Declaration Owner

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Products

Staron® Acrylic Solid Surfaces

Functional Unit

The functional unit is one square meter of countertop provided and maintained for a period of 10 years in residential use.

EPD Number and Period of Validity

SCS-EPD-08793
EPD Valid March 31, 2023 through March 30, 2028
Version: April 13, 2023

Product Category Rule

Product Category Rule for Environmental Product Declarations: *PCR for Residential Countertops*. NSF International. Valid through March 31, 2023

Program Operator

SCS Global Services
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Declaration Owner:	LOTTE Chemical
Address:	56 Gosan-ro, Uiwang-si, Gyeonggi-do, Republic of Korea
Declaration Number:	SCS-EPD-08793
Declaration Validity Period:	EPD valid March 31, 2023 through March 30, 2028
Version:	April 13, 2023
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Gerard Mansell, SCS Global Services
LCA Software:	OpenLCA v1.11 and ecoinvent v3.8 database
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☒ internal ☐ external
LCA Reviewer:	Beth Cassese, SCS Global Services
Product Category Rule:	Product Category Rule for Environmental Product Declarations: *PCR for Residential Countertops*. NSF International. Valid through March 31, 2023
PCR Review conducted by:	Evan Griffing, PhD, Environmental Clarity LLC, egriffing@environmentalclarity.com
Independent verification of the declaration and data, according to ISO 14025, ISO 21930 and the PCR	☐ internal ☒ external
EPD Verifier:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
Declaration Contents:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044 and 21930*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

ABOUT LOTTE CHEMICAL

LOTTE Chemical formerly LOTTE Advanced Materials, and Cheil Industries, established in 1954 as the founding parent company of the Samsung Group, kicked off its chemical business as part of its portfolio expansion strategy. In 1992, the company started its solid surface business and in 2009 made a foray into manufacturing of engineered stone (quartz surfaces) in a move to strengthen its business portfolio further.

PRODUCT DESCRIPTIONS

Staron® Acrylic Solid Surfaces is a homogeneous and non-porous acrylic composite surfacing material comprised predominately of polymethyl methacrylate and aluminum trihydrate. Staron offers an extensive assortment of colors and patterns and is well-suited for a range of residential and commercial interior applications. Staron is ideally used in healthcare, hospitality, corporate, retail, and residential environments. In accordance with the PCR, the product is classified as polymeric solid surface countertop. The countertop product includes 1.2% pre-consumer recycled content. The manufacturer warrants for a period of 10 years from the date of purchase.

PRODUCT CHARACTERISTICS AND PERFORMANCE

Table 1. *Product characteristics for Staron® Acrylic Solid Surfaces.*

Characteristic	Nominal Value	Unit
Sheet thickness	12 (0.50)	mm (inch)
Sheet length	3,680 (145)	mm (inch)
Sheet width	760 (30.0)	mm (inch)
Sheet weight	19.6 (4.0)	kg/m^2 (lb/ft^2)
Underlayment included	N	Y/N
VOC Emissions Test Method	GREENGUARD GOLD	-

Table 2. *Product performance test results for Staron® Acrylic Solid Surfaces.*

Properties	Results	Test Method
Tensile strength	6,000 psi	ASTM D638
Tensile modulus	600,000 psi	ASTM D638
Flexural strength	10,000 psi	ASTM D790
Flexural modulus	1,000,000 psi	ASTM D790
Elongation	0.50%	ASTM D638
Hardness	92 Rockwell "M" Scale 65 Barcol Impressor	ASTM D785 ASTM D2583
Thermal expansion	2.0 x 10-5 in/in F°	ASTM D696
Gloss (60 Gardner)	Between 5 – 20	NEMA LD-3
Color stability	No change-200hrs	NEMA LD-3
Stain resistance	Pass Rating 41	ANSI Z124
Abrasion resistance	Pass	ANSI Z124
Boiling water surface resistance	No effect	NEMA LD-3
High temperature resistance	No effect	NEMA LD-3
IZOD Impact resistance (notched)	0.28 ft.lb/in	ASTM D256
Ball drop ½" (12.3 mm) sheet	144" w/ 1/2 lb ball, No failure	NEMA LD-3
Fungi and Bacterial resistance	No growth	ASTM G21, G22
Specific gravity Solid colors Patterned colors	 1.72 1.69	ASTM D792
Water absorption	0.04% (1/2", 24hrs) 0.11%, (1/8", 24hrs)	ASTM D570
Flammability Flame spread Smoke density	Class A / Class 1 10 10	UBC 8-1 ASTM E84 ASTM E84
Radiant heat resistance	No visual effect	NEMA LD-3
Toxicity	84.4g (Solid Color) 81.8g (Patterned Color)	Pittburgh Test Protocol (LC50 Test)

MATERIAL COMPOSITION

Table 3. *Material composition of Staron® Acrylic Solid Surfaces in kilograms per functional unit and in percentage of total weight.*

Material	Amount in Final Product (kg/m^2)	Percent of Total (%)	Material Resources Type
Product			
Alumina trihydrate	14.4	64%	Virgin non-renewable
Methyl methacrylate	6.09	27%	Virgin non-renewable
Polymethyl methacrylate	1.39	6.2%	Virgin non-renewable
Recycled polymethyl methacrylate	0.110	0.49%	Recycled* non-renewable
Pigment	0.220	0.98%	Virgin non-renewable
Additives	0.280	1.2%	Virgin non-renewable
Total	**22.5**	**100%**	**-**
Packaging			
Protection film (LDPE)	$5.00x10^{-2}$	12%	Virgin non-renewable
Wood pallet	0.360	88%	Virgin renewable
Total	**0.410**	**100%**	**-**

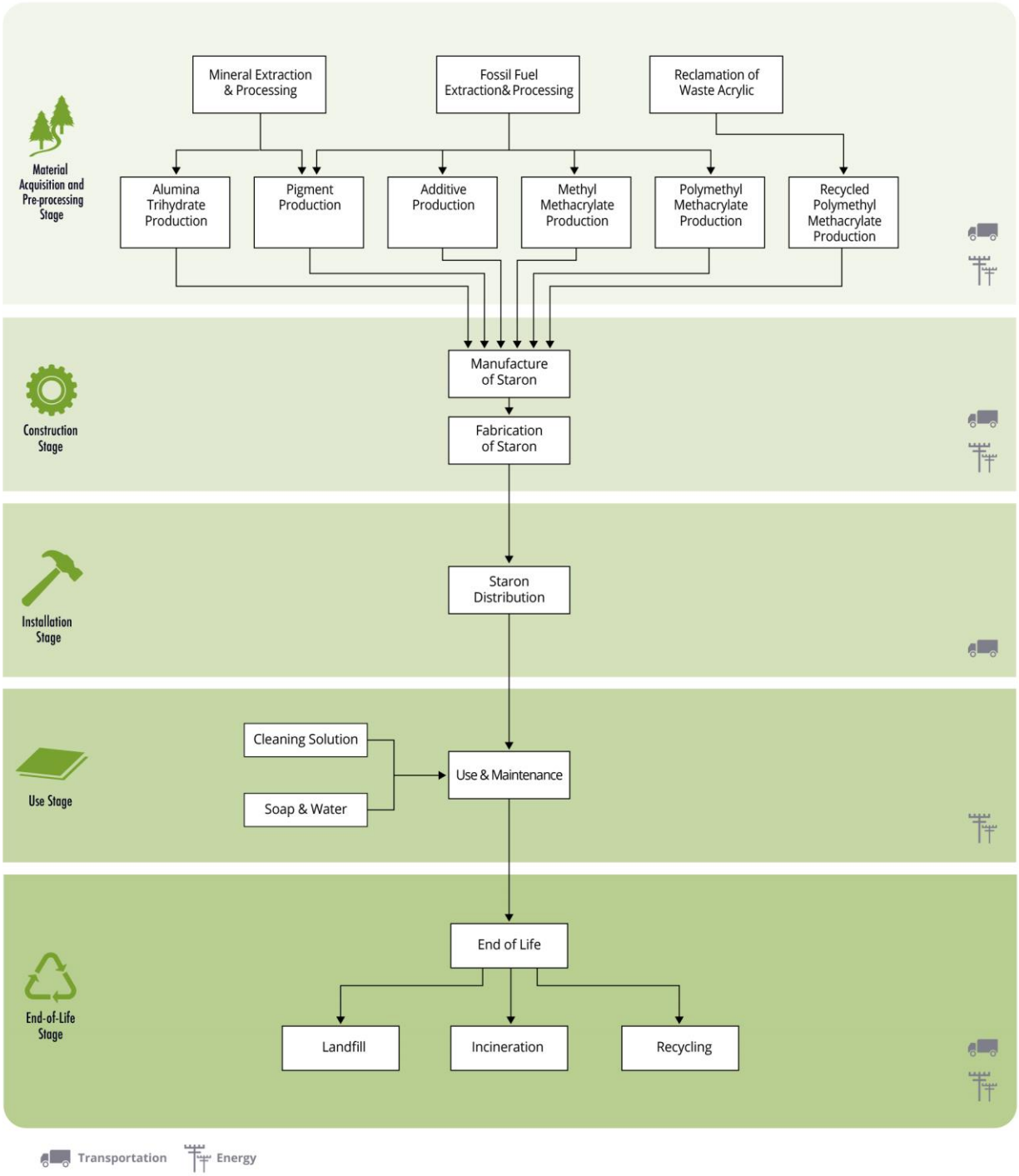
*100% pre-consumer recycled content

LIFE CYCLE ASSESSMENT STAGES

A cradle-to-grave life cycle assessment (LCA) was completed for this product in accordance with ISO 14040, ISO 14044, and the Product Category Rule for Environmental Product Declarations: *PCR for Residential Countertops*. The diagram below illustrates the life cycle stages included in this EPD.

PRODUCT LIFE CYCLE FLOW DIAGRAM

The diagrams below are a representation of the most significant contributions to the life cycle of Staron® Acrylic Solid Surfaces. This includes material acquisition and pre-processing, construction (assembly and fabrication), installation, use, and end-of-life.



LIFE CYCLE INVENTORY

The life cycle inventory (LCI) flows for the EPD are shown in Table 4 through Table 6 in conformance with the requirements of the PCR. Water usage from electricity generation is included.

Table 4. *Air and water emissions for 1 m^2 Staron® Acrylic Solid Surfaces installed and maintained for a period of 10 years.*

Parameter	Unit	Raw Materials	Manufacturing	Installation	Use & Maintenance	Disposal	Total
Air Emissions							
Carbon dioxide	kg	69.2	26.6	10.8	3.40	1.11	111
	%	62%	24%	9.7%	3.1%	1%	100%
Carbon monoxide	kg	0.130	$1.06x10^{-2}$	$2.00x10^{-2}$	$2.83x10^{-3}$	$3.25x10^{-3}$	0.166
	%	78%	6.4%	12%	1.7%	2%	100%
Methane	kg	0.482	$6.34x10^{-2}$	$8.09x10^{-3}$	$3.90x10^{-3}$	$8.35x10^{-4}$	0.558
	%	86%	11%	1.4%	0.7%	0.15%	100%
Nitrogen oxides	kg	0.175	$3.15x10^{-2}$	$7.27x10^{-2}$	$5.69x10^{-3}$	$7.73x10^{-3}$	0.293
	%	60%	11%	25%	1.9%	2.6%	100%
Nitrous oxide	kg	$3.60x10^{-4}$	$2.58x10^{-4}$	$2.84x10^{-4}$	$1.06x10^{-3}$	$4.87x10^{-5}$	$2.01x10^{-3}$
	%	18%	13%	14%	53%	2.4%	100%
Sulfur oxides	kg	0.316	$2.31x10^{-2}$	$3.25x10^{-2}$	$4.44x10^{-3}$	$1.56x10^{-3}$	0.378
	%	84%	6.1%	8.6%	1.2%	0.41%	100%
Water Emissions							
Dioxin	kg	$5.35x10^{-16}$	$6.30x10^{-18}$	$6.51x10^{-18}$	$6.04x10^{-18}$	$1.42x10^{-18}$	$5.55x10^{-16}$
	%	96%	1.1%	1.2%	1.1%	0.26%	100%
Heavy metals	kg	$8.41x10^{-4}$	$4.99x10^{-4}$	$1.11x10^{-4}$	$9.06x10^{-5}$	$7.57x10^{-4}$	$2.30x10^{-3}$
	%	37%	22%	4.8%	3.9%	33%	100%
Nitrates	kg	$4.24x10^{-3}$	$4.70x10^{-3}$	$8.30x10^{-4}$	$7.97x10^{-2}$	$5.15x10^{-5}$	$8.96x10^{-2}$
	%	4.7%	5.2%	0.93%	89%	0.058%	100%
Phosphates	kg	$2.86x10^{-2}$	$1.43x10^{-2}$	$2.36x10^{-3}$	$1.57x10^{-3}$	$2.57x10^{-4}$	$4.71x10^{-2}$
	%	61%	30%	5%	3.3%	0.55%	100%

Table 5. *Resource use and waste flows for 1 m^2 Staron® Acrylic Solid Surfaces installed and maintained for a period of 10 years.*

Parameter	Unit	Raw Materials	Manufacturing	Installation	Use & Maintenance	Disposal	Total
Resources							
Primary Energy Demand	MJ	1,310	460	165	109	18.2	2,060
	%	63%	22%	8%	5.3%	0.89%	100%
Non-renewable, fossil	MJ	1,210	418	162	17.1	17.9	1,830
	%	66%	23%	8.8%	0.94%	0.98%	100%
Non-renewable, nuclear	MJ	78.2	28.0	1.85	1.21	0.170	109
	%	71%	26%	1.7%	1.1%	0.16%	100%
Renewable, wind, solar, geothermal	MJ	0.907	0.776	0.257	0.190	$2.17x10^{-2}$	2.15
	%	42%	36%	12%	8.8%	1%	100%
Renewable, water	MJ	7.08	1.68	1.01	0.589	$8.35x10^{-2}$	10.4
	%	68%	16%	9.6%	5.6%	0.8%	100%
Renewable, biomass	MJ	5.80	12.1	0.529	86.6	$3.77x10^{-2}$	105
	%	5.5%	11%	0.5%	82%	0.036%	100%
Water use	m^3	1.10	0.587	0.107	0.565	$9.70x10^{-3}$	2.37
	%	46%	25%	4.5%	24%	0.41%	100%
Wastes							
Hazardous waste	kg	$1.77x10^{-4}$	$3.05x10^{-4}$	$4.00x10^{-4}$	$4.25x10^{-5}$	$4.26x10^{-5}$	$9.67x10^{-4}$
	%	18%	32%	41%	4.4%	4.4%	100%
Non-hazardous waste (landfill)	kg	18.2	13.2	7.71	0.595	22.6	62.3
	%	29%	21%	12%	0.96%	36%	100%
Recycling	kg	0.00	0.00	$7.50x10^{-3}$	0.00	0.00	$7.50x10^{-3}$
	%	0%	0%	100%	0%	0%	100%
Incineration	kg	0.00	0.00	8.05x10-2	0.00	0.00	8.05x10-2
	%	0%	0%	100%	0%	0%	100%

Table 6. *Additional parameters per ISO 21930: Resource use and waste flows for 1 m^2 Staron® Acrylic Solid Surfaces installed and maintained for a period of 10 years.*

Parameter	Unit	Raw Materials	Manufacturing	Installation	Use & Maintenance	Disposal	Total
Resources							
RPR_E	MJ	13.8	14.5	1.79	87.4	0.143	118
	%	12%	12%	1.5%	74%	0.12%	100%
RPR_M	MJ	0.00	0.00	0.00	0.00	0.00	0.00
	%	0%	0%	0%	0%	0%	0%
$NRPR_E$	MJ	949	446	163	18.3	18.1	1,590
	%	60%	28%	10%	1.1%	1.1%	100%
$NRPR_M$	MJ	344	0.00	0.00	0.00	0.00	344
	%	100%	0%	0%	0%	0%	100%
SM	kg	0.120	0.00	0.00	0.00	0.00	0.120
		100%	0%	0%	0%	0%	100%
RSF	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
RE	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
FW	m^3	1.10	0.587	0.107	0.565	$9.70x10^{-3}$	2.37
	%	46%	25%	4.5%	24%	0.41%	100%
Wastes							
HWD	kg	$1.77x10^{-4}$	$3.05x10^{-4}$	$4.00x10^{-4}$	$4.25x10^{-5}$	$4.26x10^{-5}$	$9.67x10^{-4}$
	%	18%	32%	41%	4.4%	4.4%	100%
NHWD	kg	18.2	13.2	7.71	0.595	22.6	62.3
	%	29%	21%	12%	0.96%	36%	100%
HLRW	kg	$2.66x10^{-5}$	$1.56x10^{-4}$	$7.78x10^{-6}$	$4.97x10^{-6}$	$6.53x10^{-7}$	$1.96x10^{-4}$
	%	14%	80%	4%	2.5%	0.33%	100%
ILLRW	kg	$4.66x10^{-4}$	$4.13x10^{-4}$	$1.07x10^{-3}$	$3.98x10^{-5}$	$1.21x10^{-4}$	$2.11x10^{-3}$
	%	22%	20%	51%	1.9%	5.7%	100%
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00
MR	kg	0.00	0.00	$7.50x10^{-3}$	0.00	0.00	$7.50x10^{-3}$
MER	kg	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
EE	MJ	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

Neg. = Negligible

LIFE CYCLE IMPACT ASSESSMENT

The life cycle impact assessment (LCIA) for the EPD is conducted in accordance with requirements of the PCR. Impact category indicators are estimated using the TRACI 2.1 and CML characterization methods. The LCIA results are calculated using OpenLCA v1.11 software.

Table 7. *LCIA results for 1 m^2 Staron® Acrylic Solid Surfaces installed and maintained for a period of 10 years.*

Impact Category	Unit	Raw Materials	Manufacturing	Installation	Use & Maintenance	Disposal	Total
TRACI							
Global warming	kg CO_2 eq	81.6	28.3	11.1	3.80	1.14	126
	%	65%	22%	8.8%	3%	0.91%	100%
Acidification	kg SO_2 eq	0.445	$4.82x10^{-2}$	$8.45x10^{-2}$	$1.62x10^{-2}$	$7.03x10^{-3}$	0.601
	%	74%	8%	14%	2.7%	1.2%	100%
Eutrophication	kg N eq	0.141	$3.81x10^{-2}$	$1.53x10^{-2}$	$2.69x10^{-2}$	$1.42x10^{-3}$	0.223
	%	63%	17%	6.8%	12%	0.64%	100%
Smog formation	kg O_3 eq	4.36	0.788	1.80	0.154	0.192	7.29
	%	60%	11%	25%	2.1%	2.6%	100%
Ozone depletion	kg CFC-11 eq	$1.91x10^{-6}$	$2.75x10^{-6}$	$2.54x10^{-6}$	$2.39x10^{-7}$	$2.86x10^{-7}$	$7.72x10^{-6}$
	%	25%	36%	33%	3.1%	3.7%	100%
Fossil fuel depletion	MJ surplus	178	62.2	23.2	1.77	2.65	267
	%	66%	23%	8.7%	0.66%	0.99%	100%
CML							
Global warming	kg CO_2 eq	83.0	28.5	11.2	3.77	1.14	128
	%	65%	22%	8.7%	3%	0.9%	100%
Acidification	kg SO_2 eq	0.469	$4.48x10^{-2}$	$7.58x10^{-2}$	$1.47x10^{-2}$	$5.76x10^{-3}$	0.610
	%	77%	7.3%	12%	2.4%	0.95%	100%
Eutrophication	kg $(PO_4)^{3-}$ eq	$7.72x10^{-2}$	$1.97x10^{-2}$	$1.39x10^{-2}$	$1.34x10^{-2}$	$1.40x10^{-3}$	0.126
	%	61%	16%	11%	11%	1.1%	100%
Photochemical oxidation	kg C_2H_4 eq	$2.23x10^{-2}$	$2.87x10^{-3}$	$2.27x10^{-3}$	$2.10x10^{-3}$	$2.02x10^{-4}$	$2.97x10^{-2}$
	%	75%	9.6%	7.6%	7.1%	0.68%	100%
Ozone layer depletion	kg CFC-11 eq	$1.64x10^{-6}$	$2.09x10^{-6}$	$1.91x10^{-6}$	$2.15x10^{-7}$	$2.15x10^{-7}$	$6.08x10^{-6}$
	%	27%	34%	31%	3.5%	3.5%	100%
Abiotic depletion, fossil fuels	MJ	1,210	418	162	17.1	17.9	1,830
	%	66%	23%	8.8%	0.93%	0.98%	100%
Abiotic depletion	kg Sb eq	83.0	28.5	11.2	3.77	1.14	128
	%	65%	22%	8.7%	3%	0.9%	100%

ADDITIONAL ENVIRONMENTAL INFORMATION

Manufacturer of Staron, LOTTE Chemical Co., Ltd., is committed to the "Green Movement" and is constantly striving to improve the environment and keep our nature pristine. In order to keep our environment clean, we, at LOTTE Chemical Co., Ltd., has implemented the following production process for the materials of Staron acrylic solid surfaces.

Lotte Chemical is accredited with ISO 14001:2004 Environmental Management System, and as such aims to reduce the environmental footprint of its manufacturing processes and decrease the pollution and waste produced. The manufacturing process and post process is considered "Environmentally Friendly and Sound".

There are no heavy metals or toxic chemicals used in the production of Staron. All suppliers of the raw materials used in the manufacture of Staron are supervised under a strict Lotte quality control programme. Materials are inspected by both internal/external examining bodies RoHS (Restricting the use of Hazardous Substances) and NSF (National Sanitation Foundation, USA) ensuring that Staron manufacturing meets the environmental standards required.

The high standards and efficiency of production in the manufacture of Staron result in limited waste and reduced energy consumption. Scrap and waste generated during production process are recycled and re-used in the manufacture of new products. Energy consumption is managed using respected management systems comparable to 6 Sigma and TPM. Additionally, Staron recycled series products are manufactured using pre-consumer recycled content and certified by Scientific Certification Systems (SCS) that can contribute to LEED® MR Credits 4.1 and 4.2 for recycled content, resulting in a reduction of industrial waste and energy consumption utilized during the manufacturing process. Using recycled content helps conserve energy and resources, alleviates pressure on landfill space and reduces the need for transportation during certain phases of a product's life cycle.

Staron has a very low VOC (Volatile Organic Compound) content and have achieved Greenguard Certificate in US and the HB Certificate in Korea, both of which require a very strict indoor air purification policy. They have passed the requirements of two GREENGUARD certification programs. GREENGUARD Indoor Air Quality Certified® product certification is granted for low-emitting interior building materials, furnishings and finish systems. The more stringent GREENGUARD for Children & Schools^{SM} certification is granted for low-emitting interior building materials, furnishings and finish systems used in educational (day-care and K-12) environments. The positive results streamline the process for attaining points toward LEED® for Commercial Interiors certification in its Environmental Quality (EQ) 4.5 section. Any architect, builder or developer who includes GREENGUARD-certified Staron products in commercial, institutional or multi-family housing projects will no longer have to wait for the otherwise lengthy LEED certification process for its "Low-Emitting Materials, Systems Furniture and
Seating" category.

Staron is considered a re-usable material and can be refurbished to look "as new" reflecting effective recycling of this quality product. This demonstrates consideration for our environment and also reflects potential cost control. Otherwise, waste product can be incinerated, or disposed of to landfill in compliance with local regulations.

SUPPORTING TECHNICAL INFORMATION

Unit processes are developed with openLCA 1.11 software, drawing upon data from multiple sources. Primary data were provided by LOTTE Chemical for their manufacturing, upstream transport, and distribution processes. The primary sources of secondary LCI data are from Ecoinvent.

Table 8. *LCI datasets and associated databases used to model the Staron® Acrylic Solid Surfaces product system.*

Flow	Dataset	Data Source	Publication Date
Materials			
Alumina trihydrate	aluminium hydroxide production | aluminium hydroxide | Cutoff, S/RoW	Ecoinvent v3.8	2021
Methyl methacrylate	methyl methacrylate production | methyl methacrylate | Cutoff, S/RoW	Ecoinvent v3.8	2021
Polymethyl methacrylate	polymethyl methacrylate production, beads | polymethyl methacrylate, beads | Cutoff, S/RoW	Ecoinvent v3.8	2021
Recycled polymethyl methacrylate	polymethyl methacrylate production, beads -Recycled | polymethyl methacrylate, beads | Cutoff, S/RoW	Ecoinvent v3.8; SCS	2017
Pigment	market for titanium dioxide | titanium dioxide | Cutoff, S/RoW; carbon black production | carbon black | Cutoff, S/GLO	Ecoinvent v3.8	2021
Additives	chemical production, organic | chemical, organic | Cutoff, S/GLO	Ecoinvent v3.8	2021
Packaging			
Protection Film	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cutoff, S/RoW	Ecoinvent v3.8	2021
Wooden Pallet	EUR-flat pallet production | EUR-flat pallet | Cutoff, S/RoW	Ecoinvent v3.8	2021
Electricity/Heat/Resources for Manufacturing			
Electricity	market for electricity, medium voltage | electricity, medium voltage | Cutoff, S/KR	Ecoinvent v3.8	2021
Natural Gas	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, natural gas | Cutoff, S/RoW	Ecoinvent v3.8	2021
Propane	propane, burned in building machine | propane, burned in building machine | Cutoff, S/GLO	Ecoinvent v3.8	2021
Steam	market for heat, from steam, in chemical industry | heat, from steam, in chemical industry | Cutoff, S/RoW	Ecoinvent v3.8	2021
Fabrication			
Electricity	market group for electricity, medium voltage | electricity, medium voltage | Cutoff, S/RNA	Ecoinvent v3.8	2021
Adhesive	methyl methacrylate production | methyl methacrylate | Cutoff, S/RoW	Ecoinvent v3.8	2021
Transportation			
Road	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff, S/RoW	Ecoinvent v3.8	2021
Ship	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, S/GLO	Ecoinvent v3.8	2021

Data Quality

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 5 years old (typically 2016). All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. Manufacturer-supplied data (primary data) are based on annualized production for 2021.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Electricity use for product manufacture is modeled using representative data for regional power mixes from the Ecoinvent database. Surrogate data used in the assessment are representative of global or regional operations. Data representative of global operations are considered sufficiently similar to actual processes. Data representing product disposal are based on US statistics.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Representative datasets, specific to the type of material, are used to represent the actual processes, as appropriate.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of the products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent v3.8 data where available. Different portions of the product life cycle are equally considered.
Reproducibility: Qualitative 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	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	For manufacturing and packaging, primary data were provided by LOTTE Chemical. Similarly, the upstream transport of materials is based on primary data provided by LOTTE Chemical. The fabrication process was derived from fabrication manuals provided by LOTTE Chemical to derive key parameters for calculations. For the distribution of product from manufacturing facility to distribution center, a weighted average based on primary data was provided by LOTTE Chemical. The transport of the products from fabrication facility to installation are based on the RITA transport survey. For secondary LCI data, Ecoinvent v3.8 LCI data are used.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the products and packaging is low. Actual supplier data for all upstream operations were not available and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

Allocation

Resource use at the Yeosu-si, Jeollanam-do, South Korea facility (e.g., water and energy) was allocated to the product based on the product weight as a fraction of the total facility production.

The countertop product system includes recycled materials, which are allocated using the recycled content allocation method (also known as the 100-0 cut off method). Using the recycled content allocation approach, system inputs with recycled content do not receive any burden from the previous life cycle other than reprocessing of the waste material. At end of life, materials which are recycled leave the system boundaries with no additional burden.

Impacts from transportation were allocated based on the mass of material and distance transported.

System boundaries

The system boundary of the life cycle assessment for the countertop was cradle-to-grave.

Elements excluded from the system boundary include the following:

- Construction activities, capital equipment, and infrastructure;
- Maintenance and operation of equipment;
- Personnel travel and resource use;
- Forklifts, storage frames, clamps, templating materials, and other reusable tools for fabrication;
- A-frames and strapping for shipping from manufacturing facility to distribution center;
- Ancillary and labeling materials used in manufacturing; and
- Repair of the countertops.

The deletion of these processes and inputs is permitted since it is not expected to significantly change the overall conclusions of the study and complies with the cut-off criteria requirements specified by the PCR.
A description of the system boundaries for this EPD are as follows:

- **Material acquisition and pre-processing stage** – This stage includes extraction of virgin materials and reclamation of non-virgin feedstock. Resource use, emissions, and generated wastes associated with extraction and processing of the raw materials are included. All upstream transportation, including transportation to the manufacturing facility, is included.
- **Construction stage** – This stage includes all the relevant manufacturing and fabrication processes. Resource use, emissions, and generated wastes associated with these processes are included. Transport of semi-finished products between facilities and materials used in packaging of the product are included. Production of capital goods, infrastructure, production of manufacturing equipment, and personnel related activities are excluded.
- **Installation stage** – This stage includes the delivery of the countertop to the point of installation, and energy and ancillary materials used during installation. Waste generated during countertop installation is included. Sinks, plumbing fixtures, and cook tops are excluded.
- **Use stage** – The use stage includes the cleaning of the countertop during its lifetime, as well as extraction, manufacturing and transport of all sundry material for cleaning. In accordance with the PCR, maintenance and repair of the countertop is generally insignificant and is excluded from this stage. The reference service life for the countertop in this EPD is 10 years.
- **End of life stage** – The end of life stage includes the transport of the countertop and its original packaging to end of life processes including landfill, incineration, and recycling.

Cut-off criteria

According to the PCR, mass and energy flows that consist of less than 1% may be omitted from the inventory analysis. Cumulative omitted mass or energy flows shall not exceed 5%. In the present study, except as noted, all known materials and processes were included in the life cycle inventory.

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