Environmental Product Declaration

EPD of multiple products, based on representative product.
In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for, and conformity with ISO 21930:2017:

Ductile Iron Cement Lined Pipe

Range from DN100 to DN750, listed on page 4
from

Xinxing Ductile Iron Pipes Co., Ltd.

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-13048
Publication date:	2024-04-08
Valid until:	2029-04-08
	An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

Accountabilities for PCR, LCA and independent, third-party verification

Product Category Rules (PCR)

CEN standard EN 15804 serves as the Core Product Category Rules (PCR)

Product Category Rules (PCR): PCR 2019:14 Construction products Version 1.3.3 [valid until: 2024-12-20]

PCR review was conducted by: Claudia A. Peña, Director of Sustainability at ADDERE Research and Technology, cpena@addere.cl.

Life Cycle Assessment (LCA)

LCA accountability: Sijia Yang, Pinqiao Ren, Shuhan Huang, and Si Huang from IVL Swedish Environmental Research Institute

Third-party verification

Independent third-party verification of the declaration and data, according to ISO 14025:2006, via:

☒ EPD verification by individual verifier

Third-party verifier: Claudia Peña,
Director of Sustainability at ADDERE R&T

Approved by: The International EPD® System

Procedure for follow-up of data during EPD validity involves third party verifier:
☐ Yes ☒ No

[Procedure for follow-up the validity of the EPD is at minimum required once a year with the aim of confirming whether the information in the EPD remains valid or if the EPD needs to be updated during its validity period. The follow-up can be organized entirely by the EPD owner or together with the original verifier via an agreement between the two parties. In both approaches, the EPD owner is responsible for the procedure being carried out. If a change that requires an update is identified, the EPD shall be re-verified by a verifier]

LCA practitioner:

IVL Swedish Environmental Research Institute Beijing Office
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The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

It should be noted that the EPD report cannot be used without including module C.

Company information

Owner of the EPD: Xinxing Ductile Iron Pipes Co., Ltd.

Contact: Jinbao Wen (Tel: +86-0769-88288292)

Description of the organisation:
Xinxing Ductile Iron Pipes Co., Ltd. (Hereinafter shorted as "Xinxing") is exclusively launched and established by Xinxing Cathay International Group. Xinxing was listed on Shenzhen Stock Exchanges in 1997 and Xinxing Cathay International Group holds 50.01%. Developing for several years, Xinxing became a trans-regional and multi-industry company which has many production bases located in Handan City of Hebei Province, Wuhu City of Anhui Province, Huangshi City of Hubei Province, Taojiang City of Hunan Province, and Yangjiang City of Guangzhou Province, also in Xinjiang Province and Sichuan Province. With the largest DIP (Ductile Iron Pipes) production base in the world, Xinxing owns an annual production capacity of 3.5 million tons DI (Ductile Iron) pipes and 100 000 tons DI fittings. The continuous investment in R&D has enabled Xinxing to develop and improve various joints and coatings. Now, Xinxing has DN80~DN3000 mm pipes with Tyton type, K type, S type, N1 type, SIA joint, XT2 joint, TF joint, Xanchor joint, XTJ joint, restrained joints. To apply for different corrosive soil conditions, the internal protection includes cement mortar lining, polyurethane lining, epoxy ceramic lining etc., while the external protection includes zinc with finishing layer of bitumen paint, polyurethane coating, epoxy coatings, aluminium powder paint etc.

Product-related or management system-related certifications:
For products: ISO 7186:2011 Ductile iron products for sewerage applications, BS EN 545:2006 Ductile iron pipes, fittings, accessories and their joints for water pipelines – Requirements and test methods, AS/NZS2280 Ductile iron pipes.
For management system: ISO 9001: 2015 - Quality management systems, ISO 14001:2015 - Environmental management systems, and ISO 45001:2018 - Occupational health and safety management systems.

Name and location of production site(s):
Xinxing Wuan Factory, located in Wuan, Handan City, Hebei Province, China.

Product information

Product name: Ductile Iron Cement Lined Pipe (DICL pipe). In this study, the representative product of the product family is DN200 cement coated product. DN200 cement coated product is selected as the representative product since the production quantity of DN200 is the highest in the Wuan Factory of this product family depending on the record of 2022 provided by Xinxing.

Product identification:
In accordance with ISO 7186:2011, BS EN 545:2006, and AS/NZS2280.

Product description:
All products in the product family can be used for water supply and drainage, agricultural irrigation, seawater desalination, as well as the supply and distribution of water and gas. According to installation and usage conditions, multiple coatings can be used for manufacturing. The products in the family differ only in size and coating, but the main function is all the same, which can be used above or below ground. Depending on the relevant research, a reference service life of 100 years is used for this family product (see appendix).

Table 1 Product list of the DICL pipes reported in the EPD

Product	Nominal diameters of the products (mm)					
DICL produced by Xinxing	DN100	DN150	DN200	DN225	DN250	DN300
	DN375	DN450	DN500	DN600	DN750	

This EPD is the EPD of multiple products, based on representative product. The representative product of this EPD is the DN200 DICL pipe.

The performance of the products in this family is shown in the table below, provided by Xinxing and referred to standard AS/NZS 2280. Please note that it is the requirement for the product design and quality control. All products in the family are supposed to meet the following performance, otherwise they would be regarded as defective products and not be sold to the market.

Table 2 Product performance

Performance	Amount
Tensile strength (Mpa)	≥420 MPa
Elongation (%)	≥10%
Brinell Hardness (HB)	≤230 HBW

<u>UN CPC code:</u>
41291

<u>HS code:</u>
730300

<u>Geographical scope:</u>
Modules A1-A3 represent production of DICL pipe products in Wuan, Handan City, Hebei Province, China. Module A4 and A5 represent delivery from China to Oceania, mainly Australia, and the rest are sent to Fiji and installation in these countries. Module B, C, and D represent the use and end-of-life treatment with benefits out of the system boundary of the products in Oceania countries.

LCA information

<u>Declared unit:</u>
One tonne of ductile iron pipe.

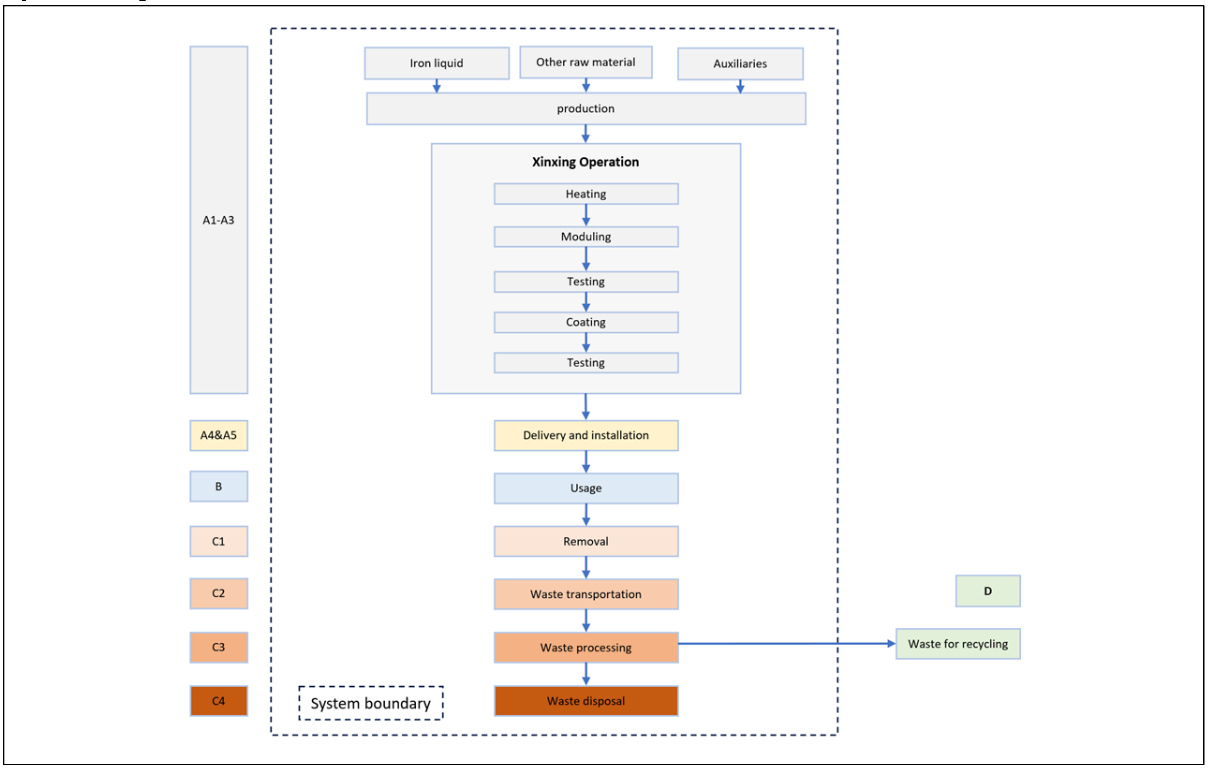
<u>Reference service life:</u>
100 years according to Xinxing (see appendix).

<u>Time representativeness:</u>
2022 (January to December).

<u>Database(s) and LCA software used:</u>
Managed LCA Content 2023.1 Databases (2023.1 Edition) and Ecoinvent 3.9.1, LCA for Expert (Gabi).

<u>Description of system boundaries:</u>
Cradle to grave and module D (A + B + C + D), serving for type (b) EPD.

System diagram:



No processes were excluded in the declared modules.

Manufacturing processes:

The iron pipes product is produced in the Xinxing factory. Xinxing has several production sites in China, in this LCA analysis, products are produced only in Wuan, Handan City, Hebei Province, China. The data of representative product is based on the production quantity of different nominal diameters of products produced in Wuan factory.

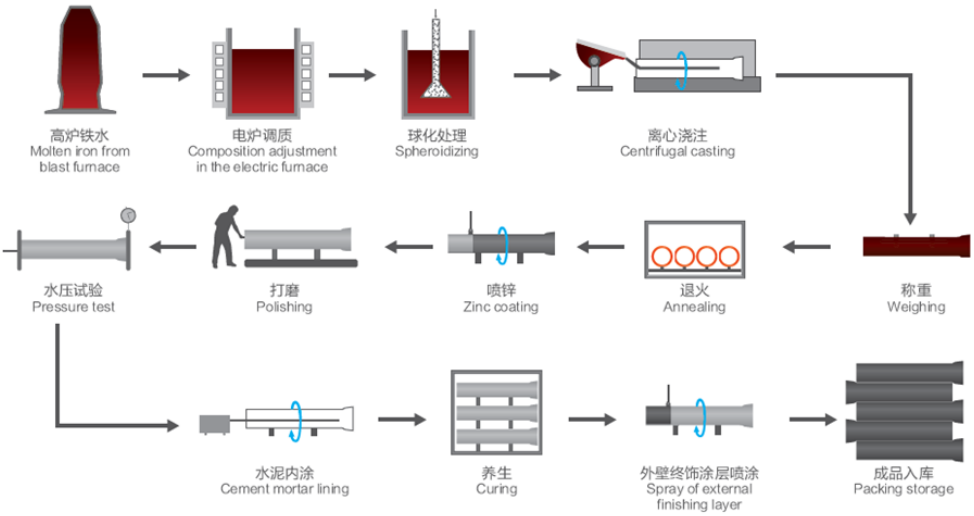


Figure 1 The main production process of studied product.

The raw materials for manufacture of ductile iron pipe shells are liquid iron, steel scrap & ferrosilicon. The liquid iron is added into the electric furnace and the composition is adjusted by adding steel scrap and ferrosilicon. The iron is then treated by adding magnesium for ductility. The molten ductile iron together is poured into a steel mould together with inoculant and spun in a centrifugal casting machine to form the pipe shell. The end of the mould is plugged using a sand core which also forms the shape of the pipe inner socket. After extracting the pipe from the mould, the spent sand core is extracted from the pipe and sent to the internal recycling station to produce new sand cores. The ductile iron pipe shell is then weighed and sent to the annealing furnace.

Since the product is produced in China, the electricity dataset used in A3 is from the Managed LCA Content 2023.1 Databases (2023.1 Edition) which referred to the China electric power yearbook (reference year 2019-2025). The data set represents the average country or region-specific electricity supply for final consumers, including electricity own consumption, transmission/distribution losses of electricity supply and electricity imports from neighbouring countries. Table 2 lists the energy source behind the electricity consumption mix of China and its climate impact using the indicator of GWP-GHG.

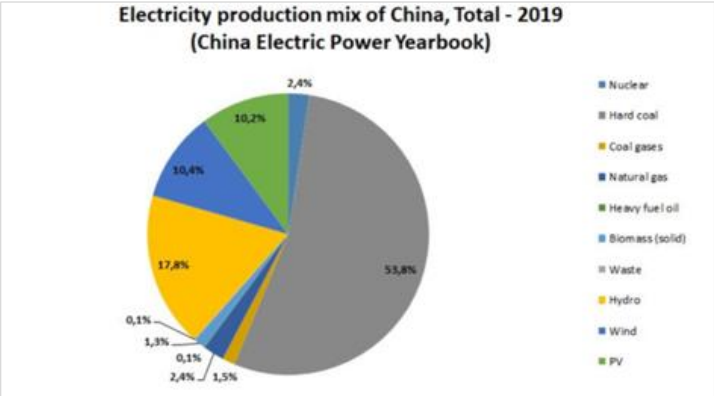


Figure 1 Mix of energy sources for electricity production, cited from the documentation of the datasets of Managed LCA Content 2023.1 Databases (2023.1 Edition).

Table 2 Data sets used in the model and their climate impact (CO_2 eq./kwh)

Energy source behind the electricity	Data sets used in the model	GWP-GHG (CO_2 eq./kwh)
Electricity from nuclear power	CN: Electricity from nuclear power Sphera	4.5E-03
Electricity from coal gas	CN: Electricity from coal gas Sphera	1.4E+00
Electricity from biomass	CN: Electricity from biomass Sphera	6.9E-02
Electricity from wind power	CN: Electricity from wind power Sphera	1.7E-02
Electricity from hydro power	CN: Electricity from hydro power Sphera	7.5E-03
Electricity from hard coal	CN: Electricity from hard coal Sphera	1.1E+00
Electricity from heavy fuel oil	CN: Electricity from heavy fuel oil Sphera	9.9E-01
Electricity from natural gas	CN: Electricity from natural gas Sphera	5.8E-01
Electricity from photovoltaic	CN: Electricity from photovoltaic Sphera	2.9E-02

More information:

Scenarios and additional technical information:

- The products are manufacturing in China, and the waste treatment of the waste generated during the manufacturing process was included in the system boundary.
- The product is used in Oceania countries (mainly Australia and Fiji). The relevant waste treatment scenario is based on Oceania's condition.
- Regarding the A5 phase, the installation of iron pipes requires the consumption of diesel for digging, rubber rings and sleeving for installing the pipes. There is no product mass loss happened in the construction stage, either. Also, the whole packaging of the product will be wasted after the construction process.

- In module B, the product in this study does not generate emission and consume energy and water during the whole use phase, so the use phase environmental impact is deemed to be zero.
- In module C, the deconstruction (C1) is assumed that the same amount of diesel as A5 stage is used to dig out the iron pipes. In C2, the distance is assumed as 1 000 km for transportation of all the waste products. In C3, the 5% weight loss during C stage, which could be sent to disposal. Therefore 95% of the iron pipe is assumed to be recycled and 5% of the iron pipe is landfilled. And in C4, all the waste goes to landfill.
- About module D calculation, since the product has post-consumer material (only steel scrap) as its raw material, all steel scrap is excluded from the calculation of the benefit to avoid the double-counting of the benefit. Meanwhile, there are no co-products are generated in the production of the reported products, so there is no issue of co-product allocation in this project. Besides, the mass loss during module D is assumed to be zero, since we used the datasets and the plan directly from Sphera database which does not consider the mass loss.

Allocation:
The allocation to each production line on one declared unit of the product is conducted depending on the yield rate of the product. For example, the annual yield rate of DN200 is 1.18% of the workshop, then the electricity consumption of DN200 production line is 1.18% of the total consumption of the whole workshop. The allocation of auxiliary materials and waste generation is considered as the same logic.

Cut-off rules:
Not applied in this study.

Modules declared, geographical scope, share of specific data (in GWP-GHG results) and data variation (in GWP-GHG results):

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Geography	CN	CN	CN	CN to OA	OA	OA	OA	OA	OA	OA	OA	OA	OA	OA	OA	OA	OA
Specific data used	>90%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	<10%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%					-	-	-	-	-	-	-	-	-	-	-	-

Content information

This EPD is the EPD of multiple products, based on representative product. The representative product of this EPD is DN200 DICL pipe. The content declaration of the representative product is listed below.

Representative product:

Product components	Weight, kg	Post-consumer material, weight-% of total product	Biogenic material, kg C/product
Ferrosilicon Alloy	10.57	0.00%	0.00
Mg Granules	1.70	0.00%	0.00
Sand	91.61	0.00%	0.00
Cement	73.30	0.00%	0.00
Water-based Paint	4.91	0.00%	0.00
Zinc Wire	6.01	0.00%	0.00
Inoculant	0.79	0.00%	0.00
Scrap steel	104.25	10.43%	0.00
Iron liquid	706.86	0.00%	0.00
TOTAL	1 000.00	10.43%	0.00
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	**Weight biogenic carbon, kg C/product**
Polyethylene	0.02	0.00%	0.00
Wooden pallet	5.16	0.52%	0.34
Steel belt	3.78	0.38%	0.00
TOTAL	8.96	0.90%	0.34

The content declaration of the product family is shown below.

The raw material composition range of the product family (corresponding to one declared unit):

Product composition	Percentage range of the product family	Product composition	Percentage range of the product family
Ferrosilicon Alloy	1.01%-1.13%	Magnesium Granules	0.16%-0.18%
Sand	8.75%-9.82%	Cement	0%-11.37%
Water-based paint	0.47%-0.53%	Zinc	0.67%-0.76%
Inoculant	0.08%	Scrap steel	9.96%-11.18%
Iron liquid (hot metal/molten iron)	67.53%-75.79%	Special coating (epoxy resin)	0%-0.53%
Total		**100%**	

Packaging Material composition	Packaging percentage of the product family
Polythylene	0.93%
Wooden pallet	17.44%
Steel belt	81.63%
Total	**100%**

At the time of data collection, no substance included in the Candidate List of Substances of Very High Concern (SVHC) for authorization under the REACH Regulations is present in the products covered by this LCA and EPD either above the threshold for registration with the European Chemicals Agency or above 0.1% (wt/wt).

Depending on the PCR, in general, the production and end-of-life processes of infrastructure or capital goods used in the product system should be excluded, unless there is evidence that they are relevant in terms of their environmental impact, or when a generic LCI dataset includes infrastructure/capital goods, and it is not possible, within reasonable effort, to subtract the data on infrastructure/capital goods from this dataset (directly citation from section 4.3.2 of PCR 1.3.3). In this study, the infrastructure and capital goods are not included in the LCA analysis since they are used plenty of times for several years for the product manufacturing. According to the PCR, it should be excluded.

All results in this LCA analysis are calculated by the EN 15804+A2. The “EN 15804 reference package” is calculated based on EF 3.0.

Results of the environmental performance indicators

The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

Mandatory impact category indicators according to EN 15804

Results per functional or declared unit																
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-fossil	kg CO_2 eq.	1.69E+03	1.74E+02	1.13E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.26E-01	8.77E+01	0.00E+00	2.09E+01	-1.47E+03
GWP-biogenic	kg CO_2 eq.	-2.45E+00	2.57E+00	1.87E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.09E-02	3.70E+00	0.00E+00	5.70E-01	7.53E-01
GWP-luluc	kg CO_2 eq.	6.47E-01	3.87E-03	7.02E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E-05	2.38E-03	0.00E+00	2.44E-03	-3.04E-02
GWP-total	kg CO_2 eq.	1.69E+03	1.77E+02	1.15E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.57E-01	9.14E+01	0.00E+00	2.15E+01	-1.47E+03
ODP	kg CFC 11 eq.	3.12E-05	7.26E-12	1.29E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.37E-14	5.22E-12	0.00E+00	7.74E-09	-3.22E-12
AP	mol H^+ eq.	8.14E+00	2.50E+00	6.88E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.30E-03	3.58E-01	0.00E+00	3.69E-02	-3.17E+00
EP-freshwater	kg P eq.	4.57E-01	1.98E-05	1.28E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.31E-08	1.11E-05	0.00E+00	2.46E-05	-2.67E-04
EP-marine	kg N eq.	1.64E+00	1.06E+00	2.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.61E-03	1.67E-01	0.00E+00	1.55E-02	-5.57E-01
EP-terrestrial	mol N eq.	1.76E+01	1.16E+01	2.51E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.87E-02	1.84E+00	0.00E+00	1.70E-01	-4.89E+00
POCP	kg NMVOC eq.	9.52E+00	2.82E+00	7.86E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.03E-03	3.25E-01	0.00E+00	5.74E-02	-2.26E+00
ADP-minerals&metals*	kg Sb eq.	9.79E-03	1.01E-06	3.54E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.83E-09	5.77E-07	0.00E+00	4.18E-07	-3.67E-03
ADP-fossil*	MJ	2.46E+04	2.29E+03	1.83E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E+01	1.24E+03	0.00E+00	3.61E+01	-1.35E+04
WDP*	m^3	3.12E+02	5.25E-01	3.35E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.26E-03	3.89E-01	0.00E+00	3.97E-01	-2.74E+02
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption															

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

Additional mandatory and voluntary impact category indicators

Results per functional or declared unit																
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-GHG[1]	kg CO_2 eq.	1.56E+03	1.72E+02	9.93E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.16E-01	8.63E+01	0.00E+00	2.03E+01	-1.41E+03

To be noted, although the weight of steel scrap contributes around 10% of the whole product composition, however, the GWP-GHG result from the scrap steel of the product does not contribute that much, which occupies around 0.20% of the total A1-A3 result of the representative product.

Resource use indicators

Results per functional or declared unit																
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	2.62E+03	7.01E+00	4.94E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-02	6.84E+00	0.00E+00	3.19E+00	8.53E+02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.62E+03	7.01E+00	4.94E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-02	6.84E+00	0.00E+00	3.19E+00	8.53E+02
PENRE	MJ	2.46E+04	2.30E+03	1.83E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E+01	1.24E+03	0.00E+00	3.61E+01	-1.35E+04
PENRM	MJ	1.71E-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.46E+04	2.30E+03	1.83E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E+01	1.24E+03	0.00E+00	3.61E+01	-1.35E+04
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	7.44E+00	1.43E-02	7.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.72E-05	1.04E-02	0.00E+00	1.04E-02	-6.18E+00
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water															

[1] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.

Waste indicators

Results per functional or declared unit																
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	1.44E-04	8.89E-10	1.94E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E-12	3.09E-10	0.00E+00	2.89E-09	-1.05E-07
Non-hazardous waste disposed	kg	2.01E+01	8.17E-02	1.88E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.95E-04	4.73E-02	0.00E+00	5.01E+01	2.05E+02
Radioactive waste disposed	kg	1.04E-01	6.43E-04	1.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.76E-06	4.49E-04	0.00E+00	4.06E-04	1.68E-03

Output flow indicators

Results per functional or declared unit																
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Appendix 1. Certificates for Standards

Lloyd's Register

Current issue date: 1 August 2021
Expiry date: 31 July 2024
Certificate identity number: 10390768

Original approval(s): ISO 9001 - 3 July 2003

Certificate of Approval

This is to certify that the Management System of:

Xinxing Ductile Iron Pipes Co., Ltd

Wuan City, Hebei Province, China

Unified Social Credit Code: 91130400104365768G

has been approved by Lloyd's Register to the following standards:

ISO 9001:2015
GB/T 19001-2016

Approval number(s): ISO 9001 – 0072199

This certificate is valid only in association with the certificate schedule bearing the same number on which the locations applicable to this approval are listed.

The scope of this approval is applicable to:

Design, manufacture and service of (DN80-DN2600mm) ductile iron pipes, fittings,accessories and (DN40-DN300mm) cast iron drainage pipes, fittings, accessories and cast iron products. Manufacture and service of pig iron, hot rolled ribbed steel bars, hot rolled plain bars, hot rolled round steel, steels for cold heading and cold extruding, quality carbon structure steels, screw-thread steel bars for the prestressing of concrete, hot rolled ribbed bars for threaded resin anchor bolts and continuous casting blanks. Manufacture and service of steel grating. Manufacture and service of plastic-steel-plastic composite pressure pipes. Manufacture and service of Φ73-Φ245mm hot rolled andΦ19-Φ325mm extruded,
cold rolled and cold drawn seamless steel pipes. Manufacture and service of DN15-DN300 light gauge stainless steel tubes and fittings. Manufacture and service of centrifugal casting steel pipes, compound casting steel pipes and steel pipe billets up to 1000mm outside diameter and steel ingots up to 10 tons. Manufacture of hard cokes and coal tars. Engineering design for metallurgical, foundry and mechanical industries, and development of the associated new products and technology. Management of engineering contracting projects, project management and provision associated technology & management service in metallurgical, foundry and mechanical industries.

Rhett Wang

Area Operations Manager, North Asia

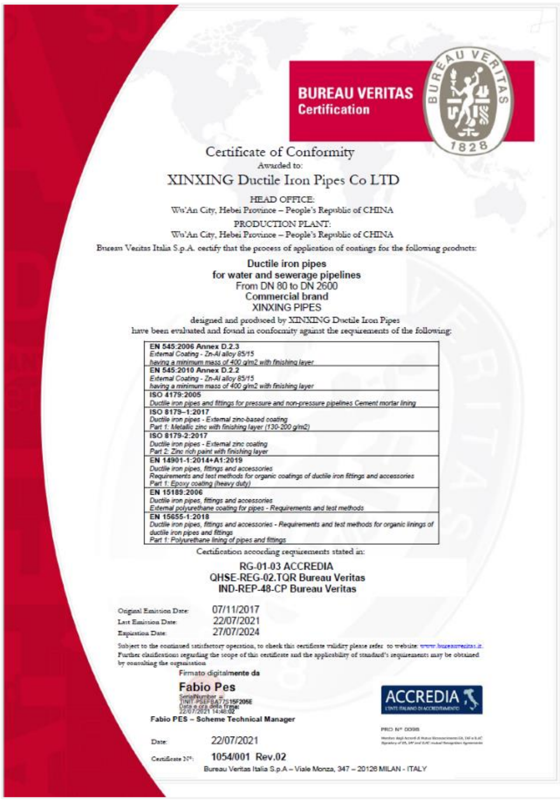
Issued by: Lloyd's Register Quality Assurance (Shanghai) Co., Ltd.

for and on behalf of: Lloyd's Register Quality Assurance Limited

UKAS MANAGEMENT SYSTEMS 0001

The certificate can be checked for validity on CNCA website (www.cnca.gov.cn) 30 working days after the date of issuance. This approval is subject to surveillance assessment carried out in accordance with the LRQA assessment and certification procedures.
Lloyd's Register Group Limited, its affiliates and subsidiaries, including Lloyd's Register Quality Assurance Limited (LRQA), and their respective officers, employees or agents are, individually and collectively, referred to in this clause as 'Lloyd's Register'. Lloyd's Register assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant Lloyd's Register entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.
Issued by: Lloyd's Register Quality Assurance (Shanghai) Co., Ltd., Room 1901-02, Ocean Tower, No. 550 Yan An Dong Road, Shanghai, 200001 for and on behalf of: Lloyd's Register Quality Assurance Limited, 1 Trinity Park, Bickenhill Lane, Birmingham B37 7ES, United Kingdom

Page 1 of 5



BUREAU VERITAS Certification

BUREAU VERITAS 1828

Certificate of Conformity

Awarded to:

XINXING Ductile Iron Pipes Co LTD

HEAD OFFICE:
Wu'An City, Hebei Province – People's Republic of CHINA
PRODUCTION PLANT:
Wu'An City, Hebei Province – People's Republic of CHINA

Bureau Veritas Italia S.p.A. certify that the process of application of coatings for the following products:

Ductile iron pipes
for water and sewerage pipelines
From DN 80 to DN 2600
Commercial brand
XINXING PIPES

designed and produced by XINXING Ductile Iron Pipes
have been evaluated and found in conformity against the requirements of the following:

EN 545:2006 Annex D.2.3 *External Coating - Zn-Al alloy 85/15* *having a minimum mass of 400 g/m2 with finishing layer*
EN 545:2010 Annex D.2.2 *External Coating - Zn-Al alloy 85/15* *having a minimum mass of 400 g/m2 with finishing layer*
ISO 4179:2005 *Ductile iron pipes and fittings for pressure and non-pressure pipelines Cement mortar lining*
ISO 8179–1:2017 *Ductile iron pipes - External zinc-based coating* *Part 1: Metallic zinc with finishing layer (130-200 g/m2)*
ISO 8179-2:2017 *Ductile iron pipes - External zinc coating* *Part 2: Zinc rich paint with finishing layer*
EN 14901-1:2014+A1:2019 *Ductile iron pipes, fittings and accessories* *Requirements and test methods for organic coatings of ductile iron fittings and accessories* *Part 1: Epoxy coating (heavy duty)*
EN 15189:2006 *Ductile iron pipes, fittings and accessories* *External polyurethane coating for pipes - Requirements and test methods*
EN 15655-1:2018 *Ductile iron pipes, fittings and accessories - Requirements and test methods for organic linings of ductile iron pipes and fittings* *Part 1: Polyurethane lining of pipes and fittings*

Certification according requirements stated in:

RG-01-03 ACCREDIA
QHSE-REG-02.TQR Bureau Veritas
IND-REP-48-CP Bureau Veritas

Original Emission Date: 07/11/2017
Last Emission Date: 22/07/2021
Expiration Date: 27/07/2024

Subject to the continued satisfactory operation, to check this certificate validity please refer to website: www.bureauveritas.it. Further clarifications regarding the scope of this certificate and the applicability of standard's requirements may be obtained by consulting the organisation

Firmato digitalmente da
Fabio Pes

Fabio PES – Scheme Technical Manager

ACCREDIA L'ENTE ITALIANO DI ACCREDITAMENTO

PRD N° 009B

Date: 22/07/2021

Certificate N°: 1054/001 Rev.02

Bureau Veritas Italia S.p.A – Viale Monza, 347 – 20126 MILAN - ITALY

EMS GHC

ENVIRONMENT MANAGEMENT SYSTEM CERTIFICATE

Audit and Confirm by Beijing Grand Honour Certification Co., Ltd.

Xinxing Ductile Iron Pipes Co., Ltd.

Unified social credit code：91130400104365768G

Has established and implement an environment system in conformity with

GB/T 24001-2016/ISO 14001:2015 standard.

The scope covered by this management system:
Products and activities:
Production, selling and supporting activites of the seamless steel tubes, continuous casting steel round billets, ingot casting, hot-rolled pipes, extruded tubes, cold-rolled and cold-drawn pipes of carbon steel for special industry, low-alloy steel, alloy steel, stainless steel, nickel-based alloy steel, metallurgy composite bimetallic, centrifugally cast ductile iron pipes, stainless steel pipes and the matched fittings, new type of compound pipes and the matched fittings, castings as well as the correlative products; steel gratings; coke and its by-products-crude benzene, tar, agricultural fertilizer and sulfur ammonia; oxygen making and its by-products- argon gas and nitrogen gas; the iron and steel smelting and the production and sales of the rolled and drawn steel products; the supporting services and the correlative control activities.
Physical locations:
Xinxing Cast Pipe Industrial Zone of Wuan City, Hebei Province. No. 4, Shihua Street, Fuxing District, Handan City, Hebei Province. 108 Taohua west Road, Taohuajiang Town, Taojiang County, Yiyang City, Hunan Province. No. 1 Xinxing Street, Matou Industrial City, Handan City, Hebei Province.

Certificate registration:02221E3052R6L Issuing date: Sep.2, 2021 Effective date: From Sep.2, 2021 to Sep.1, 2024

The certified organization should accept the annual surveillance audit on schedule.This certificate shall be used in conjunction with annually surveillance audit stamp issued by GHC.

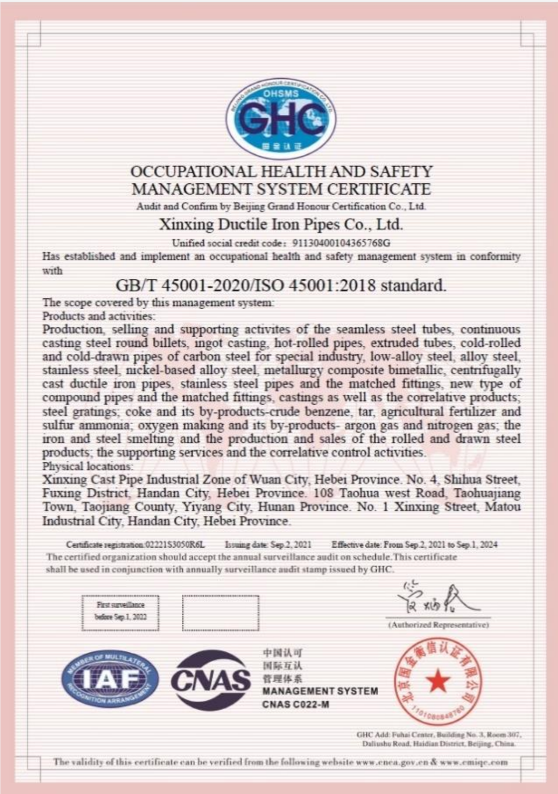
First surveillance before Sep.1, 2022

(Authorized Representative)

IAF CNAS 中国认可 国际互认 管理体系 MANAGEMENT SYSTEM CNAS C022-M

GHC Add: Fuhai Center, Building No. 3, Room 307, Daliushu Road, Haidian District, Beijing, China.

The validity of this certificate can be verified from the following website www.cnca.gov.cn & www.cmiqc.com



OHSMS GHC

OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM CERTIFICATE

Audit and Confirm by Beijing Grand Honour Certification Co., Ltd.

Xinxing Ductile Iron Pipes Co., Ltd.

Unified social credit code：91130400104365768G

Has established and implement an occupational health and safety management system in conformity with

GB/T 45001-2020/ISO 45001:2018 standard.

The scope covered by this management system:
Products and activities:
Production, selling and supporting activites of the seamless steel tubes, continuous casting steel round billets, ingot casting, hot-rolled pipes, extruded tubes, cold-rolled and cold-drawn pipes of carbon steel for special industry, low-alloy steel, alloy steel, stainless steel, nickel-based alloy steel, metallurgy composite bimetallic, centrifugally cast ductile iron pipes, stainless steel pipes and the matched fittings, new type of compound pipes and the matched fittings, castings as well as the correlative products; steel gratings; coke and its by-products-crude benzene, tar, agricultural fertilizer and sulfur ammonia; oxygen making and its by-products- argon gas and nitrogen gas; the iron and steel smelting and the production and sales of the rolled and drawn steel products; the supporting services and the correlative control activities.
Physical locations:
Xinxing Cast Pipe Industrial Zone of Wuan City, Hebei Province. No. 4, Shihua Street, Fuxing District, Handan City, Hebei Province. 108 Taohua west Road, Taohuajiang Town, Taojiang County, Yiyang City, Hunan Province. No. 1 Xinxing Street, Matou Industrial City, Handan City, Hebei Province.

Certificate registration:02221S3050R6L Issuing date: Sep.2, 2021 Effective date: From Sep.2, 2021 to Sep.1, 2024

The certified organization should accept the annual surveillance audit on schedule.This certificate shall be used in conjunction with annually surveillance audit stamp issued by GHC.

First surveillance before Sep.1, 2022

(Authorized Representative)

IAF CNAS 中国认可 国际互认 管理体系 MANAGEMENT SYSTEM CNAS C022-M

GHC Add: Fuhai Center, Building No. 3, Room 307, Daliushu Road, Haidian District, Beijing, China.

The validity of this certificate can be verified from the following website www.cnca.gov.cn & www.cmiqc.com

Appendix 2. Research report on the service life of the Ductile Iron Pipe

球墨铸铁管使用寿命模型的建立、修正及其
寿命评估计算项目研究报告

北京科技大学
2022 年 7 月

于腐蚀裕量时，管道寿命到期即:

$$\Delta e = S = v \times t$$

则腐蚀寿命 t 为:

$$t = \Delta e / v$$

由已经修正的裸管（外表面未加工）在鹰潭土壤所得腐蚀速率模型和表 1-6-3 各个地区腐蚀速率与鹰潭地区腐蚀的比率可以获得各规格球铁管道在各地区的预测寿命，其中 R_m 为 420MPa。涂敷涂层的所有产品均可达到 100 年以上寿命，寿命随产品管径壁厚增加而增大；裸管产品在大港、成都寿命都在 100 年以上，鹰潭地区在 DN1000 以上大管径厚壁规格也可达到 100 年以上寿命，库尔勒地区在 DN200 及以上也可以达到 100 年以上寿命。

Research Report on the Establishment and Modification of Ductile Iron Pipe Service Life Model and its Life Assessment Calculation Project
University of Science and Technology Beijing, July 2022

<u>The translation of the main conclusions in the report:</u>
From the corrected corrosion rate model of bare pipe (outer surface unprocessed) in Yingtan soil and Table 1-6-3 the ratio of corrosion rate in each area to the corrosion in Yingtan area, we can obtain the predicted service life of ductile iron pipes of various specifications in each area, in which the Rm is 420 MPa. All the products coated with coating can reach a service life of more than 100 years, and the service life increases with the increase of the product diameter and wall thickness; the service life of bare pipe in Dagang and Chengdu is more than 100 years, and that of thick pipes with large diameters above DN1000 in Yingtan area is more than 100 years. Dagang, Chengdu life are more than 100 years, DN1000 above large diameter thick wall specifications in Yingtan area can also reach more than 100 years of life, DN200 and above in Korla area can also reach more than 100 years of life.

<u>Statement of the LCA practitioner:</u>
Please note, this report is not a public released report due to some reasons related to business and industry and data confidentiality, as far as we know. However, this report has been signed by the University of Science and Technology Beijing, which was the major research body of the study, and provided to Xinxing. For this EPD project, Xinxing provided the full text of the report to us as a reference. As the LCA practitioner, we consider this report has credibility.

Appendix 3. Statement of recyclability of the waste product

MERCATUS

Statement

To: Xinxing Ductile Iron Pipes Co., Ltd.

The ductile iron pipes and fittings produced by your company are currently in use in overseas regions such as Oceania. The quality of related products is qualified and there are no major issues, which are still in use. According to our company's sustainable development strategy, we plan to fully recycle the waste product after the service life.

This is to certify.

Mercatus International Group Pty Ltd
ABN 54 635 188 260
22/12/2022

+61 7 3707 3182
www.mercatus.net.au
174a Wecker Rd Mansfield
Queensland, Australia 4122

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reece group

Sunday, 24 December 2023

Att: Mr. Chen Wang

XINXING DUCTILE IRON PIPES
61 Intl Trading Dept,
Fortune Financial Center Ffc.
No. 5 Dongsanhuanzhong Rd.,
Beijing, China (100020)

Re: Ductile Iron Pipe Recyclability

Dear Chen,

The ductile iron pipes and fittings produced by Xinxing Ductile Iron Pipe Company and distributed by Reece Group in many regions in Oceania are currently in use as part of drinking water, raw water, and wastewater infrastructure. The quality of related products is certified with no ensuing issues giving an outlook of one-hundred-year design life for these products.

This letter is to certify that according to our company's sustainable development strategy, Ductile Iron Pipes that have reached the end of their design life are to be fully recycled.

Best Regards,

Charles Cauchi
Category Lead – Metals
On behalf of Reece Group Pty. Ltd.

57 Balmain St, Cremorne Victoria 3121 | Private Bag 107, Burwood Victoria 3125 | T 61 3 9274 0000, F 61 3 9274 0199 | ABN 84 004 097 090, www.reecegroup.com.au

References

Emami, N., Heinonen, J., Marteinsson, B., Säynäjoki, A., Junnonen, J.-M., Laine, J., & Junnila, S. (2019). A Life Cycle Assessment of Two Residential Buildings Using Two Different LCA Database-Software Combinations: Recognizing Uniformities and Inconsistencies. Buildings, 9(1), 20. https://doi.org/10.3390/buildings9010020

Gabi LCA software (LCA for Expert). The Gabi LCA software and corresponding database are provided by Sphera in Leinfelden-Echterdingen, Germany. CUP 2023.1 was used.

Global Guidance Principles for LCA databases. A basis for greener processes and products, 'Shonan Guidance Principles', 2011; ISBN: 978-92-807-3174-3.

GPI (2021), General Programme Instructions for the International EPD System version 4.0.

ISO (2006a). ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

ISO (2006b). ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework.

ISO (2006c). ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines.

Kalverkamp, M., Helmers, E., & Pehlken, A. (2020). Impacts of life cycle inventory databases on life cycle assessments: A review by means of a drivetrain case study. Journal of Cleaner Production, 269, 121329. https://doi.org/10.1016/j.jclepro.2020.121329

LCA database published by the ecoinvent association originally known as the ecoinvent Centre, the Swiss Centre for Life Cycle Inventories. Since June 2013 ecoinvent is a not-for-profit association founded by institutes of the ETH Domain and the Swiss Federal Offices. The version 3.9.1 was used.

Managed LCA Content 2023.1 Databases (Gabi database) provided by Sphera.

Pauer, E., Wohner, B., & Tacker, M. (2020). The Influence of Database Selection on Environmental Impact Results. Life Cycle Assessment of Packaging Using GaBi, Ecoinvent 3.6, and the Environmental Footprint Database. Sustainability, 12(23), 9948. https://doi.org/10.3390/su12239948

PCR Construction, PCR 2019:14, Version 1.3.3, Valid until 2024-12-20

Sphera. The provider of the Gabi LCA software and database.

The International EPD system, https://www.environdec.com.

University of Science and Technology Beijing (2022). Research Report on the Establishment and Modification of Ductile Iron Pipe Service Life Model and its Life Assessment Calculation Project.

Xinxing Ductile Iron Pipes Co., Ltd. products promotional documents (2022).

Xinxing Ductile Iron Pipes Co., Ltd. technical files (2022).