ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

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-20220210-ICC1-EN
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Valid to	05.09.2027

AGEPAN® Wood Fibreboards

Sonae Arauco, S.A.

Institut Bauen und Umwelt e.V.

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ECO PLATFORM EPD VERIFIED

1. General Information

Sonae Arauco, S.A.	AGEPAN® Wood Fibreboards
Programme holder IBU – Institut Bauen und Umwelt e.V. Hegelplatz 1 10117 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-20220210-ICC1-EN	**Declared product / declared unit** AGEPAN® Wood Fibreboards, uncoated, per m^3
This declaration is based on the product category rules: Wood based panels, 01.2019 (PCR checked and approved by the SVR)	**Scope:** This document refers to AGEPAN® Wood Fibreboards 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 Fibreboards by Sonae Arauco group.
Issue date 06.09.2022	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. The EPD was created according to the specifications of *EN 15804+A2*. In the following, the standard will be simplified as *EN 15804*.
Valid to 05.09.2027	**Verification** The standard *EN 15804* serves as the core PCR Independent verification of the declaration and data according to *ISO 14025:2011* ☐ internally ☒ externally
Dipl. Ing. Hans Peters (chairman of Institut Bauen und Umwelt e.V.)	
Dr. Alexander Röder (Managing Director Institut Bauen und Umwelt e.V.))	Dr. Stefan Diederichs (Independent verifier)

2. Product

2.1 Product description/Product definition

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

- AGEPAN® THD is a wood fibre insulating panel with an asymmetric density profile, manufactured in a dry process.
- AGEPAN® THD Static is a wood fibre 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® DWD 600 is a vapour-permeable wood fibre board ideal for sheathing in rear-ventilated facades and a second water-repellent layer in roof and wall.
- AGEPAN® UDP is another wood fibre insulation board in our construction system for quick and easy working.
- AGEPAN® TEP is a wood fibre insulation board with an asymmetric density profile and provides good technical values and simple processing.

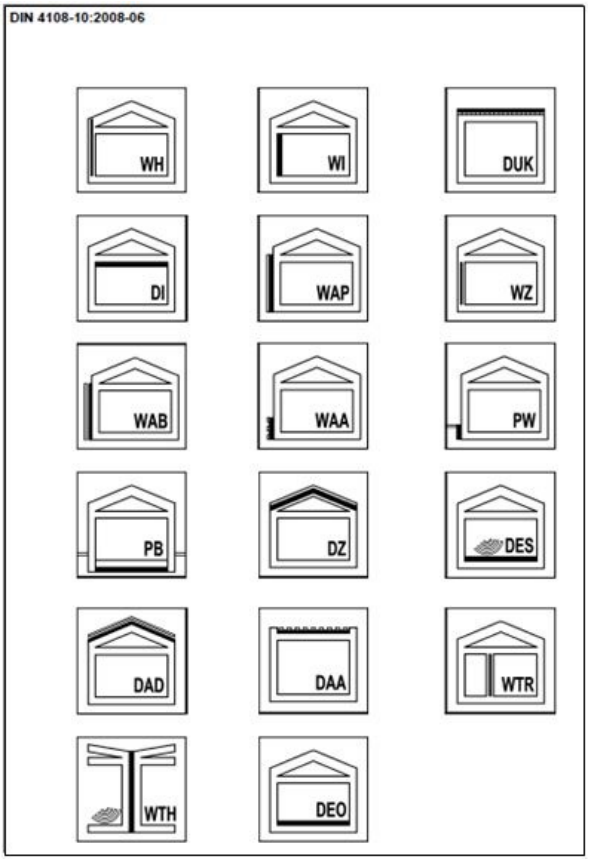
For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) *Regulation (EU) No. 305/2011 (CPR)* applies. The product needs a declaration of performance taking into consideration *EN 13171:2008, Thermal insulation products for buildings – Factory made wood fibre (WF) products – Specification* and the CE-marking.
For the application and use the respective national provisions apply.

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® DWD 600 for sheathing in rear-ventilated facades, second water-repellent layer in roof and wall and for approved fire resistance construction in the Agepan System.
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.

Product	Application
AGEPAN® THD T+G	DIN 4108-10: DAD-ds / WAB-ds / WH EN 14964: Sarking board Type IL
AGEPAN® THD Static	DIN 4108-10: WAB-ds / WH
AGEPAN® DWD	EN 14964: Sarking board Type IL
AGEPAN® DWD 600	EN 14964: Sarking board Type IL
AGEPAN® UDP	DIN 4108-10: DAD-ds / WAB-ds / WH
AGEPAN® TEP	DEO-ds / DES-sg

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; Köln.

2.3 Technical Data

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

Values cover the range of uncoated AGEPAN® Wood Fiberboards produced by Sonae Indústria / Glunz AG (see table above).

Name	Value	Unit
Gross density according to EN 323	210 - 650	kg/m^3
Bending strength (longitudinal) according to EN 310	14 - 23	N/mm^2
E-module (longitudinal) according to EN 310	1900 - 2700	N/mm^2
Thermal conductivity according to EN 12524	0.14	W/(mK)
Water vapour diffusion resistance factor according to DIN 52615	3 - 12	-
Moisture content at delivery according to EN 322	4 - 9	%
Tensile strenght perpendicular to the plan according to EN 319	0.18 - 0.65	N/mm^2

Technical Data	Unit	AGEPAN® THD				AGEPAN® THD Static			AGEPAN® DWD				AGEPAN® DWD 600			AGEPAN® UDP			AGEPAN® TEP		
Certification standard		DIN EN 13171				DIN EN 13171			EN 13986				EN 13986			DIN EN 13171			DIN EN 13171		
Certification code						Z-9.1-725			Z-9.1-382				Z-9.1-382								
Nominal thickness	mm	40	50	60	80	40	60	80	16				16			22	25	32	40	60	80
Dimensions	mm	1890X600				3000X1250			2510x635	2510x1010	3000x1247	3000x1265	2515X640	2515X1015	3000X1247	2520X610			1890X500		
Coverage	mm	1875X585				3000X1250			2500x625	2500x1000	3000x1247	3000x1250	2500X625	2515X1000	3000X1247	2500X590			1890X500		
Edge finish		T + G				butt-edged			T + G	T + G	STD	T + G (lengthwise)	T + G	T + G	Butt - edged	T + G			Lengthwise grooved + loose tongue		
Approximated weight	Kg/m2	9,2	11,5	13,8	18,4	11,6	17,4	23,2	9,04							5,94	6,75	8,64	9,20	13,80	18,40
Bulk density	Kg/m3	230				290			565				600			270			230		
Nominal value for thermal conductivity λ	W/(m*K)	0,047				0,057			0,090				0,10			0,051			0,047		
Rated thermal conductivity	W/(m*K)	0,049				0,060										0,054			0,049		
Water vapor diffusion resistance factor μ		3				3			11				12			5			3		
Equivalent air layer thickness s_d	m	0,12	0,15	0,18	0,24	0,12	0,18	0,24	0,18				0,19			0,11	0,13	0,16	0,12	0,18	0,24
Compressive strength	kPa	≥ 200				≥ 200										≥ 300			≥ 200		
Specific thermal capacity	J/(kg*K)	2100				2100										2100			2100		
Formaldehyde emission class		E1 – Formaldehyde free glued				E1 – Formaldehyde free glued			E1 – Formaldehyde free glued				E1 – Formaldehyde free glued			E1 – Formaldehyde free glued			E1 – Formaldehyde free glued		
Euroclass (according to DIN EN 13501-1)		E				E			D-s1,d0				D-s2,d0			E			E		
Construction material class (according to DIN 4102)		B2				B2			B2				B2			B2			B2		
Maximum rafter spacing	m	0,90	1,00	1,00	1,00				1,00				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													

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to:

- *EN 13171:2008, Thermal insulation products for buildings – Factory made wood fibre (WF) products – Specification.*
- *EN 13986:2004+A1:2015, Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking.*

2.4 Delivery status

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

Information 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

2.5 Base materials/Ancillary materials

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

- Wood chips, approx. 90 %
- Water, approx. 5-9 %
- PMDI glue (4.4' diphenylmethane 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 Fibreboards.

This product contains substances listed in the *ECHA candidate list* (date: 08.06.2021) exceeding 0.1 percentage by mass:

- no

This product contains other carcinogenic, mutagenic or reprotoxic (CMR) substances in categories 1A or 1B which are not on the *ECHA candidate list*, exceeding 0.1 percentage by mass:

- no

Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) *Ordinance on Biocide Products No. 528/2012*:

- no

2.6 Manufacture

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

- Debarking the logs
- Chipping the wood to chips of approx. 3 x 3 cm in size
- Boiling the chips
- Defibring in the refiner
- Glueing the fibres with synthetic resin
- Drying the fibres to an approx. moisture of 4% to 8%
- Scattering the dried and glued fibre on a forming belt
- Pressing the fibre mat in a continuous hot press under high pressure
- Cooling
- Staking for stabilization
- Cooling
- Staking and Packing

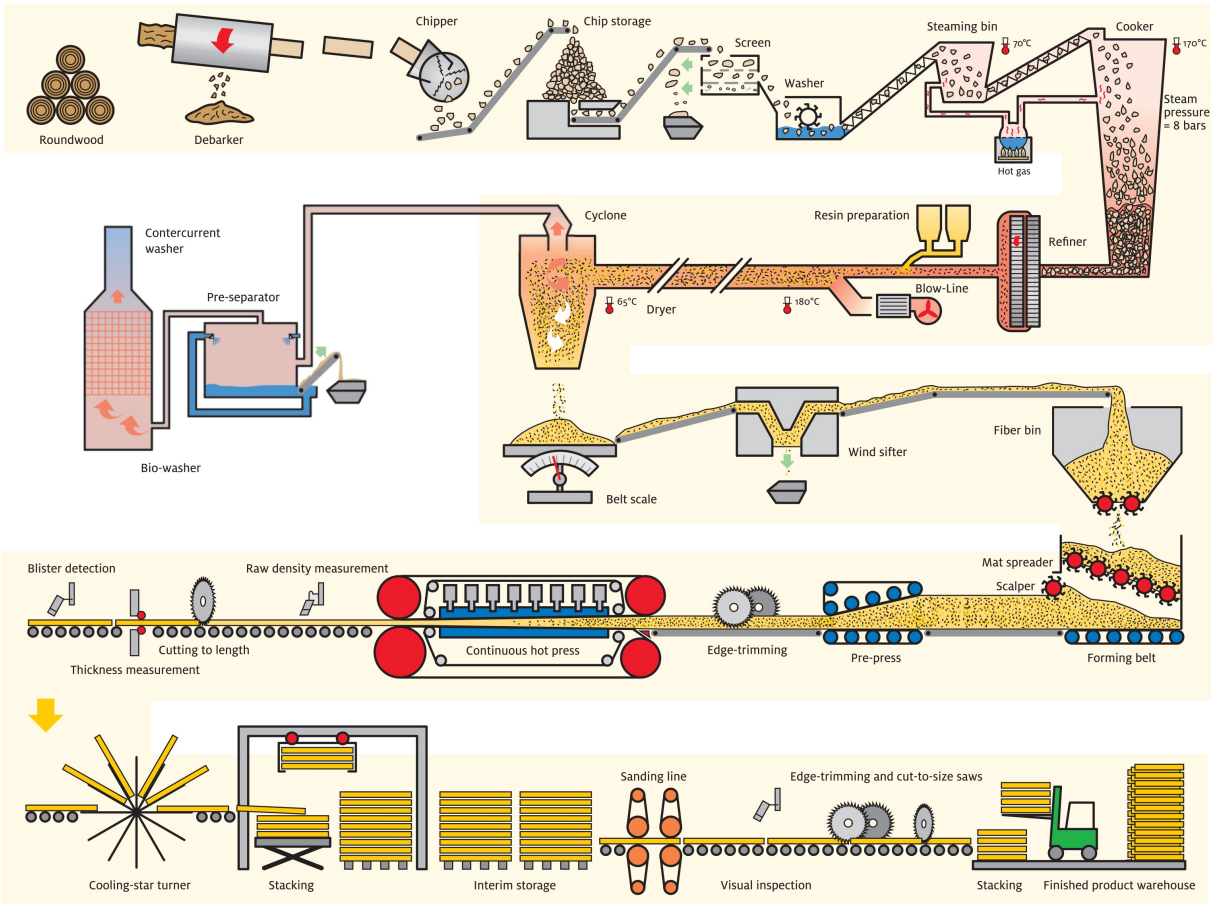
A process diagram is presented below.

Note: Sanding stage is represented in the diagram since it exists in the plant, but is not used currently for AGEPAN fibreboards production

The production site is certified according to the following standards:

- *ISO 9001*
- *ISO 45001*
- *EN ISO 50001*

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



2.7 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 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 fertilizer.

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 *ISO 14001* certified.

2.8 Product processing/Installation

AGEPAN Wood Fibreboards 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.

2.9 Packaging

AGEPAN® Wood Fibreboards are supplied packed with supporting timbers made of chipboard or medium-denistiy fibreboard (MDF), bundled with plastic made of recycled polyethylene terephthalate (PET) (PET bottles) and covered with cardboard.

The film for wrapping the T + G materials is made of recyclable low-density polyethylene.

If re-use or recycling is impractical, the packaging should not be landfilled, but rather directed towards energy recovery.

2.10 Condition of use

The components making up uncoated AGEPAN® Wood Fibreboards correspond with the base material compositions as outlined in Clause 2.5. 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 Fibreboards are labelled as class A+ according to the French regulation on the labelling of emissions of volatile compounds from construction and decoration products (with reference to the wall scenario, as a worst case).

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

Carbon storage:
AGEPAN® Wood Fibreboards at an average density of 464.2 kg/m³ stores 775 kg CO_2-eq/m³ over their service life.

2.11 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 Fibreboards are used as designated.
VOC emissions at very low levels are basically composed of natural wood ingredients.

2.12 Reference service life

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

2.13 Extraordinary effects

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

Fire protection (for DWD (for DWD 600)):

Name	Value
Building material class	D
Smoke gas development	s1 (s2)
Burning droplets	d0

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

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

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

2.14 Re-use phase

Recycling: AGEPAN® Wood Fibreboards from construction can be collected separately and utilized 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. 16.6 MJ/kg at a 20 % moisture content assumed for post-consumer boards, AGEPAN® Wood Fibreboards 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.

2.15 Disposal

AGEPAN® Wood Fibreboards 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

2.16 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 m³ of AGEPAN® Wood Fibreboard.
The declared unit represents an average product, calculated as the weighted average of the production volumes of the different AGEPAN® Wood Fibreboard products in 2020.

Information on the declared unit

Name	Value	Unit
Declared unit	1	m³
Density	464,2	kg/m³

3.2 System boundary

Type of the EPD: cradle-to-gate with modules C1 to C4 and module D (A1-A3, C and D)

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 such 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 A4 covers the transport of the product from the production site to the construction site by a lorry over a default distance of 460 km.

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 fuels recovered energy exported from the product system in Module A5 are declared in Module D; the benefits of recycled packaging are conservatively neglected due to minimal quantities.

Module C1 manual deconstruction is assumed. The declared values are thus 0.

Module C2 includes the transport of the de-constructed product to a recycling centre by over 50 km.

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 C4 is not relevant for the assumed end-of-life scenario. The declared values are thus 0.

Module D compiles all the benefits and burdens associated with the secondary fuels and exported energy leaving the production system in the modules A5 and C3.
Therefore, module D covers the avoided burdens 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 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 EPD.

3.4 Cut-off criteria

The applicable criteria for the exclusion of inputs and outputs are defined in *EN 15804*, clause 6.3.6, and in the IBU PCR part A (*IBU 2020*), respectively.
All data were taken into account that resulted from the data collection procedure in the plant, 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.

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 3.7.1* were used as background data exclusively. Therefore, the latest update of the background data took place in 2020.

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 2020*) 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 of the declared products;
- The background datasets comply with the quality guidelines of *ecoinvent 3.7.1*; deviations from the methodological prescriptions of *EN 15804* and the IBU PCR part A (*IBU 2020*) respectively are possible but acceptable according to IBU PCR part A *(IBU 2020*).

3.7 Period under review

The company data gathered for this EPD represents the year 2020.

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 glueing system for AGEPAN® Wood Fibreboard does not contain formaldehyde. Consequently, minor

amounts of formaldehyde resulting from the drying of wood in AGEPAN® Wood Fibreboard were attributed to standard MDF.

The inventories for the wood inputs were taken from *ecoinvent 3.7.1*, based on *Werner et al. 2015*. 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 a fuel 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.

Ecoinvent 3.7.1 was used as the background database.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic carbon

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic carbon in product	464,2	kg C
Biogenic carbon in packaging	3,87	kg C

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).

Transport to the construction site (A4)
The product is transported from the production site to the construction site by a lorry (15% emissions class EURO 5; 85% emissions class EURO 6) over a default distance of 460 km.

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 3.7.1*).

Deconstruction (C1)
Manual deconstruction is assumed. The declared values are thus 0.

Transport to waste treatment (C2)
This module includes the transport of the de-constructed product to a recycling centre by a lorry (15% emissions class EURO 5; 85% emissions class EURO 6) by over 50 km.

Waste treatment (C3)
464.2 kg of AGEPAN® Wood Fibreboard are chipped and exported from the product life cycle into module D, assuming a moisture content of 20% and a lower heating value of 16.6 MJ/kg. The biogenic carbon stored in the product and the content of primary energy are exported from the product system as material inherent properties.

Disposal (C4)
This module is not relevant for the assumed end-of-life scenario. The declared values are thus 0.

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; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

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	X	X	ND	ND	MNR	MNR	MNR	ND	ND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: AGEPAN® Wood Fibreboard, per m³

Core Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	[kg CO_2-Eq.]	-4.89E+2	3.70E+1	1.70E+1	0.00E+0	4.95E+0	7.79E+2	0.00E+0	-4.12E+2
GWP-fossil	[kg CO_2-Eq.]	3.00E+2	3.70E+1	2.82E+0	0.00E+0	4.95E+0	3.95E+0	0.00E+0	-4.12E+2
GWP-biogenic	[kg CO_2-Eq.]	-7.89E+2	0.00E+0	1.42E+1	0.00E+0	0.00E+0	7.75E+2	0.00E+0	0.00E+0
GWP-luluc	[kg CO_2-Eq.]	6.80E-1	1.26E-2	5.70E-5	0.00E+0	2.06E-3	7.99E-3	0.00E+0	-1.61E-1
ODP	[kg CFC11-Eq.]	4.06E-5	8.40E-6	9.24E-8	0.00E+0	1.09E-6	2.01E-7	0.00E+0	-6.01E-5
AP	[mol H^+-Eq.]	1.45E+0	1.10E-1	5.44E-3	0.00E+0	1.45E-2	2.10E-2	0.00E+0	-4.65E-1
EP-freshwater	[kg P-Eq.]	2.49E-2	2.76E-4	2.39E-6	0.00E+0	4.25E-5	4.09E-4	0.00E+0	-8.02E-3
EP-marine	[kg N-Eq.]	4.49E-1	2.46E-2	2.47E-3	0.00E+0	3.13E-3	2.88E-3	0.00E+0	-3.46E-2
EP-terrestrial	[mol N-Eq.]	4.21E+0	2.73E-1	2.77E-2	0.00E+0	3.48E-2	3.27E-2	0.00E+0	-3.84E-1
POCP	[kg NMVOC-Eq.]	2.46E+0	9.86E-2	8.18E-3	0.00E+0	1.26E-2	9.09E-3	0.00E+0	-2.00E-1
ADPE	[kg Sb-Eq.]	1.91E-3	1.35E-4	6.53E-7	0.00E+0	2.35E-5	9.82E-6	0.00E+0	-1.88E-4
ADPF	[MJ]	5.46E+3	5.60E+2	6.05E+0	0.00E+0	7.41E+1	8.10E+1	0.00E+0	-7.94E+3
WDP	[m^3 world-Eq deprived]	1.04E+2	1.62E+0	3.26E-2	0.00E+0	2.33E-1	8.44E-1	0.00E+0	-1.40E+1

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: AGEPAN® Wood Fibreboard, per m³

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	[MJ]	1.47E+2	7.50E+0	1.39E+2	0.00E+0	1.17E+0	1.25E+1	0.00E+0	-2.52E+2
PERM	[MJ]	8.17E+3	0.00E+0	-1.39E+2	0.00E+0	0.00E+0	-8.03E+3	0.00E+0	0.00E+0
PERT	[MJ]	8.31E+3	7.50E+0	6.65E-2	0.00E+0	1.17E+0	-8.01E+3	0.00E+0	-2.52E+2
PENRE	[MJ]	4.65E+3	5.61E+2	5.53E+1	0.00E+0	7.42E+1	8.84E+2	0.00E+0	-7.85E+3
PENRM	[MJ]	8.51E+2	0.00E+0	-4.92E+1	0.00E+0	0.00E+0	-8.02E+2	0.00E+0	0.00E+0
PENRT	[MJ]	5.50E+3	5.61E+2	6.05E+0	0.00E+0	7.42E+1	8.17E+1	0.00E+0	-7.85E+3
SM	[kg]	3.10E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	3.57E+2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	7.67E+3
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	8.02E+2
FW	[m^3]	9.61E+0	3.43E-1	1.34E-3	0.00E+0	1.34E-3	1.40E+0	0.00E+0	-2.83E+1

Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: AGEPAN® Wood Fibreboard, per m³

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD	[kg]	5.23E-3	1.46E-3	5.57E-6	0.00E+0	1.98E-4	3.25E-5	0.00E+0	-8.40E-3
NHWD	[kg]	4.25E+1	2.74E+1	1.68E-1	0.00E+0	2.95E+0	5.07E-1	0.00E+0	1.31E+0
RWD	[kg]	3.07E-2	8.21E-3	8.23E-5	0.00E+0	1.07E-3	1.04E-3	0.00E+0	-2.61E-2
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	3.38E-1	0.00E+0	9.38E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.64E+2	0.00E+0	0.00E+0
EEE	[MJ]	3.37E-2	0.00E+0	6.91E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	3.87E-1	0.00E+0	7.95E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: AGEPAN® Wood Fibreboard, per m³

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PM	[Disease Incidence]	1.04E-5	2.36E-6	7.51E-8	0.00E+0	2.71E-7	6.05E-8	0.00E+0	-3.11E-7
IRP	[kBq U235-Eq.]	1.37E+1	2.46E+0	2.43E-2	0.00E+0	3.27E-1	7.04E-1	0.00E+0	-1.52E+1
ETP-fw	[CTUe]	9.45E+3	4.30E+2	5.00E+0	0.00E+0	5.92E+1	4.53E+1	0.00E+0	-7.80E+2
HTP-c	[CTUh]	1.82E-6	1.53E-8	2.86E-9	0.00E+0	2.35E-9	2.71E-9	0.00E+0	1.04E-7
HTP-nc	[CTUh]	1.70E-5	4.22E-7	1.17E-8	0.00E+0	5.49E-8	3.60E-8	0.00E+0	-3.07E-7
SQP	[-]	4.76E+4	3.91E+2	1.22E+0	0.00E+0	4.40E+1	1.19E+1	0.00E+0	-2.55E+2

Caption	PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”.This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit for humans – cancerogenic”, “Potential comparative toxic unit for humans - not cancerogenic”, “potential soil quality index”. The results of this environmental impact indicator shall be used with care as theuncertainties on these results are high as there is limited experience with the indicator.

6. LCA: Interpretation

The following Figure illustrates the contribution of each life cycle stage to the overall indicator results of the impact assessment (impact from module A1-C4 = 100 %).

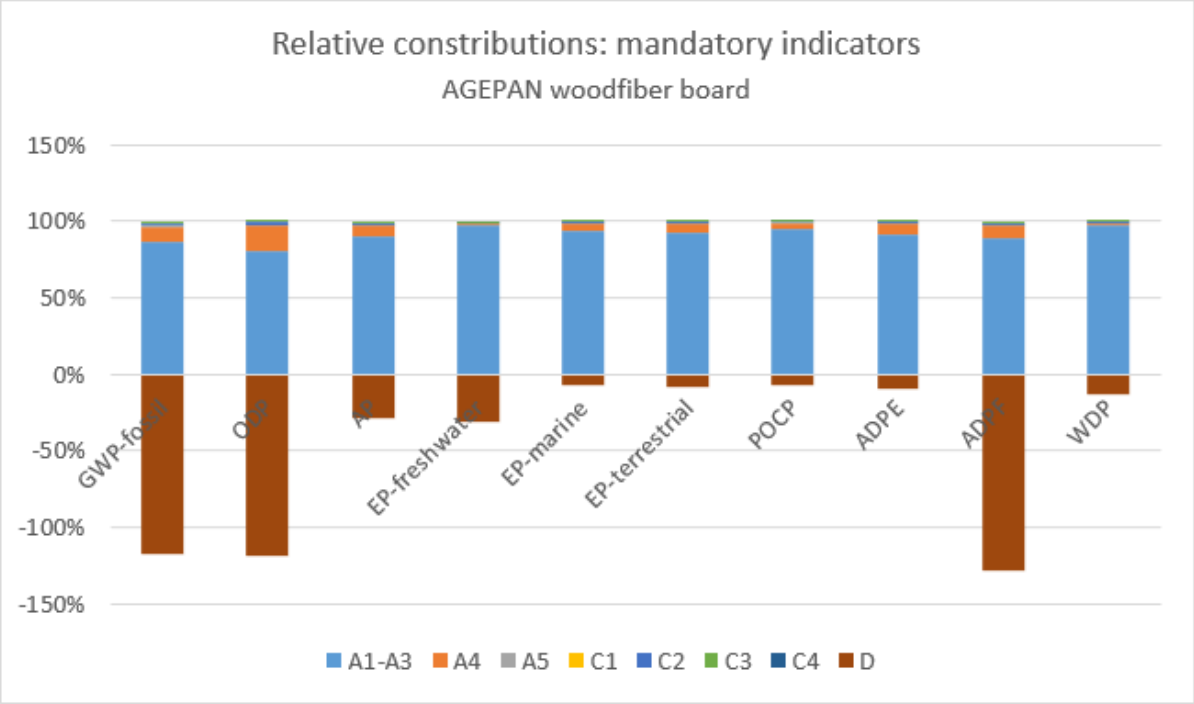


Figure 1: Environmental impacts of AGEPAN® Wood Fibreboard along its life cycle (impacts from production modules A1-C4 = 100)

Figure 1 shows that the impacts over the life cycle of the product are predominantly caused during the production of the wood fibreboard; the impacts from other parts of the life cycle are not significant.
It illustrates also that for the GWP, the ODP and the ADP fossil, the benefits from the energy recovery of AGEPAN® Wood Fibreboard are higher than the impacts during the life cycle, notably the impacts from production; for other impact categories, the benefits of energy recovery lie between 10 % to 35 %, depending on the impact category under consideration.

The *global warming potential (GWP)* is an indicator for the contribution to climate change and is quan-tified based on the emissions of gases that absorb radiative forcing.
The production phase of AGEPAN® Wood Fibreboard is largely caused by the upstream processes of the production of PMDI (around 30 %); the generation of

electricity causes around 35% of the GWP, the use of natural gas during production causes another 20 %; in sum, 10 % of the GWP are related to the forestry processes and 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 mod-ule 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.

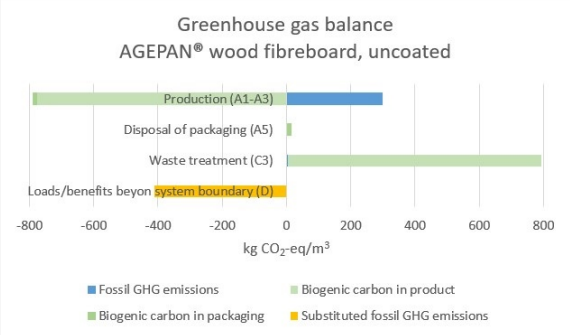


Figure2: Carbon footprint of AGEPAN®Wood Fibreboard

The *ozone layer depletion potential (ODP)* is quantified based on the emissions of gases that can de-stroy stratospheric ozone.
The ODP is caused mainly by emissions of Halon 1211, which are associated with the production and transport of natural gas. Around 20 % of the ODP are associated with the use of natural gas on-site for the production of AGEPAN® Wood Fibreboard, 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, notably for the production of PMDI.

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 production of heat; the other 75 % are associated with upstream combustion processes, notably for heat production in the production of the PMDI (50 %), for the generation of electricity (17 %), and related to production and transport of wood inputs (10%).
The AP is caused in comparable shares by emissions of ammonia, nitrogen oxides and sulphur dioxide.

The *eutrophication potentials (EP)* quantify 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 65% of the POCP are caused by the on-site emissions at the production site. 20 % of the POCP are associated with the production of PMDI resins; another 8% are caused by harvesting operations of stemwood and its transport to the production site.
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 as natural gas or crude oil.
The ADP (fossil resources) is caused mainly by the production of PMDI (35%), by the on-site consumption of natural gas (20%) and by the generation of electricity (30%).

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 copper, zinc and gold.

Selected indicators from the life cycle inventory

The main use of renewable primary energy is the heating value of the wood in AGEPAN® Wood Fibreboard; 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 processes for the production of PMDI. A minor share is used as a material, i.e., as com-po-nents 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 Fibreboard is non-hazardous waste, mainly resulting from the disposal of the infrastructure associated with, e.g., production halls or roads.
Hazardous wastes are generated throughout the production chain, e.g., related to the disposal of ashes, production wastes from chemical industry or from the production of primary aluminium for infrastruc-ture 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 by 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

AGEPAN® Wood Fibreboards meet the requirements of the German Chemicals Prohibition Regulation (ChemVerbotsV),

ZE05 Certificates by MPA Eberswalde, No. 31/22/3757/01/ZE05
The determination of the formaldehyde content according to DIN EN 717-1 (chamber method) for AGEPAN® Wood Fibreboards are below 0.05 ppm, complying with the E1 requirements of EN13986.

Measuring agency: MPA Eberswalde

Test report, date: 31/21/4562/01, dated 02-12-2021

Result: Formaldehyde emissions tests were performed for DWD and values measured was 0,012 ppm (below the 0,05 ppm limit)

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/m³.

7.3 Checking for the pre-treatment of the substances used

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

7.4 TVOC emissions

VOC emissions tests were performed for THD and DWD products according to *ISO16000-11*, with the wall panel loading scenario.

Measuring agency: Eurofins Denmark

Test report, date: G11664 and G15792, dated 17-01-2012 and 19-06-2012

Result: The measured emissions were lower than 1000 µg/m³, resulting in a classification A+.

AGEPAN® fiberboards are labelled as class A according to the French regulation on the labelling of emissions of volatile pollutants (with reference to the wall scenario, as a worst case).

Measuring agency: MPA Eberswalde

Product, test reports, date:
THD, 31/18/3359/03, 04.05.2018
UDP, 31/18/3359/01, 04.05.2018
DWD, 31/18/3359/02, 04.05.2018

AgBB overview of results (28 days [µg/m³])

Name	Value	Unit
TVOC (C6 - C16)	0,7	µg/m³
Sum SVOC (C16 - C22)	< 0,005	µg/m³
R (dimensionless)	1	-
VOC without NIK	< 0,005	µg/m³
Carcinogenic Substances	< 1	µg/m³

7.5 PCP/Lindane

The wood preservative agents pentachlorophenol (PCP) and lindane are not detected in the AGEPAN® fiberboards

Measuring agency: MPA Eberswalde, Materialprüfanstalt Brandenburg GmbH, Germany

Test report, date: 31/21/4562/01, dated 02-12-2021

Result: PCP and lindane could not be determined in the board sample of AGEPAN® DWD, examined. Limit of determination: 0.10 mg/kg.

8. References

Product category rules of IBU

IBU (2021)
IBU (2021): General Instructions for the EPD Programme of the Institut Bauen & Umwelt e.V. (General Instructions for the IBU EPD Programme). Version 2.0, Institut Bauen & Umwelt, Berlin.

IBU (2021)
IBU (2021): PCR Part A: Calculation rules for the life cycle assessment and requirements for the project report according to EN 15804+A2:2019. Version 2.1., Institut Bauen & Umwelt, Berlin.

IBU (2019)
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, 2019-01.

Standards and legal documents

EN 15804
EN 15804+A2:2019, Sustainability of construction works - Environmental product declarations - Core rules for the product category construction products.

ISO 14025
ISO 14025:2006-07, Environmental labels and declarations - Type III Environmental declarations - Principles and procedures.

ISO 14044
EN ISO 14044:2006-07, Environmental management - Life cycle assessment - Requirements and guidance (ISO 14044:2006); German and English versions EN ISO 14044:2006.

ISO 9001
ISO 9001:2015, Quality management systems – Requirements.

ISO 14001
ISO 14001:2015, Environmental management systems – Requirements with guidance for use.

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

ISO 45001
ISO 45001:2018:03, Occupational health and safety management systems - Requirements with guidance for use.

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 717-1
EN 717-1:2005-01, Wood-based panels – Determination of formaldehyde release – Formaldehyde emission by the chamber method.

EN 13501
EN 13501-1:2019-05, 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 14964
EN 14964: 2007-01, Rigid underlays for discontinuous roofing - Definitions and characteristics.

DIN 4108
DIN 4108, Thermal protection and energy economy in buildings (several parts).

EN 300
EN 300: 2006, Oriented Strand Boards (OSB) – Definitions, classification and specifications.

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 50001:2018-12, Energy management systems – Requirements with guidance for use.

Regulation (EU) No. 305/2011
Regulation No. 305/2011 (Construction Products Regulation, or CPR) of the European Parliament and of the European Council is a regulation of 9 March 2011 that lays down harmonised conditions for the marketing of construction products and replaces Construction Products Directive (89/106/EEC).

ECHA candidate list
Candidate List of substances of very high concern for Authorisation, published in accordance with Article 59(10) of the REACH Regulation. European Chemicals Agency, Brussels.

Ordinance on Biocide Products No. 528/2012
REGULATION (EU) No 528/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 May 2012 concerning the making available on the market and use of biocidal products.

European List of Waste
Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste (notified under document number C(2000) 1147).

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Werner et al. 2015
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