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TNO report

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Resistance to artificial weathering according to EN 438-2 of various sheets of High Pressure Laminates (HPL)

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Contents

1 Introduction

At the request of Stylam Laminates Limited, TNO Quality Services B.V. investigated the resistance to artificial weathering of 18 different sheets of high pressure laminates. The weathering test and examination and expression of the results was carried out as mentioned in EN 438-2:2005 paragraph 29.

The investigations were carried out under the conditions listed in the TQS quotation with reference TQS-OFF-09-7160 dated July 30th, 2009.
The tests were carried out in the period November 2009 till May 2010.

2 Sample material

From the client 18 different coloured sheets of HPL material were received on November 9th, 2009 and registered at TNO Quality Services under sample number 09.0519.
The samples, of size 30x20 cm and 6 mm thick, were marked with the following numbers:
120 - 142 - 572 - 1020
1031 - 1033 - 1034 - 1037 - 1038 - 1039
1040 - 1044 - 1046 - 1047 - 1048 - 1049
1050 - 1906

An overview of the received samples/colours is given in pictures below.

120 *142* *572* *1020*

1031 *1033* *1034*

1037 *1038* *1039*

1040 *1044* *1046*

1047 *1048* *1049*

1050 *1906*

3 Investigation

The artificial weathering of the samples was carried out in an Atlas Weather-Ometer Ci 3000 apparatus in accordance with ISO 4892, parts 1 and 2. In table 3.1 the conditions used are listed which correspond with procedure of EN 438-2:2005 paragraph 29.4 Test pieces were exposed for 1500 and 3000 hours. After these exposure times the test pieces were examined for colour contrast and appearance.

From each sample three test pieces were sawn of size 2.5 x 15 cm to fit the specimen holder. Two test pieces were placed in the apparatus and one was kept in the dark as reference. The surface of the samples that was not marked was exposed to the light source.

Table 3.1 Conditions in the Weather-Ometer Ci 3000.

Apparatus	Weather-Ometer Ci 3000 (Atlas Electric Devices Company)
Light source	6500 Watt cooled Xenon Arc Lamp
Filter combinations	Inner and outer filter glass type "S" Borosilicate
Replacement schedule lamps and filters	As recommended by the manufacturer
Light intensity (controlled)	0.50 W/m² at 340 nm
Test chamber temperature (controlled)	40 °C
Black standard temperature (controlled)	65 °C
Relative air humidity (controlled)	65 %
Spray cycle	Duration of spraying 18 minutes, dry interval between spraying 102 minutes
Mounting of test specimens	Specimen holder type SL-3T, with metal backing
Carrier	Continuous exposure to light

The colour contrast of the specimens was determined in accordance with EN 438-2:2005 paragraph 29.5.1. The colour contrast between exposed and unexposed specimens was assessed in terms of a gray scale as defined in EN20105-A02. This scale is numbered in steps ranging from 5, 5/4, 4... to 1 where 5 means no contrast and 1 a very large contrast. An examples of a grey scale is given in figure 3.1

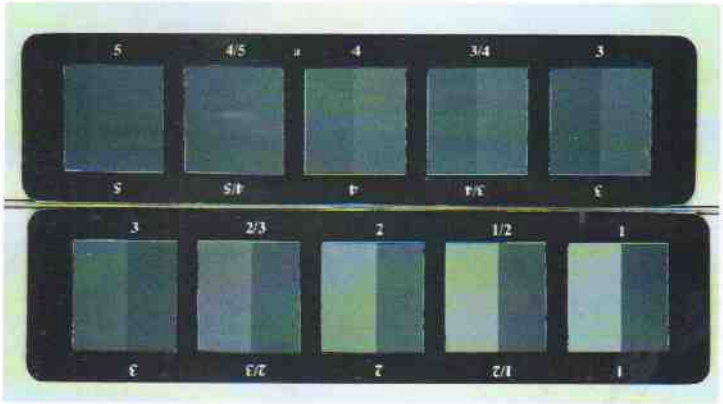


Figure 3-1 Example of grey scale according to EN 20105-A02

The appearance of the specimens was assessed as described in paragraph 29.5.2 of EN 438-2:2005.
The surface of the specimens was judged with the naked eye at a distance of 50 cm and rated according to the following scale:

Rating 5: No visible changes
(note from the author: this does not include the changes in contrast or colour)
Rating 4: Change of gloss only.
Rating 3: Hairline surface cracks and/or erosion of surface.
Rating 2: Surface cracks.
Rating 1: Blistering and/or delamination.

4 Results

The results of the contrast rating and appearance rating and summarized in table 4.1.

Table 4.1 Resistance to artificial weathering
Contrast and appearance after 1500 and 3000 hours of exposure

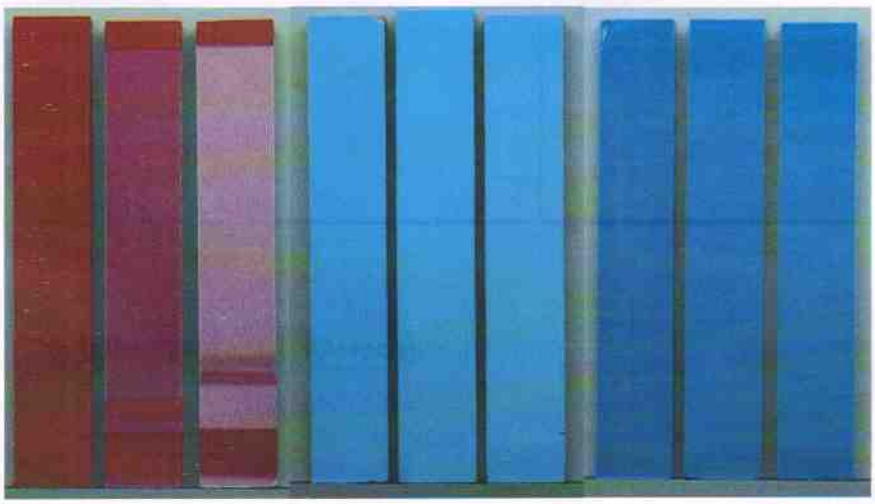
Sample	Contrast		Appearance	
	1500 h	3000 h	1500 h	3000 h
120	5	5	5	5
142	5	5	5	5
572	2	1	5	5
1020	5	5	5	5
1031	5	5	5	5
1033	5	5	5	5
1034	4/5	4/5	5	5
1037	5	5	5	5
1038	4/5	4	5	5
1039	4	4	5	5
1040	5	5	5	5
1044	4	3/4	5	5
1046	5	5	5	5
1047	4	4	5	5
1048	5	5	5	5
1049	5	5	5	5
1050	5	5	5	5
1906	4	4	5	5

5 Discussion

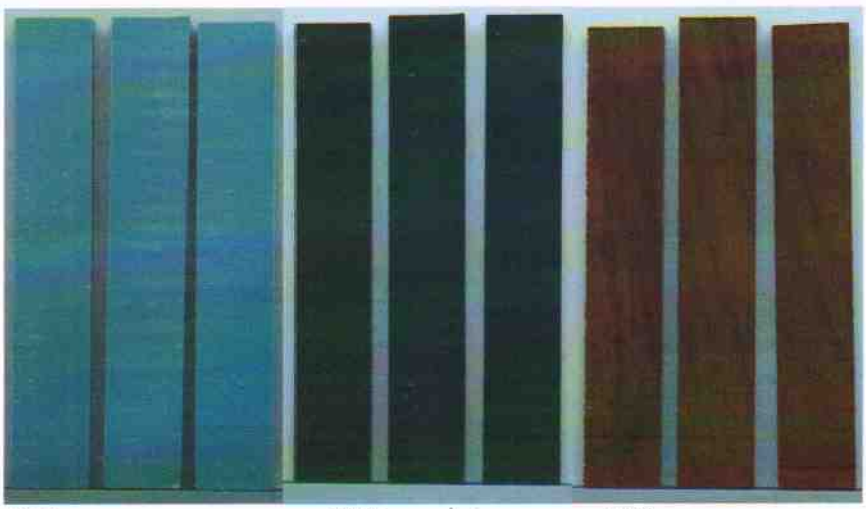
Only one sample (572) showed a major change in colour after exposure. Five samples showed a contrast of 4 or 3 / 4 after 3000 hours of exposure. In practice this means that a contrast in colour is visible but normally not considered as inconvenient.
All other samples showed hardly any colour change.

The appearance of all samples did not change (colour changes not included). No change of gloss or cracks in the polymer matrix of the surface were visible. Also no delamination or hairline cracks occurred in the cross-section.

In the pictures below the samples with a contrast 4 or lower are given.
Per sample form left to right, the reference specimen, the specimen after 1500 h exposure and after 3000 h exposure.



572 *1038* *1039*



1044 *1047* *1906*

6 Signature

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(This is the end of this TNO report).