



OWNER OF THE DECLARATION: DIAB ITALY



ENVIRONMENTAL PRODUCT DECLARATION

PRODUCT NAME: DIVINYCELL IPN GRADES

PLANT: VIA ALEMAGNA, 29 - 32013 LONGARONE (BL), ITALY

in compliance with ISO 14025 and EN 15804: 2012+A1:2013

| | |
|---------------------|---------------|
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Standard EN 15804 serves as the core PCR (PCR ICMQ-001/15 rev 2.1)

Independent verification of the declaration and data, according to ISO 14025:2006

| | | |
|----------------------|---|---|
| Internal | External | X |
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| Accredited by: | ACCREDIA | |

EPDs within the same product category but from different programs may not be comparable.

EPD of construction products may not be comparable if they do not comply with EN 15804.

The present environmental declaration has been developed according to the EPDItaly program regulation rev. 4 dated 03/06/2019.

www.epditaly.it

General information

Information about the organization

Owner of the EPD: DIAB S.p.A., via Alemagna, 29, 32013 Longarone (BL), Italy. Fabiano Nart, Fabiano.Nart@it.diabgroup.com, +39 334 6409205. The EPD owner has the sole ownership, liability, and responsibility for the EPD.

Description of the organisation: Diab is a world leader in high-performance composite core materials. Diab has developed composite core material development for over sixty years, supplying a wide range of markets including marine, wind energy, transport, aerospace and industry.

Diab has ISO 9001- and 14001-certificates

Name and location of production site: Diab produces IPN core materials at one location in Longarone, Italy.

About the company

Diab is a global company that develops, manufactures and sells core materials for sandwich composite structures used in for example leisure boats, wind turbine blades and components for aircraft, trains, industrial applications and buildings. The core materials have a combination of characteristics such as low weight, high strength, insulation properties and chemical resistance.

The company has production units in Sweden, Italy, the US and China. Material processing takes place in the production units as in Lithuania and Ecuador as well.

The market for core material is growing due to the underlying demand for energy efficiency, which is leading to a greater need for high-strength, lightweight solutions. Wind turbines, leisure boats and various applications requiring the combination of lightweight and high strength are the main application areas for the material.



Product information

Product name: Divinycell IPN grades CY33, CY55, MX10-8, H60, H80, HP60, and HP80

Product identification: Divinycell IPN grades are produced from PVC, isocyanates, anhydrides and blowing agents.

Product description:

CY series, it stands for “cryogenic” and they are used as insulator for LNG transportation oversea. MX series, it stands for “matrix”, basically the same density of the homologues H-series, but with higher mechanical properties at room temperature. HP series, it stands for “high performance”, basically the same density of the homologues H-series, but with higher mechanical properties at high temperature.

LCA information

Declared unit: 1 kg lightweight IPN core material block

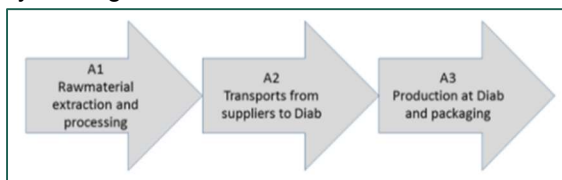
Reference service life: Minimum 25 years

Time representativeness: Data representative for production year 2019. For materials, energy and transports generic industry data from Ecoinvent has been used. Assessment time for background data is 2010-16.

Database(s) and LCA software used: Ecoinvent 3.3 and SimaPro 8.3

System diagram:

This is a cradle to gate EPD. The following life cycle stages are included:



Description of system boundaries:

A1: Extraction and processing of raw materials and generation of electricity and gas

All Divinycell IPN grades are core materials used for sandwich structure. These composites are a special class of composite materials with the typical features of low weight, high stiffness and high strength. Sandwich materials are fabricated by attaching layers of polymers or metals to the lightweight IPN core.

All Divinycell IPN grades have good thermal stability and are recyclable.

UN CPC code: 363 (semi-manufactures of plastics)

Geographical scope: Italy

A2: Transports from suppliers to Diab

A3: Manufacturing of the product at Diab and packaging materials used

Estimates and assumptions: electricity and gas use as well as waste in production and packaging use are calculated as an average for all IPN products produced using yearly production data and rate for 2019 from the production location in Italy.

There are different grades within the IPN product range with small differences in mixture of raw material substances.

This EPD represents an average IPN product and covers all grades. All grades are within a 10% variation in environmental impact.

Cut off criteria: All major materials, production energy use and waste are included. Materials less than 1% weight in the IPN grades are not considered.

All emissions from manufacturing is either zero or well below the quantifiable threshold.

Data quality: The data quality can be described as fair to good. The primary data collection has been done thoroughly; all relevant flows are considered.

| Life cycle environmental information of | | | | | | | Other environmental information |
|---|----|----|----------------------------|-----|-----------|-------------------|---------------------------------|
| Product stage | | | Construction process stage | | Use stage | End of life stage | Reuse recovery stage |
| A1 | A2 | A3 | A4 | A5 | B1-B7 | C1-C4 | D |
| X | X | X | MND | MND | MND | MND | MND |

Description of the system boundary (X = included in LCA; MND = Module Not Declared)

Content declaration

Product

| Materials / chemical substances | % |
|---------------------------------|-------|
| PVC | 30-75 |
| Aromatic polyurea | 15-50 |
| Polyamide | 3-10 |

There are no SVHC substances according to REACH in the product or in the waste.

Packaging

Distribution packaging: Wood, corrugated board and PE packaging film

Recycled material

Provenience of recycled materials (pre-consumer or post-consumer) in the product: NA

Interpretation of LCA results

Environmental impact for 1 kg Divinycell IPN grade lightweight core material block is mainly caused by extraction and processing of materials like PVC used in the recipe of the product (calculated in module A1). Impact in A1 is further increased by product waste from sawing, sanding and sometimes milling the final product to the desired dimensions and customer shape.

Impact from other waste in the process is insignificant. Impact for generation and supply of electricity is also calculated in module A1.

Approximately 70% of the greenhouse warming potential comes from raw materials in the product. For impact factors acidification and eutrophication potential raw materials in A1 also accounts for approximately 70% of the total. The other environmental contribution in A1 comes from production of electricity.

Train and lorry transport is used to send materials from suppliers to Diab in Longarone. Environmental impact from these transports is calculated in module A2 and is small in relation to impact in module A1 and A3.

In module A3, environmental impact from packaging material is calculated as well as impact of emission by natural gas used in the production process. Impact from packaging materials leaving the factory with products is very low but impact from use of natural gas is significant.

Greenhouse warming potential from A3 accounts for 20% of the total potential for IPN. For impact factors acidification and eutrophication potential A3 accounts for less than 5% of the total potential for A1+A2+A3 together.

Environmental performance

Potential environmental impact/kg IPN

| PARAMETER | UNIT | A1 | A2 | A3 | TOTAL A1-A3 |
|---|--------------------------------------|----------|----------|----------|-------------|
| Global warming potential (GWP) | kg CO ₂ eq. | 5,68E+00 | 7,55E-02 | 1,38E+00 | 7,13E+00 |
| Depletion potential of the stratospheric ozone layer, ODP | kg CFC-11 eq. | 1,49E-05 | 1,05E-08 | 1,68E-07 | 1,51E-05 |
| Acidification potential (AP) | kg SO ₂ eq. | 2,36E-02 | 2,37E-04 | 1,07E-03 | 2,49E-02 |
| Eutrophication potential (EP) | kg PO ₄ ³⁻ eq. | 3,83E-03 | 6,64E-05 | 2,00E-04 | 4,10E-03 |
| Formation potential of tropospheric ozone (POCP) | kg C ₂ H ₄ eq. | 1,21E-03 | 7,10E-06 | 9,44E-05 | 1,31E-03 |
| Abiotic depletion potential – Elements | kg Sb eq. | 6,53E-02 | 4,85E-04 | 1,18E-02 | 7,76E-02 |
| Abiotic depletion potential – Fossil resources | MJ, net calorific value | 1,48E+02 | 1,13E+00 | 2,43E+01 | 1,73E+02 |

Use of resources/kg IPN

| PARAMETER | UNIT | A1 | A2 | A3 | TOTAL A1-A3 | |
|--|-------------------------|-------------------------|----------|----------|-------------|----------|
| Primary energy resources – Renewable | Use as energy carrier | MJ, net calorific value | 2,73E+00 | 1,10E-02 | 6,71E-01 | 3,42E+00 |
| | Used as raw materials | MJ, net calorific value | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |
| | TOTAL | MJ, net calorific value | 2,73E+00 | 1,10E-02 | 6,71E-01 | 3,42E+00 |
| Primary energy resources – Non-renewable | Use as energy carrier | MJ, net calorific value | 1,48E+02 | 1,13E+00 | 2,43E+01 | 1,73E+02 |
| | Used as raw materials | MJ, net calorific value | 1,22E+01 | 0,00E+00 | 8,00E-02 | 1,22E+01 |
| | TOTAL | MJ, net calorific value | 1,60E+02 | 1,13E+00 | 2,44E+01 | 1,85E+02 |
| Secondary material | kg | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | |
| Renewable secondary fuels | MJ, net calorific value | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | |
| Non-renewable secondary fuels | MJ, net calorific value | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 | |
| Net use of fresh water | m ³ | 8,44E+00 | 4,84E-04 | 2,14E-03 | 8,44E+00 | |

Waste production and output flows

Waste production/kg IPN

| PARAMETER | UNIT | A1 | A2 | A3 | TOTAL A1-A3 |
|------------------------------|------|----------|----------|----------|-------------|
| Hazardous waste disposed | kg | 6,32E-05 | 3,22E-07 | 2,30E-05 | 8,65E-05 |
| Non-hazardous waste disposed | kg | 1,68E-01 | 8,48E-05 | 3,51E-01 | 5,19E-01 |
| Radioactive waste disposed | kg | 2,96E-05 | 9,65E-07 | 2,47E-06 | 3,30E-05 |

Output flows/kg IPN

| PARAMETER | UNIT | A1 | A2 | A3 | TOTAL A1-A3 |
|-------------------------------|------|----------|----------|----------|-------------|
| Components for reuse | kg | 0,00E+00 | 0,00E+00 | 1,60E-02 | 1,60E-02 |
| Material for recycling | kg | 0,00E+00 | 0,00E+00 | 1,00E-02 | 1,00E-02 |
| Materials for energy recovery | kg | 0,00E+00 | 0,00E+00 | 1,00E-02 | 1,00E-02 |
| Exported energy, electricity | MJ | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |
| Exported energy, thermal | MJ | 0,00E+00 | 0,00E+00 | 0,00E+00 | 0,00E+00 |

Additional product information

Divinycell IPN grades (IPN stands for Interpenetrating Polymer Network) are a mixture of thermoplastic PVC and thermoset polymers as polyurea and polyamide. The main products are available in sheets from approximately 80 mm thickness down to 0,5 mm, further it can be milled and grooved to various structures according to customer request.

Divinycell IPN grades provide mechanical properties to low weight. The IPN chemical structure, yields impressive mechanical performance to a low weight. Other key features of Divinycell IPN grades include adhesion/peel strength, excellent chemical resistance, low water absorption and good thermal/acoustic insulation.

Divinycell IPN grades are widely used and has a proven track record in virtually every application area where sandwich composites are employed including the marine (leisure, military and commercial), land transportation, wind energy, civil engineering/infrastructure, buildings and general industrial markets.

Technical data

Datasheets for all specific grades are available for all Divinycell IPN-grades on our website www.diabgroup.com

Delivery status

The products are delivered as ordered, which varies from standard plain sheet size to complex milled details requiring specially constructed packages.

Base materials and manufacture

Divinycell IPN grades are produced from PVC, isocyanates, anhydrides and blowing agents in a process containing the main steps as follows. There are no SVHC substances according to REACH in the product.

The raw material used, with a short description of their functions, are the following:

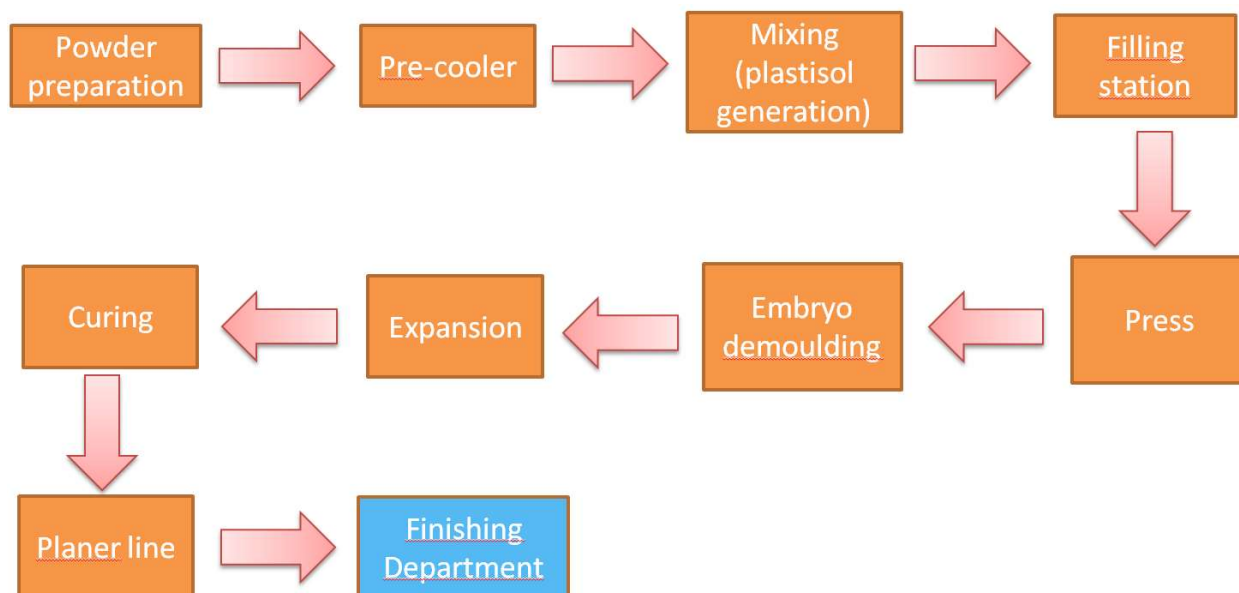
- PVC resin, thermoplastic component
- Isocyanates, they contribute to build both new thermoplastic polymer and thermoset to increase mechanical properties
- Anhydride, plasticizer and contributor to gas phase
- Blowing agents AZDN/AIBN (azobis-isobutironitrile), ADC (azodicarbonamide), ADK (sodium bicarbonate), they generate the gas phase for the foaming
- Surfactant, compatibilizer and catalyst
- Zeolite, filler.

Product processing

All Divinycell IPN grades are core materials used for sandwich structure. These composites are a special class of composite materials with the typical features of low weight, high stiffness and high strength. Sandwich materials are fabricated by attaching layers of polymers or metals to the lightweight IPN core.

The main production steps are as follows:

- Mixing of raw materials to a homogeneous plastisol.
- Filling the plastisol into moulds followed by putting them into presses and adding heat and pressure. This creates a rubbery small visually solid block, SLAB.
- The SLAB is expanded and further cured in heated water / steam environment in different chambers with varying temperatures related to which grades that are produced. Here the final block is created and all chemical reactions are finalized. All the following process steps are pure machining.
- Cutting, sawing and milling of the blocks according to customer specification.
- Some grades for special applications also have a heat treatment step after sawing to sheets in order to further stabilize the dimensions.
- The products are finally packed and shipped to customer.



Process flow of IPN production.

Production mix 2019

In Italy the following commercial grades are produced or requalified and sold to the market:

- CY series, it stands for “cryogenic” and they are used as insulator for LNG transportation oversea.
- H series, it is the historical name of the first recipe.
- MX series, it stands for “matrix”, basically the same density of the homologues H-series, but with higher mechanical properties at room temperature.
- HP series, it stands for “high performance”, basically the same density of the homologues H-series, but with higher mechanical properties at high temperature.

Ground recipe with average material content in representative IPN grade as well as average for representative IPN grade.

| Raw material | CY33 | CY55 | MX10-8 | H60 | H80 | HP60 | HP80 | avg |
|--|------|------|--------|------|------|-------|-------|------|
| PVC | 43,5 | 46,3 | 39,1 | 40,3 | 47,5 | 45,4 | 46,2 | 44,0 |
| Isocyanate (total) the two isocyanates are similar, the polymeric is a sort of monomeric polymerized | 37 | 40,5 | 50,7 | 50,8 | 41,1 | 46,59 | 46,17 | 44,7 |
| anhydride (total) the two anhydrides are very similar, so we can consider them as one material | 14 | 8,5 | 4,4 | 4,4 | 6,5 | 3,5 | 3,2 | 6,4 |
| blowing agent (AZDN) this can be considered as main blowing agent | 4,3 | 3,6 | 4,1 | 4 | 3,8 | 3,9 | 3,8 | 3,9 |
| Others | 1.2 | 1.1 | 1.7 | 0.5 | 1.1 | 0.61 | 0.63 | 1 |
| Weight % | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

Packaging

Generally, the material is packed using cardboard, stretch film (LLDPE) and packaging tape (PP).

Environment and health during use

Inhalation: No fumes or inhalation hazard at normal use temperatures. Molten plastic may emit fumes; exposed individuals should be moved to fresh air.

Skin contact: Foam is not irritating to skin.

Eye contact: By direct contact with shaving or dust, irrigate with flowing water. Consult medical personnel if irritation persists.

Ingestion: Material is non-toxic; consult medical personnel if large amounts have been swallowed.

The foam material is **not hazardous** under normal handling and storage conditions but when machining ensure good ventilation for dust reduction.

When exposed to a direct flame, the material can generate carbon dioxide, CO, hydrogen chloride and hydrogen cyanide (HCN). As soon as the direct flame is removed, the material self-extinguishes. The primary hazard is dust generation during processing with cutting, sanding and sawing operations. Dust mask protection should be used when performing these types of operations. The dust will ignite if given sufficient ignition source. The dust should be processed in a way to avoid static sparks and accumulation of extra dust in the manufacturing area with good cleaning practices in the manufacturing areas.

End of life

The material is considered chemically inert and is not expected to present a risk if mechanically destructed. If the Divinycell IPN material is dismantled from the sandwich construction it can be taken back to Diab for re-use.

The foam material is not classified as a hazardous waste material. There are no SVHC substances according to REACH in the waste. Consult local authorities when handling larger quantities of waste

- Not flammable organic waste
- Not environmentally hazardous waste
- Waste class: Not hazardous waste
- Waste code (EWC): 07 02 13

References

EN 15804:2012 Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products

ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines

EPDItaly General Programme Instructions, v 4 (03/06/2019)


Product Category Rules PCR ICMQ-001/15, "Construction products and construction services", rev2.1 (03/06/2019)

Greenhouse Gas Protocol (Dual Reporting) Report for Diab dated Jan. 19, 2018

Ecoinvent 3.3 database, <http://www.ecoinvent.org/>

LCA software SimaPro Analyst 8.3

Contact information:

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