Corrosion Resistance Analysis

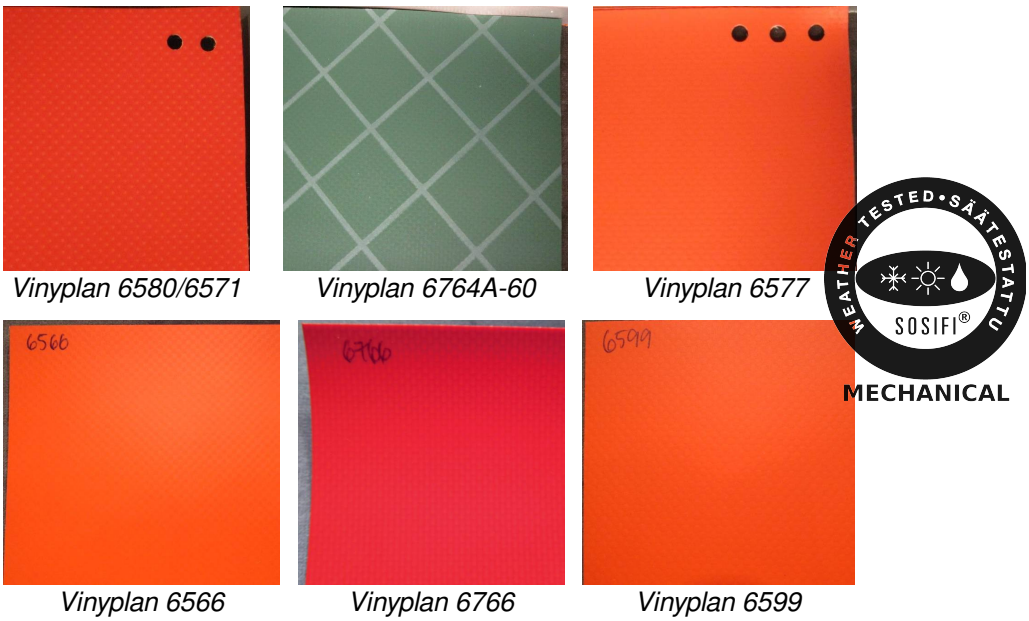
Customer:

SCANTARP

Oy Scantarp Ab
Kirsi Grahn
Lukkosalmentie 4
Kuopio

Target:

Six different coated fabrics shown in Fig. 1.



Vinyplan 6580/6571 *Vinyplan 6764A-60* *Vinyplan 6577*

Vinyplan 6566 *Vinyplan 6766* *Vinyplan 6599*

Fig. 1. *Material samples under test.*

Purpose of the Test:

To expose the materials to contaminating fluids. The selected fluids are those for which the material is likely to be exposed to during its life cycle, either occassionally or over extended periods.
The customer will perform mechanical tests, i.e. tear and tensile strength tests, on the exposed samples.

Test Method:

Exposure

Test method based on MIL810G 504.1 “Contamination by fluids”
Selected fluids: Diesel (commercial), kerosene (JET-A1), crude oil (Sour, min 0,5% of Sulphur)
Test cycle: 8h immersing (soaking), 16h drying in air for kerosene and diesel
Continuous immersion for crude oil, applied by brushing
Ambient temperature: +23°C (room temperature)
Fluid temperature: +23°C (room temperature)
Duration: 8 weeks

Mechanical tests

DIN 53363 tear strength test
EN ISO 1421 / DIN 53354 tensile strength test

Validation of the Test Method:

During its life cycle, material may be accidentally or intentionally exposed to one or more fluids that could have an adverse effect on the material. As a result, exposure of material to contaminating fluids may either temporarily or permanently impair the operation of the material by changing the physical and mechanical properties of the material.

Performed Actions:

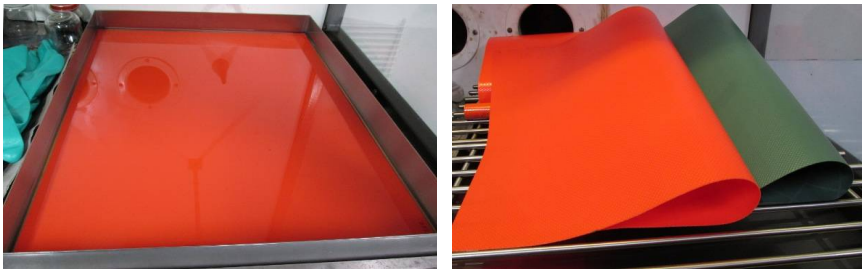
The exposure was performed with both the fluids and the test specimens at standard ambient conditions. The ambient temperature was either +(23 ± 2)°C (Vinyplan 6571/6580, Vinyplan 6764A-60 and Vinyplan 6577) or +(25 ± 3)°C (Vinyplan 6566, Vinyplan 6766 and Vinyplan 6599).

The test specimens were immersed in diesel and kerosene and let soak in containers for ~ eight hours. After an exposure of ~ eight hours, the test specimens were removed from the fluids. Excess fluid was drained off and the items were allowed to dry in air for ~ 16 hours.
The exact duration of immersion and drying periods varied occasionally from 8 and 16 hours, respectively, but in total 1/3 of the time was immersing and 2/3 of the time was drying.

Photographs of the immersion-drying process are shown in Fig. 2. Exposure to diesel was performed in an open container, whereas the exposure to kerosene was carried out under a lid.

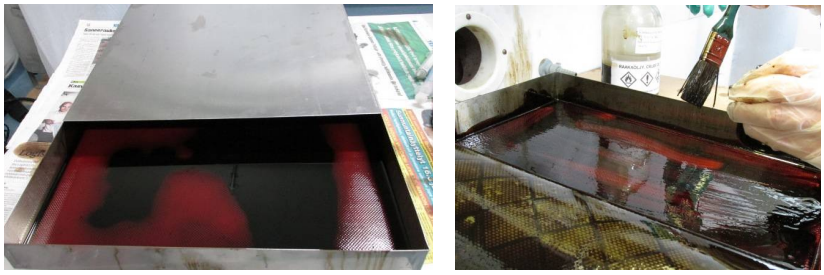
A continuous exposure to crude oil was carried out by immersion in a container closed with a lid as shown in Fig. 3(a). Fresh crude oil was added by brushing a few times during the exposure [Fig. 3(b)].

All containers were made of stainless steel.



(a) (b)

Fig. 2. *Exposure to diesel by immersion (a). Samples drying in air (b).*



(a) (b)

Fig. 3. *Continuous exposure to crude oil in a container closed with a lid (a). Crude oil was applied by brushing onto each sample (b).*

After each immersing and drying cycle, the samples were examined visually and possible changes in elasticity and stiffness of the materials were assessed by hand feel. Observations made during and after the exposure are given in Table 1.

Table 1. Observations on stiffness of the samples exposed to contaminating fluids.

	Vinyplan 6571/6580	**Vinyplan 6764A-60**	**Vinyplan 6577**
Diesel	Stiff	Stiff	No effect
Kerosene	Stiff	Stiff	No effect
Crude oil	No effect	No effect	No effect
	Vinyplan 6566	**Vinyplan 6766**	**Vinyplan 6599**
Diesel	No effect	Some stiffness	Stiff
Kerosene	No effect	Stiff	Clearly stiff
Crude oil	No effect	No effect	No effect

After a total exposure of eight weeks, the samples were removed from the contaminating fluids. An excess fluid was wiped with an oil absorbent cloth. The samples were gently washed with a mild dish-washing detergent followed by rinsing with running water and then wiped dry with a soft cloth.

Crude oil could not be properly removed with this procedure. The remains of crude oil can be seen as a darker colour of the samples in Figs. 4 and 5. The exposure to diesel or kerosene did not affect the colour of the samples. Figure 4 shows samples Vinyplan 6571/6580, Vinyplan 6764A-60 and Vinyplan 6577 and Fig. 5 shows samples Vinyplan 6566, Vinyplan 6766 and Vinyplan 6599 photographed after the washing.

A fracture was observed on Vinyplan 6766 after the exposure to kerosene, as shown in Fig. 6. Otherwise, the surface structure of the samples was not altered due to exposure, i.e., no cracking, blistering or other damages could be observed.

It should be noted that there were no reference samples, therefore, all the assessments during and after the exposure are made without a non-exposed reference.

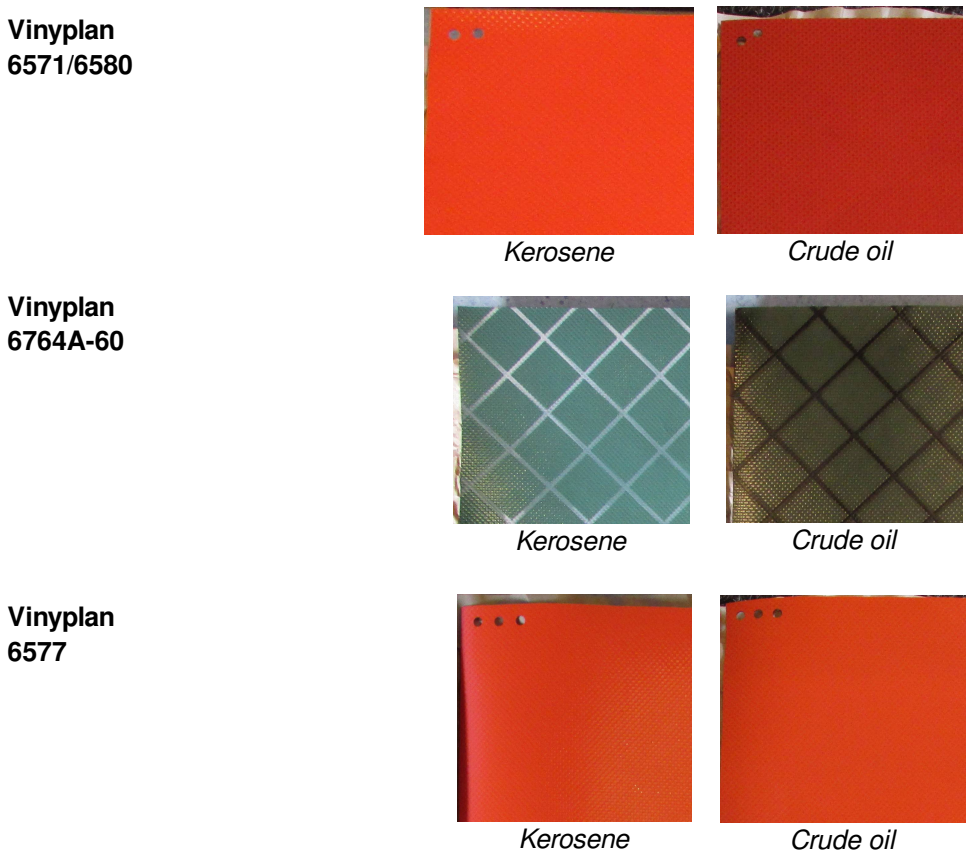


Fig. 4. *Samples Vinyplan 6571/6580, Vinyplan 6764A-60 and Vinyplan 6577 after the exposure and washing with a mild dish-washing detergent. Photographs after the exposure to diesel are missing. It can be noted that the the effect of diesel was similar to that of kerosene on those samples.*

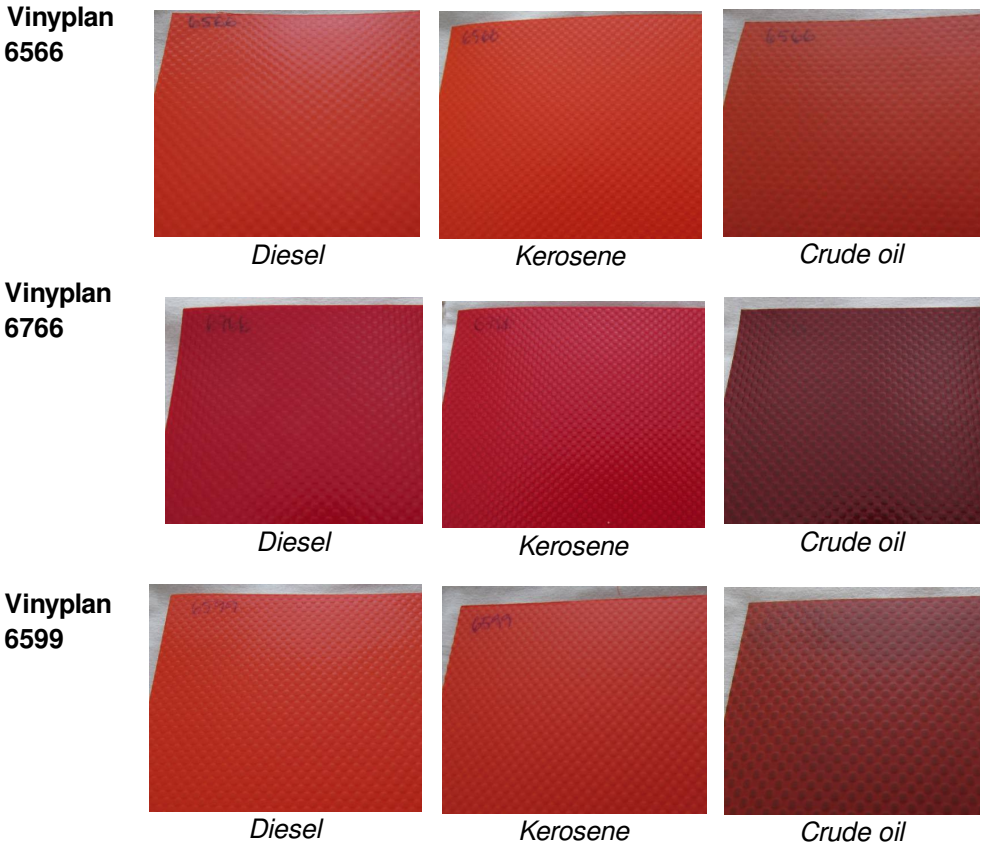


Fig. 5. *Samples Vinyplan 6566, Vinyplan 6766 and Vinyplan 6599 after the exposure and washing with a mild dish-washing detergent.*

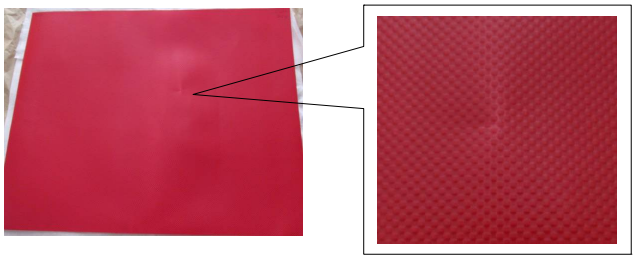


Fig. 6. *Fracture on sample Vinyplan 6766 that has been exposed to kerosene.*

Mechanical Analysis

Mechanical testing and analysis of the tensile and tear properties of the materials under test was performed by Oy Scantarp Ab. The tensile strength has been tested according EN ISO 1421 / DIN 53354 test method and the tear strength according DIN 53363 test method.

Oy Scantarp Ab is using a quality management system ISO 9001:2008 and, in addition, they operate in accordance with AQAP 2110 system.

Results of the tensile and tear strength tests are shown in Tables 2 – 4. Each measurement was performed in warp and weft direction.

The tensile and tear properties of products containing only PVC, i.e., the products for which the amount of PU in top coat was 0 %, weakened more than the properties of products containing PU. The best results were obtained for the product with the highest amount of PU in the top coat. For other products, the difference is not so clear, since the various plasticisers used in the products also affect to the results.

Table 2. Results of the tensile (DIN 53354) and tear (DIN 53363) strength tests after an exposure to diesel.

Product information			**Specification**				**Diesel**			
			DIN 53354 N/5 cm		DIN 53363 N		DIN 53354 %		DIN 53363 %	
Product number	Production number	Amount of PU in top coat %	Warp direction	Weft direction	Warp direction	Weft direction	Warp direction	Weft direction	Warp direction	Weft direction
6571/6580	20133508	35	8000	7500	1300	1200	-10.6	-15.4	according to spec	according to spec
6764A-60	20123418	10	4000	4000	550	550	according to spec	-8.8	according to spec	-16.4
6577	20103421	48	4000	4000	550	550	-7.3	according to spec	according to spec	according to spec
6566	20141913	33	4000	4000	550	550	according to spec	-23.1	according to spec	-18.0
6766	2010	0	4000	4000	550	550	-6.7	-9.9	-35.5	-30.4
6599	20142007	0	8000	7500	1300	1200	according to spec	-15.9	-20.2	-26.3

Table 3. Results of the tensile (DIN 53354) and tear (DIN 53363) strength tests after an exposure to kerosene.

Product information			Specification				Kerosene			
			DIN 53354 N/5 cm		DIN 53363 N		DIN 53354 %		DIN 53363 %	
Product number	Production number	Amount of PU in top coat %	Warp direction	Weft direction	Warp direction	Weft direction	Warp direction	Weft direction	Warp direction	Weft direction
6571/6580	20133508	35	8000	7500	1300	1200	according to spec	-9	according to spec	according to spec
6764A-60	20123418	10	4000	4000	550	550	according to spec	according to spec	according to spec	according to spec
6577	20103421	48	4000	4000	550	550	according to spec	according to spec	according to spec	according to spec
6566	20141913	33	4000	4000	550	550	according to spec	-14.3	according to spec	-21.1
6766	2010	0	4000	4000	550	550	-13.1	-20.4	-44.7	-43.1
6599	20142007	0	8000	7500	1300	1200	according to spec	-27.9	-19.9	-27.0

Table 4. Results of the tensile (DIN 53354) and tear (DIN 53363) strength tests after an exposure to crude oil.

Product information			Specification				Crude oil			
			DIN 53354 N/5 cm		DIN 53363 N		DIN 53354 %		DIN 53363 %	
Product number	Production number	Amount of PU in top coat %	Warp direction	Weft direction	Warp direction	Weft direction	Warp direction	Weft direction	Warp direction	Weft direction
6571/6580	20133508	35	8000	7500	1300	1200	according to spec	-9.8	according to spec	according to spec
6764A-60	20123418	10	4000	4000	550	550	according to spec	according to spec	according to spec	-15.1
6577	20103421	48	4000	4000	550	550	-11.9	according to spec	according to spec	according to spec
6566	20141913	33	4000	4000	550	550	-7.4	-11.1	according to spec	-18.0
6766	2010	0	4000	4000	550	550	-6.0	-10.6	-36.7	-31.1
6599	20142007	0	8000	7500	1300	1200	-12.6	-14.1	-17.4	-17.1

Used Equipment:
Fume hood, Corrosion lab
Temperature: Corrosion lab / No. 42 / Temp, calibrated 13th January, 2014, calibration is valid
Mechanical tests: Zwick Z010 machine

Conclusions and Recommendations:

The materials under test, coated fabrics Vinyplan 6571/6580, Vinyplan 6764A-60, Vinyplan 6577, Vinyplan 6566, Vinyplan 6766 and Vinyplan 6599, were exposed to contaminating fluids. The applied fluids were diesel, kerosene and crude oil.

Visually, the surface structure of the samples was not altered due to exposure, i.e., no cracking, blistering or other damages could be observed, except for one sample, Vinyplan 6766, a fracture was observed after an exposure to kerosene.

The tensile and tear properties of the materials were tested according EN ISO 1421 / DIN 53354 and DIN 53363 test methods, respectively. The tensile and tear properties of products containing only PVC weakened more than the properties of products containing also PU. The best results were obtained for the product with the highest amount of PU in the top coat.

Remarks:

Contents of this report is derived from reports
ScantarpGrahn__tr250214HS.pdf
ScantarpGrahn__tr210514HS.pdf
Oy Scantarp Ab: ID 16876 and ID 17416.

Actions, operations and reporting are in accordance with IEC/ISO 17025 'General requirements for the competence of testing laboratories'.

Signatures:

Riitta Perälä
Littoinen, 22nd December, 2014
Solar Simulator Finland

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