BMP Europe Ltd

Treehugger™

Material Qualification & Performance Testing

TREE HUGGER™

SUSTAINABLE TREE PROTECTION

Revision List

Revision	Issue Date	Prepared		Checked		Approved	
		Name	Signed	Name	Signed	Name	Signed

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Introduction

It is worth noting that most of the test methods and ISO standards stated in various websites and literature around products of this type are based on plastic materials. BMP Europe Treehugger™ does not contain any plastics and as such, the test requirements and conditions have been specifically tailored to meet the real life requirements of the product once deployed and throughout its working life.

Raw Materials

All materials utilised within Treehuggers™ are sustainably sourced containing no plastics or derivatives.

- Pine Rosin - Manufactured from trees certified in accordance with the Swedish FSC® and PEFC standards
- Cotton Substrate – Manufactured, inspected and assessed in accordance with GOTS (Global Organic Textile Standards) 5.0

Going forward the cotton substrate will comply as a minimum to the GOTS (Global Organic Textile Standards) 5.0

Start of Life Assessment

X-Ray Fluorescence

Initial testing of coated material was carried out independently by an ISO/IEC 17025 certified laboratory to assess for the presence of harmful elements.

A sample of resin impregnated cotton weave was screened using a calibrated RoHS program using a wavelength dispersive X-Ray Fluorescence (XRF) spectrometer. The RoHS program measures levels of total chromium (Cr), total bromine (Br), mercury (Hg), cadmium (Cd) and lead (Pb). The pass/fail screening levels are 1000ppm (0.1wt %) for Cr, Br, Hg and Pb, and 100ppm (0.01wt %) for Cd.

The sheet was also analysed by semi-Quantified XRF, which measures all elements above carbon in the periodic table. This can give the composition in terms of elements or oxides and normalised to 100%.

The Lower Limits of Detection (LLD) for this XRF technique for the RoHS sample holder are better than 10ppm for chromium, cadmium, bromine, lead, and 20ppm for mercury. The quantified XRF results are shown in **Table 1** for each of the elements from RoHS. The values are shown in parts per million.

Sample	**Concentration in ppm**				
	Chromium	**Cadmium**	**Lead**	**Bromine**	**Mercury**
W81 – One Sheet	<LLD	<LLD	10	<LLD	<LLD
RoHS Screening	Pass	Pass	Pass	Pass	Pass

Table 1. Results of XRF Screening using RoHS calibrated program.

Compliance limits 1000ppm for Cr, Br, Pb, Hg and 100ppm for Cd.

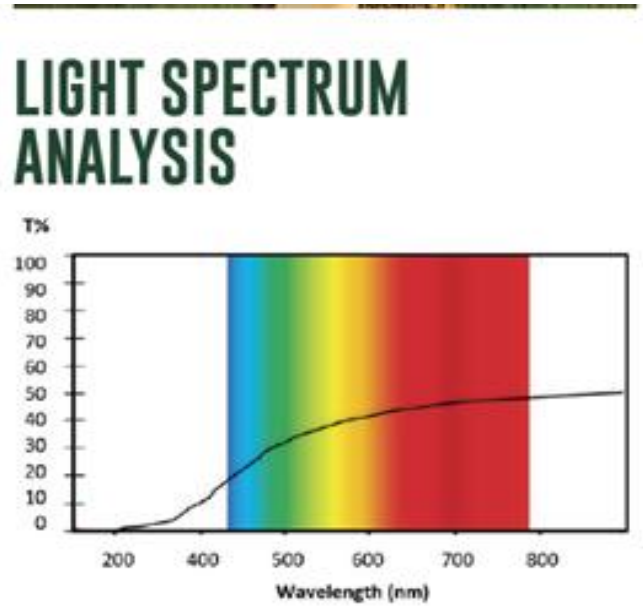
The sample of resin encapsulated cotton sheet passes the RoHS screening for chromium, cadmium, lead, bromine and mercury by total elemental presence.

The semi-quantified XRF analysis reveals no significant levels of any other hazardous elements either.

Light Spectrum Analysis

The whole visible spectrum is important but some wavelengths are more important to initiate photosynthesis and healthy growth.
As from below, we have the highest transmittance of red light (50%) which is the most important wavelength and lower transmittance of blue light (20%) which as described can be harmful to plant growth in excessive amounts.

Red
Red (630-720 nm) light is required for the development of the photosynthetic apparatus and photosynthesis. It is essential for the growth of stems, as well as the expansion of leaves. This wavelength also regulates flowering, dormancy periods, and seed germination.
Blue
Blue (400-520 nm) light is important for the synthesis of chlorophyll, chloroplast development, stomatal opening and photo morphogenesis. Blue light needs to be carefully mixed with light in other spectra since overexposure to light in this wavelength may stunt the growth of certain plant species.
Green
Green (500 – 600 nm) penetrates through thick top canopies to support the leaves in the lower canopy. Green light alone is not enough to support the growth of plants because it is least absorbed by the plant but when used in combination with red, blue, and far-red, green light will certainly show some important physiological effects.



Working Life Assessment.

Biodegradation Assessment. (BS EN ISO 20200: 2015)

Newly manufactured material is under testing in full compliance with BS EN ISO 20200: 2015.

This is to determine the degree of degradation throughout the Treehugger™ working life.

The initial 90-day test period will be completed on the 24th July 2022 and an assessment made. Once this is complete, the initial test samples will be tested again for a repeat 90-day assessment to determine the linearity of the degradation. This 90-day test period will be repeated on the original samples to establish the rate and nature of the degradation.

Test Period (Days)	Initial Dry Mass (gms)	Post Test Dry Mass (gms)	Mass Loss (%)
90	11.25	10.65	5.333
180	10.65	9.85	7.600

This initial, and ongoing, 90-day degradation tests results conforms fully to the projected product performance requirements.

Material Tensile/Tear Properties. (BS ISO 37: 2017 & 34-1: 2015)

BMP Europe has extensive experience of assessing materials using tensile and tear properties. Utilising the test methods detailed in BS ISO 37: 2017 & BS ISO 34-1: 2015 we can establish the properties of our Treehugger™ material at start of life and periodically throughout its working life. This assessment will establish the strength of the material and its suitability in protecting new growth trees.

Biodegraded Tensile Properties.

As the Treehuggers™ will be deployed outdoors, BMP has developed a hybrid test the incorporates the conditions detailed within BS EN ISO 20200: 2015 but utilising tensile and tear test pieces to determine the effects of biodegradation on these properties.

BMP also has Treehuggers™ deployed externally and test samples will be removed and tested to compare laboratory tests with real world material tests.

Test will be carried out, ongoing, on a monthly basis.

Material Tensile/Tear Properties. (BS ISO 37: 2017 & 34-1: 2015)

Tensile Properties (BS ISO 27: 2017)					
Sample	Stress @ 1.00% (MPa)	Stress @ 2.00% (MPa)	Stress @ 5.00% (MPa)	Stress @ Peak (MPa)	Strain @ Peak (%)
SOL	20.58	35.37	58.32	73.40	7.13
External 5 Month	14.00	22.90	39.05	65.30	10.00
Hybrid 1 Month	18.21	25.34	41.26	68.67	9.21
Hybrid 2 Months	18.11	23.25	40.29	66.34	9.05
Hybrid 3 Months	18.02	22.48	39.68	65.21	8.92
Hybrid 4 Months	17.86	21.25	37.26	64.44	8.40
Hybrid 5 Months	17.74	20.77	36.65	63.20	7.86
Hybrid 6 Months	17.11	20.54	36.07	62.74	7.69
Hybrid 7 Months	17.06	20.45	35.96	62.52	7.55

Material Tensile/Tear Properties. (BS ISO 37: 2017 & 34-1: 2015)

Tear Properties (BS ISO 34-1: 2015)		
Sample	Strength Method B (N/mm)	Force @ Peak (N)
SOL	159.54	99.36
External 5 Month	165.15	111.88
Hybrid 1 Month	164.21	100.22
Hybrid 2 Months	161.21	98.96
Hybrid 3 Months	160.58	98.22
Hybrid 4 Months	159.34	97.87
Hybrid 5 Months	159.00	97.14
Hybrid 6 Months	157.24	96.26
Hybrid 7 Months	156.88	96.08

Eco Toxicity (OECD 207 Acute Earthworm Study)

BMP has material on test to establish its performance and effect, if any, to the above standard. Testing completed November 2022.

The application of a biodegradable tree shelter material had no significant effect on the mortality or weight of earthworms *Eisenia fetida*. (Full report available on request)

Eco Toxicity (OECD 208OECD 208, Effect on Non-Target Plants: Seedling Emergence Test)

Once the OECD 207 testing is complete BMP will review and determine if further testing to the above standard is required.

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