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