

WL 5831B/11

**Comparative investigation of the soiling behaviour
and the cleaning performance of floor coverings**

Customer:

Forbo Flooring BV
Mr. Willem Burmanje
Industrieweg 12
NL-1566 JP Assendelft

Project leader:

Dipl.-Ing. Anke Ophüls

CEO:

Dr. Jürgen Bohnen

Date:

January 31, 2011

CONTENT

	page
1. INTRODUCTION	4
2. TESTING CONDITIONS	4
2.1 Determination of the soiling behaviour	4
2.2 Determination of the cleaning performance	5
2.3 Notes	5
3. RESULTS	6-7
3.1 Soiling behaviour	6
3.2 Cleaning performance	7

ANNEX A – CONCLUSION OF THE RESULTS

ANNEX B – PICTURES OF THE PRODUCTS IN THE STATE AS DELIVERED

ANNEX C – L-VALUES OF THE PRODUCTS AFTER DELIVERY (UNSOILED)

1 INTRODUCTION

As instructed the soiling behaviour and the cleaning performance of floor coverings were investigated as described under paragraph 2. The following floor coverings were tested:

product	code of the floor coverings given by the customer	dosage of cleaning agent "Jontec 300 N.C conc. F4c" for determination of the cleaning performance
A	Linoleum 1	5 mL of diluted product 20 mL / 10 L
B	Linoleum 2	5 mL of diluted product 20 mL / 10 L
C	Linoleum 3	5 mL of diluted product 20 mL / 10 L
D	Linoleum 4	5 mL of diluted product 20 mL / 10 L
E	Topshield 2	5 mL of diluted product 20 mL / 10 L

The floor coverings and the cleaning agent Jontec 300 N.C conc. F4c (1 x 1 L HDPE bottle, batch number ENS 382021 11 248 08:31) were provided by the customer. The dosage of the cleaning agent was chosen as recommended on the package. The floor coverings were used in this investigation the state as delivered.

2 TESTING CONDITIONS

2.1 Determination of the soiling behaviour

Determination of the soiling behaviour of the floor coverings was carried out applying Leverkusener standard soil (LD 40) with a Sheen scrub tester onto the surface of the floorings during 10 double strokes.

The soiling behaviour is defined by the difference of the measured brightness value (L^* -value) of the flooring before and after the soiling procedure with the Leverkusener standard soil. The evaluation of the soiling behaviour was carried out photometrically according to DIN 5033 part 3 (07.1992) using a spectrophotometer which allows the measurement of the total reflectance over the wavelength of visual light filtering the UV part of the incoming spectrum by a filter. The L^* -values of each track of the unsoiled and soiled coverings were determined. The soiling behaviour was calculated using the following equation:

$$\Delta \text{ soiling} = L^* \text{ unsoiled surface} - L^* \text{ soiled surface}$$

The L^* -values were determined under the following measuring conditions:

Measuring equipment: BYK spectro-guide sphere gloss
 Measuring geometry: d / 8°
 D 65 / 10° observer
 with UV-filter (400 nm cut off)
 Measuring diameter: 11 mm
 Gloss: 60°

The determination of the soiling behaviour was carried out at five samples per floor covering (5 samples x 4 tracks x 5 measurements per track = 100 measurements).

Statistically significant differences between the results of the different floor coverings were calculated based on Tukey's HSD (Honest Significant Difference, 95 % confidence level).

2.2 Determination of the cleaning performance

The comparative assessment of the cleaning performance was made 24 hours after preparation of the soiled surfaces, using an automatic multi-track scrub tester, by scrubbing with a cloth onto which the cleaning agent Jontec 300 N.C conc. F4c was pipetted. Homogeneous cloths of one weight range were cut, without any further preparations, to approx. 13 x 10 cm. After inserting the cloth and attaching it, 5 ml of the diluted cleaning agent were evenly pipetted on. The measurement was carried out with bearing weight of 300 g per cloth holder. In preliminary trials the suitable number of strokes to reach a complete cleaning under the test conditions given above was investigated using product E ("Topshield 2") which was designated by the customer as the reference product. The required number of strokes was 5 strokes (1 stroke = one to-and-fro movement). This number of strokes was used to compare the cleaning performance of all test products. Ten minutes after the cleaning cycle the cleaned surfaces were measured.

Photometrical determination of cleaning performance was carried out according to DIN 5033 part 3 (07.1992) using a spectrophotometer which allows the measurement of the total reflectance over the wavelength of visual light filtering the UV part of the incoming spectrum by a filter. The L*-values of each track of the unsoiled, soiled and cleaned floor coverings was determined. The L*-values were determined under the following measuring conditions:

Measuring equipment: BYK spectro-guide sphere gloss
 Measuring geometry: d / 8°
 D 65 / 10° observer
 with UV-filter (400 nm cut off)
 Measuring diameter: 11 mm
 Gloss: 60°

The cleaning performance was calculated with the following equation:

$$\text{cleaning performance in \%} = \frac{L^*_{\text{cleaned surface}} - L^*_{\text{soiled surface}}}{L^*_{\text{un soiled surface}} - L^*_{\text{soiled surface}}} \times 100 \%$$

The determination of the cleaning performance was carried out at five samples per floor covering (5 samples x 4 tracks x 5 measurements per track = 100 measurements).

Statistically significant differences between the results of the different floor coverings were calculated based on Tukey's HSD (Honest Significant Difference, 95 % confidence level).

2.3 Notes

The results are only valid for the investigated samples and their qualities at the time of the investigation as well as for the adjusted test conditions as ordered.

wfk-test reports, wfk-test results or any other wfk-data or wfk-information must not be communicated to any third parties except in full, with the corresponding reports, attachments etc.. Any use for publication, advertising or other purposes is only permitted with the prior written consent of the wfk-Institut für Angewandte Forschung GmbH.

3 RESULTS

3.1 Soiling behaviour

The results of the soiling behavior calculated as Δ soiling are given in **Table 1**.

Table 1 Soiling behavior as Δ soiling - arithmetical mean of 100 measurements with standard deviation and confidence interval				
product	code	Δ soiling	standard deviation	confidence interval
A	Linoleum 1	24,82	1,06	0,21
B	Linoleum 2	24,40	1,76	0,35
C	Linoleum 3	22,72	1,61	0,32
D	Linoleum 4	20,85	0,99	0,20
E	Topshield 2	18,27	1,22	0,24

The results of the statistical differences based on Tukey's HSD at a significance level of 95 % cleaning performance are given in **Table 2**.

Table 2 Statistical evaluation based on Tukey-Kramer (95 % confidence level)- frequency on paired wins on Δ soiling (+ /not sig / -)								
	A	B	C	D	E	product	comparisons +/-	ranking
A		+0/1/-0	+1/0/-0	+1/0/-0	+1/0/-0	E	4	1
B	+0/1/-0		+1/0/-0	+1/0/-0	+1/0/-0	D	2	2
C	+0/0/-1	+0/0/-1		+1/0/-0	+1/0/-0	C	0	3
D	+0/0/-1	+0/0/-1	+0/0/-1		+1/0/-0	A	-3	4
E	+0/0/-1	+0/0/-1	+0/0/-1	+0/0/-1		B	-3	4

3.2 Cleaning performance

The results of the cleaning performance are given in **Table 3**. The highest score of the photometrical results is 100 which corresponds to 100 % cleaning performance, the lowest score is 0, which represents a cleaning performance of 0%.

Table 3 Cleaning performance in % - arithmetical mean of 100 measurements with standard deviation and confidence interval

product	code	% cleaning performance	standard deviation	confidence interval
A	Linoleum 1	76,36	3,80	0,75
B	Linoleum 2	76,19	4,64	0,92
C	Linoleum 3	72,56	3,25	0,64
D	Linoleum 4	87,83	4,01	0,80
E	Topshield 2	90,08	4,36	0,87

The results of the statistical differences based on Tukey's HSD at a significance level of 95 % cleaning performance are given in **Table 4**.

Table 4 Statistical evaluation based on Tukey-Kramer (95 % confidence level)- frequency on paired wins on cleaning performance in % (+ /not sig / -)

	A	B	C	D	E	product	comparisons +/-	ranking
A		+0/1/-0	+0/0/-1	+1/0/-0	+1/0/-0	E	4	1
B	+0/1/-0		+0/0/-1	+1/0/-0	+1/0/-0	D	2	2
C	+1/0/-0	+1/0/-0		+1/0/-0	+1/0/-0	B	-1	3
D	+0/0/-1	+0/0/-1	+0/0/-1		+1/0/-0	A	-1	3
E	+0/0/-1	+0/0/-1	+0/0/-1	+0/0/-1		C	-4	4

ANNEX A – CONCLUSION OF THE RESULTS

Soiling behaviour

Product E (“Topshield 2”) presents a statistically significant better soiling behaviour in comparison to products A, B, C and D.

Cleaning performance

Product E (“Topshield 2”) presents a statistically significant better cleaning performance in comparison to products A, B, C and D.

ANNEX B – PICTURES OF THE PRODUCTS IN THE STATE AS DELIVERED



**product A
Linoleum 1**



**product B
Linoleum 2**



**product C
Linoleum 3**



**product D
Linoleum 4**



**product E
Topshield 2**

ANNEX C – L-VALUES OF THE PRODUCTS AFTER DELIVERY (UNSOILED)

For determination of the soiling behaviour it is necessary to proof that the initial colour of the products is comparable. Therefor the L* values of the samples in the state as delivered was measured (5 samples x 4 tracks x 5 measurements per track = 100 measurements). The L*- values of the unsoiled surface are given in **Table 5**.

Table 5 L-values of the unsoiled floor coverings - arithmetical mean of 100 measurements with standard deviation and confidence interval

product	code	L* values unsoiled	standard deviation	confidence interval
A	Linoleum 1	75,21	0,58	0,12
B	Linoleum 2	76,55	0,81	0,16
C	Linoleum 3	76,07	0,78	0,16
D	Linoleum 4	74,87	0,58	0,11
E	Topshield 2	75,48	0,70	0,14