



Cycle Assessment Procedure for Eco-impacts of Materials

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Environmental Product Declaration

In accordance with EN 15804

Product name:	MOSO Density®, caramel
Date of Issue:	5 April 2016
Validity:	5 years
Product unit:	Beams and Boards made of MOSO Density®, caramel, for various interior applications, per kg

Scope of the Declaration

Type of EPD is 'Cradle to gate with options' including transport to building site and End of Life. The LCA is performed by Stichting Agrodome, based on the process and production data of MOSO International BV.

Product Description

MOSO Density® products are made of rough bamboo fibres, which are put in resin after which, under high compression, they are pressed in moulds to form high density beams and panels. It is a semi-finished material which can be applied in several indoor applications such as flooring, panelling, window frames, stairs, etc.



Goal and scope

Goals of the research is to gather data regarding the environmental effects during the lifespan of the MOSO Density® products to get a better understanding of the environmental impact over the lifecycle.

The results can be used to improve the production process in terms of environmental impact. Furthermore, the results can be used to inform potential customers about the environmental impact of the MOSO Density® products compared to other materials.

Product

Application

MOSO Density® products are made of rough bamboo fibers, which are put in resin after which, under high compression, they are pressed in moulds to form high density beams and panels. The result is an extremely hard material with a look that is hardly distinguished from tropical hardwood.

It is a semi-finished material which can be used in several indoor applications. Because of the high hardness it is ideally used in applications where this hardness is utilized, such as (top layers of) flooring, stairs and panels for table tops.

MOSO Density® products consists for 95-96 % of rough strips made from the giant bamboo species “Phyllostachus Pubescens” from China (diameter up to 15 cm, length up to 15 meters) and is also available with FSC certificate.

Technical data

Name	Value
Density	1050 kg/m ³
Hardness (Brinell)	> 9,5kg/mm ² (EN 1534)
Fire resistance class	B, EN 13501-1
Heat transfer (λ)	0,26 W/mK

Bill of Materials

Material	Amount
Bamboo strips	95,5%
Other substances	4,5%

Temporary carbon storage

Bamboo is a fast growing crop that absorbs CO₂ during the growth of the material. As long as the product is in use this carbon is stored in the product. For MOSO Density® this amount is 1,58 kg CO₂ / kg MOSO Density® materials¹ and is not included in the overall LCA results.

¹ Calculation: 0,96 (bamboo content) x 0,9 (factor 10% > 0% moisture content) x 0,5 (carbon content) x 3,67 (mol ratio CO₂ - C) = 1,58 kg CO₂ / kg MOSO Density® materials

LCA calculation rules

Product Unit

1 kg MOSO Density® caramel beams or boards, suitable for various interior applications.

Name	Value	Unit
Declared unit	1,00	kg
Density	1080	Kg/m3

System boundary

This EPD is made for “Cradle to Gate with options” including transport to building site and End of Life according to EN 15804

Comparability

A comparison or evaluation of EPD data is only possible if all datasets are made following EN 15804 applying the same relevant product category rules and for the same modules.

LCA-modules

The following data refer to the declared modules and form the basis for further calculations. All provided values refer to the declared product unit.

The European norm EN 15804 is based on four main modules corresponding with the various phases in the lifecycle of a building material: Module A (production and construction stage), Module B (use stage), Module C (End of life stage) and Module D (Environmental effects outside of the system boundary). See figure 1.

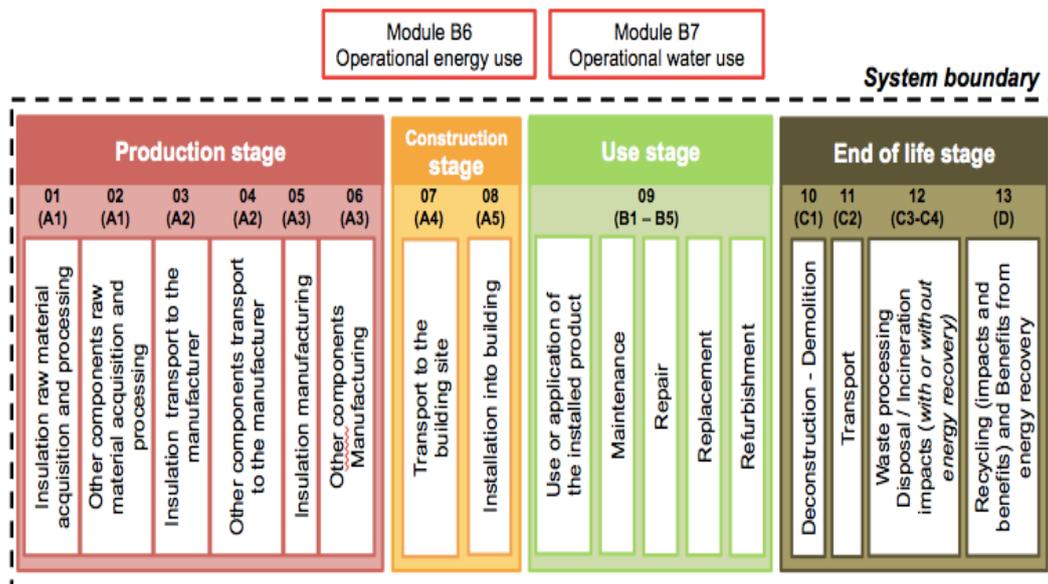


Figure 1: Division of the modules over the lifecycle of a building material as determined in EN 15804.

This EPD gives information about the stages A1-3, A4, C1-4 and D.

LCA results

In the table below the results for the various environmental categories are provided for 1 kg of MOSO Density® material.

Basic profiles		A1-3	A4	A5	B1	B2	C1	C2	C3 + C4	D
Stage(s) EN 15804	Unit									
Abiotic depletion, non fuel	kg antimony eq.	9,40E-07	5,82E-08	-	-	-	0	4,35E-08	-4,07E-09	0
Abiotic depletion, fuel	kg antimony eq.	5,96E-03	1,52E-04	-	-	-	0	1,06E-04	-5,28E-03	0
Global warming (GWP100)	kg CO2 eq.	8,08E-01	2,06E-02	-	-	-	0	1,47E-02	-5,82E-01	0
Ozone layer depletion (ODP)	kg CFK-11 eq.	4,69E-08	3,40E-09	-	-	-	0	2,36E-09	-4,63E-08	0
Photochemical oxidation	kg ethylene eq.	6,32E-04	1,76E-05	-	-	-	0	1,08E-05	-4,21E-05	0
Acidification	kg SO2 eq.	9,16E-03	1,08E-04	-	-	-	0	7,95E-05	-5,78E-04	0
Eutrophication	kg PO4- eq.	9,49E-04	2,99E-05	-	-	-	0	2,19E-05	6,84E-05	0
Human toxicity	kg 1,4- DB eq.	6,35E-01	7,20E-03	-	-	-	0	5,07E-03	-5,55E-02	0
Fresh water aquatic ecotox.	kg 1,4- DB eq.	5,14E-02	2,05E-03	-	-	-	0	1,45E-03	2,36E-03	0
Marine aquatic ecotoxicity	kg 1,4- DB eq.	9,47E+01	4,10E+00	-	-	-	0	2,94E+00	-3,25E+01	0
Terrestrial ecotoxicity	kg 1,4- DB eq.	4,59E-03	4,85E-05	-	-	-	0	3,37E-05	-3,31E-04	0
Total renewable energy	MJ	3,52E-01	4,14E-03	-	-	-	0	3,07E-03	-3,27E-01	0
Total non renewable energy	MJ	1,21E+01	3,52E-01	-	-	-	0	2,47E-01	-1,11E+01	0
Total Energy	MJ	1,25E+01	3,57E-01	-	-	-	0	2,50E-01	-1,15E+01	0
Water, fresh water use	m3	1,08E+00	2,41E-02	-	-	-	0	1,79E-02	-2,68E-01	0
Waste, non hazardous	kg	2,85E-02	5,16E-03	-	-	-	0	3,10E-03	1,13E+02	0
Waste, hazardous	kg	2,97E+01	8,14E-03	-	-	-	0	5,81E-03	-5,58E-01	0

Representativeness production process

This product is made following the production protocols of MOSO in the factories in China, which is representative for all MOSO Density® material sold worldwide.

Representativeness Geographically

MOSO Density® material as described in this EPD is made from giant bamboo sourced from sustainable managed production forests. Harvesting and first processing takes place in the region Anji in Zhejiang province, China. The final manufacturing processes are executed in Hangzhou and Jianyang, China after which the products are shipped via Shanghai and Rotterdam to the warehouse of MOSO International in Zwaag, the Netherlands.

For the transport to the building site an average distance was assumed in the LCA calculations of 150 kilometres which is representative for the Dutch situation.

Qualitative information

MOSO Density® material is produced in ISO 9001 and 14001 certified factories. Various MOSO products are available with CE mark and FSC certification. All indoor products meet the European E1 norm (EN 717) with respect to indoor emissions while several products even comply with E0, the strictest emission class available.

Sourcing raw materials

MOSO works with a limited amount of suppliers for the main input material, the giant bamboo. The various other ingredients are sourced from several suppliers which are therefore based on generic LCA data from the Dutch SBK- and the Ecoinvent database.

Data quality

The data about the process and products are mainly based upon the LCA study documented in the INBAR Technical-Report-No.35: The Environmental Impact of Industrial Bamboo Products: Life-cycle Assessment and Carbon Sequestration by: P. van der Lugt and J. Vogtländer of Delft University of Technology.

As some production data from this report might be slightly outdated there has been frequent contact with MOSO International to guarantee that this EPD is based on the most up-to-date production data. There were no adaptations on the data necessary. Missing data was collected from Eco-invent version 2.2.

For the production phase (A1-3) the information of the INBAR study from 2014 is used. For the other phases the fixed values have been assumed following the Dutch SBK-bepalingsmethode 2.0. This applies for transport distances to the building site and waste scenarios in the End-of-Life phase.

Life Cycle Stages (A1-3)

Flowchart for the production of MOSO Density®.

INPUT		PROCESS	OUTPUT	
MATERIAL	ENERGY		MATERIAL	EMISSIONS
	chainsaw gasoline →	Harvesting of bamboo on sustainably managed plantations		exhaustgases
culms →	truck, 5 tons diesel	Transport from plantation to strip manufacturing facility		exhaustgases
	electricity for equipment →	Strip making		Saw dust
	truck, 28 tons diesel	Transport from strip manufacturing facility to factory		exhaustgases
	electricity for equipment →	Rough planing		
	electricity for equipment →	Splitting strips in half		Saw dust
	electricity for equipment →	Preservation & coloring: carbonization		
	electricity for equipment →	Drying		heat
	electricity for equipment →	Crushing strips		Saw dust
Phenol formaldehyde (glue) (wet condition) →		Glue application		
	electricity for equipment →	Pressing strips to beam		
	electricity for equipment →	Activating glue in oven		heat
	electricity for equipment →	Sawing beams		Saw dust
	electricity for equipment →	Sanding beams		Saw dust
	truck, 28 tons diesel	Transport from factory to harbor		exhaustgases

Product stage (A1-3)

The cultivation and harvesting of the bamboo stems is included in the calculations. No fertilizers nor pesticides have been assumed. Harvesting of mature stems takes place with machetes and sometimes chainsaws. Bamboo is harvested like an agricultural crop and will grow back automatically after the annual harvest of 20-25% of the mature stems (ready for harvest after 4-5 years). As a result by default no deforestation occurs.

The bamboo stems are transported to strip making factories for first processing. Transport of the stems is done with trucks in various sizes. Distances for this EPD are based on projections by the producer.

After harvesting the mature bamboo stems are split in longitudinal direction and the inner and outer skin is removed. The strips naturally have a light yellow colour (natural), but can be steamed for a light brown colour (caramel) or thermally treated for a dark brown colour (chocolate). After drying the strips are compressed and glued under high pressure, creating a very dense (increasing from 700 kg/m³ to 1050 kg/m³) and therefore extremely hard material.

Construction stage (A4-5)

Transport to building site (A4)

Transport to the building site is assumed to be based on full load with empty return. The default value of 150 km has been applied.

Installation of the product in the building (A5)

This phase was excluded as it is dependent on the final application.

Use stage (B1-7)

This phase was excluded as it is dependent on the final application.

End of life stage (C1-4)

Demolition (C1)

Demounting and demolition assumed manually, no industrial process.

Transport (C2)

Assumptions transport phase: 50 km to sorting installation and 100 km from sorting location to final waste processing. Transport with a >16-ton lorry

Waste processing (C3-C4)

As waste scenario after the demolition stage, incineration for energy production was assumed as scenario following default values for division between incineration (95%) and dump (5%)

Benefits and loads beyond the system boundary (D)

The avoided energy use as a result from the incineration of the Moso Density[®] are not considered as benefits beyond the system boundary, but is calculated in the waste processing. (C3-C4).

Accountability

The LCA research for this EPD was executed by Agrodome in 2015, based on the following report:

- INBAR Technical Report No. 35
The Environmental Impact of Industrial Bamboo Products: Life-cycle Assessment and Carbon Sequestration (2014). Authors: J.G. Vogtländer and P. van der Lugt.

Furthermore, the following publications were used:

- Design Interventions for Stimulating Bamboo Commercialization (2008) PhD thesis. Author: Pablo van der Lugt (Delft University of Technology).
- Life Cycle Assessment and Carbon Sequestration, Bamboo products of MOSO International (2014). Author: J.G. Vogtländer (Delft University of Technology).

The LCA was executed following EN 15804 and was verified following the SBK-bepalingsmethode 2.0, versie november 2014.

When calculating the environmental impact categories Simapro version 8.0.4.30 was used as well as environmental data from de Dutch SBK-basisprocessendatabase, versie 1.7 juni 2015 and in some case, where no SBK data was available was made use of Ecoinvent-database, version 2.2. When making calculations in Simapro long term effects (emissions occurring after 100 years) were not included. Effects of capital goods and infrastructural processes have been included.

References

Agrodome

LCA-rapport Moso massieve plaat, Density®, Bamboo X-treme, February 2016, Agrodome, Wageningen, the Netherlands. Authors: S. Verspeek and F. van der Burgh.

CAPEM (www.capem.eu)

The CAP'EM method to Life Cycle Assessment of building materials, 2.0 July 2014

EN 15804:2012-04

Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction

Stichting Bouwkwaliiteit

Bepalingsmethode gebouwen en GWW-werken, versie 2.0 definitief 2014
Rijswijk, 2014

INBAR

The Environmental Impact of Industrial Bamboo Products: Life-cycle Assessment and Carbon Sequestration. INBAR Technical Report 35 (2014). Authors: J.G. Vogtländer and P. van der Lugt.

Delft University of Technology

Design Interventions for Stimulating Bamboo Commercialization - Dutch Design meets Bamboo as a Replicable Model (2008) PhD thesis. Author: Pablo van der Lugt.

Life Cycle Assessment and Carbon Sequestration -Bamboo products of MOSO International (2014). Author: J.G. Vogtländer.

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