ENVIRONMENTAL PRODUCT DECLARATION

TRISTONE® (ACRYLIC SOLID SURFACES)

TriStone®

Functional unit is 1 m^2 (10.8 ft^2) of product for a period of 10 years in use.

TriStone™ by Lion Surfaces

TriStone® (Acrylic Solid Surfaces) is a man-made material usually composed of a combination of Alumina Trihydrate (ATH), acrylic, epoxy or polyester resins and pigments with Lion Chemtech's own technology.

TriStone® has great durability with quality materials and excellent technology. TriStone® is superior to natural marble in impact resistance and scratch resistance and free from bacteria, blotch, and contamination.

TriStone® can be fabricated in a way similar to wood processes. TriStone® can be thermoformed and used for various life style applications to fulfill the customer's needs. With TriStone®, you can enjoy limitless styles with a wide range of seamless processes.

TriStone® offers various collections from simple white colors to high quality intricate patterns. TriStone® produces beautiful and practical space having various colors and textures with influenced designs from normal life motifs and nature's inspirations..

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

TriStone™ by Lion Surfaces

Acrylic Solid Surfaces

According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Provided
DECLARATION HOLDER	UL Provided
DECLARATION NUMBER	UL Provided
DECLARED PRODUCT	TriStone®
REFERENCE PCR	UL Provided
REFERENCE PCR STANDARD	☐ Product Category Rule for Environmental Product Declarations for Residential Countertops, NSF Sustainability, 2018 ☐ Addendum to NSF Countertop PCR: Surfaces and ISO Conformance (Draft 2017-02-24)
DATE OF ISSUE	UL Provided
PERIOD OF VALIDITY	UL Provided
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	UL Provided
	UL Provided
	UL Provided
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	
	UL Provided

ENVIRONMENTAL PRODUCT DECLARATION

TriStone™ by Lion Surfaces

Acrylic Solid Surfaces

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This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	UL Provided

Environment

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Key Environmental Parameters

Key environmental parameters are shown in Table 1.

Parameter	Amount
Global warming [kg CO_2 eq.]	114.2
Primary energy demand [MJ]	1,454
Post-consumer recycled content percentage [%]	0

Table 1 : Key environmental parameters

Company Description

Communicating with nature, life & art and Creating human space by adding the history which has been accumulated over billions of years, this is the philosophy and future of Lion Chemtech.

Lion Chemtech is the only manufacturer that professionally produces Quartz and Acrylic Solid Surface in Korea. Established in 1973, with certified technology and beautiful design, Lion Chemtech is leading the industry and endeavoring globalization. Through continuous R&D for elegant Quartz and Solid Surface enables Lion Chemtech products to have excellent durability and luxury. The value of Lion Chemtech's products will never change in spite of change of several generations.

Product Specifications

Product Description

TriStone® (Acrylic Solid Surfaces) is man-made material usually composed of a combination of Alumina Trihydrate (ATH), acrylic, epoxy or polyester resins and pigments with Lion Chemtech own technology.

Excellent Durability

TriStone® has great durability through the use of quality materials and advaned technology. TriStone® is superior to natural marble in impact and scratch resistance and free from bacteria, blotch, and contamination.

Home space production by excellent fabrication ability

TriStone® can be fabricated in a way similar to wood processes. TriStone® can be thermoformed and used for various life style applications to fulfill customer's needs. With TriStone®, you can enjoy limitless styles with a wide range of seamless process.

Various color and patterns

TriStone® offers various collections from simple white colors to high quality intricate patterns. TriStone® produces beautiful and practical space having various colors and textures with influenced designs out of normal life motifs and nature's inpsiriations.

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Superior Hi-tech and environment-friendly material

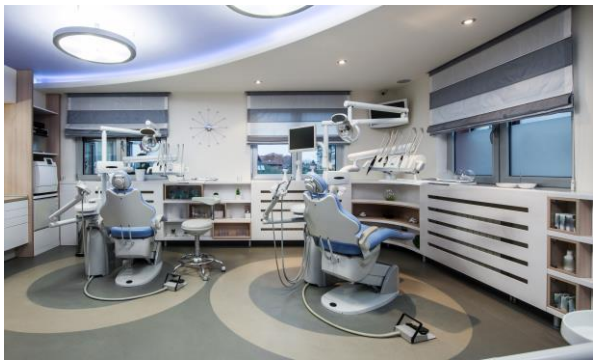
TriStone® uses non-hazardous materials and seeks to excel in the category of environmental friendliness and lead this category in the industry. TriStone® considers the environment, nature, and humanism as the most precious values, therefore is certificated by NSF, Green Guard, etc.

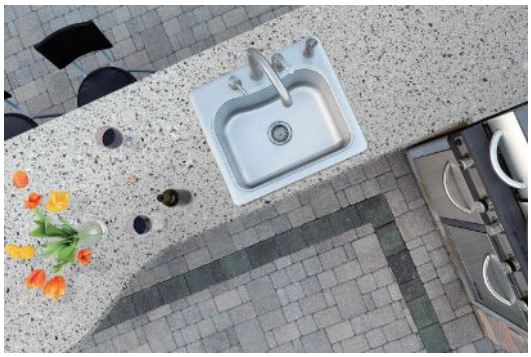
Application

TriStone® can be used in residential applications, including kitchens and bathrooms, as well as in commercial applications for both horizontal and vertical installations.

- Residential: Kitchen Top, Sink Bowl for home, Bathtub (Wash Basin), Living Space, Furniture
- Commercial: Public Building and Office, Facades and Wall cladding, Shops and Exhibitions, Healthcare and Hospital, Educational institutions, and others (Hotel, Marine industry, Airport, etc.)

Product Photos




Environment

Figure 1: TriStone® in its various applications

Product Characteristics

TriStone® conforms to the following technical specifications for solid surface

- NSF/ANSI 51 – Food equipment materials
- ISO 19712-1 Classification and specification of solid surfaces
- ISO 19712-2 Classification and specification of sheets
- ASTM D792 – 13 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- ASTM D570 Standard Test Method for Water Absorption of Plastics
- ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- ASTM G22 Standard Practice for Determining Resistance of Plastics to Bacteria (Withdrawn 2002)
- ASTM D1499 – 99 Standard Practice Filtered Open-Flame Carbon-Arc Type Exposures of Plastics
- ASTM D648-07 Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position (Withdrawn 2016)
- ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- ASTM D785 Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
- ASTM D638 Standard Test Method for Tensile Properties of Plastics
- ASTM D638-14 Standard Test Method for Tensile Properties of Plastics
- PS 18:1966 International Association of Plumbing and Mechanical Officials – Material and Property Standard for Cultured Marble Lavatory
- ANSI UL 723 (ASTM E84) Standard for Test for Surface Burning Characteristics of Building Materials

Technical details and product characteristics are detailed in Table 2 and Table 3.

Characteristic	Nominal Value	Unit
Primary material thickness	12 (1/2)	mm (inch)
Sheet/slab length	368 (144)	cm (inch)
Sheet/slab width	76 (30)	cm (inch)
Primary material weight	21,450	g/m^3 (lbs/ft^3)
Underlayment included	None	-
Underlayment type	None	-
VOC emissions test method	• EPA Compendium Method TO-17 – Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling onto Sorbent Tubes • ASTM D 6196 – Standard Practice for Choosing Sorbents, Sampling Parameters and Thermal Desorption Analytical Conditions for Monitoring Volatile Organic Chemicals in Air • EPA Compendium Method TO-11A – Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC) [Active Sampling Methodology] • ASTM D 5197 – Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active	

	Sampler Methodology)
Other characteristics	GREENGUARD and GREENGUARD GOLD certification

Table 2 : Solid surface characteristics

Additional Characteristics	Nominal Value	Test Method
Specific gravity	1.749	ASTM D792
Water absorption	0.03%	ASTM D570
Fungal resistance	ASTM rating of 0	ASTM G21
Bacterial resistance	No observed growth on product at 100x power	ASTM G22
Light resistance/color stability	No effect (blisters, crazing, cracking, dulling) Moderate effect (color change)	NEMA LD3
Cleanability/stain resistance	PASS	IAPMO/ANSI124.1.2
Light resistance	No effect (blisters, crazing, cracking) Moderate effect (dulling) Slight effect (color change)	NEMA LD3
Boiling water resistance	No effect	NEMA LD3
High temperature resistance	No effect (crazing, color change, cracking) Moderate effect (blisters) Slight effect (dulling)	NEMA LD3
Carbon Arc Exposure	No effect (blisters, crazing, cracking) Slight effect (color change, dulling)	ASTM D1499-99
Maximum Temperature of Use in ℉	212 ℉	NSF/ANSI 51 Food equipment materials
Boiling water resistance	No effect	NEMA LD3
Ball impact resistance	> 95	ISO 19712-1(NEMA LD3)
Specular gloss, 60○ (average)	77	NEMA LD3
Izod impact strength	16J/m	ASTM D648-07
Flexural strength	62.8Mpa	ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
Flexural modulus	10.0Gpa	ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
Hardness, Rockwell M scale	90	ASTM D785
Hardness, Barcol	63	ISO 19712-2 (ASTM D2583)
Light resistance	PASS	ISO 19712-2
Stain / chemical resistance test	PASS	
Resistance to cigarette burns	PASS	

Resistance to dry heat	PASS	
Resistance to wet heat	PASS	
Hot/cold cycle water-resistance test	PASS	
Load test	PASS	
Elongation at break point	0.73%	ASTM D638
Tensile strength	31.6Mpa	ASTM D638-14
Tensile modules of elasticity	9.93Gpa	
Impact resistance	No visible cracks	PS 18:1966 International Association of Plumbing and Mechanical Officials – Material and Property Standard for Cultured Marble Lavatory
Flame spread index (FSI)	20	ANSI UL 723 (ASTM E84)
Smoke developed index	5	

Table 3 : Additional solid surface characteristics

Material Content

TriStone® is an acrylic solid surface. It is composed primarily of an inert material held together with an acrylic binder. Various pigments are included, along with catalysts and processing materials. Ingredients are shown in Table 4.

Material	Mass [%]	Mass [kg]
Alumina Trihydrate (ATH)	63.70	38
Methyl Methacrylate (MMA)	27.81	17
Poly Methyl Methacrylate (PMMA)	7.19	4
Other ingredients	1.30	0.8

Table 4 : TriStone® material composition

Underlying Life Cycle Assessment

The analysis was conducted according to the NSF product category rule for residential countertops (NSF International, 2013) and accompanying addendum (UL, 2017). The analysis represents the average environmental performance of TriStone® from LionChemtech's facilities, as weighted by sales to North America. Since sales and primary data were obtained for the 2016 calendar year as LionChemtech, all colors and sheet dimensions are included.

Functional Unit

The functional unit is 1 m^2 (10.76 ft^2) of 12-mm thick surface for a period of 10 years in use.

System Boundary

The entire life cycle of TriStone® is to be covered including all industrial processes from raw material acquisition. The countertop pre-processing into a countertop pre-form; construction of the countertop, distribution,and transportation

and installation at the end user location, use/maintenance, and end-of-life. Figure 3 provides an overview of the manufacturing process for the TriStone®.

- **Material acquisition and pre-processing stage**: The material acquisition, pre-processing, and intermediate processing stage start when the material is extracted from nature, or recovered from previous use and ends when the material reaches the gate of the countertop construction facility. The countertop consists of main sheet, front edge and backsplash which have the same material composition and fabrication processes.
- **Construction**: During construction, raw materials for the countertop are processed into sheets. This stage also includes production and inbound transport of packaging materials.
- **Installation:** This is the step of installing the produced countertop at the construction site. During the installation process a polysulphide adhesive is used in the construction process. It also consumes electricity from the grinders and circular sanders for adhesive removal and surface sanding.
- **Use and Maintenance:** The period of use of TriStone® is 10 years. TriStone® is a durable product that you can keep for a long time. One luxury of artificial marble is the simple maintenance, which only requires the marble to be wiped with diluted bleach once a month.
- **End-of-Life:** TriStone® cannot be used for countertops applied to various buildings, and it is impossible to obtain the primary data for the disposal process. Data was collected by applying the waste stage scenario presented in the PCR.

Cut-off Criteria

Cut off rules applied in this study come from the PCR for Environmental Product Declarations for Residential Countertops, NSF Sustainability, 2018.

- 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%.
- Mass or energy flows that contribute more than 10% to an impact category shall be included.

Allocation

Facility inputs were allocated based on Lion Chemtech's engineering judgment. The cut-off allocation approach was used to address secondary material use, as well as any packaging material recycling at the end-of-life.

Background Data

The LCI database applied to external purchasing materials, energy and utilities utilized the Ecoinvent v2.2 revised in 2010, USLCI revised in 2012 and the LCI database approved by the government of the Republic of Korea.

Data Quality

Inventory data quality is judged by its precision (measured, calculated, estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied) and representativeness (geographical, temporal, and technological).

To cover these requirements and to ensure reliable results, first-hand industry data in combination with consistent background LCA information from the Ecoinvent v2.2, USLCI and the Korea National LCI database were used. The LCI datasets from the Ecoinvent v2.2 and USLCI database are widely distributed and used with the SimaPro Software. Korea National LCI database is applied with domestic electricity use and industrial use.

The datasets have been used in LCA models worldwide in industrial and scientific applications internationally as well as in many critically reviewed and published studies. In the process of providing these datasets they are cross-

checked with other databases and values from industry and science.

Life Cycle Assessment Results and Analysis

Life cycle assessment results are presented per the functional unit.

Materials Resources

Materials resources, listed in Table 5, consist of all of the elementary flows included in the entire product system. Virgin renewable resources consist largely of air and carbon dioxide needed in materials acquisition, while virgin non-renewable resources mainly consist of rock, mineral and crude oil resources.

	Unit	Material acquisition	Construction	Installation	Use & maint.	End-of-life	Total
Virgin renewable resources	kg	6.79E+00	2.37E+01	9.93E-03	5.13E-03	8.48E-03	3.05E+01
Recycled resources	kg	-	-	-	-	-	-
Virgin non-renewable resources	kg	2.93E+01	1.28E+01	5.78E-01	2.20E-01	2.07E+00	4.50E+01

Table 5 : TriStone® materials resource results per functional unit

Energy Consumption

LCI categories	Unit	Material acquisition	Construction	Installation	Use	End of life	Total
Non-renewable							
Fossil-fuel based	MJ	-	1.187E+01	-	-	-	1.187E+01
Nuclear	MJ	-	5.145E+00	-	-	-	5.145E+00
Renewable							
Solar	MJ	1.324E-02	1.296E-01	5.283E-03	3.023E-04	1.544E-04	1.486E-01
Wind	MJ	4.211E-01	3.718E-01	9.927E-03	1.066E-02	7.031E-03	8.205E-01
Hydro	MJ	8.040E+00	3.627E+00	1.671E-01	7.662E-02	1.138E-01	1.202E+01
Biomass	MJ	4.360E+00	2.589E+02	8.373E-02	2.993E-02	2.238E-02	2.634E+02
Geothermal	MJ	-		-	-	-	

Table 6 : TriStone® energy consumption results per functional unit

Impact Assessment

Impact assessment results are listed in Table 7. The Global warming potential (GWP), Acidification potential (AP), photochemical ozone creation potential (POCP), eutrophication potential (EP), and ozone depletion potential (ODP) results were calculated using the TRACI 2.1 methodology. Abiotic depletion potential (ADP) results are based on CML 2001 (v4.7, January 2016).

	Unit	Material acquisition	Construction	Installation	Use	End of life	Total
GWP	kg CO_2 eq.	7.837E+01	2.979E+01	1.124E+00	1.937E-01	4.737E+00	1.142E+02
ODP	kg CFC-11 eq.	3.253E-06	2.130E-06	2.958E-08	2.425E-08	5.594E-08	5.493E-06
AP	kg SO_2 eq.	1.234E-01	8.446E-02	8.844E-04	2.504E-04	1.712E-03	2.107E-01
EP	kg N eq.	5.139E-02	1.225E-02	4.627E-04	1.737E-04	1.152E-03	6.543E-02
POCP	kg O_3 eq.	4.255E+00	2.646E+00	2.712E-02	8.175E-03	5.685E-02	6.993E+00
ADPE	kg antimony eq.	7.069E-05	5.751E-06	1.667E-07	1.980E-07	1.335E-07	7.694E-05
ADPF	MJ	7.076E+02	1.385E+02	5.027E+00	2.366E+00	1.154E+00	8.547E+02

Table 7 : TriStone® impact assessment results per functional unit

Emissions and Wastes

LCI categories	Unit	Material acquisition	Construction	Installation	Use	End of life	Total
Emission to air							
SO_X	kg	-		-	-	-	
SO_2	kg	2.607E-01	5.293E-02	1.906E-03	3.729E-04	3.844E-04	3.163E-01
NO_X	kg	1.715E-01	1.059E-01	1.088E-03	3.285E-04	2.289E-03	2.811E-01
CO_2	kg	6.757E+01	2.858E+01	1.015E+00	1.822E-01	4.282E+00	1.016E+02
CO_2 (biogenic)	kg	2.567E-01	2.037E+00	7.245E-03	4.644E-03	2.862E-03	2.308E+00
Methane	kg	4.202E-01	3.146E-02	3.783E-03	3.905E-04	1.756E-02	4.733E-01
N_2O	kg	7.337E-04	7.330E-04	4.366E-05	4.286E-06	5.174E-05	1.566E-03
CO	kg	9.499E-02	4.827E-02	3.395E-04	1.251E-04	9.483E-04	1.447E-01
Emission to water							
Phosphates	kg	1.414E-03	1.531E-03	8.465E-05	3.689E-05	2.308E-05	3.089E-03

Nitrates	kg	4.392E-04	9.381E-04	3.624E-04	1.095E-05	1.993E-03	3.743E-03
Dioxin	kg	-		-	-	-	
Heavy metals, As	kg	2.314E-04	1.198E-05	5.769E-07	9.278E-08	1.510E-06	2.456E-04
Heavy metals, Cd	kg	2.052E-07	6.073E-07	1.066E-07	2.121E-09	5.694E-07	1.491E-06
Heavy metals, Cr	kg	3.924E-04	3.428E-05	7.113E-07	7.820E-07	2.662E-06	4.308E-04
Heavy metals, Pb	kg	1.184E-05	5.666E-06	9.846E-08	2.834E-08	9.208E-08	1.773E-05
Heavy metals, Hg	kg	1.105E-07	1.079E-07	5.925E-09	1.691E-09	1.887E-08	2.448E-07
Water input	kg	3.605E+04	2.781E+04	1.555E+03	6.315E+02	8.097E+02	6.686E+04
Freshwater consumption	kg	3.605E+04	2.780E+04	1.555E+03	6.314E+02	8.095E+02	6.684E+04
Waste management							
Incineration	kg	-	4.019E+00	2.703E-01	-	1.720E+00	6.009E+00
Landfill (nonhazardous waste)	kg	-	1.163E+00	1.163E+00	-	6.879E+00	9.205E+00
Hazardous waste	kg	-	-	-	-	-	
Landfill avoidance (recycling)	kg	-	7.947E-01	7.122E-01	-	1.720E+00	3.227E+00

Table 7 : TriStone® impact assessment results per functional unit

Interpretation

The results of this study do not constitute a comparative assertion, though architects and builders will be able to use them to compare with similar products presented in other EPDs that follow the same PCR.

The results from the LCIA methodologies indicate that the largest contributor in most impact categories is the methyl methacrylate, ATH and poly methyl methacrylate inputs and emissions from the transportation of raw materials and product.

The analysis results represent the cradle-to-grave environmental performance of Corian® as produced by Lion Chemtech and sold in North America. All primary data from a twelve-month period during 2016 calendar year were

collected from Lion Chemtech facility in Korea. Secondary data came from Ecoinvent v2.2, USLCI and Korea national LCI databases and are representative of the years 2010-2012. As the study intended to communicate the environmental impact of TriStone® to stakeholders for the reference year 2016, temporal representativeness is considered to be high.

All primary and secondary data were modeled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used. Technological representativeness is considered to be high. Data was collected from Lion Chemtech which produces TriStone®.

Additional Environmental Information

GREENGUARD Gold Certification for Low Chemical Emissions

NSF Certification for Food Contact

ISO 14001 Environmental Management System

References

NSF International. (2013). *PCR for Residential Countertops.*

UL. (2017). Addendum to NSF PCR for Residential Countertops.

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