ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	Sonae Arauco, S.A.
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-SON-20150247-IBA1-EN
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AGEPAN® Wood Fiberboards

Sonae Arauco, S.A.

Institut Bauen und Umwelt e.V.

www.bau-umwelt.com / https://epd-online.com

1. General Information

Sonae Arauco, S.A.	AGEPAN® Wood Fiberboards
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** Sonae Arauco, S.A. C/Ronda de Poniente, 6 - B Centro Empresarial Euronova 28760 Tres Cantos (Madrid) España
Declaration number EPD-SON-20150247-IBA1-EN	**Declared product / Declared unit** AGEPAN® Wood Fiberboards, uncoated, per m^3
This Declaration is based on the Product Category Rules: Wood based panels, 07.2014 (PCR tested and approved by the SVR)	**Scope:** This document refers to AGEPAN® Wood Fiberboards manufactured in the following plant of the Sonae Arauco group: Sonae Arauco Deutschland GmbH Meppen Plant Grecostrasse 1 49716 Meppen Germany The production volume of this plant covers 100 % of the total production of AGEPAN® Wood Fiberboards by Sonae Arauco group.
Issue date 29/02/2016	The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Valid to 27/02/2022	**Verification** The CEN Norm /EN 15804/ serves as the core PCR Independent verification of the declaration according to /ISO 14025/ ☐ internally ☒ externally
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	Manfred Russ (Independent verifier appointed by SVR)
Dr. Burkhart Lehmann (Managing Director IBU)	

2. Product

2.1 Product description

AGEPAN® System Wood Fiberboards are panel-shaped wood-based materials in accordance with EN 316 that is manufactured in dry process by means of compression under heat of wood fibres with adhesive. AGEPAN® System boards can be raw, sanded or profiled. Owing to their various densities and adhesive systems, they can display a variety of material properties:

- AGEPAN® THD is a blunt-edged wood fibre insulating panel with an asymmetric density profile, manufactured in a dry process.
- AGEPAN® THD Static is a wood fiber insulation board with an asymmetrical bulk density profile and load-bearing capacities.
- AGEPAN® DWD boards are permeable wall and roof boards manufactured in dry process with and without tongue and groove profiles.
- AGEPAN® UDP is another wood fiber insulation board in our system construction program for quick and easy working.
- AGEPAN® TEP is a wood fiber insulation board with an asymmetric density profile and provides good technical values and simple processing.

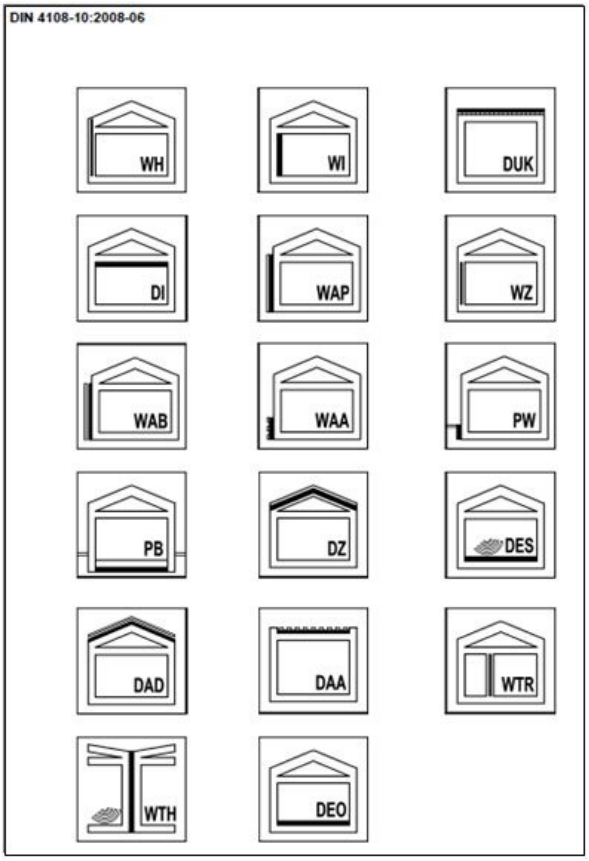
2.2 Application

AGEPAN® THD for windproof, heat-insulating, vapour permeable and noise insulating planking in roof and wall areas.
AGEPAN® THD Static for prefabricated elements for site assembly and bare-bone houses with load-bearing capacities (planking of in-plane loaded wall panels).

AGEPAN® DWD for reinforcement of timber frame constructions as a stable panel and second water-bearing layer in roof and wall.
AGEPAN® UDP for exterior planking in roof and walls as a second waterproof layer in various constructions.
AGEPAN® TEP for dry screed constructions as a direct underlay for floating floorings.

Applications in accordance with DIN 4108-10	
Product	**Application**
AGEPAN® THD N+F	DAD-ds / DI-dm / DEO-ds / WAB-ds / WAP / WI-dm / WTR / WH
AGEPAN® THD Static	DAD-ds / DI-dm / DEO-ds / WAB-ds / WI-dm / WTR / WH
AGEPAN® DWD protect N+F	Under-roof panel according to EN 14964: Type IL
AGEPAN® UDP N+F	DAD-ds / DI-dm / DEO-ds / WAB-ds / WI-dm / WH
AGEPAN® TEP	DI-dm / DEO-ds / DES-sg / WH / WI-dm / WTR

Note: The legend for the acronyms used in the table above can be found in the German standard DIN 4108-10:2008-06.



Source: DIN 4108-10:2008-06, Technische Baubestimmungen, DVD, Stand 02/2015; Verlagsgesellschaft Rudolf Müller; Koln.

Technical Data	Unit	AGEPAN® THD				AGEPAN® THD Static			AGEPAN® DWD				AGEPAN® UDP			AGEPAN® TEP		
Certification standard		DIN EN 13171				DIN EN 13171							DIN EN 13171			DIN EN 13171		
Certification code		Z-23.15-1508				Z-9.1-725			Z-9.1-382							Z-23.15-1508		
Nominal thickness	mm	40	50	60	80	40	60	80	16				22	25	32	40	60	80
Dimensions	mm	1890 x 600				3000 x 1250			2510 x 635	2510 x 1010	3000 x 1247	3000 x 1265	2520 x 610			1890 x 590		
Calculation dimensions	mm	1875 x 585				3000 x 1250			2500 x 625	2500 x 1000	3000 x 1247	3000 x 1250	2500 x 590			1880 x 500		
Edge finish		N + F				blunt			N + F	N + F	N + F	lgs N + F	N + F			alongside tongue & groove		
Aproximated weight	kg/m²	9,2	11,5	13,8	18,4	9,20	13,80	18,40	9,04				5,94	6,75	8,64	9,20	13,80	18,40
Bulk density	kg/m³	230				230			565				270			230		
Nominal value for thermal conductivity λ_D	W/(m*K)	0,047				0,052			0,090				0,051			0,047		
Calculation value for thermal conductivity λ_R	W/(m*K)	0,050				0,055							0,063			0,050		
Water vapor diffusion resistance factor μ		3				3			11				5			3		
Equivalent air layer thickness	m	0,12	0,15	0,18	0,24	0,12	0,18	0,24	18				0,11	0,13	0,16	0,12	0,18	0,24
Compressive strength	kPa	≥ 200				≥ 200							≥ 300			≥ 200		
Thermal capacity	J/(kg*K)	2100				2100			2100				2100			2100		
Formaldehyde emission class		E1				E1			E1				E1			E1		
Euroclass (according to DIN EN 13501-1)		E				E			D-s1, d0				E			E		
Construction material class (according to DIN 4102)		B2				B2			B2				B2			B2		
Maximum rafter interval	m	0,90	1,00	1,00	1,10				1,00				0,85	0,90	1,00			
Char. capacity of cramps R_k	N/Cramp					530	670	620										
Shear strength $f_{v,k}$	N/mm²					0,6	0,6	0,5										
Shear modulus G	N/mm²					100	100	100										
K_{ser}* Usage class 1	N/mm					300	400	350										
K_{ser}* Usage class 2	N/mm					200	300	250										

2.3 Technical Data

Values cover the range of uncoated AGEPAN® Wood Fiberboards produced by Sonae Arauco, S.A. (see table above).

2.4 Placing on the market / Application rules

Sonae Arauco, S.A. AGEPAN® Wood Fiberboards complies with the following product standards:

- EN 316:2010, Wood fibre boards — Definition, classification and symbols
- EN 622-5:2010, Fibreboards. Specifications — Requirements for dry process boards (MDF)
- EN 13986:2015, Wood-based panels for use in construction — Characteristics, evaluation of conformity and marking
- ISO 16895-1:2008, Wood-based panels — Dry-process fibreboard — Part 1: Classification
- ISO 16895-2:2010, Wood-based panels — Dry-process fibreboard — Part 2: Requirements
- EN 13171:2013: Thermal insulation products for buildings — Factory made wood fibre (WF) products — Specification
- EN 14964:2006, Rigid underlays for discontinuous roofing — Definitions and characteristics

They can be used in various applications in accordance with the table in section 2.2.

2.5 Delivery status

AGEPAN® Wood Fiberboards ranging in thickness from 16 to 80 mm can be procured as uncoated boards. The boards are offered in standard formats. Fixed formats are also available and selected formats are offered with a tongue and groove profile.

Further details on dimensions can be seen in the table included in 2.3 (above).

For updated information on available dimensions, please refer to www.sonaearauco.com

2.6 Base materials / Ancillary materials

AGEPAN® Wood Fiberboards consist of (dimensions as % by mass):

- Wood chips, approx. 90 %
- Water, approx. 5-9 %
- PMDI glue (polymer 4.4' diphenyl methane diisocyanate), approx. 3.5 %
- Paraffin wax emulsion, 0.5-3 %

Wood from indigenous, largely regional forestry plantations is used for manufacturing raw AGEPAN® Wood Fiberboards. Wood certified in accordance with PEFC™ and FSC® schemes is given preference in the range selection.

Furthermore, sawmill residues are also used in the production of AGEPAN® Wood Fiberboards.

2.7 Manufacture

The manufacturing of AGEPAN® Wood Fiberboards comprises the following steps:

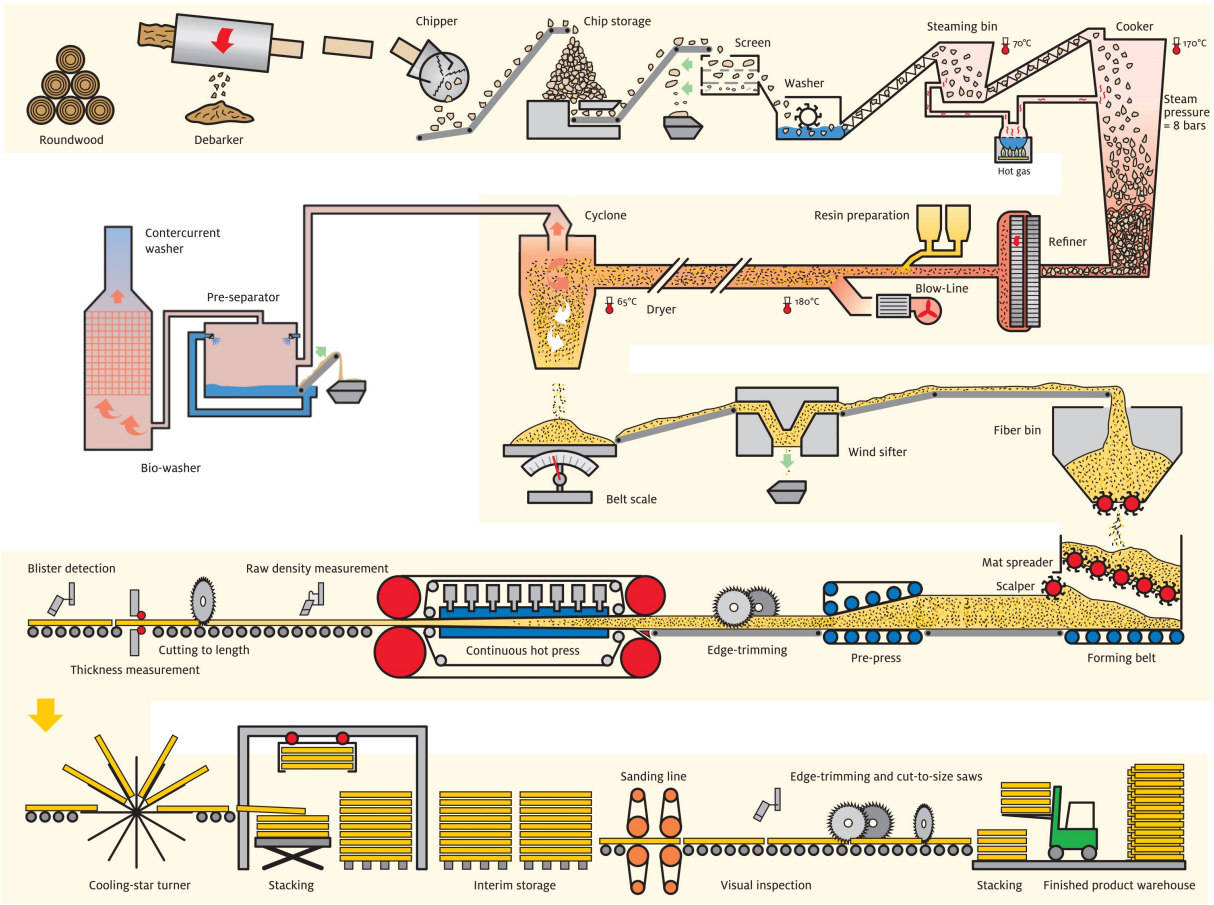
1. Debarking the logs
2. Chipping the wood to chips of approx. 3 x 3 cm in size
3. Boiling the chips
4. Defibring in the refiner
5. Gluing the fibres with synthetic resin
6. Drying the fibres to an approx. residual moisture of 2-3 %
7. Scattering the glued fibred on a forming belt
8. Pressing the fibre mat in a continuous hot press under high pressure
9. Distributing the fibre strings among raw board formats
10. Cooling the raw boards in star coolers
11. Stacking
12. Sanding the top or underside after the air-conditioning phase

A process diagram is presented below.

The production site is certified according to the following standards:

- EN ISO 9001:2008;
- EN ISO 14001:2009;
- OHSAS 18001:2007;
- EN ISO 50001:2011.

Additionally, all range includes CE marked products, and PEFC™ and FSC® certified products can be made available on request.



2.8 Environment and health during manufacturing

Health protection: The manufacturing conditions do not demand any special measures as regards health protection. The reference occupational exposure limit values are complied with.

Emissions into air: Waste air generated during production is cleaned in accordance with regulatory specifications. Emissions are below the limit values specified by the operation license of the site, specified according to the German law.

Emissions into water/soil: No contamination of water or soil. Waste water generated by production is treated and directed into the municipal sewage system following pre-purification. Sludge generated during water treatment is used in agriculture as a fertiliser.

Noise: Sound protection analyses have established that all values communicated inside and outside the production facilities are below the standards applicable in Germany. Noise-intensive plant areas such as chipping are encapsulated appropriately by structural measures.

The production site is EN ISO 14001:2009 certified.

2.9 Product processing/Installation

Sonae Arauco, S.A. Wood Fiberboards can be sawn, milled, planed, sanded and drilled using standard machinery. Please refer to the respective data sheets for processing recommendations. Correct structural installation must be ensured. When selecting additional products, please ensure that they do not have a negative influence on the designated environmental compatibility properties of the building products referred to.

2.10 Packaging

Sonae Arauco, S.A. AGEPAN® Wood Fiberboards are supplied on squared timber bound by plastic or metal bands and covered with corrugated cardboard.

MDF and steel or PET packing bands for transport packaging can be sorted and directed to the recycling circuit. If re-use or recycling is impractical, the packaging should not be landfilled, but rather directed towards energy recovery.

2.11 Condition of use

The components making up uncoated AGEPAN® Wood Fiberboards correspond with the base material compositions as outlined in Clause 2.6. During hot pressing, the binding agent chemically reacts irreversibly by means of poly-condensation and firmly bonded with the wood. The binding agents are chemically and stably bound to the wood.

VOC emissions: AGEPAN® Wood Fiberboards are labelled as class A+ according to the French regulation on the labelling of emissions of volatile pollutants from construction and decoration products (with reference to the wall scenario, as a worst case).

Additionally, AGEPAN® Wood Fiberboards have been certified with the IBU environmental quality label.

Carbon storage:
Sonae Arauco, S.A. AGEPAN® Wood Fiberboards at an average density of 384 kg/m3 stores 639 kg CO2-eq/m3 over their service life.

2.12 Environment and health during use

Environmental protection: According to current information, water, air and soil are not exposed to any dangers when the respective products outlined above are used as designated.

Health protection: According to current information, no damage to or impairment of health can be anticipated when AGEPAN® Wood Fiberboards are used as designated.
VOC emissions at very low levels are basically composed of natural wood ingredients.

2.13 Reference service life

Due to the wide range of applications of Sonae Arauco, S.A. AGEPAN® Wood Fiberboards, no reference service life is declared.

2.14 Extraordinary effects

Fire
Fire retardant classification of AGEPAN® Wood Fiberboards is done according to EN 13171. Fire retardant classes are defined in accordance with EN 13501-1.

Fire protection (just for DWD):

Name	Value
Building material class	D
Smoke gas development	s1
Burning droplets	d0

For all other AGEPAN® Wood Fiberboards the classification is E.

Water
No ingredients are washed out which could be hazardous to water. AGEPAN® Wood Fiberboards are not resistant to permanent exposure to water; damaged areas can however be replaced locally.

Mechanical destruction
AGEPAN® Wood Fiberboards breakage features display relatively brittle performance, whereby sharp edges can arise on the broken panel edges (risk of injury).

2.15 Re-use phase

Recycling: Sonae Arauco, S.A. AGEPAN® Wood Fiberboards from construction can be collected separately and utilised in the manufacture of particleboard. This is based on the condition that the wooden boards are not fully glued.

Energy recovery: due to the high heating value of approx. 16.5 MJ/kg at a 20 % moisture content assumed for post-consumer boards, Sonae Arauco, S.A. AGEPAN® Wood Fiberboards can be used for energy recovery and the generation of heat and electricity (e.g. in CHP plants), following the cascading principle for wood use.

2.16 Disposal

Sonae Arauco, S.A. AGEPAN® Wood Fiberboards leftovers and residual materials incurred as a result of demolition measures on the building site should be primarily directed towards material recycling. If this is not possible, they must be directed toward energy recovery instead of landfilling.

Waste code according to the European List of Waste: 17 02 01

2.17 Further information

Further information such as technical datasheets etc. can be downloaded under:

www.sonaearauco.com

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit for the LCA is 1 m^3 of AGEPAN® Wood Fiberboard.
The declared unit represents an average product, calculated as weighted average of the production volumes of the different AGEPAN® Wood Fiberboard products in 2012.

Information on the declared unit

Name	Value	Unit
Declared unit	1	m^3
Conversion factor to 1 kg	0.00264	-
Mass reference	384	kg/m^3

3.2 System boundary

Type of the EPD: cradle to gate - with options

Modules A1 – A3 of the production stage cover the manufacturing of the products, including raw material extraction and processing, energy generation, the production of ancillary products and packaging materials, transport, as well as all waste treatment processes. Eventual benefits of recycling or energy recovery are neglected.
The resource aspects of wood were inventoried via material inherent properties as resource extraction of CO_2 from the atmosphere and the lower heating value as the use of renewable energy. Material inherent properties are subject to co-product allocation as ruled in EN 15804.
For the input of post-consumer wood, the carbon stored in wood is inventoried as material inherent property as negative input of stored carbon, expressed in CO_2-equivalent, whereas the energy content of wood is inventoried as input of renewable secondary material/fuel (as applicable).

The use of secondary wood as a material or fuel input to the product system is inventoried from the end-of-waste status of the recycled wood onward.

Module A5 covers the transport of the packaging material from the construction site and its disposal. Default end-of-waste states for the packaging materials from the packed products at the construction site are defined in analogy for wastes occurring in modules A1-A3. Eventual further inputs for the installation of the products are not considered due to the broad applicability of the assessed products.
The substituted primary material from the net amount of recycled material and from recovered energy exported from the product system in Module A5 are declared in Module D.

Module C3 covers the preparation of the post-consumer board to become a secondary fuel: the end-of-waste status for recycled wood-based boards is defined as the point where they have been sorted and chipped, ready to be used as secondary fuels.
In line with EN 16485, the export of the biogenic carbon stored in the board, expressed in CO_2-equivalent is also reported in module C3.

Module D compiles all the benefits and burdens associated with the secondary fuels, secondary materials and exported energy leaving the production system in the modules A5 and C3.
Therefore, module D covers the avoided burdens from recycling and from energy recovered from the waste treatment in module A5 as well as the transports of the obsolete boards to a biomass combustion plant, the combustion process itself and the loads and benefits of the substitution of fossil fuels and/or electricity.
Substitution effects in module D are always calculated for the net amount of secondary material or secondary fuel of the product system in line with EN 16485.

3.3 Estimates and assumptions

For the quantification of the net flows of recycled wood (input of post-consumer wood used as a fuel minus post-consumer wood exiting the product system into module D for energy recovery), it was assumed that all inputs of post-consumer wood are used as a fuel.
Beyond that, no relevant estimates or assumptions had to be made beyond the information provided in this EDP.

3.4 Cut-off criteria

The applicable criteria for the exclusion of inputs and outputs are defined in EN 15804, clause 6.3.5, and in the IBU PCR part A (IBU 2013), respectively.
All data were taken into account that resulted from the data collection procedure in the plants, e.g. related to fuels, raw material Input, use of ancillary materials, waste flows, emissions into air, water use, waste water, transport means and transport distances, etc..
Expenses for the general management, research & development, administration and marketing – if known – were not taken into account.
The production of eventual packaging of ancillary material or other inputs used during production (and some of the reported wastes) were generally neglected; in most cases reusable bins or containers are used. In addition, the amounts of reported (unspecific) wastes are that small that their production can be considered not relevant for the life cycle assessment. Additional plant specific information can be found in the respective chapters for each plant.
Beyond that some ancillary materials were cut-off due to very small amounts and as inputs not directly related to production processes but to the maintenance of infrastructure, e.g. acetylene and oxygen for soldering, etc.
With this approach also mass and energy flows below 1 percent of total mass and energy flows caused by the declared products were included in the assessment.
Beyond that, no material or energy flows were neglected that would have been known by the persons re-sponsible for the project and that could have been expected to contribute significantly to the environmental indicators declared. It can thus be assumed that the total contribution of the neglected processes is not higher than 5 % of the declared impact categories.

3.5 Background data

Datasets from ecoinvent v.2.2 including all updates available under www.lc-inventories.ch were used as background data exclusively; these updates include the update of energy mixes and some process chains, e.g. for the provision of natural gas. Therefore, the latest update of the background data took place in 2014.

3.6 Data quality

The requirements on the data quality and the background data correspond to the provisions in EN 15804 and the IBU PCR part A (IBU 2013) respectively:

- Data are as current as possible. Datasets used for calculations were updated within the last 10;
- years for generic data and within the last 5 years for producer specific data;
- Datasets are based on 1 year averaged data as a general rule;
- The time period over which inputs to and outputs from the system are accounted for is 100 years from the year for which the data set is deemed representative;
- The technological coverage reflects the physical reality for the declared products;
- The background datasets comply with the quality guidelines of ecoinvent 2.2; deviations from the methodological prescriptions of EN 15804 and the IBU PCR part A (IBU 2013) respectively are possible but acceptable according to IBU PCR part A (IBU 2013).

3.7 Period under review

The company data gathered for this EPD represents the year 2012.

3.8 Allocation

Total fuel input and electricity consumption as well as all ancillary materials, wastes, airborne emissions and waste water on plant level were attributed based on the total weight of the production volumes of each of

the main products produced in the plant and then broken down to per m^3 values.
No separate data were available for the production of the two products. Formaldehyde emissions were attributed 100 % to standard MDF production, as the gluing system for AGEPAN® Wood Fiberboard does not contain formaldehyde. Consequently, minor amounts of formaldehyde resulting from the drying of wood in AGEPAN® Wood Fiberboard were attributed to standard MDF.
The inventories for the wood inputs were taken from ecoinvent 2.2. In ecoinvent, the forestry and sawmilling processes are allocated based on revenues of the different co-products of a joint co-production process (Werner et al., 2007, based on Schweinle, 2000). In these datasets, resource corrections are made for incorporated biogenic carbon and renewable energy; these flows thus reflect the real physical flows.
Post-consumer secondary wood is used as an input to produce the board; at the input side as well as for the end-of-life scenario, the end-of-waste status was defined after the sorting and chipping of the wood-based board in line with EN 16485 (see also clause 3.2). In the end-of-life, loads and benefits of energy recovery are thus reported in module D.
Waste packaging in module A5 was considered not to reach the end-of-waste state as a fuel. Its incineration is reported in A5, the benefits of energy recovery in module D. The benefits of the recycling of a minor amount of cardboard packaging, steel, and plastics are disregarded.
Biogenic carbon and primary energy content are considered material inherent properties and "imported" and "exported" to/from the system in line with the mass flows of wood.
No co-product allocation was made in the modelling of the life cycle assessment underlying this EPD.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

4. LCA: Scenarios and additional technical information

The following technical information is a basis for the declared modules or can be used for developing specific scenarios in the context of a building assessment if modules are not declared (MND).

Installation (A5)
Eventual further inputs for the installation of the products are not considered due to the broad applicability of the assessed products.
An average transport distance of 30 km was assumed for packaging waste from the construction site to the recycling plant or to the municipal waste incineration plant. The municipal waste incineration plant is assumed to have an overall energy efficiency of 53 % related to the lower heating value of the waste input; 92 % of the recovered energy is heat, 8 % is electricity (according to specifications of MWI plants in ecoinvent 2.2).

Waste treatment (C3)
439 kg of AGEPAN® Wood Fiberboard are chipped, of which 416 kg are exported from the product life cycle into module D, assuming a moisture content of 20 % and a lower heating value of 16.5 MJ/kg.

Reuse, recycling, recovery potential (D)
According to default assumptions in other IBU EPDs, post-consumer wood is used as a secondary fuel for energy recovery in a biomass combustion plant with an over-all energy efficiency of 93 % related to the lower heating value of the fuel input; 91 % of the recovered energy is heat, 9 % is electricity.

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	X	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	X	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: AGEPAN® Wood Fiberboard, per m³

Parameter	Unit	A1-A3	A5	C3	D
Global warming potential	[kg CO_2-Eq.]	-423.49	28.29	643.40	-416.36
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	1.20E-5	4.88E-8	1.78E-7	-4.53E-5
Acidification potential of land and water	[kg SO_2-Eq.]	7.30E-1	9.18E-3	1.65E-2	-3.96E-1
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	1.52E-1	2.15E-3	2.17E-3	-3.84E-2
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	3.46E-2	3.63E-4	7.46E-4	-3.83E-2
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	2.81E-4	1.25E-6	2.54E-6	-4.91E-5
Abiotic depletion potential for fossil resources	[MJ]	5002.33	16.23	72.46	-8085.74

RESULTS OF THE LCA - RESOURCE USE: AGEPAN® Wood Fiberboard, per m³

Parameter	Unit	A1-A3	A5	C3	D
Renewable primary energy as energy carrier	[MJ]	2160.00	0.16	8.83	-185.89
Renewable primary energy resources as material utilization	[MJ]	6790.00	0.00	0.00	0.00
Total use of renewable primary energy resources	[MJ]	8948.86	0.16	8.83	-185.89
Non-renewable primary energy as energy carrier	[MJ]	4040.00	16.93	84.10	-7880.42
Non-renewable primary energy as material utilization	[MJ]	751.00	0.00	0.00	0.00
Total use of non-renewable primary energy resources	[MJ]	4794.98	16.93	84.10	-7880.42
Use of secondary material	[kg]	0.00	0.00	0.00	0.00
Use of renewable secondary fuels	[MJ]	365.00	0.00	0.00	6240.00
Use of non-renewable secondary fuels	[MJ]	0.00	0.00	0.00	667.00
Use of net fresh water	[m³]	9.19	0.03	0.15	-2.53

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: AGEPAN® Wood Fiberboard, per m³

Parameter	Unit	A1-A3	A5	C3	D
Hazardous waste disposed	[kg]	6.10E-3	8.46E-6	9.76E-5	-2.77E-3
Non-hazardous waste disposed	[kg]	9.88	0.33	0.46	2.39
Radioactive waste disposed	[kg]	1.30E-2	1.28E-5	7.30E-4	-1.47E-2
Components for re-use	[kg]	0.00	0.00	0.00	0.00
Materials for recycling	[kg]	13.50	1.36	0.00	0.00
Materials for energy recovery	[kg]	0.00	0.00	439.00	0.00
Exported electrical energy	[MJ]	0.10	16.20	0.00	0.00
Exported thermal energy	[MJ]	0.31	186.00	0.00	0.00

6. LCA: Interpretation

Figure 1 illustrates the contribution of each life cycle stage to the overall indicator results of the impact assessment (impact from module A1-A3 = 100 %). The Figure illustrates that for the GWP, the ODP, the POCP and the ADP fossil, the benefits from the energy recovery of AGEPAN® Wood Fiberboard are higher that the impacts during the life cycle, notably the impacts from production; for other impact categories, the benefits of energy recovery lie between 15 % to 65 %, depending on the impact category under consideration.

The *global warming potential (GWP)* is an indicator for the contribution to climate change and is qua-ntified based on the emissions of gases that absorb radiative forcing.

The production phase of AGEPAN® Wood Fiberboard is caused to a large extend by the upstream processes of the generation of electricity (about 40 %); the use of natural gas during production causes another 25 % of the GWP. 20 % of the GWP are related to the production of the PMDI resin and about 8 % are caused by the transport for raw material acquisition.
Figure 2 illustrates that the biogenic carbon stored in the product, expressed as CO_2-equivalent, is higher than the CO_2 emissions from fossil sources, leading to a negative GWP for the production module A1-A3.The potential substitution effect in module D more than offsets the GHG emissions during the production phase (module A1-A3)
The GWP is dominated by CO_2 emissions and removals.

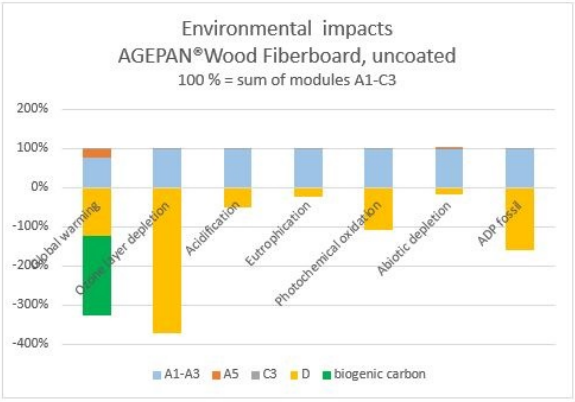


Figure 1: Environmental impacts of AGEPAN® Wood Fiberboard along its life cycle (impacts from production modules A1-A3 = 100 %; for illustrative purposes, the biogenic carbon included in the GWP is documented separately)

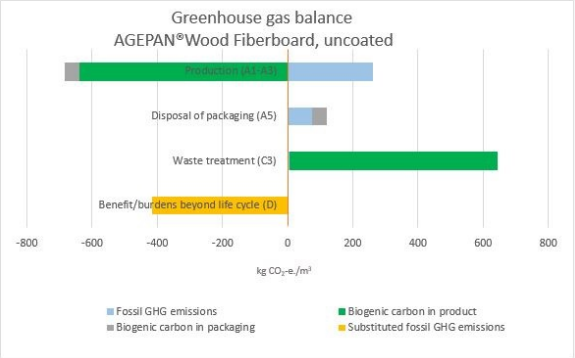


Figure 2: Carbon footprint of AGEPAN® Wood Fiberboard

The *ozone layer depletion potential (ODP)* is quantified based on the emissions of gases that can destroy stratospheric ozone.
The ODP is caused mainly by emissions of Halon 1211, which are associated with the production and transport of natural gas. Around 10 % of the ODP are associated with the direct use of natural gas on-site for the production of AGEPAN® Wood Fiberboard, the rest of the ODP is caused by the use of natural gas in upstream processes in line with the consumption patterns of natural gas in the process chain.

The *acidification potential (AP)* is created with the transformation of airborne emissions into acids, which among other can reduce soil fertility.
Roughly 25 % of the AP are caused by the on-site combustion processes for the generation of heat and electricity; the other 75 % are associated with upstream combustion processes, notably for the generation of electricity (20 %), for heat production in the production of the PMDI (30 %) and related to transports of raw materials.
The AP is caused in comparable shares by emissions of ammonia, nitrogen oxides and sulphur dioxide.

The *eutrophication potential (EP)* quantifies the accumulation of nutrients in soils and watersheds, which can cause increased growth of algae and shifts in species composition.
The EP is caused by a variety of processes, mainly in combustion processes or disposal processes, e.g. of mining residues from lignite extraction related to the generation of electricity.
The EP is caused mainly by airborne emissions of nitrogen oxides as well as phosphate emissions into the groundwater.

The *photochemical oxidation potential (POCP)* assesses the contribution of airborne emissions that contribute to summer ozone creation.
About 35% of the POCP are associated with the production of PMDI resins; minor contributions stem from upstream processes of electricity generation (20 %), the on-site combustion of natural gas (15 %) as wells as from transport of the raw materials. These contributions are caused by emissions of SO_2, CO and CH_4.

The *abiotic resource depletion potential of fossil resources (ADP fossil)* assesses the use of scarce fossil resources such a natural gas or crude oil.
The ADP (fossil resources) is caused mainly by the generation of electricity (40 %), the production of PMDI (20 %) and by the on-site consumption of natural gas (25 %).

The *abiotic resource depletion potential for mineral resource (ADP elements)* assesses the use of scarce mineral resources such as ores and other mineral raw materials.
The ADP (elements) is caused almost completely by infrastructure processes, such as the buildings required for the production of chemicals; the main resources contributing to the ADP (elements) are zinc, copper and gold.

The main use of renewable primary energy is the heating value of the wood in AGEPAN® Wood Fiberboard; this amount of non-used renewable energy is exported in module C3 and used energetically as a renewable secondary fuel in module D. The renewable primary energy used as energy is mainly woody biomass.

The major share of the non-renewable primary energy is used energetically, mainly as natural gas in the upstream process for the production of PMDI. A minor share is used as a material, i.e. as components of the gluing systems; this non-renewable primary energy used as a material is not used within the life cycle of AGEPAN® Wood Fiberboard; it is exported in module C3 and used energetically as a non renewable secondary fuel in module D.

The indicator values for wastes refer to the amount of wastes that is landfilled after an eventual pre-treatment of the wastes.
The main part of the wastes associated with the production of AGEPAN® Wood Fiberboard is non-hazardous waste, mainly resulting from the disposal of infrastructure associated with e.g. production halls or roads.
Hazardous wastes are generated throughout the production chain, e.g. related to disposal of ashes, production wastes from chemical industry or from the production of primary aluminium for infrastructure processes.

The generation of radioactive waste is associated with the production of nuclear power.

The *net consumption of fresh water* is caused mainly by cooling processes throughout the production chain as well as partly for the generation of electricity.

The *further indicators on environmental aspects* are singular values that result from the inventorying of waste streams into thermal waste treatment, energy recovery and recycling.

7. Requisite evidence

7.1. Formaldehyde

Measuring agency: Eurofins Denmark
Test report, date: G11664 and G15792, dated 17-01-2012 and 19-06-2012
Result: Formaldehyde emissions tests were performed for THD and DWD products according to ISO16000-11, with the wall panel loading scenario. The measured formaldehyde emissions were lower than 10 mg/m^3, resulting in a classification A+.

7.2. MDI

For PMDI bonded boards:

Measuring agency: Wessling Beratende Ingenieure GmbH, Altenberg, Germany
Test report, date: IAL-09-0566 dated 12 January 2010
Result: Test chamber analysis of wooden materials (MDI). The analysis was carried out in accordance with the test guidelines of the RAL Environmental Label 76 (wooden materials). No emissions of monomer MDI and other isocyanates in the test chamber could be detected. The detection limit was 0.1µg/m^3.

7.3 Checking for the pre-treatment of the substances used

No post-consumer wood is used in the production of AGEPAN® Wood Fiberboard.

7.4 TVOC emissions

Measuring agency: Eurofins Denmark
Test report, date: G11664 and G15792, dated 17-01-2012 and 19-06-2012
Result: VOC emissions tests were performed for THD and DWD products according to ISO16000-11, with the wall panel loading scenario.
The measured emissions were lower than 1000 mg/m^3, resulting in a classification A+.

7.5 PCP/Lindane

Measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany
Test report, date: 31/13/7835/03
AGEPAN® DWD Protect N+F, dated 20-11-2013
Result: The wood preservative agents pentachlorophenol (PCP) and lindane could not be determined in the board sample examined.
Limit of determination: 0.10 mg/kg

8. References

Institut Bauen und Umwelt
Institut Bauen und Umwelt e.V., Berlin(pub.): Generation of Environmental Product Declarations (EPDs);

General principles
for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013/04
www.bau-umwelt.de

ISO 14025
DIN EN ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures

EN 15804
EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

PCR Part B
Institut Bauen und Umwelt e.V, Berlin (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations for Institut Bauen und Umwelt (IBU), Part B: Requirements on the EPD of wood based panels, 2013-10.

ISO 9001
ISO 9001:2008, Quality management systems – Requirements.

ISO 14001
ISO 14001:2009, Environmental management systems – Requirements with guidance for use.

OHSAS 18001
OHSAS 18001:2007, Occupational Health and Safety Management Systems – Requirements.

ISO 16000
ISO 16000-11:2006, Indoor air – Part 11: Determination of the emission of volatile organic compounds from building products and furnishing – Sampling, storage of samples and preparation of test specimens.

EN 13501
EN 13501-1:2010-01, Fire classification of construction products and building elements – Classification using test data from reaction to fire tests.

EN 13171
EN 13171:2008, Thermal insulation products for buildings – Factory made wood fibre (WF) products – Specification.

EN 16485
EN 16485:14-07, Round and sawn timber – Environmental Product Declarations – Product category rules for wood and wood-based products for use in construction.

EN ISO 50001
EN ISO 50001:2011-06, Energy management systems – Requirements with guidance for use.

ecoinvent 2.2: Life cycle inventory data, May 2010. Ecoinvent Center, Duebendorf.

Schweinle, J. (2000): Analyse und Bewertung der forstlichen Produktion als Grundlage für weiterführende forst- und holzwirtschaftliche Produktlinien-Analysen. Mitteilungen der Bundesforschungsanstalt für Forst- und Holzwirtschaft Hamburg, Komissionsverl. Max Wiedebusch, Hamburg.

Werner, F., T. Künniger, H.-J. Althaus und K. Richter (2007): Life cycle inventories of wood as fuel and construction material, Duebendorf. Centre for life cycle inventories in the ETH domain, Duebendorf.

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