

Environmental Product Declaration



In Accordance With ISO 14025 and EN 15804 for;
BarChip 48, BarChip 54 and BarChip 60 Macro Synthetic Fibre
Concrete Reinforcement from BarChip Inc.

| | |
|---------------------------|--|
| Programme: | EPD Australasia, https://epd-australasia.com/ |
| Programme operator | EPD Australasia Limited |
| EPD registration number: | S-P-02054 |
| Publication date: | 1 December 2020 |
| Valid until: | 1 December 2025 |
| Geographical scope of EPD | Global |

Using This EPD

The International EPD® System is a worldwide programme operating in accordance with ISO 14025 for type III environmental declarations and relevant EPDs and PCRs are compliant with European standard EN 15804. They operate a system to verify and register EPDs and maintain a publicly-available library of EPDs and PCRs. Over 1100 EPDs for a wide range of product categories are currently registered by companies in 45 countries.

EPDs may be used in building assessment schemes to quantify the life cycle environmental impacts of the ongoing construction materials. EPDs are suitable for building assessment schemes since they are:

- Based on international standards
- Include the life cycle perspective (cradle-to-gate or cradle-to-grave, depending on the product)
- Cover multiple environmental impact categories
- Are independently verified and aim for comparability within the same product category

Such building assessment schemes include:



Green Star uses a robust, transparent and independent assessment process, and projects that certify can proudly display the Green Star Certification Trademark. Only projects that have been certified by GBCA can claim to achieve a Green Star rating.



The Infrastructure Sustainability Council of Australia (ISCA) is a member-based, not-for-profit peak body operating in Australia and New Zealand with the purpose of enabling sustainability outcomes in infrastructure.



LEED by the US Green Building Council (USGBC) is one of the building assessment schemes that have come the furthest in giving benefits for projects where EPDs are available to encourage the use of products with life-cycle information.



BREEAM is the world's leading sustainability assessment method for master planning projects, infrastructure and buildings. It recognises and reflects the value in higher performing assets across the built environment lifecycle, from new construction to in-use and refurbishment.

BarChip Inc.



History

Founded in 1962, Hagihara Industries is one of the world's leading manufacturers of woven yarn products.

In 1996, Hagihara began development of one of the first high-performance macro synthetic fibre (MSF) concrete reinforcements, *BarChip M*. Hagihara saw an opportunity to improve the performance of this new technology and decades of plastics extrusion experience enabled Hagihara to design and build new extrusion and cutting machines for this purpose.

In 2000, Hagihara entered into partnership with Elasto Plastic Concrete (EPC) to distribute BarChip internationally. Within a few short years, this partnership produced the revolutionary *BarChip Shogun* fibre. Shogun was the first MSF capable of matching and surpassing the performance of traditional reinforcement in concrete. This performance milestone saw massive growth in the use of BarChip and paved the way for the current generation of high performance BarChip products.

In 2018, EPC was acquired by Hagihara Industries and renamed BarChip Inc. The acquisition allowed BarChip to have complete control of the fibre pipeline, from design and manufacturing all the way to application on the work site.

Today, BarChip is recognised by numerous international standards and guidelines. BarChip is used in nearly every type of concrete application across every continent and is widely recognised as the fibre of choice for demanding applications and major infrastructure projects.

Product Information

Product(s) Covered by EPD

This EPD covers three products, BarChip 48, BarChip 54 and BarChip 60, which are produced at the BarChip PT Hagihara West Java Industries site in West Java, Indonesia. BarChip 48, 54 and 60 are manufactured to ISO 9001:2015 standards with BarChip 48 and 54 having additional CE certification. The products are synthetic fibre used for structural reinforcement in concrete and will last the lifetime of the concrete in which they are cast. The fibres are embossed to provide anchorage with the surrounding concrete matrix and are added to concrete at the mixing stage to ensure even distribution throughout the mix. BarChip 54 and BarChip 60 have almost identical properties, with the only difference being the length the fibres are cut to.

Table 1: Industry classification

| Product | Classification | Code | Category |
|--|-----------------|------|---|
| BarChip 48 BarChip 54 BarChip 60 | UN CPC Ver.2 | 355 | Man made fibres. The product falls into two classes 3551 and 3554. These classes are synthetic filament tow and staple fibres as well as artificial filament tow and staple fibres, respectively. |

Declared Unit

The results in this EPD are for 1kg of synthetic fibre product used as an additive to concrete for the purposes of concrete reinforcement. The 1kg of synthetic fibre does not include the respective masses of the packaging or optional plastic puck wrappings around bundles of fibres, however, the impacts for such packaging are included.

Content Declaration

Table 2: Content declaration by mass%

| Materials / chemical substances | BarChip 48 Mass composition (%) | BarChip 54, BarChip 60 Mass composition (%) | Environmental / hazardous properties |
|---------------------------------|------------------------------------|--|--------------------------------------|
| Virgin Polypropylene | > 98 | > 97 | None |
| Additives | < 2 | < 3 | None |

Packaging

The fibre products are packaged in different ways, to support use in a variety of concrete plants. The most common packaging is a paper bag containing the standard dosage of parallel packed fibre. In this instance, the whole bag, including both paper and fibre product, are added directly to the mixer, where the paper packaging breaks down and becomes part of the final concrete product. For plants with fibre dosing systems, the product can be supplied as 'pucks' in a bulk bag. The pucks are small bundles wrapped in a thin water-soluble plastic film, which allows the product to be stored and dosed correctly and is also incorporated into the concrete. In some instances, pucks may be packaged in a paper bag for direct addition.

All packaging options are shipped on recycled plastic pallets with pallet covers.

All packaging systems result in even distribution of the fibres within the concrete. A summary of the packaging forms available for each BarChip product in this EPD is provided below.

Table 3: Product packaging options

| Product | Product Form | Packaging Options |
|------------|-----------------|---------------------------------|
| BarChip 48 | Parallel Packed | Paper Bag (2.5 kg) |
| | Pucks | Bulk Polypropylene Bag (420 kg) |
| BarChip 54 | Parallel Packed | Paper Bag (3 kg) |
| | Pucks | Paper Bag (5 kg) |
| | Pucks | Bulk Polypropylene Bag (410 kg) |
| BarChip 60 | Parallel Packed | Paper Bag (3 kg) |

Manufacturing Process

BarChip products are made on a linear production line. All emissions associated with the extrusion, processing and transportation of raw materials are included within this production stage.

Raw materials are mixed and heated in a vat before being extruded, tempered, stretched, embossed, cooled and rolled. Where products are sold as pucks, bundles of fibres are wrapped in polyvinyl alcohol. Fibres are cut into to the appropriate lengths and packaged ready for distribution.

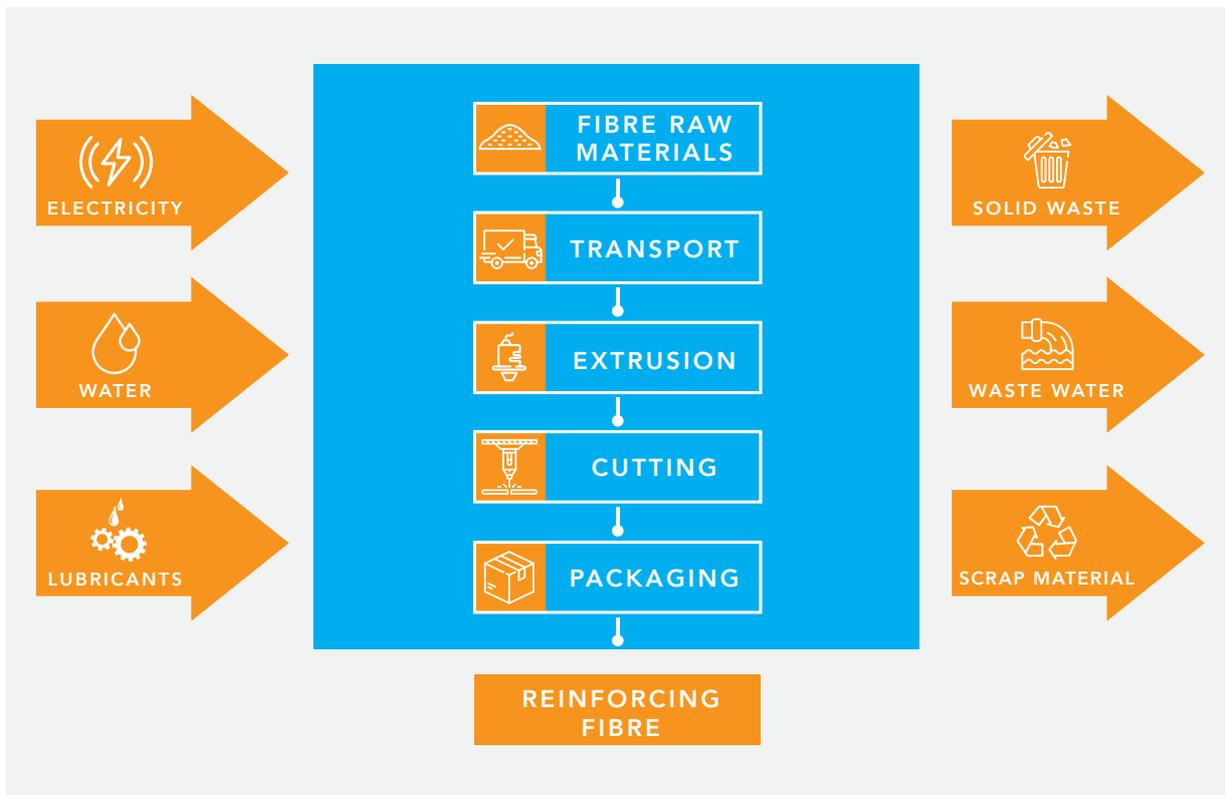


Figure 1: Flow diagram of production system

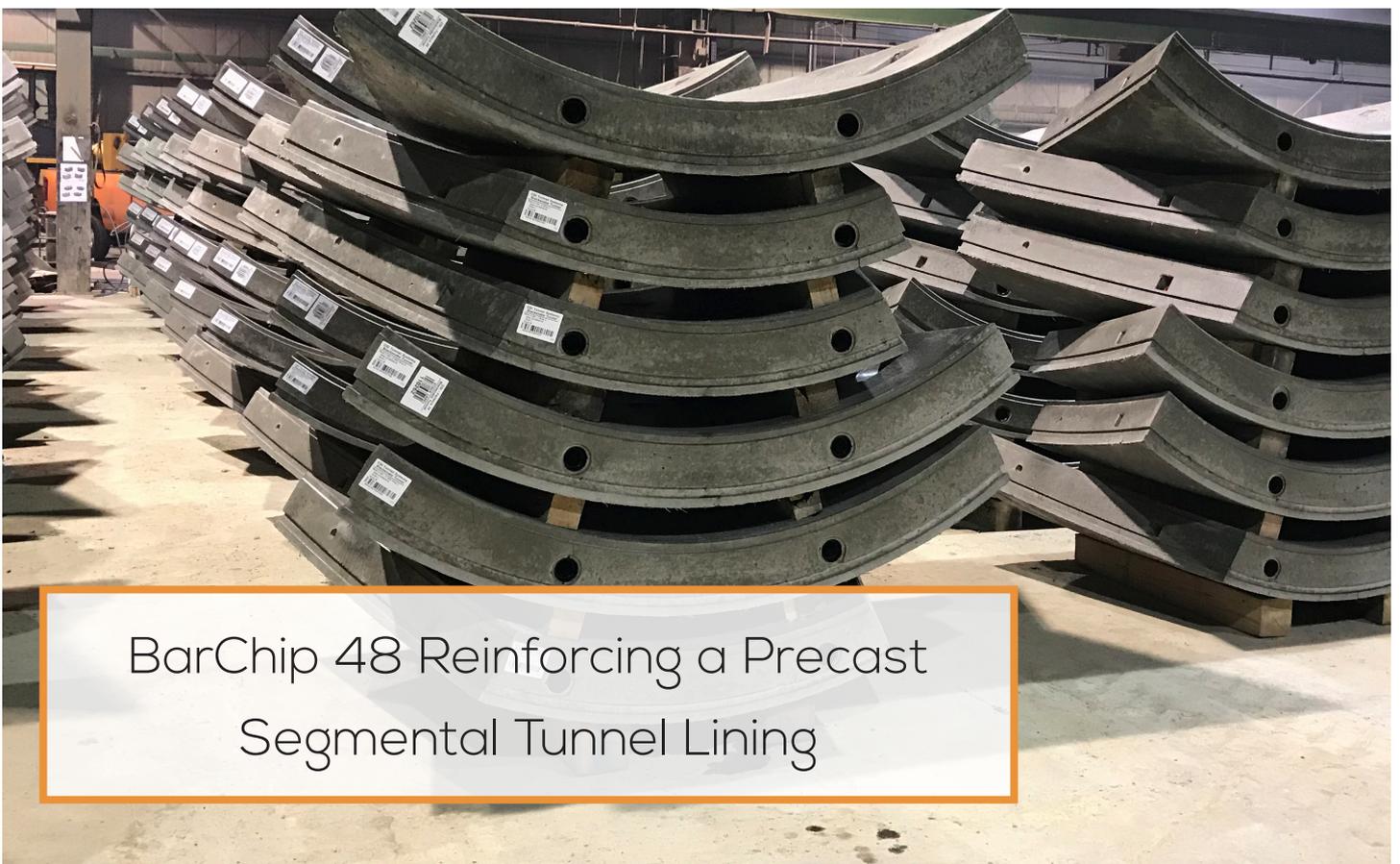
System Boundaries

As shown in the table below, this EPD is cradle-to-gate. Other life cycle stages (Modules A4-A5, B1-B7, C1-C4 and D) are not declared.

Table 4: Modules included in the scope of the EPD

| Product Stage | | | Construction process stage | | Use Stage | | | | | | | End of life stage | | | | Benefits and loads beyond the system boundary |
|---------------------|----------------------------|---------------|----------------------------|-----------------------------|-----------|-------------|--------|-------------|---------------|------------------------|-----------------------|-----------------------------|-------------------------------|------------------|----------|---|
| Raw Material Supply | Transport of raw materials | Manufacturing | Transport to customer | Construction / Installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstruction / demolition | Transport to waste processing | 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 | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND |

X = included in the EPD; MND = Module not declared (such a declaration shall not be regarded as an indicator result of zero)



BarChip 48 Reinforcing a Precast Segmental Tunnel Lining

Life Cycle Inventory (LCI) Data and Assumption

Primary data from the period April 2018 to March 2019 were used for all manufacturing operations up to the factory gate, including for the transport modes and distances of raw materials to the factory.

All data in the background system, including raw material inputs, were from the GaBi Life Cycle Inventory Database 2020 (Sphera, 2020). Most datasets have a reference year between 2016 and 2019 and all fall within the 10 year limit allowable for generic data under EN 15804 (CEN, 2013).

Datasets used for raw material inputs were predominantly Japanese, Indian or Malaysian, which were broadly representative of BarChip's supply network.

Electricity consumed in the manufacturing of the product has been modelled using the 2016 Indonesian grid mix (1kV-60kV) database from Sphera. In 2016 the Indonesian grid mix was 54.5% hard coal, 26.4% natural gas, 7.8% hydro, 6.3% heavy fuel oil, 0.5% biogas and 0.2% biomass with a carbon intensity of 887 gCO₂e/kWh.

Waste

The extrusion and cutting manufacturing steps produce offcuts. All the offcuts from the BarChip 48, BarChip 54 and BarChip 60 products are recovered for use in BarChip's products with recycled and recovered content. This production waste was modelled using the cut-off approach, with no further impacts in the current life cycle.

Explanation of Representative Products & Variation

As BarChip 54 and 60 are comprised of the same materials and simply cut to different lengths their

impacts are virtually identical and are declared as a single result. BarChip 54 was chosen as the representative product as the slightly more frequent cutting and higher cutting loss rate lead to a marginally higher impact per kg of finished product.

The results presented in the EPD are for the loose fibres in paper bags, which are representative of all packaging options. Sensitivity analysis showed that the different packaging formats have similar overall impacts, deviating by less than 4%, except for ODP which is significantly lower for the bulk bag option.

Cut off Criteria

The cut-off criteria for this study includes items which represented less than 1% and summed to less than 5% of the total input of mandatory modules (A1-A3). Furthermore, none of the excluded flows should be of any known particular environmental concern.

The following materials and processes have been excluded:

- Packaging of incoming consumables.
- Inbound transport of packaging materials.
- Production and disposal of packaging offcuts that might occur during packaging.
- Ink used for printing on packaging materials.

All other reported data were incorporated and modelled using the best available life cycle inventory data.

Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary as per the PCR (EPD International, 2019a), section 7.5.4.

Allocation

Annual site-wide data was provided for consumption of electricity, water and consumables and disposal of waste. Given the common production process and similarity of products, it is most appropriate to allocate these process impacts based on mass.

No allocation is given to the polypropylene production offcuts, which are recovered within the system boundary. No secondary materials are used in production.

Assessment Indicators

The results tables describe the different environmental indicators for each product per declared unit, for A1-A3. The first section of each table contains the environmental impact indicators, describing the potential environmental impacts of the product as shown in Table 5. The second section shows the resource indicators, describing the use of renewable and non-renewable material resources, renewable and non-renewable primary energy and water, as shown in Table 6. The final section of each table displays the waste and other outputs, as shown in Table 7.

Table 5: Indicators for life cycle impact assessment

| Abbreviation | Unit | Indicator |
|--------------|--------------------------------------|--|
| GWP | kg CO ₂ eq. | Global warming potential |
| ODP | kg CFC11 eq | Ozone depletion potential |
| AP | kg SO ₂ eq. | Acidification potential |
| EP | kg PO ₄ ³⁻ eq. | Eutrophication potential |
| POCP | kg C ₂ H ₄ eq. | Photochemical ozone creation potential |
| ADPE | kg Sb eq. | Abiotic depletion potential for non-fossil resources |
| ADPF | MJ | Abiotic depletion potential for fossil resources |

Table 6: Life cycle inventory indicators on use of resources

| Abbreviation | Unit | Indicator |
|--------------|-------------------------|--|
| PERE | MJ, net calorific value | Use of renewable primary energy excluding renewable primary energy resources used as raw materials |
| PERM | MJ, net calorific value | Use of renewable primary energy resources used as raw materials |
| PERT | MJ, net calorific value | Total use of renewable primary energy resources |
| PENRE | MJ, net calorific value | Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials |
| PENRM | MJ, net calorific value | Use of non-renewable primary energy resources used as raw materials |
| PENRT | MJ, net calorific value | Total use of non-renewable primary energy resources |
| SM | kg | Use of secondary material; |
| RSF | MJ, net calorific value | Use of renewable secondary fuels |
| NRSF | MJ, net calorific value | Use of non-renewable secondary fuels |
| FWT | m ³ | Total use of net fresh water |

Table 7: Life cycle inventory indicators on waste categories and output flows

| Abbreviation | Unit | Indicator |
|--------------|------|-------------------------------|
| HWD | kg | Hazardous waste disposed |
| NHWD | kg | Non-hazardous waste disposed |
| RWD | kg | Radioactive waste disposed |
| CRU | kg | Components for reuse |
| MER | kg | Materials for energy recovery |
| MFR | kg | Materials for recycling |
| EEE | MJ | Exported electrical energy |
| EET | MJ | Exported thermal energy |

The following indicators are not relevant to the studied product system, hence result in zero values:

- Use of renewable primary energy as raw materials (PERM)
- Use of renewable secondary fuels (RSF)
- Use of non-renewable secondary fuels (NRSF)
- Components for re-use (CRU)
- Materials for recycling (MFR)
- Materials for energy recovery (MER)
- Exported electrical energy (EEE)
- Exported thermal energy (EET)



**BarChip 54 Reinforcing Ground Support
in a Metro Rail Tunnel**

Results

Potential Environmental Impact

| Parameter | Unit | BarChip 48 Total A1 - A3 | BarChip 54, 60 Total A1 - A3 |
|-----------|--------------------------------------|-----------------------------|---------------------------------|
| GWP | kg CO ₂ eq. | 1.99 | 2.01 |
| ODP | kg CFC11 eq. | 2.68E-13 | 2.24E-13 |
| AP | kg SO ₂ eq. | 0.00864 | 0.00891 |
| EP | kg PO ₄ ³⁻ eq. | 9.64E-04 | 9.87E-04 |
| POCP | kg C ₂ H ₄ eq. | 6.87E-04 | 7.10E-04 |
| ADPE | kg Sb eq. | 8.75E-08 | 8.78E-08 |
| ADPF | MJ, net calorific value | 74.8 | 75.2 |

Use of Resources

| Parameter | Unit | BarChip 48 Total A1 - A3 | BarChip 54, 60 Total A1 - A3 |
|-----------|-------------------------|-----------------------------|---------------------------------|
| PERE | MJ, net calorific value | 1.99 | 1.91 |
| PERM | MJ, net calorific value | 0 | 0 |
| PERT | MJ, net calorific value | 1.99 | 1.91 |
| PENRE | MJ, net calorific value | 31.3 | 31.7 |
| PENRM | MJ, net calorific value | 43.7 | 43.6 |
| PENRT | MJ, net calorific value | 75.0 | 75.3 |
| SM | kg | 0 | 0 |
| RSF | MJ, net calorific value | 0 | 0 |
| NRSF | MJ, net calorific value | 0 | 0 |
| FWT | m ³ | 0.00672 | 0.00679 |

Waste Production and Output Flows

| Parameter | Unit | BarChip 48 Total A1 - A3 | BarChip 54, 60 Total A1 - A3 |
|-----------|------|-----------------------------|---------------------------------|
| HWD | kg | 1.26E-08 | 1.16E-08 |
| NHWD | kg | 0.0211 | 0.0211 |
| RWD | kg | 4.77E-05 | 4.75E-05 |
| CRU | kg | 0 | 0 |
| MER | kg | 0 | 0 |
| MFR | kg | 0 | 0 |
| EEE | MJ | 0 | 0 |
| EET | MJ | 0 | 0 |

Interpretation of Results

Analysis of the results showed that the polymer input materials contribute at least 50% of impacts for all products in this EPD, for Global Warming Potential (GWP), Photochemical Ozone Creation Potential (POCP), Abiotic Depletion Potential of fossil fuels (ADPF) and Abiotic Depletion Potential of elements (ADPE), and also contribute significantly to Eutrophication Potential (EP) and Acidification Potential (AP). Electricity consumption contributes significantly to GWP, AP, EP and POCP. Transport of the raw materials has measurable impacts for AP, EP and POCP. Ozone Depletion Potential (ODP) is dominated by the production of paper used in packaging.

Products with a common extruded material (e.g. BarChip 54 and BarChip 60), where differences are limited to the length of product and cutting losses, have no significant differences in their results with less than 1% variation in results for all impact categories. The addition of additives in BarChip 54 and BarChip 60 increases their impacts slightly compared to BarChip 48.

Packaging is a significant hotspot for ODP, but is otherwise a very minor source of impact. Sensitivity analysis of the different packaging formats found little variation in results, except for ODP which is significantly lower for the bulk bag option. The overall ODP results are very low due to the global phase out of ozone depleting substances, which also results in the indicator being highly sensitive.

References

EN 15804:2012+A1:2013; Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. Brussels: European Committee for Standardization.

EPD Australasia (2018). Instructions of the Australasian EPD Programme: A regional annex to the General Programme Instructions of the International EPD® System. URL: www.epd-australasia.com.

EPD International (2019a). General Programme Instructions of the International EPD® System. Stockholm: International EPD® System. URL: www.environdec.com

EPD International (2019b). PCR 2012:01 Construction Products and Construction Services, Version 2.33, 2020-09-18. Stockholm: International EPD® System. URL: www.environdec.com

ISO 14040:2006; Environmental management – Life cycle assessment – Principles and framework. Geneva: International Organization for Standardization.

ISO 14044:2006; Environmental management – Life cycle assessment – Requirements and guidelines. Geneva: International Organization for Standardization.

ISO 14025:2006; Environmental labels and declarations — Type III environmental declarations — Principles and procedures. Geneva: International Organization for Standardization.

Sphera. (2020). GaBi life cycle inventory database documentation. URL: <http://www.gabi-software.com/support/gabi/gabi-database-2020-lci-documentation/>

General Information

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

Declaration Owner:



BarChip Inc.

Web: <https://www.barchip.com>

Email: info@barchip.com

Post: Kanda System Building 7F 7 Kanda Konya-cho,
Chiyoda-ku, Tokyo, Japan 101-0035

Geographical Scope:

Global

Reference Year of Data

April 2018 - March 2019

EPD produced by:



thinkstep Pty Ltd

Web: www.thinkstep-anz.com

Email: anz@thinkstep-anz.com

Post: 25 Jubilee Street, Perth, Western Australia 6151

EPD programme operator:



EPD Australasia Limited

Web: www.epd-australasia.com

Email: info@epd-australasia.com

Post: EPD Australasia Limited, 315a Hardy Street,
Nelson 7010, New Zealand

CEN standard EN 15804+A1 served as the core PCR

PCR:

PCR 2012:01 Construction Products and Construction Services, Version 2.33, 2020-09-18

PCR review was conducted by:

The Technical Committee of the International EPD® System

Chair:

Massimo Marino. Contact via info@environdec.com

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

EPD process verification (Internal)

EPD verification (External)

Third party verifier:



Life Cycle Logic

Andrew D. Moore (Life Cycle Logic)

A handwritten signature in black ink, appearing to read "Andrew D. Moore".

.....
Email: andrew@lifecyclelogic.com.au

Verifier approved by:

EPD Australasia

Procedure for follow-up of data during EPD validity involved third-party verifier

Yes

No



“

Up to 500,000 BarChip fibres are evenly distributed in every cubic metre of concrete. Not one will ever suffer from corrosion.

”

BarChip 48, BarChip 54, BarChip 60 Environmental Product Declaration

OUR VISION

BarChip has a simple vision - revolutionise the world of concrete reinforcement. For over 100 years the technology of concrete reinforcement has barely changed. We set out to create a new reinforcement for the 21st century. We created BarChip synthetic fibre reinforcement.

OUR PROCESS

We believe that long term business relationships can only be sustained by a commitment to provide the highest quality products and services. We make sure to understand your concrete, know the performance requirements and work with you to get the right design and the right performance outcomes.

YOUR PRODUCT

When you work with BarChip you know that your concrete asset has been reinforced to the latest engineering standards. It will never suffer from corrosion. It will be cheaper and quicker to build. It will be safer and it will keep performing throughout its entire design life.

BarChip Inc.

info@barchip.com

Australia: +61 1300 131 158

N. America: +1 704 843 8401

EMEA: +353 (0) 1 469 3197

Asia: +65 6835 7716

S. America: +56 2 2703 1563

Brazil: +55 19 3722 2199