Test report no.: 127028/17-III

Client:
RENOLIT Belgium NV
Industriepark DeBruwaan 43
9700 Oudenaarde
BELGIUM

Order: Determination of resistance to root damage to flexible sheets and coatings for roof planting according to FLL (2008) on the flexible sheet "Alkorplan L 35177" nominal thickness 2.0 mm

Letter of: 2017-09-05 **Ref.:** Van der Sype, Dirk

Sample received: 2017-12-20 **Sample taken:** -

Test period: 2017-12-20 till 2019-12-20

This test report comprises 30 pages including two annexes.

Würzburg, 2020-05-20
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1 Order

The company RENOLIT Belgium NV, Industriepark DeBruwaan 43, 9700 Oudenaarde, Belgium, ordered the SKZ – Testing GmbH with letter dated 05 September 2017 with the determination of resistance to root damage to flexible sheets and coatings for roof planting according to FLL (2008) on the flexible sheet "Alkorplan L 35177" nominal thickness 2.0 mm.

2 Test material

On 20 December 2017 SKZ – Testing GmbH received the following samples for testing:

- 8 testing containers equipped with a grey coloured membrane with a nominal thickness of 1.5 mm
- one section (1.0 m x 0.7 m) of the above mentioned sheet with T-joint in its middle with a nominal thickness of 2.0 mm

According to the client the membrane was made from plasticized polyvinylchloride (PVC-P) with a glass fleece reinforcement and is denominated "Alkorplan L 35177". The other dates given by the client are listed in annex 1.

3 Execution of test

Usually we carry out tests according to standards for which we have an accreditation. The list of all standards for which we are accredited is shown on the homepage at www.skz.de. All non-accredited procedures are marked with a *.

The 2 year-long test was carried out on the membrane in 1.5 mm thickness (see test report 127028/17) in accordance with the "Procedure for investigating resistance to root penetration at greenroof sites" (FLL, 2008)*. The complete description of the FLL test procedure can be found in annex 2 of this report. The test was carried out between December 2017 and December 2019 comprising 8 containers equipped with the membrane to be tested. Another 3 containers without membrane were serving as control that allows the comparison of the plant development in the different containers. The membrane was cut, jointed and installed into the containers at the test site of the SKZ-Testing GmbH by Renolit Belgium NV. A reference sample of the flexible sheet was taken

and stored at the test institute. The final inspection included the noting of any root and rhizome penetration into and through the tested membrane.

4 Test results

4.1 Plant development

The plants, Firethorn and Coach Grass, performed well during the whole test period. Growth of the test plants in the control containers (without membrane) was on average not significantly differing from plant growth in the test containers covered by the membrane "Alkorplan L 35177". The required minimum vigorousness of Firethorn in the test containers (80 % of the average vigorousness of growth in the control containers) was reached (86 - 101 %). Coach Grass performed during the whole test period a high density of stand. Detailed information concerning vigorousness of growth is given in Table 1 - 5.

Table 1: Height and trunk diameter of Firethorn in 8 test containers

	June 2018		December 2018		June 2019		December 2019	
	Ø	Height	Ø	Height	Ø	Height	Ø	Height
Cont. No.	mm[1) 2)]	cm[2)]	mm[1) 2)]	cm[2)]	mm[1) 2)]	cm[2)]	mm[1) 2)]	cm[2)]
P 1	9	120	8,4	180	11,4	180	13,2	178
P 2	6	105	7,9	180	13,0	213	13,4	208
P 3	7	110	9,7	200	14,3	235	15,0	203
P 4	7	105	9,7	190	12,8	213	11,3	208
P 5	7	110	9,5	180	11,5	208	13,6	208
P 6	5	85	11,4	200	14,6	210	13,1	195
P 7	7	115	10,1	195	12,0	183	12,1	203
P 8	7	115	11,2	220	13,1	205	14,5	190
P1 – P8	7	108	9,7	193	12,8	206	13,3	199

[1)] Trunk diameter measured at 20 cm above substrate surface

[2)] Results from test-report no. 127028/17 of the smallest "Alkorplan L 35177" (nominal thickness 1.5 mm)

Table 2: Height and trunk diameter of Firethorn in 3 control containers

	June 2018		December 2018		June 2019		December 2019	
	Ø	Height	Ø	Height	Ø	Height	Ø	Height
Cont. No.	mm[1)]	cm	mm[1)]	cm	mm[1)]	cm	mm[1)]	cm
K 1	8	120	10,8	190	14,9	200	13,4	203
K 2	5	95	10,0	190	11,8	213	13,6	200
K 3	8	110	10,0	200	17,7	228	16,1	188
K 1 – K 3	7	108	10,3	193	14,8	213	14,4	197

[1)] Trunk diameter measured at 20 cm above substrate surface

Table 3: Average values of height and trunk diameter of Firethorn in 8 test containers related to the values of the plants in 3 control containers (data in %, nominal value: ≥ 80 %)

	June 2018		December 2018		June 2019		December 2019	
	Ø	Height	Ø	Height	Ø	Height	Ø	Height
Cont. No.	%	%	%	%	%	%	%	%
P 1 – P 8	100	100	94	100	86	97	92	101

Table 4: Classification of the stand density of Coach Grass in 8 test containers

Cont. No.	June 2018	December 2018	June 2019	December 2019
	Classification[1)]	Classification[1)]	Classification[1)]	Classification[1)]
P 1	4	5	4	4
P 2	4	5	5	4
P 3	2	2	2	1
P 4	3	4	4	4
P 5	4	4	3	2
P 6	4	5	3	4
P 7	4	4	5	4
P 8	3	4	3	4
P 1 – P 8	4	4	4	3

[1)] Results from test-report no. 127028/17 of the smallest "Alkorplan L 35177" (nominal thickness 1.5 mm)

Table 5: Classification of the stand density of Coach Grass in 3 control containers

Cont. No.	June 2018	December 2018	June 2019	December 2019
	Classification	Classification	Classification	Classification
K 1	5	4	4	4
K 2	3	4	4	4
K 3	3	5	3	4
K 1 – K 3	4	4	4	4

4.2 Penetration and perforation of roots and rhizomes at the end of test period

At the end of the test period (December 2019) the containers were emptied for a detailed check of the membrane "Alkorplan L 35177" for root or rhizome penetration and perforation. The surface and the joints of the tested membrane did not show any perforations or penetrations caused by roots and rhizomes, see figure 1 – 3.

Figure 1: Membrane surface

Figure 2: Membrane surface with T-joint

Figure 3: Membrane surface with wall corner made by an internal corner.

5 Summary

In accordance with the "Method of testing resistance to root damage to flexible sheets and coatings for roof planting" (FLL, 2008) a two year-long test was carried out with the membrane "Alkorplan L 35177" manufactured by RENOLIT Belgium NV, Industriepark DeBruwaan 43, 9700 Oudenaarde, Belgium.

The surface and the joints of the tested membrane did not show any perforations or penetrations caused by roots and rhizomes. The membrane "Alkorplan L 35177" is therefore considered to be resistant to roots and rhizomes according to FLL standard. The test on root resistance relates to the data and material characteristics as well as the applied jointing technique and manufacturing technique described in Annex 1 of this report.

Reference samples of the tested membranes were taken and are stored at SKZ - Testing GmbH. This test report was compiled in December 2019 and has a 10 years period of validity. This report comprises 30 pages and is only allowed to be used unabridged.