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Final results of the weathering fastness test (colour fastness) according to RAL-GZ 716, technical appendix, section II, part II-a-3 on window profiles made of PVC-U laminated with foil

Test order no. 124153/17 (Continuation of order no. 114536/15)

Dear Mr. Lee,

Please find below the following results of the final assessment of the weathering fastness after the artificial weathering of approx. **15,278** hours:

Irradiation energy: approx. **30 GJ/m²**

Artificial weathering according to (DIN) EN 513: 1999-10, procedure **1** (simulation of a **moderate** climate zone **M**) up to an irradiation dose of **30 GJ/m²** in the wave length range between 300 nm and 800 nm.

1. Colourimetric assessment:

The sample colour was measured by means of a spectrophotometer of a wave length area of 360 - 750 nm, standard light type D65, gloss inclusion, 10° normal inspection. The colour distance ΔE^*_{ab} was determined according to DIN EN ISO 11664-4: 2012-06. Prior to and after artificial weathering, colour was measured at the same position on the sample to obtain reproducible results despite the structured surface.

Please note that the colourimetric assessment of the structured foils can only be taken as a guide value.

Sample 1: "XE-HF2GOL"

Time of exposure	Dose of irradiation	Colour coordinates			Total colour distance ΔE^*
		ΔL^*	Δa^*	Δb^*	
1000 h	2 GJ/m ²	-0.1	0.3	1.1	1.1
2000 h	4 GJ/m ²	-0.2	0.2	1.1	1.1
3000 h	6 GJ/m ²	-0.2	0.2	1.2	1.2
4130 h	8 GJ/m ²	-0.1	0.3	1.3	1.3
5000 h	10 GJ/m ²	0.0	0.3	1.3	1.3
6111 h	12 GJ/m ²	0.2	0.5	1.7	1.8
7000 h	14 GJ/m ²	0.3	0.6	1.9	2.0
8000 h	16 GJ/m ²	0.5	0.8	2.1	2.3
9000 h	18 GJ/m ²	0.6	1.0	2.4	2.7
10185 h	20 GJ/m ²	0.8	1.1	2.7	3.0
11000 h	22 GJ/m ²	1.2	1.0	2.3	2.8
12000 h	24 GJ/m ²	1.0	1.3	3.1	3.5
13000 h	26 GJ/m ²	1.2	1.5	3.3	3.8
14000 h	28 GJ/m ²	1.3	1.6	3.5	4.1
15278 h	30 GJ/m ²	1.5	1.7	3.8	4.4

Sample 2: "XE-HF2GOK"

Time of exposure	Dose of irradiation	Colour coordinates			Total colour distance ΔE^*
		ΔL^*	Δa^*	Δb^*	
1000 h	2 GJ/m ²	-0.2	0.1	0.7	0.7
2000 h	4 GJ/m ²	-0.2	0.1	0.8	0.8
3000 h	6 GJ/m ²	-0.1	0.2	0.8	0.8
4130 h	8 GJ/m ²	-0.1	0.3	1.2	1.2
5000 h	10 GJ/m ²	-0.2	0.4	1.3	1.4
6111 h	12 GJ/m ²	1.5	1.7	3.8	4.4
7000 h	14 GJ/m ²	0.5	0.9	1.9	2.2
8000 h	16 GJ/m ²	0.8	1.1	2.3	2.7
9000 h	18 GJ/m ²	0.9	1.3	2.6	3.0
10185 h	20 GJ/m ²	1.1	1.5	2.8	3.4
11000 h	22 GJ/m ²	1.2	1.6	3.1	3.7
12000 h	24 GJ/m ²	1.3	1.6	3.1	3.7
13000 h	26 GJ/m ²	1.5	1.7	3.3	4.0
14000 h	28 GJ/m ²	1.7	1.7	3.4	4.2
15278 h	30 GJ/m ²	1.9	1.6	3.5	4.3

Sample 3: "XE-HF2MGK"

Time of exposure	Dose of irradiation	Colour coordinates			Total colour distance ΔE^*
		ΔL^*	Δa^*	Δb^*	
1000 h	2 GJ/m ²	-0.5	0.2	0.5	0.7
2000 h	4 GJ/m ²	-0.4	0.2	0.7	0.8
3000 h	6 GJ/m ²	-0.4	0.2	0.7	0.8
4130 h	8 GJ/m ²	-0.4	0.1	0.6	0.7
5000 h	10 GJ/m ²	-0.4	0.1	0.6	0.7
6111 h	12 GJ/m ²	-0.3	0.1	0.7	0.8
7000 h	14 GJ/m ²	-0.3	0.2	0.8	0.9
8000 h	16 GJ/m ²	-0.3	0.2	0.8	0.9
9000 h	18 GJ/m ²	-0.3	0.2	0.8	0.9
10185 h	20 GJ/m ²	-0.2	0.3	1.0	1.1
11000 h	22 GJ/m ²	-0.1	0.3	1.1	1.1
12000 h	24 GJ/m ²	-0.1	0.4	1.1	1.2
13000 h	26 GJ/m ²	-0.1	0.6	1.3	1.4
14000 h	28 GJ/m ²	-0.1	0.7	1.4	1.6
15278 h	30 GJ/m ²	0.0	0.9	1.6	1.8

Sample 4: "XE-HF2DWK"

Time of exposure	Dose of irradiation	Colour coordinates			Total colour distance ΔE^*
		ΔL^*	Δa^*	Δb^*	
1000 h	2 GJ/m ²	-0.8	0.1	0.7	1.1
2000 h	4 GJ/m ²	-0.6	0.2	0.9	1.1
3000 h	6 GJ/m ²	-0.5	0.2	1.0	1.1
4130 h	8 GJ/m ²	-0.5	0.2	1.0	1.1
5000 h	10 GJ/m ²	-0.3	0.2	0.9	1.0
6111 h	12 GJ/m ²	-0.6	0.1	0.9	1.1
7000 h	14 GJ/m ²	-0.5	0.2	1.1	1.2
8000 h	16 GJ/m ²	-0.3	0.2	1.2	1.3
9000 h	18 GJ/m ²	-0.3	0.3	1.3	1.4
10185 h	20 GJ/m ²	-0.2	0.3	1.5	1.5
11000 h	22 GJ/m ²	-0.2	0.4	1.5	1.6
12000 h	24 GJ/m ²	-0.2	0.5	1.6	1.7
13000 h	26 GJ/m ²	-0.1	0.6	1.8	1.9
14000 h	28 GJ/m ²	0.0	0.7	1.9	2.0
15278 h	30 GJ/m ²	0.2	1.0	2.0	2.2

Sample 7: "SE-HM2GOL"

Time of exposure	Dose of irradiation	Colour coordinates			Total colour distance ΔE^*
		ΔL^*	Δa^*	Δb^*	
1000 h	2 GJ/m ²	-1.1	0.8	2.9	3.2
2000 h	4 GJ/m ²	-1.4	0.9	3.3	3.7
3000 h	6 GJ/m ²	-0.9	0.6	2.5	2.7
4130 h	8 GJ/m ²	-0.4	0.3	1.4	1.5
5000 h	10 GJ/m ²	-0.3	0.2	1.3	1.4
6111 h	12 GJ/m ²	0.0	0.2	1.5	1.5
7000 h	14 GJ/m ²	0.2	0.2	1.4	1.4
8000 h	16 GJ/m ²	0.1	0.2	1.5	1.5
9000 h	18 GJ/m ²	0.4	0.1	1.5	1.6
10185 h	20 GJ/m ²	0.6	0.2	1.6	1.7
11000 h	22 GJ/m ²	0.8	0.3	1.8	2.0
12000 h	24 GJ/m ²	0.9	0.4	2.1	2.3
13000 h	26 GJ/m ²	1.0	0.6	2.3	2.6
14000 h	28 GJ/m ²	1.2	0.8	2.6	3.0
15278 h	30 GJ/m ²	1.4	1.1	3.1	3.6

Sample 16: "ME-HK2GOP"

Time of exposure	Dose of irradiation	Colour coordinates			Total colour distance ΔE^*
		ΔL^*	Δa^*	Δb^*	
1000 h	2 GJ/m ²	-0.2	0.1	1.0	1.0
2000 h	4 GJ/m ²	-0.8	0.5	2.6	2.8
3000 h	6 GJ/m ²	-0.5	0.3	1.7	1.8
4130 h	8 GJ/m ²	-0.3	0.1	1.1	1.1
5000 h	10 GJ/m ²	-0.1	0.0	0.9	0.9
6111 h	12 GJ/m ²	0.1	-0.1	1.0	1.0
7000 h	14 GJ/m ²	0.1	-0.1	1.2	1.2
8000 h	16 GJ/m ²	0.1	-0.1	1.3	1.3
9000 h	18 GJ/m ²	0.1	-0.2	1.4	1.4
10185 h	20 GJ/m ²	0.2	-0.2	1.5	1.5
11000 h	22 GJ/m ²	0.2	-0.3	1.5	1.5
12000 h	24 GJ/m ²	0.1	-0.3	1.4	1.4
13000 h	26 GJ/m ²	0.1	-0.3	1.6	1.6
14000 h	28 GJ/m ²	0.1	-0.2	1.7	1.7
15278 h	30 GJ/m ²	0.0	-0.2	1.8	1.8

Sample 19: "MP-HM2GOP"

Time of exposure	Dose of irradiation	Colour coordinates			Total colour distance ΔE^*
		ΔL^*	Δa^*	Δb^*	
1000 h	2 GJ/m ²	-0.9	0.5	2.3	2.5
2000 h	4 GJ/m ²	-1.2	0.7	3.4	3.7
3000 h	6 GJ/m ²	-0.8	0.5	2.4	2.6
4130 h	8 GJ/m ²	-0.4	0.2	1.2	1.3
5000 h	10 GJ/m ²	-0.4	0.1	1.3	1.4
6111 h	12 GJ/m ²	-0.3	0.0	1.2	1.2
7000 h	14 GJ/m ²	-0.2	-0.1	1.2	1.2
8000 h	16 GJ/m ²	-0.2	-0.2	1.1	1.1
9000 h	18 GJ/m ²	-0.1	-0.3	1.1	1.1
10185 h	20 GJ/m ²	0.0	-0.4	1.0	1.1
11000 h	22 GJ/m ²	0.1	-0.4	1.0	1.1
12000 h	24 GJ/m ²	0.0	-0.5	1.0	1.1
13000 h	26 GJ/m ²	0.0	-0.4	1.2	1.3
14000 h	28 GJ/m ²	0.1	-0.4	1.3	1.4
15278 h	30 GJ/m ²	0.0	-0.3	1.6	1.6

Sample 21: "MP-HM2DWP"

Time of exposure	Dose of irradiation	Colour coordinates			Total colour distance ΔE^*
		ΔL^*	Δa^*	Δb^*	
1000 h	2 GJ/m ²	-1.3	0.7	2.3	2.7
2000 h	4 GJ/m ²	-1.9	0.9	3.0	3.7
3000 h	6 GJ/m ²	-1.4	0.7	2.3	2.8
4130 h	8 GJ/m ²	-0.4	0.2	1.0	1.1
5000 h	10 GJ/m ²	-0.6	0.3	1.2	1.4
6111 h	12 GJ/m ²	-0.4	0.2	1.2	1.3
7000 h	14 GJ/m ²	-0.4	0.1	1.1	1.2
8000 h	16 GJ/m ²	-0.3	0.1	1.1	1.1
9000 h	18 GJ/m ²	-0.2	0.0	0.9	0.9
10185 h	20 GJ/m ²	-0.2	-0.1	0.7	0.7
11000 h	22 GJ/m ²	-0.1	-0.1	0.7	0.7
12000 h	24 GJ/m ²	-0.1	-0.2	0.7	0.7
13000 h	26 GJ/m ²	-0.3	-0.1	0.9	1.0
14000 h	28 GJ/m ²	-0.5	0.0	1.3	1.4
15278 h	30 GJ/m ²	-0.7	0.0	1.3	1.5

Visual assessment

Visual assessment was performed according to DIN EN 20105-A03 and DIN EN 20105-A02 with the grey scale.

Sample 1: "XE-HF2GOL"

Time of exposure	Dose of irradiation	Grey scale value		Remark
		A02	A03	
1000 h	2 GJ/m ²	4 - 5	4 - 5	more yellow
2000 h	4 GJ/m ²	4 - 5	4 - 5	more yellow
3000 h	6 GJ/m ²	4 - 5	4 - 5	more yellow
4130 h	8 GJ/m ²	4 - 5	4 - 5	more yellow
5000 h	10 GJ/m ²	4 - 5	4 - 5	more yellow
6111 h	12 GJ/m ²	4 - 5	4 - 5	more yellow
7000 h	14 GJ/m ²	4 - 5	4 - 5	more yellow
8000 h	16 GJ/m ²	4 - 5	4 - 5	more yellow
9000 h	18 GJ/m ²	4 - 5	4 - 5	more yellow
10185 h	20 GJ/m ²	4 - 5	4 - 5	more yellow
11000 h	22 GJ/m ²	4 - 5	4 - 5	more yellow
12000 h	24 GJ/m ²	4 - 5	4 - 5	more yellow
13000 h	26 GJ/m ²	4 - 5	4 - 5	more yellow
14000 h	28 GJ/m ²	4 - 5	4 - 5	more yellow
15278 h	30 GJ/m ²	4 - 5	4 - 5	more yellow, lighter

Sample 2: "XE-HF2GOK"

Time of exposure	Dose of irradiation	Grey scale value		Remark
		A02	A03	
1000 h	2 GJ/m ²	4 - 5	4 - 5	more yellow
2000 h	4 GJ/m ²	4 - 5	4 - 5	more yellow
3000 h	6 GJ/m ²	4 - 5	4 - 5	more yellow
4130 h	8 GJ/m ²	4 - 5	4 - 5	more yellow
5000 h	10 GJ/m ²	4 - 5	4 - 5	more yellow
6111 h	12 GJ/m ²	4 - 5	4 - 5	more yellow
7000 h	14 GJ/m ²	4 - 5	4 - 5	more yellow
8000 h	16 GJ/m ²	4 - 5	4 - 5	more yellow
9000 h	18 GJ/m ²	4 - 5	4 - 5	more yellow
10185 h	20 GJ/m ²	4 - 5	4 - 5	more yellow
11000 h	22 GJ/m ²	4 - 5	4 - 5	more yellow
12000 h	24 GJ/m ²	4 - 5	4 - 5	more yellow
13000 h	26 GJ/m ²	4 - 5	4 - 5	more yellow
14000 h	28 GJ/m ²	4 - 5	4 - 5	more yellow
15278 h	30 GJ/m ²	4 - 5	4 - 5	more yellow, lighter

Sample 3: "XE-HF2MGK"

Time of exposure	Dose of irradiation	Grey scale value		Remark
		A02	A03	
1000 h	2 GJ/m ²	4 - 5	4 - 5	more yellow
2000 h	4 GJ/m ²	4 - 5	4 - 5	more yellow
3000 h	6 GJ/m ²	4 - 5	4 - 5	more yellow
4130 h	8 GJ/m ²	4 - 5	4 - 5	more yellow
5000 h	10 GJ/m ²	4 - 5	4 - 5	more yellow
6111 h	12 GJ/m ²	4 - 5	4 - 5	more yellow
7000 h	14 GJ/m ²	4 - 5	4 - 5	more yellow
8000 h	16 GJ/m ²	4 - 5	4 - 5	more yellow
9000 h	18 GJ/m ²	4 - 5	4 - 5	more yellow
10185 h	20 GJ/m ²	4 - 5	4 - 5	more yellow
11000 h	22 GJ/m ²	4 - 5	4 - 5	more yellow
12000 h	24 GJ/m ²	4 - 5	4 - 5	more yellow
13000 h	26 GJ/m ²	4 - 5	4 - 5	more yellow
14000 h	28 GJ/m ²	4 - 5	4 - 5	more yellow
15278 h	30 GJ/m ²	4 - 5	4 - 5	more yellow

Sample 4: "XE-HF2DWK"

Time of exposure	Dose of irradiation	Grey scale value		Remark
		A02	A03	
1000 h	2 GJ/m ²	4 - 5	4 - 5	darker
2000 h	4 GJ/m ²	4 - 5	4 - 5	more yellow
3000 h	6 GJ/m ²	4 - 5	4 - 5	more yellow
4130 h	8 GJ/m ²	4 - 5	4 - 5	more yellow
5000 h	10 GJ/m ²	4 - 5	4 - 5	more yellow, darker
6111 h	12 GJ/m ²	4 - 5	4 - 5	more yellow
7000 h	14 GJ/m ²	4 - 5	4 - 5	more yellow
8000 h	16 GJ/m ²	4 - 5	4 - 5	more yellow
9000 h	18 GJ/m ²	4 - 5	4 - 5	more yellow
10185 h	20 GJ/m ²	4 - 5	4 - 5	more yellow
11000 h	22 GJ/m ²	4 - 5	4 - 5	more yellow
12000 h	24 GJ/m ²	4 - 5	4 - 5	more yellow
13000 h	26 GJ/m ²	4 - 5	4 - 5	more yellow
14000 h	28 GJ/m ²	4 - 5	4 - 5	more yellow
15278 h	30 GJ/m ²	4 - 5	4 - 5	more yellow

Sample 7: "SE-HM2GOL"

Time of exposure	Dose of irradiation	Grey scale value		Remark
		A02	A03	
1000 h	2 GJ/m ²	4 - 5	4 - 5	more yellow, plaque
2000 h	4 GJ/m ²	4 - 5	4 - 5	more yellow
3000 h	6 GJ/m ²	4 - 5	4 - 5	more yellow
4130 h	8 GJ/m ²	4 - 5	4 - 5	more yellow
5000 h	10 GJ/m ²	4 - 5	4 - 5	more yellow
6111 h	12 GJ/m ²	4 - 5	4 - 5	more yellow
7000 h	14 GJ/m ²	4 - 5	4 - 5	more yellow
8000 h	16 GJ/m ²	4 - 5	4 - 5	more yellow
9000 h	18 GJ/m ²	4 - 5	4 - 5	more yellow
10185 h	20 GJ/m ²	4 - 5	4 - 5	more yellow
11000 h	22 GJ/m ²	4 - 5	4 - 5	more yellow
12000 h	24 GJ/m ²	4 - 5	4 - 5	more yellow
13000 h	26 GJ/m ²	4 - 5	4 - 5	more yellow
14000 h	28 GJ/m ²	4 - 5	4 - 5	more yellow
15278 h	30 GJ/m ²	4 - 5	4 - 5	more yellow

Sample 16: "ME-HK2GOP"

Time of exposure	Dose of irradiation	Grey scale value		Remark
		A02	A03	
1000 h	2 GJ/m ²	4 - 5	4 - 5	more yellow
2000 h	4 GJ/m ²	4 - 5	4 - 5	more yellow
3000 h	6 GJ/m ²	4 - 5	4 - 5	more yellow
4130 h	8 GJ/m ²	4 - 5	4 - 5	more yellow
5000 h	10 GJ/m ²	4 - 5	4 - 5	more yellow
6111 h	12 GJ/m ²	4 - 5	4 - 5	more yellow
7000 h	14 GJ/m ²	4 - 5	4 - 5	more yellow, lighter
8000 h	16 GJ/m ²	4 - 5	4 - 5	more yellow, lighter
9000 h	18 GJ/m ²	4 - 5	4 - 5	more yellow, lighter
10185 h	20 GJ/m ²	4 - 5	4 - 5	more yellow, lighter
11000 h	22 GJ/m ²	4 - 5	4 - 5	more yellow
12000 h	24 GJ/m ²	4 - 5	4 - 5	more yellow
13000 h	26 GJ/m ²	4 - 5	4 - 5	more yellow
14000 h	28 GJ/m ²	4 - 5	4 - 5	more yellow
15278 h	30 GJ/m ²	4 - 5	4 - 5	more yellow

Sample 19: "MP-HM2GOP"

Time of exposure	Dose of irradiation	Grey scale value		Remark
		A02	A03	
1000 h	2 GJ/m ²	4 - 5	4 - 5	more yellow, plaque
2000 h	4 GJ/m ²	4 - 5	4 - 5	more yellow, plaque
3000 h	6 GJ/m ²	4 - 5	4 - 5	more yellow
4130 h	8 GJ/m ²	4 - 5	4 - 5	more yellow
5000 h	10 GJ/m ²	4 - 5	4 - 5	more yellow
6111 h	12 GJ/m ²	4 - 5	4 - 5	more yellow
7000 h	14 GJ/m ²	4 - 5	4 - 5	more yellow
8000 h	16 GJ/m ²	4 - 5	4 - 5	more yellow
9000 h	18 GJ/m ²	4 - 5	4 - 5	more yellow
10185 h	20 GJ/m ²	4 - 5	4 - 5	more yellow
11000 h	22 GJ/m ²	4 - 5	4 - 5	more yellow
12000 h	24 GJ/m ²	4 - 5	4 - 5	more yellow
13000 h	26 GJ/m ²	4 - 5	4 - 5	more yellow
14000 h	28 GJ/m ²	4 - 5	4 - 5	more yellow
15278 h	30 GJ/m ²	4 - 5	4 - 5	more yellow

Sample 21: "MP-HM2DWP"

Time of exposure	Dose of irradiation	Grey scale value		Remark
		A02	A03	
1000 h	2 GJ/m ²	4 - 5	4 - 5	more yellow, plaque
2000 h	4 GJ/m ²	4 - 5	4 - 5	more yellow, plaque
3000 h	6 GJ/m ²	4 - 5	4 - 5	more yellow
4130 h	8 GJ/m ²	4 - 5	4 - 5	more yellow
5000 h	10 GJ/m ²	4 - 5	4 - 5	more yellow
6111 h	12 GJ/m ²	4 - 5	4 - 5	more yellow
7000 h	14 GJ/m ²	4 - 5	4 - 5	more yellow
8000 h	16 GJ/m ²	4 - 5	4 - 5	more yellow
9000 h	18 GJ/m ²	4 - 5	4 - 5	more yellow
10185 h	20 GJ/m ²	4 - 5	4 - 5	more yellow
11000 h	22 GJ/m ²	4 - 5	4 - 5	more yellow
12000 h	24 GJ/m ²	4 - 5	4 - 5	more yellow
13000 h	26 GJ/m ²	4 - 5	4 - 5	more yellow
14000 h	28 GJ/m ²	4 - 5	4 - 5	more yellow
15278 h	30 GJ/m ²	4 - 5	4 - 5	more yellow

If you have any questions, don't hesitate to contact me.

Best regards

SKZ - Testing GmbH

i. A. 

M.Sc. Constantin Weck