BioFoam

Listing of properties version 9.0

Typical Properties:

PHYSICAL PROPERTIES	TEST METHOD	UNITS	SPECIFICATION
Colour and Form of feedstock			Off-White beads
Bulk Density (in octabin)	ISO 1183	g/cm³	0,66
VOC Content		%	0%
Moisture content		%	<2%
Flame retardant properties	EN 11925-2:2002		Meets Euroclass E for 30-40kg/m³ Test report R0529 Effectis (TNO) Dd 22-4-2010
Thermal insulation properties Comparison EPS and BioFoam	ISO 2796-1980	°C	Thermal Insulation W/mK* / Type 0,034 at 17 gr/l / BioFoam-HR 0,034 at 35 kg/m³ / BioFoam 0,033 at 30 kg/m³ / EPS
Flame retardant properties	BS-5852		Meets Class crib 5 suitable as filling in bags for public areas Crib 5, comparable to the energy of a compressed burning paper

Mechanical properties:

Property	**BioFoam moulded**		**BioFoam C-continuously formed drainage board**		**BioFoam HR Loose bead cavity wall with glue**	
	Kg/m³	**value**	**Kg/m³**	**value**	**Kg/m³**	**value**
white/green mW/mk	31	34	35	37,5	13	38
grey mW/mk		na		na	17	32
bending strength, kPa	35	300	35	170		na
tensile strength, kPa	40	200	40	160		na
compressive modulus MPa	40	4		na		na
shear strength kPa	35	140		na		na
shear modulus, Mpa	35	3,1		na		na
C-value for cusioning	35	2,6	35	2,6		na
halogens present		no		no		no
Fire: Euroclass E		pass		pass		pass

na = not applicable

HR means High R value and is common abbreviation for grey insulating foam with an improved low thermal conductivity.

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Granulometry control

Representative samples are taken from every octabin. One in five bins is controlled for conformity to the granulometry spec by sieving. If a deviation would be found the bin in question is disqualified and all sequential bins are and quarantined and measured.
Beads size of unexpanded raw material can be either 0,7-1,0 mm (BF710) and 1,0-1,6 mm (BF1016).

Bead Properties

BioFoam has been specially developed to serve as a feedstock for shape moulding. Minimal Achievable density 30 kg/m³, in one pass, typical range 25-50 kg/m³: loose beads are used in densities between 13-19 kg/m³.

Cradle to Cradle certification

BioFoam was recertified July 2015 by EPEA to meet the stringent C2C requirements


CRADLE TO CRADLE
PRODUCTS
INNOVATION
INSTITUTE

LICENSED MARKS:

CERTIFIED cradle to cradle SILVER

Cradle to Cradle Certified™ Silver

THE LICENSED MARKS IDENTIFIED ABOVE MAY BE LICENSED TO:

Synbra Technology B.V.

FOR THE BELOW LISTED CERTIFIED PRODUCTS ASSOCIATED WITH THE NAME:

BioFoam®

Only the following products are considered Certified Product(s) within the scope of this certification and the associated Trademark License Agreement:

BioFoam®

Cradle to Cradle Products Innovation Institute

ISSUE DATE
2 June 2015

CERTIFICATION #
2440

EXPIRATION DATE
1 June 2017

LEAD ASSESSMENT BODY:
EPEA GmbH

EPEA

Certified under version 3.1 of the Cradle to Cradle Certified™ Product Standard
Use of Licensed Marks is subject to terms and conditions of the C2CPI Trademark License Agreement and Trademark Use Guidelines.
Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute

In addition a material health certificate was given by EPEA and

100% carbon Neutral

As off July1st 2015 BioFoam was declared by EPEA to be 100% Carbon neutral.

Termite proof

Photo of termites.

Termite test All Termites died after a formal 6 weeks test, there are minor traces of attack but all termites died probably due to lack of nutrients. Conclusion was that BioFoam is not sensitive to attack by termites conform the standard EN 117/118.

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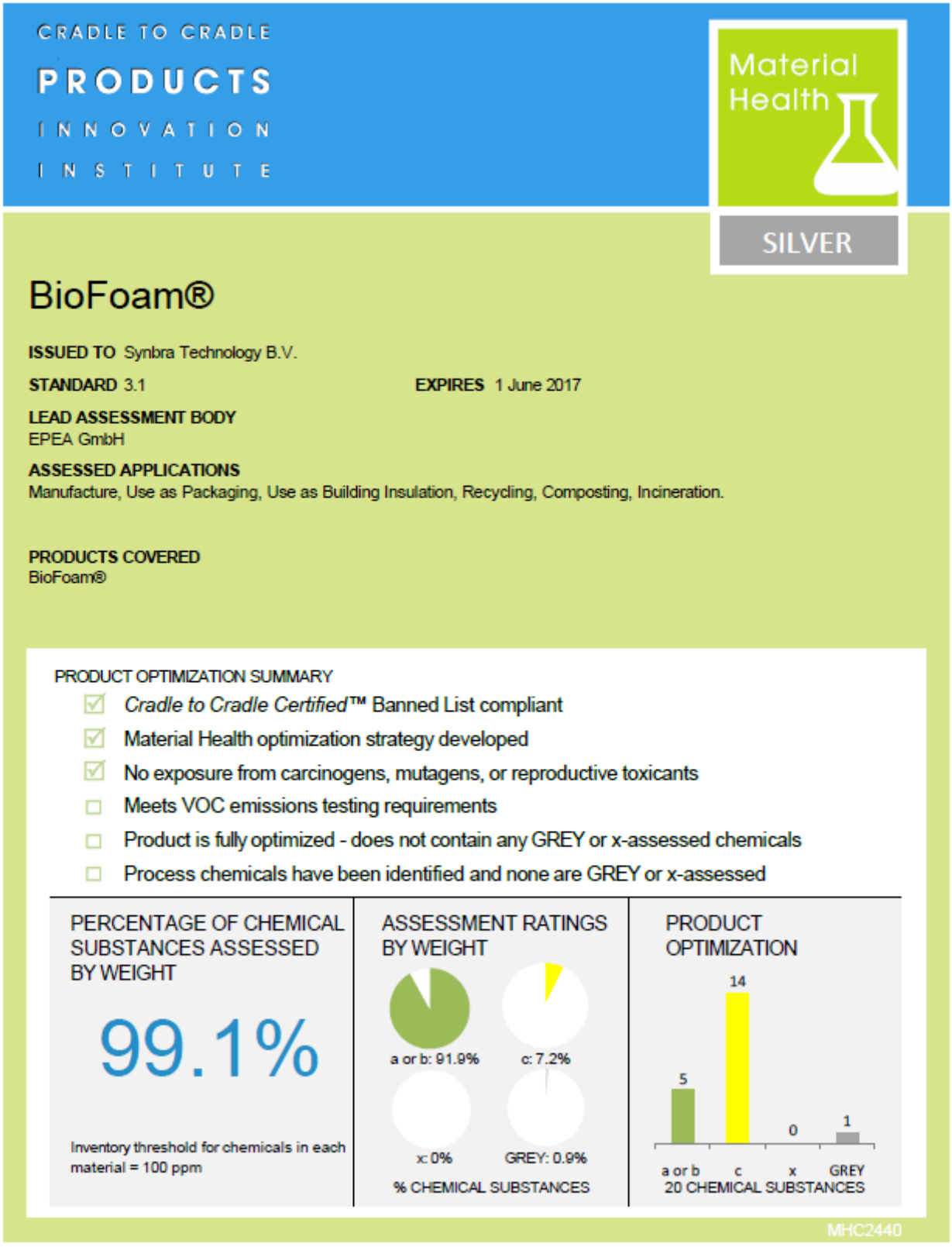
Material Health Certificate

In addition a Silver material health certificate was given by EPEA and the ticked boxes apply.



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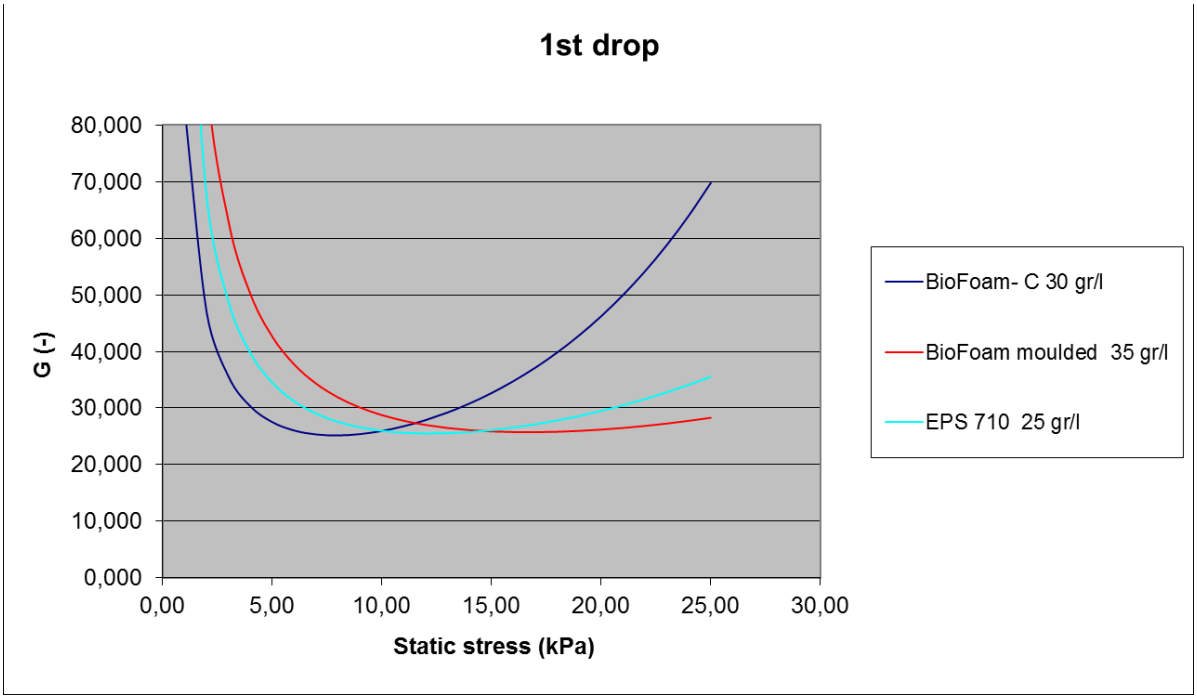
Cushioning

Dynamic Shock Cushioning Characteristics of Packaging Materials mentioned in ASTM norm 1596.
Sample 60x60x2,5 height 76 cm, 10 kg Drop, First drop 25G.
More drop testing graphs are available on request.

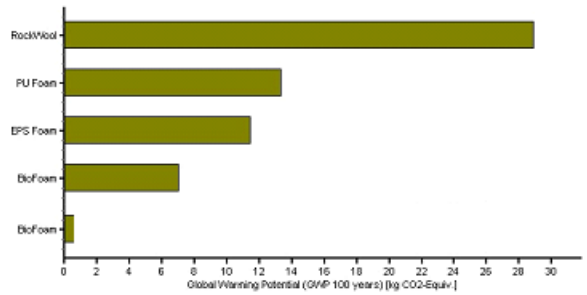


ROHS listing

All ingredients in BioFoam comply with European Directive EC1994/45/EC with regard to absence of heavy metals and mutagenic and carcinogenic substances, and therefore also complies with European Directives 2002/95/EC and 2000/53/EC.

CO2 footprint

BioFoam has a very low CO^2 footprint compared to other materials and is even better than the already very good insulant EPS. The emissions of CO^2 to produce a functional unit for a flat roof which is walkable and has an Rc of 3,5 are shown below. A formal LCA has been completed by Akzo Nobel sustainable systems and was peer reviewed. BioFoam moulded in 2015 is officially carbon neutral.



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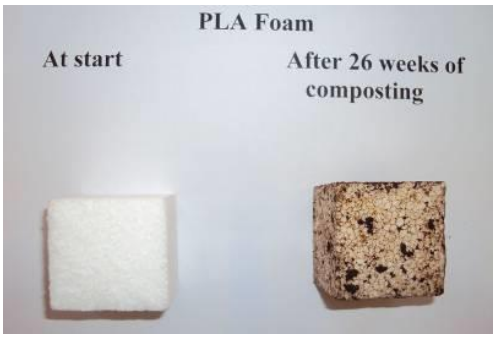
Chemical resistance against solvents

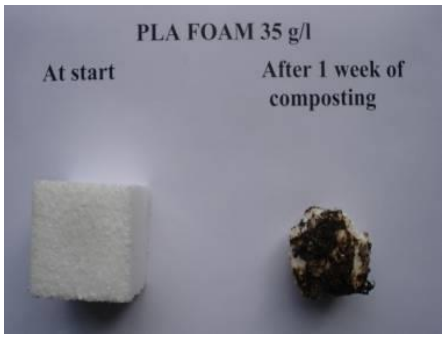
BioFoam is hardly attacked by styrene solvent present incuring formulations and has been used succesfully as a sustainable filler, saving weight during thermosetting polyster/styrene/glass- fibre systems. It thus enabled a contribution to a reduction of styrene emission during the subsequent curing process and assists in mitigating styrene emission accoring to the tightened Dutch Emission (NER) guidelines per 30 november 2010.

Composing

BioFoam at 35 g/l does **not** disintegrate after 26 weeks of composting at room temperature at 20°C. BioFoam is therefore not home compostable as proven by tests carried out by Organic waste Systems (OWS) Gent finished March 2010. Test was terminated according to the norm without visible alteration.



At room temperature (no degradation)



and at 70°C

BioFoam disintegrates **only** during **Industrial composting** at elevated temperature under the influence of moisture, bacteria and constand agitation. At room temperature it does not disintegrate.

An industrial composting trail with cucumber plantroots intergrown in BioFoam-C was carried out by Attero in Venlo, the Netherlands.

FBR Report 1561 -Final- April 2015 Composting trial.pdf

All tested BioFoam® materials were completely disintegrated after a second industrial composting cycle. As source separated municipal solid biowaste. ('GFT') generally takes several composting cycles to disintegrate sufficiently to pass the 15mm sieve, it is concluded that BioFoam® disintegrates at least as fast.

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Proven instability in construction

Naked foam displayed no degradation after 5 years in a Forest. (TNO surveyed) and as perimeter insulation it displays no degradation. (Photo of house below)

In all applications below the usage temperature of 55°C is never exceeded. It is experienced that BioFoam then does not shrink.

Perimeter insulation

Unprotected use in duration test in forest

Deco BioBio Sandwich renovation

In cavity fill green BioFoam is used and a Grey BioFoam has been developed to improve thermal conductivity in cavity fill applications. BioFoam grey and green is used by Termokomfort for cavity fill insulation.

Unlike with EPS there is no experience in excess of 5 years in a construction. So a 100 years guarantee is not possible as to not sufficient date have been generated to support that claim.

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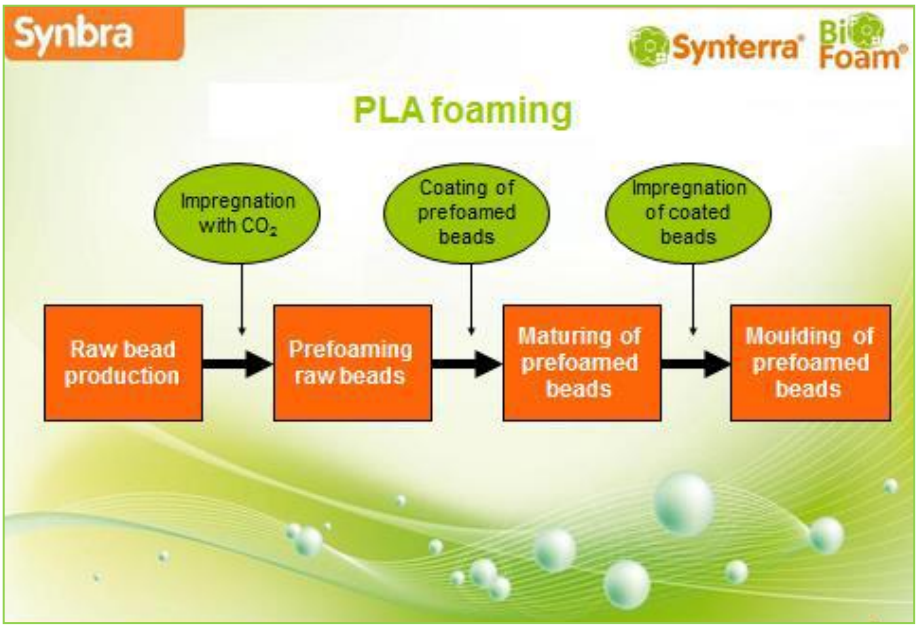
Awards

BioFoam was awarded the first position of the 2010 MKB Top 100 SME awards innovation on May 25th 2010

Processing steps of BioFoam



Processing Steps

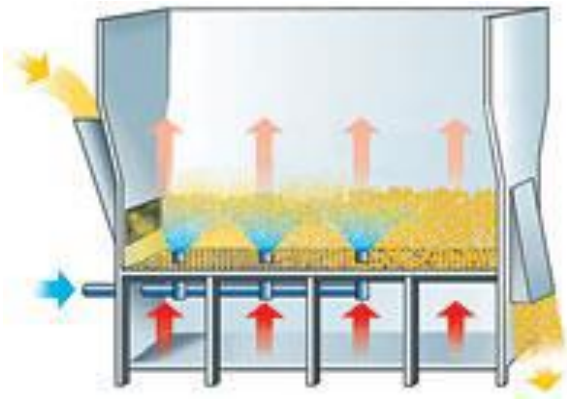
Raw material for prefoaming is E-PLA beads with a diameter range of about 0,7-1,5 mm. This is an (almost) ready to use raw material made by Synbra. It only lacks the blowing agent.

1. Impregnation with CO^2 is required in a **special pressure vessel.**

2. The impregnated beads are then released in a conventional EPS pre-expander which can process E-PLA **with a small technical modification**

3. The expanded beads are then coated with a propietary coating, in a **proprietary coating line.** Patented technology: WO 2008130226

4. After coating the material can be stored indefinitely (up to 2 years) and be reactivated by impregnation the blowing agent CO^2 **in a special pressure vessel**. This feeds the impregnated beads into a standard EPS moulding machine, which has **a small technical modification**.



In bold are the technical modifications needed to process E-PLA in conventional EPS equipment. This requires an investment in hardware.

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