ENVIRONMENTAL PRODUCT DECLARATION
as per ISO 14025 and EN 15804

Owner of the Declaration | 3A Composites GmbH
Programme holder          | Institut Bauen und Umwelt e.V. (IBU)
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ALUCOBOND
3A Composites GmbH

www.bau-umwelt.com / https://epd-online.com
1. General Information

3A Composites GmbH

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
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Germany

ALUCOBOND

Owner of the Declaration
3A Composites GmbH
Alusingenplatz 1
78224 Singen
Germany

Declaration number
EPD-3AC-20140108-IBG1-EN

This Declaration is based on the Product Category Rules:
Products of aluminium and aluminium alloys, 10-2012
(PCR tested and approved by the independent expert committee)

Scope:
This document refers to the manufacture of 1 m² ALUCOBOND. It represents an individualization of the GDA EPD (EPD-GDA-20130261-IBG1-EN). 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.

Verification
The CEN Norm EN 15804 serves as the core PCR
Independent verification of the declaration according to ISO 14025

Dr. Burkhart Lehmann
(Managing Director IBU)

Matthias Schulz
(Independent tester appointed by SVA)

2. Product

2.1 Product description
ALUCOBOND aluminium composite panels are thin sandwich panels of a symmetric design comprising aluminium top layers and a thermoplastic or mineral filled core. Thanks to the mineral filled core ALUCOBOND A2 achieves class A2-s1,d0 according to EN 13501-1 and thus meets the building regulations for non-combustible materials. ALUCOBOND is characterized by flatness, a large variety of colours and perfect formability. It has been developed as a rigid and, at the same time, flexible fascia material for architecture. The high product quality is on one hand achieved thanks to the aluminum alloy (5000 series according to DIN EN 5733) and on the other hand with high quality lacquer systems (PVDF/FEVE) that are used for the special surfaces. Moreover, ALUCOBOND is extremely weatherproof, impact-resistant and break-proof, vibration-damping, and ensures easy and fast installation.

2.2 Application
ALUCOBOND panels are used as lightweight paneling elements for rear-ventilated facades /DIN 18516-1/, lower ceilings, roofs and wall paneling and as symmetrical or bent panels or cassettes in interior applications. ALUCOBOND is suitable for use in large-surface applications with high demands on symmetry and rigidity.

2.3 Technical Data
The construction data listed here is of relevance for the product.

<table>
<thead>
<tr>
<th>Construction data</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of thermal expansion</td>
<td>2.4</td>
<td>$10^{-6}$K$^{-1}$</td>
</tr>
<tr>
<td>Modulus of elasticity</td>
<td>70000</td>
<td>N/mm$^2$</td>
</tr>
<tr>
<td>Yield strength Rp 0.2 min</td>
<td>$\geq$90</td>
<td>N/mm$^2$</td>
</tr>
<tr>
<td>Tensile strength Rm min</td>
<td>$\geq$130</td>
<td>N/mm$^2$</td>
</tr>
<tr>
<td>Tensile stress at break A5 min</td>
<td>5</td>
<td>%</td>
</tr>
<tr>
<td>ALUCOBOND normal flammability</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3mm panel weight (dimensioning)</td>
<td>0.45</td>
<td>kN/m$^2$</td>
</tr>
<tr>
<td>4mm panel weight (dimensioning)</td>
<td>0.55</td>
<td>kN/m$^2$</td>
</tr>
<tr>
<td>6mm panel weight (dimensioning)</td>
<td>0.75</td>
<td>kN/m$^2$</td>
</tr>
<tr>
<td>ALUCOBOND plus / A2 flame-retardant</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3mm panel weight (dimensioning)</td>
<td>0.60</td>
<td>kN/m$^2$</td>
</tr>
<tr>
<td>4mm panel weight (dimensioning)</td>
<td>0.75</td>
<td>kN/m$^2$</td>
</tr>
<tr>
<td>6mm panel weight (dimensioning)</td>
<td>1.10</td>
<td>kN/m$^2$</td>
</tr>
</tbody>
</table>
The coated strips are then laminated and for drying the varnishes. During this process are collected and thermally utilised coating process until the final width. Solvents used inorganic solvents. Solvent vapours are thermally utilised by means of combustion at the plant location.

Several rolling processes are usually required in order to achieve the required material properties in terms of formability and strength. The aluminium strips are coated in a continuous coil-coated to EN 1396, see EPD Coil-Coated Aluminium Sheet No. EPD-GDA-20130259-IBG1-EN, and a generally thermoplastic core layer (e.g. PE, PP, EVA). Typical aluminium alloys for the construction sector comply with the 3000 and 5000 series to /DIN 6721-1/.

Prior to varnishing, a conversion layer is applied as surface pre-treatment. This can contain chromate or chrome III or be chrome-free.

2.7 Manufacture

Rolling ingots are usually cast from the application-specific aluminium alloy via a continuous casting process. These rolling ingots are slid between two rotating steel rollers which are spaced a little less than the thickness of the rolling pieces. Friction causes entrainment by the rollers and compression to the space between the rollers. This reshaping is primarily lengthwise causing the rolled pieces to elongate. Several rolling processes are usually required in order to obtain the final thickness. Thermal treatment is performed in order to achieve the required material properties in terms of formability and strength. The aluminium strips are coated in a continuous coil coating process until the final width. Solvents used during this process are collected and thermally utilised for drying the varnishes. The coated strips are then laminated and cut to length in a further process involving a continuously manufactured core (e.g. extrusion).

2.8 Environment and health during manufacturing

The production site in Germany has been certified according to DIN EN ISO 9001, BS OHSAS 18001, DIN EN ISO 14001 and DIN EN ISO 50001.

The coating process requires the use of organic and inorganic solvents. Solvent vapours are thermally utilised by means of combustion at the plant location. No measures over and beyond the statutory requirements are demanded for the manufacture of ALUCOBOND.

2.9 Product processing/Installation

ALUCOBOND panels are cut to format using circular saws. For folding, the composite panels V-shaped grooves are milled using conventional woodworking machinery. Edges are formed manually. Cutting edges do not require sealing as the material is ductile. No specific environmental protection measures are required while processing ALUCOBOND. The General Information on Industrial Safety and Health /BGI 5081/ applies.

2.10 Packaging

PE foils, wooden pallets and plastic tape are used as packaging materials. After use, packaging materials can be re-used or recycled. Wooden pallets, plastic and paper can be collected separately and directed to the recycling circuit.

2.11 Condition of use

The product remains unchanged during its use phase. When the product is used as designated, no changes in material composition are to be anticipated during processing or use.

2.12 Environment and health during use

When ALUCOBOND is used as designated, no interactions between the environment and health are known.

Sound insulation:

Sound insulation improved by up to 12 dB can be achieved on a cellular concrete wall 200 mm thick with Rw,R = 44 dB using a back-ventilated facade with 12 cm fibre insulation and panelling featuring 4 mm ALUCOBOND (as per /EN ISO 10140-1/). Damping behaviour (e.g. drumming noises caused by driving rain) is 5 to 10 times better than when using comparable solid aluminium sheeting (as per /EN ISO 6721-1/).

2.13 Reference service life

The service life for many aluminium applications in the construction sector is often determined by the service life of the building. Maintenance is low thanks to the self-passivating surface. When used as designated, a service life of more than 70 years can be assumed.

2.14 Extraordinary effects

Fire

Building material class to /EN 13501-1/

- non-combustible A2, s1, d0 verifiably without toxic flue gases
- flame-retardant, B, s1, d0
- normal flammability D/E

Fire-retardant core materials with flame- and smoke-retardant effect.

Water

The surfaces are inert and do not flush out any or only insignificant volumes of hazardous contents even in a "worst-case scenario" /ECN-X--11-089/. ALUCOBOND does therefore not represent any hazard for soil, surface or groundwater in accordance with the EU Construction Products Directive /89/106/EC/.
Environmental Product Declaration 3A Composites GmbH – ALUCOBOND

Mechanical destruction
In the event of mechanical destruction, all substances remain bound.

2.15 Re-use phase
De-construction: Depending on the mounting system, the facade elements and smooth panels can be removed non-destructively by unscrewing or opening the studs.

Re-use and recycling
In undamaged form, the de-constructed products can be re-used in accordance with their original designated purpose. When separated by type, the elements can be shredded, for example, and the aluminium and core recycled after treatment.

2.16 Disposal
There is no specific waste code for ALUCOBOND from de-construction in accordance with the European Waste Catalogue. Allocation in accordance with EWC 17 09 04 is possible. ALUCOBOND is accepted by scrap dealers on the basis of the respective daily aluminium scrap prices.

2.17 Further information
More information available at: www.aluinfo.de.

3. LCA: Calculation rules

3.1 Declared Unit
The declared unit refers to 1 m² ALUCOBOND with a thickness of 4 mm and a weight of 7.04 kg. The average is based on 5 products from 2 manufacturers.

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion factor to 1 kg</td>
<td>0.142</td>
<td>-</td>
</tr>
<tr>
<td>Declared unit</td>
<td>1</td>
<td>m²</td>
</tr>
</tbody>
</table>

3.2 System boundary
Type of EPD: Cradle to gate - with options
This Life Cycle Assessment takes consideration of the life cycle stages of Production and End of Life (EoL). The product stage comprises Modules A1 (Raw material supply), A2 (Transport) and A3 (Production). Module D depicts the credits from the re-use, recovery and recycling potential in accordance with /EN 15804/.

3.3 Estimates and assumptions
It was assumed that ALUCOBOND is directed to aluminium recycling after the use phase. A credit is only provided for the metal content; no credits are supplied for the core material. The data set from the EPD Coil-Coated Aluminium Sheet with the Declaration number EPD-GDA-20130259-IBG1-EN was applied.

3.4 Cut-off criteria
All operating data was taken into consideration in the analysis. Processes whose entire contribution towards the final manufacturing result in terms of mass and less than 1% of all impact categories considered were ignored. It can be assumed that the processes ignored would each have contributed less than 5% to the impact categories under review.

3.5 Background data
GaBi 6 2013 - the software system for comprehensive analysis developed by PE International – was used for modelling the life cycle for the manufacture of bright aluminium sheet. The consistent data sets contained in the GaBi data base were applied for energy, transport and consumables. The Life Cycle Assessment was drawn up for Germany and France as a reference area. This means that apart from the production processes under these marginal conditions, the pre-stages also of relevance for Germany and France such as provision of electricity or energy carriers were used. The power mix for Germany and France for the reference year 2009 is applied.

3.6 Data quality
The data collated by the GDA members for the production year 2011/2012 was used for modelling the product stage of ALUCOBOND. All other relevant background data sets were taken from the GaBi 6 software data base and are less than 5 years old.

3.7 Period under review
The data for this Life Cycle Assessment is based on data sets from 2011. The period of review involves 12 months for one company and 6 months for the other one.

3.8 Allocation
Of the aluminium scrap incurred in the system during production and end-of-life, the requisite volume of recycled aluminium is redirected to production. If only primary aluminium is used in product manufacturing or more scrap is incurred than can be redirected to recycling, it is assumed that these scrap values have reached end-of-waste status. A credit is supplied with primary material minus the expenses associated with remelting. This credit (substitution of primary material) is allocated to Module D taking consideration of a recovery rate (collection rate of 98%) and processing losses (4%).

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

Modules A4, A5, B1-B7 and C1-C4 are not taken into consideration in this Declaration. Credits are incurred as a result of 100% recyclability of aluminium and are indicated in Module D. After waste collection (a 98% collection rate was assumed), the aluminium scrap is melted (remelting losses of approx. 7%) and can be re-used as recycled material. The value of the credit after remelting was calculated on the basis of the data set for primary production.
### 5. LCA: Results

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

<table>
<thead>
<tr>
<th>PRODUCT STAGE</th>
<th>CONSTRUCTION STAGE</th>
<th>USE STAGE</th>
<th>END OF LIFE STAGE</th>
<th>BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material supply</td>
<td>Transport</td>
<td>Manufacturing</td>
<td>Transport from the gate to the site</td>
<td>Assembly</td>
</tr>
<tr>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
<td>A5</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>MND</td>
<td>MND</td>
</tr>
</tbody>
</table>

#### RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: ALUCOBOND / 1m²

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1 - A3</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global warming potential</td>
<td>[kg CO₂-Eq.]</td>
<td>3.700E+1</td>
<td>-2.400E+1</td>
</tr>
<tr>
<td>Depletion potential of the stratospheric ozone layer</td>
<td>[kg CFC11-Eq.]</td>
<td>8.100E-7</td>
<td>-7.400E-7</td>
</tr>
<tr>
<td>Acidification potential of land and water</td>
<td>[kg SO₂-Eq.]</td>
<td>1.700E-1</td>
<td>-1.400E-1</td>
</tr>
<tr>
<td>Eutrophication potential</td>
<td>[kg (PO₄³⁻- Eq.)]</td>
<td>1.000E-2</td>
<td>-7.100E-3</td>
</tr>
<tr>
<td>Formation potential of tropospheric ozone photochemical oxidants</td>
<td>[kg Ethene Eq.]</td>
<td>1.200E-2</td>
<td>-7.900E-3</td>
</tr>
<tr>
<td>Abiotic depletion potential for non fossil resources</td>
<td>[kg Sb Eq.]</td>
<td>2.100E-5</td>
<td>-1.300E-5</td>
</tr>
<tr>
<td>Abiotic depletion potential for fossil resources</td>
<td>[MJ]</td>
<td>5.500E+2</td>
<td>-2.600E+2</td>
</tr>
</tbody>
</table>

#### RESULTS OF THE LCA - RESOURCE USE: ALUCOBOND / 1m²

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1 - A3</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable primary energy as energy carrier</td>
<td>[MJ]</td>
<td>1.400E+2</td>
<td>-1.300E+2</td>
</tr>
<tr>
<td>Renewable primary energy resources as material utilization</td>
<td>[MJ]</td>
<td>0.000E+0</td>
<td>0.000E+0</td>
</tr>
<tr>
<td>Total use of renewable primary energy resources</td>
<td>[MJ]</td>
<td>1.400E+2</td>
<td>-1.300E+2</td>
</tr>
<tr>
<td>Non renewable primary energy as energy carrier</td>
<td>[MJ]</td>
<td>6.000E+2</td>
<td>-3.000E+2</td>
</tr>
<tr>
<td>Non renewable primary energy as material utilization</td>
<td>[MJ]</td>
<td>2.000E+1</td>
<td>0.000E+0</td>
</tr>
<tr>
<td>Total use of non renewable primary energy resources</td>
<td>[MJ]</td>
<td>6.200E+2</td>
<td>-3.000E+2</td>
</tr>
<tr>
<td>Use of secondary material</td>
<td>[kg]</td>
<td>0.000E+0</td>
<td>0.000E+0</td>
</tr>
<tr>
<td>Use of renewable secondary fuels</td>
<td>[MJ]</td>
<td>1.800E-2</td>
<td>-1.600E-2</td>
</tr>
<tr>
<td>Use of non renewable secondary fuels</td>
<td>[MJ]</td>
<td>1.700E-1</td>
<td>-1.400E-1</td>
</tr>
<tr>
<td>Use of net fresh water</td>
<td>[m³]</td>
<td>4.000E-1</td>
<td>-3.700E-1</td>
</tr>
</tbody>
</table>

#### RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: ALUCOBOND / 1m²

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1 - A3</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous waste disposed</td>
<td>[kg]</td>
<td>3.100E-2</td>
<td>-2.000E-2</td>
</tr>
<tr>
<td>Non hazardous waste disposed</td>
<td>[kg]</td>
<td>7.200E+0</td>
<td>-6.800E+0</td>
</tr>
<tr>
<td>Radioactive waste disposed</td>
<td>[kg]</td>
<td>2.700E-2</td>
<td>-2.000E-2</td>
</tr>
<tr>
<td>Components for re-use</td>
<td>[kg]</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Materials for recycling</td>
<td>[kg]</td>
<td>-</td>
<td>6.900E+0</td>
</tr>
<tr>
<td>Materials for energy recovery</td>
<td>[kg]</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exported electrical energy</td>
<td>[MJ]</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exported thermal energy</td>
<td>[MJ]</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
6. LCA: Interpretation

Distribution of the environmental impacts in Modules A1, A2, A3 and D indicates that the contributions from Module A1 (raw materials) are the dominating ones. The credits in Module D are only attributable to recycling the aluminium scrap.

The greatest contribution to the Global Warming Potential (GWP, 100 years) is made by the supply of preliminary products (approx. 89%) - largely through manufacture of the aluminium sheet (approx. 88%) and core material (approx. 12%). The rest (approx. 11%) is caused by the provision of auxiliaries and the actual composite panel process step. All in all, approx. 65% of all GWP emissions are credited by recycling the aluminium at the end of life.

The Ozone Depletion Potential (ODP) is dominated by the provision of preliminary products (aluminium sheet approx. 99.9%). A total of 91% of all ODP emissions are credited by recycling the aluminium. Approx. 86% of all emissions during the production stage causing the Acidification Potential (AP) are triggered by the aluminium sheet. 9% are attributable to the core material in the composite panels. A credit of approx. 82% of total AP emissions is offset primarily by recycling the aluminium.

The greatest contribution to the Eutrophication Potential (EP) is made by aluminium sheet as a preliminary product (approx. 79%) and the core material (approx. 11%). Another 9% is caused by manufacturing of the actual composite sheets. Raw material transport (Module A2) accounts for 1%. In all, approx. 71% of all emissions are credited.

The Photochemical Ozone Creation Potential (POCP) is triggered by the provision of preliminary products (approx. 93%). These involve aluminium sheet (approx. 80%) and core material (approx. 11%). Credits account for approx. 66% here.

The abiotic consumption of resources (ADP elementary) is caused by the product stage (Modules A1-A3) where primarily the upstream chains from A1 (approx. 99%) (aluminium sheet approx. 72% and core material approx. 28%) contribute to overall ADP elementary. Total credits account for approx. 58%.

The abiotic consumption of resources (ADP fossil) is primarily the result of contributions made by the upstream chains in Module A1. Production of aluminium sheet (approx. 78%) and core material (approx. 34%) also make a contribution. A credit of approx. 62% is largely attributable to aluminium recycling.

Approx. 71% of total primary energy requirements is covered by non-renewable energy sources and approx. 19% by renewable energies.

The total use of renewable primary energy sources (PERT) is largely the result of the upstream chains associated with manufacturing preliminary products (Module A1), whereby the influence of aluminium sheet production is particularly apparent at approx. 97%. The credit (Module D) accounts for a total of approx. 93% which is attributable to aluminium recycling.

In an analysis of the total non-renewable primary energy requirements (PENRT), the upstream chains associated with manufacturing preliminary products (approx. 87%) make the main contribution with approx. 70% attributable to the production of aluminium sheet and approx. 13% attributable to production of the composite core material. 15% of the total PENRT is caused by manufacturing of the actual composite panels. All in all, approx. 50% is credited; credits are primarily attributable to recycling the metallic preliminary products.
7. Requisite evidence

Roof and facade product weathering is subject to several influential factors. Apart from the alloy and type of surface coating, other influential factors also include the environment (industry, sea etc.) and regional weather conditions as well as prevailing environmental conditions. Removal of the surface can only be measured specifically on the respective buildings.

8. References

**BGI 5081**: 2012-07, Component Booklet, Industrial Safety and Health at Work, Professional association for the building industry, Berlin

**DIN 18516-1**: 2010-06, Cladding for external walls, ventilated at rear – Part 1: Requirements, principles of testing

**DIN 52210**: 1984-08, Testing of acoustics in buildings; Airborne and impact sound insulation; Determination of the level difference by shafts

**EN 485**: 2008-02, Aluminium and aluminium alloys – Sheet, strip and plate

**EN 573-3**: 2009-08, Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 3: Chemical composition and form of products

**EN 1396**: 2007-04, Aluminium and aluminium alloys – Coil-coated sheet and strip for general applications – Specifications

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

**EN ISO 6721-1**: 2008-08, Plastics – Determination of dynamic mechanical properties – Part 1: General principles

**EN ISO 6892-1**: 2009-12, Metallic materials – Tensile testing – Part 1: Method of test at room temperature

**EN ISO 10140-1**: 2012-05, Acoustics – Laboratory measurement of sound insulation of building elements – Part 1: Application rules for specific products

**ECN-X--11-089**: Energy research Centre of the Netherlands, Evaluation of impact of Aluminium Construction Products on soil surface and groundwater, June 2011


**GaBi 6 2013**: PE INTERNATIONAL AG; GaBi 6: Software system and data base for comprehensive analysis. Copyright TM. Stuttgart, Echterdingen, 1992-2013


**Kammer 2009**: Aluminium Taschenbuch 2009, 16th print run, Dr.-Ing. C.Kammer, Aluminium-Verlag Marketing und Kommunikation GmbH, Düsseldorf

**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

**PCR Part A**

Institut Bauen und Umwelt e.V., Königswinter (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report. April 2013

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