

Materials Technology Ltd.

5 Rushington Court, Rushington Business Park,
Chapel Lane, Southampton SO40 9NA

Tel: +44 (0) 2380 580240

Fax: +44(0) 2380 661758

e-mail: info@mtechltd.co.uk

Web: www.mtechltd.co.uk

**1000 Hour Accelerated Weathering &
Tensile Testing on 2 Black Compounds**

Mr. Erik Schlytter-Henrichsen
Favuseal AS
PB 1213
N-3105 Tonsberg

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Introduction

This report details the accelerated weathering testing of 2 black compounds to ISO 4892 part 3 cycle 1 '*Plastics Methods of Exposure to Laboratory Light Sources*'.

The compounds were supplied as sheets and were designated 1 (New) and 2 (Old).

Standard tensile dumbbells were cut from part of the sheets for tensile testing. The materials were then exposed as both dumbbells, and as sheets to be returned to the customer on completion of the test.

Tensile testing and colour checks were performed as received (0 hrs exposure) and after 500 and 1000 hrs exposure.

Test Regime

The test was run for a period of 1000 hours, using UVA bulbs and the continuous cycling parameters detailed below:

Step	Function	Irradiance	Temperature	Duration
1	UV	0.76W/m ²	60°C	8:00 hrs
2	Condensation	-	50°C	4:00 hrs

Testing was performed using a QUV SE Accelerated Weathering Tester with 'Solar Eye' irradiance control.

Colour check measurements were performed at 0, 500 and 1000 hrs exposure using a Minolta Colourimeter, using the L*a*b colour space system (an explanation of this is attached). A visual check was also made on each sample. Tensile testing was also carried out at each stage to determine mechanical properties.

Results

Views of the samples after the test are shown in comparison with the unexposed samples in the images section of the report.

The colourimetry results are summarised in the table below. In addition a full table of colourimeter readings is shown in appendix 1.

Visual & Colour Checks			
Sample	* ΔE^*ab		Comments
	500 Hours	1000 Hours	
1. New	10.33	21.87	Some chalking visible at 500 hrs, significant chalking at 1000 hrs.
2. Old	2.26	6.29	Some water marking, no significant chalking.

*note an explanation of ΔE^*ab is given in the following section.

Tensile tests were performed at a strain rate of 200 mm/minute. The results are summarised below, these results are averages of five tests. A full table of results is shown in appendix 2.

Tensile Testing Results						
Sample		Strain (%)	Strain % Retention	UTS (MPa)	UTS % Retention	Comments
1 (New)	Virgin	89%	-	4.79	-	Significant scatter in results, no significant changes during exposure.
	500 hrs	64%	72%	5.16	108%	
	1000 hrs	77%	86.5%	5.14	107%	
2 (Old)	Virgin	56%	-	4.70	-	Significant scatter in results, increase in % strain during the test. No significant in UTS.
	500 hrs	63%	112.5%	4.95	105%	
	1000 hrs	82%	146%	5.10	109%	

As a general rule of thumb cable compounds should retain 70% of their elongation at break after 500 hrs, and 60% after 1000 hrs. As can be seen both compounds have exceeded this requirement, but it should be noted that there is significant scatter in all the tensile results.

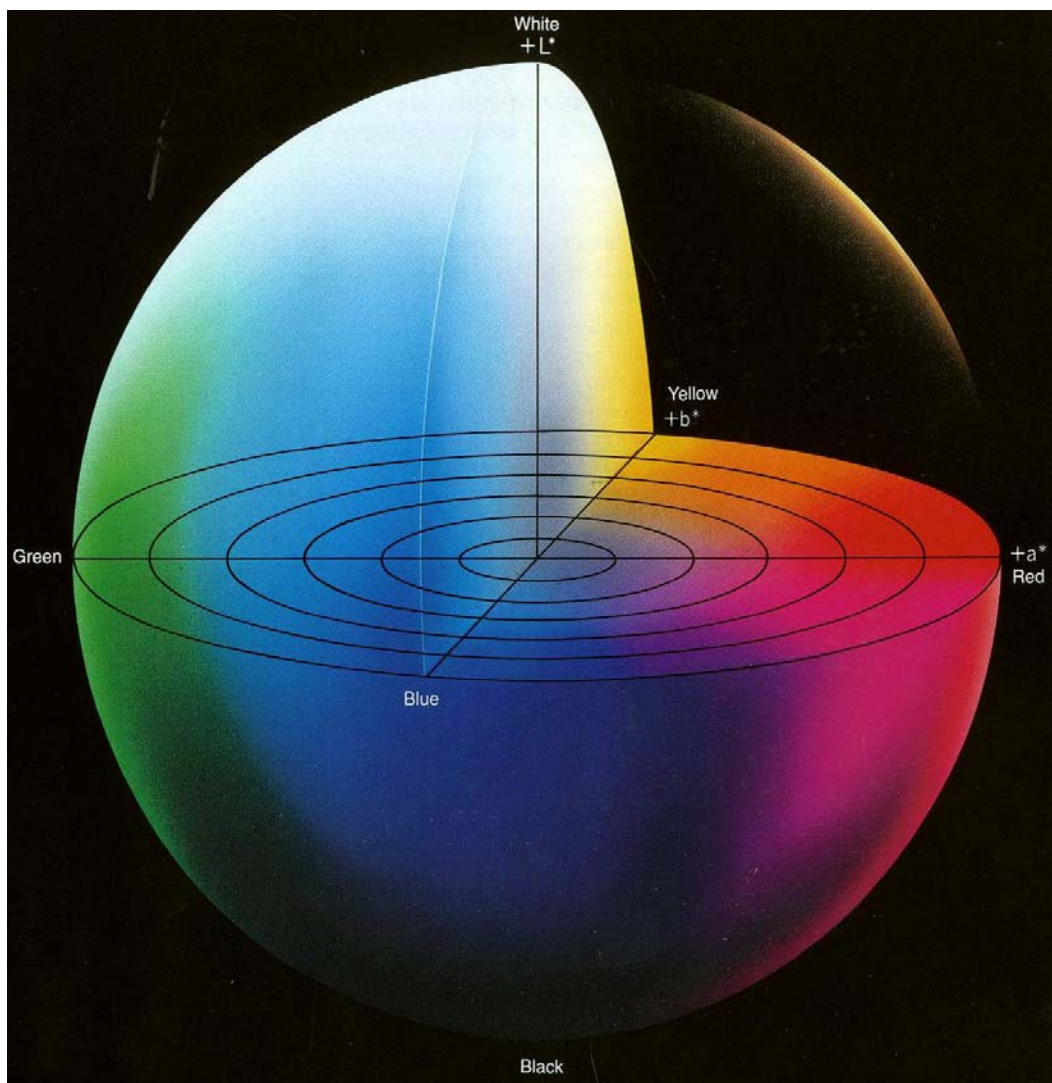
J. Bates
Director

Explanation of the L*A*B Colour space system

Colorimeter readings were taken using the Lab colour space system; this defines the colour of an object as 3 dimensional coordinate within a colour sphere. The L coordinate represents lightness and runs from 100 (complete lightness) to 0 (complete darkness), a is the red direction –a is the green direction, +b is the yellow direction and –b is the blue direction. A graphical representation of this is shown below. Lab readings taken are an average over a 2mm spot size in each case.

Three colour readings were taken on each sample in the tested and untested state, these were averaged to give a single L, a & b figure. The readings are appended to this report.

In quoting overall colour difference values it is common to produce a single value (ΔE^*ab), this is produced using Pythagoras theorem and gives an absolute value for the size of the colour difference, but not the direction of change.



Graphical representation of the L*a*b* colour space model.

Appendix 1. Full Colourimeter Results

	Pre Test			500 hours			1000 hours		
	L	A	B	L	A	B	L	A	B
Sample 1 (New)	24.33	-0.13	-0.62	35.53	-0.03	-0.35	48.60	-0.25	-0.32
	27.12	-0.03	-0.34	37.65	-0.38	-0.39	46.50	-0.23	-0.16
	25.02	-0.07	-0.57	34.27	-0.17	-0.34	46.99	-0.22	-0.03
Average	25.49	-0.08	-0.51	35.82	-0.19	-0.36	47.36	-0.23	-0.17
			ΔE^*	10.33	-0.11	0.15	21.87	-0.15	0.34
			ΔE^{*ab}	10.33			21.87		
Sample 2 (Old)	24.30	-0.06	-0.52	25.60	-0.01	-0.38	29.13	0.03	-0.54
	23.56	0.07	-0.40	25.08	0.01	-0.45	28.00	0.05	-0.44
	21.25	0.04	-0.41	25.22	-0.06	-0.41	30.86	0.05	-0.44
Average	23.04	0.02	-0.44	25.30	-0.02	-0.41	29.33	0.04	-0.47
			ΔE^*	2.26	-0.04	0.03	6.29	0.02	-0.03
			ΔE^{*ab}	2.26			6.29		

Appendix 2. Tensile Testing Results

	Sample 1 New		Sample 2 Old	
	% Elongation	UTS MPa	% Elongation	UTS MPa
Virgin	62	2.65	57.2	4.65
	119.2	5.22	51.2	4.96
	70	5.75	68.4	4.59
	74	5.31	55.6	4.63
	118.8	5.03	47.6	4.66
	89	4.79	56	4.7
500 hrs	65.6	5.22	97.6	5.62
	64.4	5.35	52.8	4.27
	33.6	4.87	45.6	5.78
	44.8	5.11	81.6	4.72
	110.4	5.26	35.6	4.35
	64	5.16	63	4.95
1000 hrs	40	5.36	110	5.71
	115.6	5.1	64.4	4.89
	94.8	5.14	64.8	4.86
	81.6	5.03	104.8	5.07
	51.6	5.08	68.4	4.96
	77	5.14	82	5.1



1. Sample 1 (New), showing pre-test, 500 hours & 1000 hours respectively.



2. Sample 2 (Old), showing pre-test, 500 hours & 1000 hours respectively.