

Environmental Product Declaration



In accordance with ISO 14025 and EN 15804:2012+A2:2019 for:

VIXUM

from

Dongsung Chemical Co., Ltd.



Programme:

Programme operator:

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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

CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): Construction Products, PCR 2019:14, Version 1.0
PCR review was conducted by: <i>The Technical Committee of the International EPD® System.</i> Chair: Gorka Benito Alonso Contact via info@environdec.com
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: <i>Ik Kim, SMaRT-Eco Co.</i> Contact via kohung@smart-eco.co.kr
Individual verifiers approved by the International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No

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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. For further information about comparability, see EN 15804 and ISO 14025.

Company information

Owner of the EPD:

- Name: Dongsung Chemical co., Ltd.
- Phone: +82-(0)51-200-4500
- Address: 99, Sinsan-ro, Saha-gu, Busan, Republic of Korea
- Contact: Mr. Brown Gwack, yunyrub@idongsung.com

Description of the organisation: Dongsung Chemical Co. Ltd. Is a specialized chemical company manufacturing polyurethane systems. Since its foundation in 1959, the company marches towards a broader world of sound health and convenience with its environmentally-friendly green chemical products with the mission to provide chemical solution necessary for healthier and comfortable life of people in a pleasant environment.

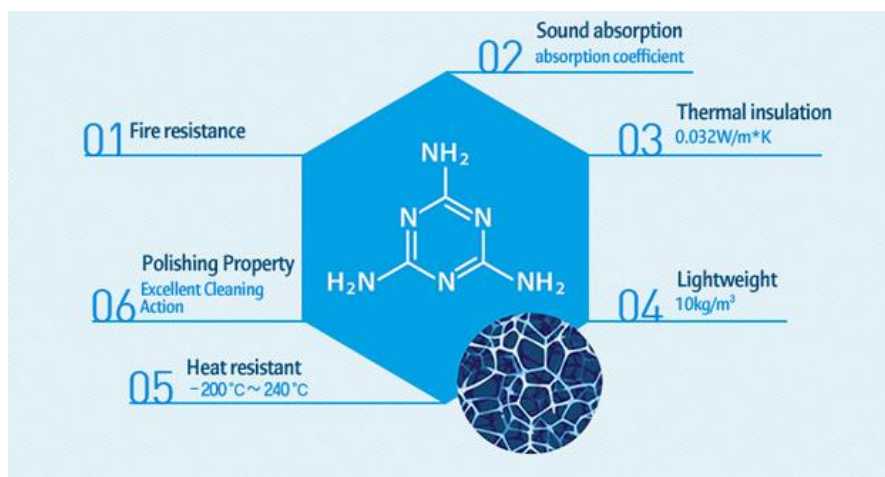
Product-related or management system-related certifications: ISO 9001- and 14001-certificates, Standard 100 by OEKO-TEX®

Name and location of production site: Shinpyeong plant, 19, Hasinbeonyeong-ro, Saha-gu, Busan

Product information

Product name: VIXUM

Product identification: Melamine foam is a foam-like material made by expanding melamine resin, thermosetting plastic, and is widely used in general construction, industry, transportation, and living areas due to its excellent absorption, insulation, and durability. Dongsung Chemical succeeded in developing its own technology of foaming melamine resin with hexagonal three-dimensional retinue structure and open cell for the second time in the world in 2013. VIXUM is a brand name that combines VI(hexagonal Cell structure) and UM(suffix meaning space).



Product description: VIXUM, created by Dongsung Chemical, is a melamine foam by foaming the thermosetting melamine resin. VIXUM has unique three dimensional hexagonal reticular structure and Open Cell foam. It is light weight thanks to its open-cell structure and can maintain its original characteristics under diverse temperature ranges from -200 °C to 240 °C, VIXUM has been used for various construction projects owing to its excellence in sound absorption and insulation performance. It is also gaining popularity as automobile hood liners, wall of trains and aircraft interior materials.

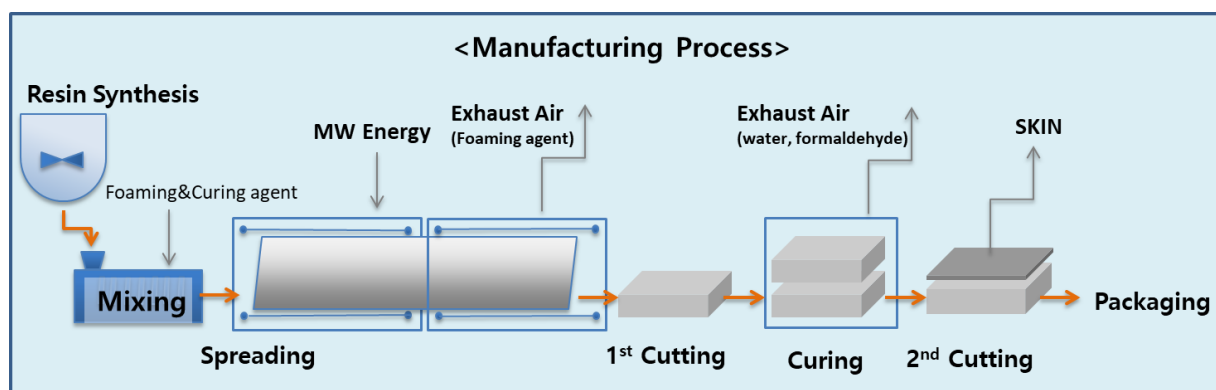
For more information, please visit the official brand website for VIXUM:

<http://www.vixum.co.kr/foreign/en/index.php>

UN CPC code: 36390

Manufacturing process: The VIXUM manufacturing process consists of the following eight steps from synthesis to packaging.

1. Resin Synthesis: Melamine resin synthesis by reaction of melamine formaldehyde
2. Mixing: mixing melamine resin, foaming agent, and curing agent
3. Spreading: Spreading the mixed melamine resin to a certain thickness
4. Foaming: Foaming the spread melamine resin by heating in a chamber
5. 1st cutting: continuously cutting the produced melamine foam into a certain size
6. Post curing: Applying heat to remove moisture and formaldehyde gas from the melamine foam
7. 2nd cutting: removing the uneven upper and lower skins
8. Packing: Finally, packaging the product and storing it until shipment



LCA information

Declared unit: 1m³ of VIXUM (Density: 8.91kg per 1m³)

Reference service life: Not applicable.

Description of system boundaries:

The system boundary on this product is c) Cradle to grave and module D (A + B + C + D). These stages correspond to the A1 to A4, C3 to C4, and D modules. Consideration was not given to stages A5 (construction installation), B1 to B7 (use stage), C1 to C2 modules (end-of-life) because the types and uses of products made from VIXUM are diverse and the environmental impact of the use stage cannot be specified.

Modules declared and geographical scope:

	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
Geography	East Asia	KR	KR	EU	-	-	-	-	-	-	-	-	-	-	-	-	-

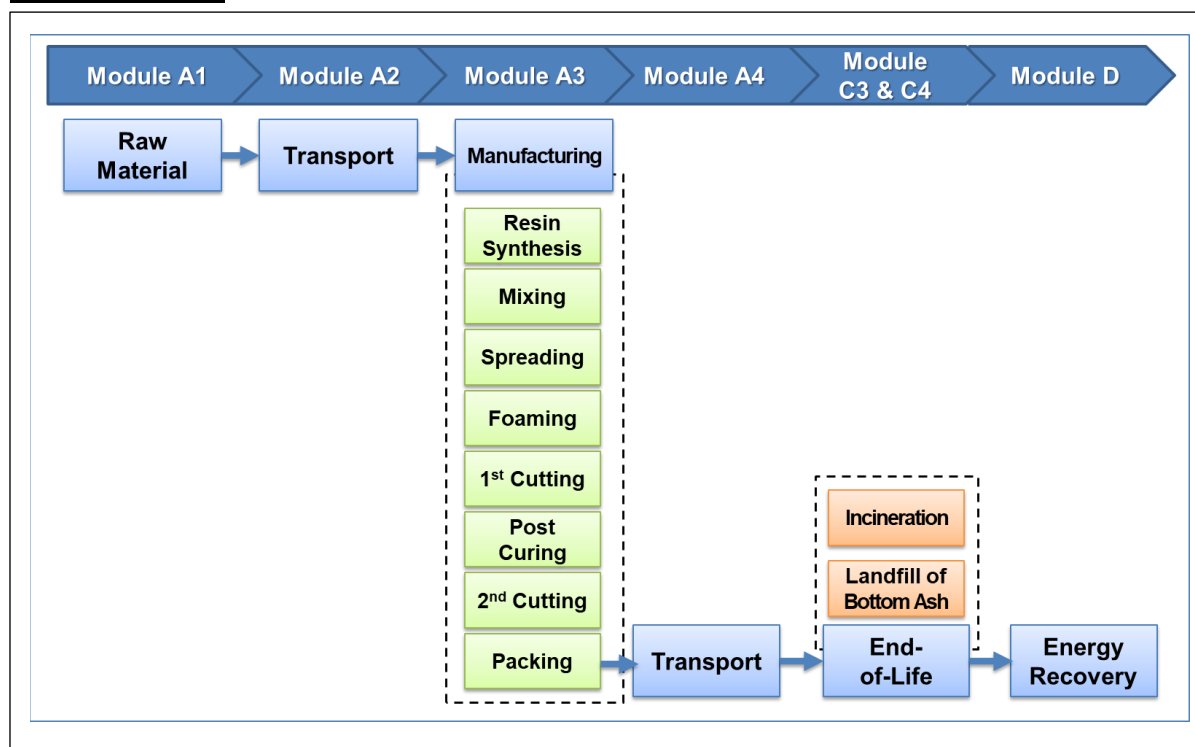
* X: Module declared

* -: Module not declared (such a declaration shall not be regarded as an indicator of a zero result).

The followings are the phases considered:

- Module A1 (Raw material supply): Extraction and production of raw materials.
- Module A2 (Transport)
 - Sea Transportation of raw materials from overseas to Korea.
 - Land transportation of raw materials inside Korea.
- Module A3 (Manufacturing)
 - Production utilities.
 - Waste output after production such as air pollutants and waste water.
- Module A4 (Transport): Transport to customers in Europe.
- Module C3 (Waste processing): Incineration of the product waste at the end of life.
- Module C4 (Disposal): Landfilling of bottom ash
- Module D (Reuse-Recovery-Recycling-potential): CO₂ Reduction by energy recovery

System diagram:



Data quality assessment:

Mass balance check for primary data was conducted to perform conformity assessment.

The data quality assessment was conducted in accordance with ISO 14044 and EN15804 requirements.

- Time related coverage: Primary on-site data were collected during fiscal year (FY) 2019.
- Geographic coverage: Primary data were collected from the Shinpyeong plant in Busan.
- Technological coverage: Primary data flows were collected from current melamine resin forming process.
- Source of the data: All input and output data were collected with an enterprise resource planning (ERP) system in which the data are sorted by product and process unit. Primary data such as measurements, engineering calculations, and purchasing records, were collected.
- Precision: Measure of the variability of the data value for each data expressed.
- Completeness: Percentage of the flow that was measured or estimated.
- Consistency: Quality assessment of the degree to which the dataset reflected the true population of interest.
- Reproducibility: Quality assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study.
- Uncertainty of the information

Cut-off rules: To avoid calculating trivial inputs and outputs, cut-off criteria were applied as follows;

- The sum of the excluded material flows in the system does not exceed 5% of total mass inputs in accordance with EN 15804

- All energies and fuels are included in the system
- All materials and energies are considered in the environmental relevance. The cut-off rules of this LCA is that the LCI data include a 99% of total inflows (mass and energy) per module.

Allocation: Economic allocation is applied and the allocation was performed according to the PCR section 4.5, and hence conforms with comparability requirements therein. The economic value of co-products was evaluated by considering the ratio of income generated by co-product. The co-products we considered is VIXUM skin. The production volume was based on one year and the product price based on the annual average value.

LCI Database and LCA software used:

- LCI Databases: SimaPro Professional Database
- LCA Software: SimaPro Software(version 9.1)

Assumptions and Limitations:

- Transport (Module A2):
 - When calculating the domestic transport distance of raw materials, we assume that the inland transportation is 10-20 ton truck with Euro 5 engines.
 - When calculating the overseas transport distance of raw materials, the land transportation distance was excluded since they were imported through agencies after being collected or purchased across the country and the sea transportation was considered as containership.
- Manufacturing (Module A3):
 - All inputs of water and pentane are evaporated during the forming and curing processes.
 - The input of formaldehyde is more than 99.9% volatile and collected in a scrubber with 99.65% removal efficiency.
 - The input materials which failed to foam are discharged into waste fluid. The waste fluid is cured into solids over time and incinerated for heat recovery.
 - The surface of the melamine foam is cut off to make 1 m³ of VIXUM during the second cutting process. Some are recycled and sold as VIXUM skin, while the rest are incinerated for heat recovery.
 - All wastes after the forming process including waste fluid, skin, etc go to 100% heat recovery.
- Transport (Module A4):
 - The domestic transport of VIXUM products was excluded, and only overseas shipments to Europe were considered based on where they were exported in 2019.
- Waste processing, disposal and resource recovery stage (Module C3, C4 and D):
 - All product wastes go to 100% heat recovery.

Content information

Product components	Weight, kg	Post-consumer material, weight-%	Renewable material, weight-%
VIXUM	8.91	100%	0%
TOTAL	8.91	100%	0%
Packaging materials	Weight, kg	Weight-% (versus the product)	
Polyethylene Bag	0.392	4.40%	
TOTAL	0.392	4.40%	

Dangerous substances from the candidate list of SVHC for Authorisation	EC No.	CAS No.	Weight-% per declared unit
Formaldehyde	200-001-8	50-00-0	0.004

Environmental Information

Potential environmental impact – mandatory indicators according to EN 15804

Results per declared unit							
Indicator	Unit	A1	A2	A3	A4	Tot. A1-A4	C3-D*
GWP-fossil	kg CO ₂ eq.	6.87E+01	7.31E-01	6.81E+01	1.72E+00	1.39E+02	-2.03E+01
GWP-biogenic	kg CO ₂ eq.	-1.76E-01	-1.18E-04	6.39E-02	-5.12E-04	-1.13E-01	1.02E-03
GWP-luluc	kg CO ₂ eq.	2.84E-02	7.17E-05	3.23E-02	1.15E-03	6.18E-02	0.00E+00
GWP	kg CO ₂ eq.	6.85E+01	7.31E-01	6.81E+01	1.72E+00	1.39E+02	-2.03E+01
ODP	kg CFC 11 eq.	9.71E-06	2.18E-08	5.18E-06	3.34E-07	1.52E-05	-1.93E-08
AP	mol H ⁺ eq.	5.08E-01	7.99E-03	1.58E-01	5.45E-02	7.28E-01	-4.88E-03
EP-freshwater	kg PO ₄ ³⁻ eq.	1.20E-02	4.30E-06	2.66E-02	6.53E-05	3.87E-02	-1.09E-07
EP-marine	kg N eq.	5.48E-02	3.04E-03	4.48E-02	1.35E-02	1.16E-01	-1.72E-03
EP-terrestrial	mol N eq.	1.44E+00	3.35E-02	4.47E-01	1.50E-01	2.07E+00	-2.43E-02
POCP	kg NMVOC eq.	1.60E-01	8.33E-03	1.73E+00	3.88E-02	1.94E+00	-4.45E-03
ADP-elements	kg Sb eq.	1.21E-03	7.96E-07	1.19E-04	1.24E-05	1.35E-03	1.14E-05
ADP-fossil*	MJ	1.36E+03	1.01E+01	9.59E+02	2.21E+01	2.35E+03	-5.13E+00
WDP	m ³	1.25E+02	4.33E-03	6.89E+00	3.12E-02	1.32E+02	-2.10E+00
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; • EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; • POCP = Formation potential of tropospheric ozone; • ADP-elements = Abiotic depletion potential for non-fossil resources; • ADP-fossil = Abiotic depletion for fossil resources potential; • WDP = Water (user) deprivation potential, deprivation-weighted water consumption						

* C3-D: Three modules (C3, C4 and D) are integrated because the incineration process includes 'incineration of the product waste'(Module C3), 'landfilling of bottom ash'(Module C4) and 'CO₂ reduction by energy recovery'(Module D).

Potential environmental impact – additional mandatory and voluntary indicators

Results per declared unit							
Indicator	Unit	A1	A2	A3	A4	Tot. A1-A4	C3-D
GWP-GHG ¹	kg CO ₂ eq.	6.87E+01	7.31E-01	6.81E+01	1.72E+00	1.39E+02	-2.03E+01

Use of resources

Results per declared unit								
Indicator		Unit	A1	A2	A3	A4	Tot. A1-A4	C3-D
Renewable Primary Energy Resources	Excluding renewable primary energy used as raw materials (PERE)	MJ	2.90E+01	2.07E-02	1.09E+01	1.44E-01	4.00E+01	2.44E-01
	Raw material (PERM)	MJ	0	0	0	0	0	0
	Total (PERT)	MJ	2.90E+01	2.07E-02	1.09E+01	1.44E-01	4.00E+01	2.44E-01
Non-renewable Primary Energy Resources	excluding non-renewable primary energy used as raw materials (PENRE)	MJ	1.48E+03	1.08E+01	1.03E+03	2.34E+01	2.54E+03	-5.53E+00
	Raw Materials (PENRM)	MJ.	0	0	0	0	0	0
	Total (PENRT)	MJ	1.48E+03	1.08E+01	1.03E+03	2.34E+01	2.54E+03	-5.53E+00
Secondary Material (SM)		kg	0	0	0	0	0	0
Renewable Secondary Fuels (RSF)		MJ	0	0	0	1	0	0
Non-renewable Secondary Fuels (NRSF)		MJ	ND	ND	0	ND	ND	ND
Net Fresh Water (FW)		m ³	2.97E+00	1.25E-04	1.57E-01	1.11E-03	3.13E+00	-4.88E-02

* "ND" (Not Declared): ND shall only be used for voluntary parameters that are not quantified because no data is available

¹ The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus equal to the GWP indicator originally defined in EN 15804:2012+A1:2013.

Waste production and output flows

Waste production

Results per declared unit							
Indicator	Unit	A1	A2	A3	A4	Tot. A1-A4	C3-D
Hazardous waste disposed	kg	1.06E-03	1.21E-06	6.56E-04	1.94E-05	1.74E-03	0.00E+00
Non-hazardous waste disposed	kg	4.37E+00	3.07E-03	4.29E+00	4.92E-02	8.70E+00	-1.56E-02
Radioactive waste disposed	kg	2.79E-03	9.22E-06	2.28E-03	1.48E-04	5.23E-03	0

Output flows

Results per declared unit							
Indicator	Unit	A1	A2	A3	A4	Tot. A1-A4	C3-D
Components for re-use	kg	0	0	0	0	0	0
Material for recycling	kg	0	0	0	0	0	0
Materials for energy recovery	kg	0	0	7.11E+00	0	7.11E+00	8.91E+00
Exported energy, electricity	kJ	0	0	0	0	0	0
Exported energy, thermal	kJ	0	0	0	0	0	0

Information on biogenic carbon content

Results per declared unit		
BIOGENIC CARBON CONTENT	Unit	QUANTITY
Biogenic carbon content in product	kg C	0
Biogenic carbon content in packaging	kg C	0

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO₂

Interpretation of LCA study Results

As the density of VIXUM is very low as 8.91kg per 1m³ compared to general construction products, the declared unit is defined as 1 m³ volume. The LCA results per declared unit 1m³ is comparatively high due to its large volume.

- **Global Warming:** When producing 1m³ of VIXUM, the CO₂ emissions are 118.81kg. The impact of Module A1(Raw material) accounts for 58% as 68.52kg CO₂ eq, followed by Module A3(Production) with 57% as 68.14kg CO₂ eq. About 15% of the total emissions for Module A1 to A4, 20.31kg CO₂ eq, is reduced by waste scenario during Module C3, C4 and D.
- **Ozone Layer Depletion:** When producing 1m³ of VIXUM, 8.91kg, the impact of Ozone Layer Depletion is 1.52E-05 kg CFC11eq. In total ozone depletion effects, Module A1(Raw material) caused the greatest as 64%, followed by Module A3(Production) as 34%.
- **Acidification:** When producing 1m³ of VIXUM, the impact of acidification is 0.72kg mol H⁺eq. In total acidification effects, Module A1(Raw material) caused the greatest as 70%, followed by Module A3(Production) as 22%.
- **Water use:** When producing 1m³ of VIXUM, the amount of water consumption is 130 m³.

Additional information

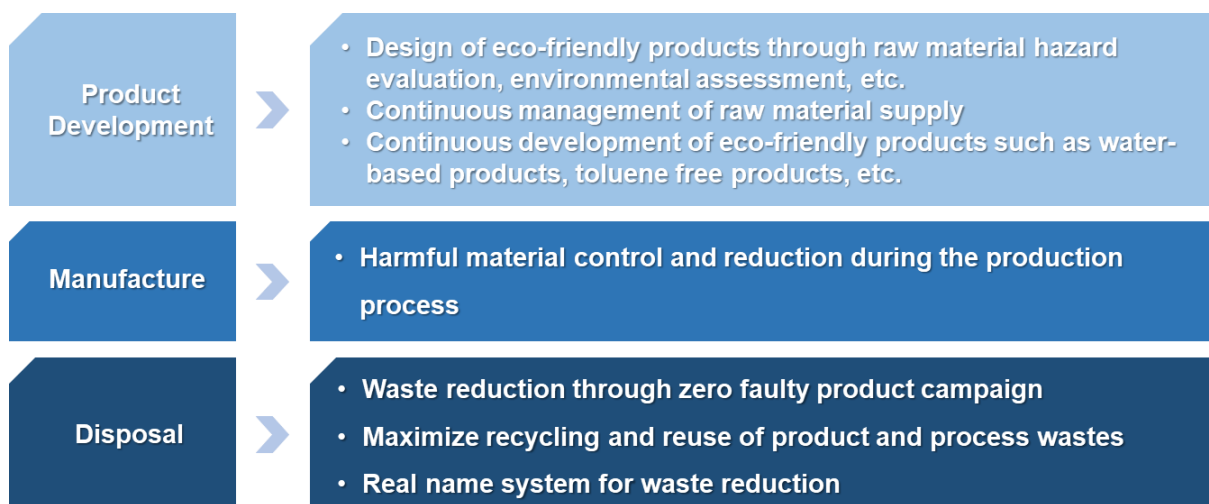
Information about recycling

VIXUM, a melamine foam, is a thermosetting polymer. Thermosetting plastic can only be heated and shaped once because it is irreversibly hardened by curing process. Therefore, It is not possible to achieve material recovery but energy recovery by thermal recycling.

Environmental management activities

In order to continue efforts to reduce environmental impact, Dongsung Chemical obtained ISO 14001:1996 certification in August 1999 and renews the certification in line with the amendment of ISO 14001:2004. In addition to our products, the company has actively adopted eco-friendly viewpoints in every aspect of our business, including production, duty transaction, and service provision.

In the product development stage, in particular, the company reviews product environmental impact and works hard on developing eco-friendly products. Such efforts continue in the manufacturing and disposal stages for better environmental protection.



Contact information

EPD Owner	Dongsung Chemical co., Ltd 99, Sinsan-ro, Saha-gu, Busan, Republic of Korea Tel. +82 (0)51-200-4500 Fax. +82 (0)51-204-5636 Website: http://www.dschem.com/eng/ Responsible person: Mr. Brown Gwack, VIXUM CU, yunyrub@idongsung.com
LCA Author	Mr. Brown Gwack, VIXUM CU, yunyrub@idongsung.com
Program Operator	EPD International AB info@environdec.com

Program-related information and Verification

Program	The International EPD® System. EPD International AB, Box 210 60, SE-100 31 Stockholm, Sweden. www.environdec.com
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Product Category Rules (PCR)	PCR 2019:14 Construction Products, Version 1.0, 2019-12-20
Independent third-party verification of the declaration and data, according to ISO 14025:2006	☐ EPD Process Certification (internal) ☒ EPD Verification (external)
Third party verifier, Approved by The International EPD® System	Ik Kim, SMaRT-Eco Co. kohung@smart-eco.co.kr
Accredited or approved by	The International EPD® System.

References

- General Programme Instructions of the International EPD® System. Version 3.01.
- PCR 2019:14. Construction Products. Version 1.0, 2019-12-10.
- SimaPro LCA Software (version 9.1)
- EN 15804:2012+A2:2019 – Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

