ENVIRONMENTAL PRODUCT DECLARATION

SBS-MODIFIED BITUMEN ROOFING MEMBRANE

INSTALLATION: HOT ASPHALT

Low-slope roofing membrane installed using hot asphalt and consisting of a SBS-modified bitumen cap sheet and base sheet.

SOPREMA is an international manufacturer specializing in innovative products for waterproofing, insulation, soundproofing and vegetated solutions for the roofing, building envelope, and civil engineering sectors.

SOPREMA was founded in 1908 in Strasbourg (France) by Charles Geisen who developed a fully waterproof, flexible and easy to install fabric, by soaking jute in hot bitumen. The result gave a lightweight but strong screed - MAMMOUTH®. SOPREMA now operates 50 manufacturing plants across the globe and 7 state of the art R&D laboratories.

SOPREMA's sustainability efforts are not new. In January 1998, SOPREMA was the first modified bitumen manufacturer to earn an ISO 14001 certification. At the heart of its values lies an environmental focus, particularly as it relates to manufacturing and R&D.

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ENVIRONMENTAL PRODUCT DECLARATION
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SOPREMA®

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INSTALLATION: HOT ASPHALT

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 Environment	
DECLARATION HOLDER	Soprema	
DECLARATION NUMBER	4787703772.101.1	
DECLARED PRODUCT	SBS-Modified Bitumen Roofing Membrane (Installation: Hot Asphalt)	
REFERENCE PCR	ASTM PCR for asphalt shingles, built-up asphalt membrane roofing and modified bituminous membrand roofing	
DATE OF ISSUE	September 29, 2017	
PERIOD OF VALIDITY	5 Years	
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:		Review Panel François Charron-Doucet, Quantis Canada (Chair) cert@astm.org
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL		Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:		Thomas Gloria, Industrial Ecology Consultants

Product Definition

Product Description

The low-slope roofing membrane included in this study consists of a styrene-butadiene-styrene (SBS)-modified bitumen cap sheet and a base sheet.

Component	Specification	Description
SBS Cap Sheet (M)	ASTM D6162, D6163, D6164, CSA A123.23	- Polyester and/or fiberglass mat coated with polymer-modified asphalt and colored mineral granule surfacing
SBS Base Sheet (M)	ASTM D6162, D6163, D6164. CSA A123.23	- Polyester and/or fiberglass mat coated with polymer-modified asphalt - A fine mineral matter may be applied as a surfacing or parting agent to both sides of the base sheets

A number of Soprema products fall into each of the above component categories. They were all considered in the life cycle assessment that served as the basis for this EPD. For cap sheets, all colors were considered, as well as regular and FR-rated versions. These products are:

SBS Cap Sheet (M: hot-mopped)

ELASTOPHENE GR (all versions including HR, HS, etc.)
SOPRALENE 180 GR (all versions)
SOPRALENE 250 GR (all versions)
SOPRASTAR HD GR (all versions)

SBS Base Sheet (M: hot-mopped)

ELASTOPHENE 180 PS (all versions)
ELASTOPHENE 180 SANDED (all versions)
ELASTOPHENE HS (all versions)
ELASTOPHENE PS (all versions)
ELASTOPHENE SANDED (all versions)
SOPRALENE 180 PS (all versions)
SOPRALENE 180 SANDED (all versions)
SOPRALENE 250 SANDED (all versions)

Manufacturing Locations

The components of the low-slope SBS-modified bitumen roofing membrane covered by this EPD are manufactured by Soprema in Chilliwack (British Columbia), Drummondville (Québec), Gulfport (Mississippi), and Wadsworth (Ohio).

Application and Uses

Low-slope roofing systems are installed on roofs with slopes less than 2:12. Low-slope roofing systems are primarily used to protect buildings and structures from the weather.

While numerous SBS-modified bituminous product and system innovations have been introduced over the years, one thing that has not changed in decades is their toughness and redundant waterproof protection. SBS-modified bitumen sheets can be applied using a variety of methods allowing the flexibility to complete the job within project parameters in virtually any climate. They can withstand heat and low temperatures in installations all over the world and are available in a wide range of thicknesses and mechanical properties to cover any design need.

Installation of both base and cap sheets in hot asphalt has been successfully performed for decades and is still done extensively in many regions of North America. Asphalt not only provides adhesion of the membranes but also contributes to the overall waterproofing ability of the roofing system.

System Description

Material content

Table 1 shows composition of the cap sheet and base sheet, weighted by the production totals (by mass) of the four manufacturing sites and the shares of cap and base sheets for the hot-mopped, M/M system.

Table 1: Material inputs for SBS-modified bitumen cap and base sheet manufacturing

Material Inputs	Production Weighted Composition [%]	
	SBS-Modified Cap Sheet M (63% of representative roofing system by mass)	**SBS-Modified Base Sheet M (37% of representative roofing system by mass)**
Mats		
Fiberglass mat	0.6	1.06
Polyester mat	2.1	4.07
Polyester + fiberglass combination mat	0.7	0.36
Reinforcement saturant		
Asphalt (oxidized)	5.5	10.5
Asphaltic compound ingredients	56.0	65.7
Asphalt (non-oxidized)	Composition of asphaltic compound not disclosed. Confidential information.	Composition of asphaltic compound not disclosed. Confidential information.
Plasticizing oil (CAS #64742-52-5)		
Limestone filler		
SBS		
Tackifying resin (CAS #64742-16-1)		
Fire retardant		
Surfacing materials (top/bottom)		
Granules	26.8	-
Sand	7.3	17.9
Fire retardant	0.9	-
Plastic film	0.1	0.16
Silicone-coated release film	0.003	0.09
Quartz powder (for lay lines)	-	0.14
Aluminum foil	0.05	-

Manufacturing Process

SBS Cap Sheets

Manufacture of SBS polymer-modified bitumen cap sheets involves the saturation of a reinforcing mat, composed of fiberglass, non-woven polyester, or combination of both, and coating the mat with a polymer-modified asphalt. The polymer-modified asphalt is produced by mixing appropriate proportions of asphalt, polymer, and limestone or other suitable mineral stabilizer. An appropriate surfacing material is applied. SBS cap sheets typically use a colored mineral granule top surfacing. Fine mineral matter (such as sand) is applied as a parting agent to the bottom surface of the cap sheet. The product is cooled, wound into rolls, and packaged for shipment.

SBS Base Sheets

Manufacture of SBS polymer-modified bitumen base sheets involves the saturation of a reinforcing mat, composed of fiberglass, non-woven polyester, or combination of both, and coating the mat with a polymer-modified asphalt. The polymer-modified asphalt is produced by mixing appropriate proportions of asphalt, polymer, and limestone or another suitable mineral stabilizer. Fine mineral matter (such as sand) is applied as a parting agent to top and bottom surfaces of the base sheet. The product is cooled, wound into rolls, and packaged for shipment.

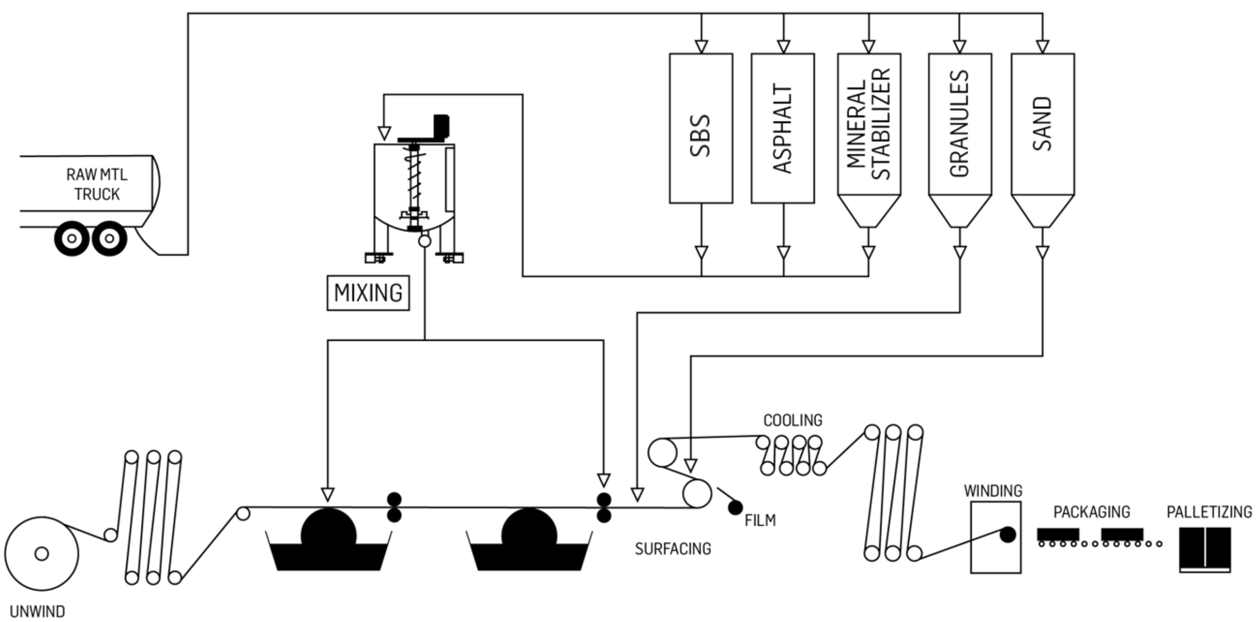

Figure 1: Modified bitumen sheet process diagram

Installation

For this EPD, a hot-mopped SBS-modified bitumen roofing membrane consists of one base sheet and one cap sheet. Hot-mopped SBS installation requires hot asphalt to be first mopped onto the roof surface and the SBS-modified bitumen base sheet to be unrolled directly onto the asphalt and pressed into place. This same process is used to install the SBS-modified bitumen cap sheet on top of the base sheet Mineral granules are applied to the asphalt bleed-out (the portion that has migrated out of the cap sheet seams) to protect it from UV and for aesthetic reasons.

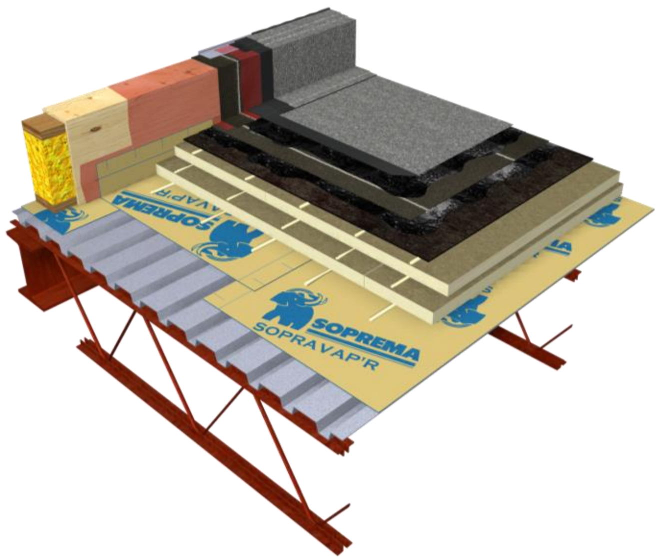

Figure 2: Hot mopped SBS-modified bitumen roof membrane system example

Table 2 presents the components of a typical SBS hot-mopped system, which are the same as those presented in the Asphalt Roofing Manufacturers Association (ARMA) study (thinkstep, Inc. , 2015). The effective coverage includes the required overlap of sheets while the scrap rate accounts for material wasted during installation.

Table 2: Hot-mopped, M/M installation details

	Weight of Material [kg / m²]	Effective Coverage [m² of Material / 1 m² of Roof]	Scrap Rate	Required Quantity of Material [kg / 1 m²]
Inputs				
Cap sheet M	4.52	1.10	5%	5.18
Base sheet M	2.62	1.10	5%	3.00
Flashing	0.095	N/A	10%	0.10
Mopping asphalt[1]	2.44	N/A	5%	2.56
Granules (at seams)	0.08	N/A	-	0.08
Propane for kettles	2.60 (MJ)	N/A	-	2.60 (MJ)
Diesel (pump to roof[2])	0.0005 (MJ)	N/A	-	5.0×10^{-4} (MJ)
NMVOCs (asphalt kettle[3])	0.008	N/A	-	0.008
Outputs[4]				
Installed system				10.4
Waste				0.52

[1] 1.22 kg / 1 m² per layer
[2] Assumes 4-story building[1] and 3.95 m story height[2]
[3] 3.1 kg NMVOCs (non-methane volatile organic compounds) / metric tonne of asphalt
[4] Excludes combustion emissions from propane and diesel use

[1] https://www.eia.gov/consumption/commercial/data/2012/bc/cfm/b6.php
[2] http://www.pnl.gov/main/publications/external/technical_reports/PNNL-20380.pdf

End-of-Life

At the end-of-life, the low-slope membrane is removed by manual labor, often with roofing shovels. The debris is collected and transported off-site via truck. The waste is brought to a landfill.

Life Cycle Assessment – Product Systems and Modeling

Declared Unit

The declared unit of this study is 1 m^2 (10.8 ft^2) of the installed roofing membrane. The associated reference flow (the quantity of material required to fulfill the declared unit) is 10.4 kg/m^2.

Life Cycle System Boundaries

The study encompasses the following life cycle stages: production, construction (installation), transport, and end-of-life (EoL). Table 3 depicts the modules included in the study, in accordance with EN 15804 and the referenced PCR (ASTM, 2014). As the use stage is excluded, a reference service life is not specified for the systems under study.

Table 3: System boundary modules

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)															
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE			
Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

Assumptions

The analysis uses the following assumptions:

- Mineral granules can be made in a variety of colors, which affects the composition of the required mineral granule coating. White mineral granules were selected as a representative product for this study because the pigment used for white products, titanium dioxide, generally has a higher impact than other pigments; therefore, using white is a conservative assumption.
- Due to lack of data availability some proxy background data were used, specifically in the context of the geographical scope of the study.

Cut-off Criteria

No cut-off criteria were applied in this study. All reported data were incorporated and modeled using best available life cycle inventory (LCI) data.

Transportation

Average transportation distances and modes of transport are included for the transport of the raw materials, operating materials, and auxiliary materials to production facilities and installation sites.

For distribution, the different transport distances from the four facilities to their respective distribution centers plus the average distance from the distribution centers to the construction sites are considered.

Table 4: Weighted distance from the four facilities to distribution center

Weighted transport distances	Truck km (miles)
Cap sheet M	781 (485)
Base sheet M	95 (459)

The transport of finished products from distribution center to the construction site and of waste from the construction site to landfill were each assumed to be 32.2 km (20 miles).

Temporal, Technological, and Geographical Coverage

Temporal: All primary data were collected for a 12-month period during the years 2014 to 2015. All secondary data come from the GaBi 2016 databases and are representative of the years 2007-2016, with the exception of asphalt oxidation information for which the only available source was from 1977. As the study intended to represent the product systems for the reference year 2015, temporal representativeness is considered to be high.

Technological: 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

Geographical: The geographic coverage represented by this study is the United States and Canada. Whenever US background data were not readily available, European data or global data were used as proxies, depending on appropriateness and availability. Geographical representativeness is considered to be high.

Background Data

The LCA model was created using the GaBi ts Software system for life cycle engineering, developed by thinkstep AG. The GaBi 2016 database provides the LCI data for several of the raw and process materials obtained from the background system. Secondary data, information from relevant literature, are from a range of sources between 1977 (asphalt oxidation information) and 2016.

Data Quality

As the relevant foreground data is primary data or modeled based on primary information sources of the owner of the technology, no better precision is reachable within this product. All primary data were collected with the same level of detail, while all background data were sourced from the GaBi 2016 databases, with the exception of granule production and asphalt oxidation. Allocation and other methodological choices were made consistently throughout the model.

Allocation

As several products are often manufactured at the same plant, participating sites used mass allocation to report data since the environmental burden in the industrial process (energy consumption, emissions, etc.) is primarily governed by the mass throughput of each sub-process.

All packaging waste generated during installation, as well as 40% of the wooden pallets used for shipping of products, are assumed to be sent to landfill and the system credited with any avoided production of electricity generated from the combustion of landfill gas.

The impacts due to the use of any recycled materials during manufacturing come only from further processing required during the recycling process. Where in-house recycling is used to create other products, co-product allocation by mass is used and any additional processing steps required for use of the recovered materials are accounted for. It is conservatively assumed that all roofing materials disposed at EoL are sent to landfill.

Life Cycle Assessment – Results and Analysis

Environmental Product Declarations (EPDs) created under a different Product Category Rule (PCR) are not comparable. Additionally, EPDs based on a declared unit shall not be used for comparisons between products, regardless of the EPDs using the same PCR.

The environmental impacts, primary energy consumption, materials resource consumption, and waste generation associated with the installed roofing membrane are presented below for the production, installation, and EoL stages. Primary energy consumption results are given as higher heating value (HHV), per the PCR. Renewable energy is negative for installation due to the credit given for reusing pallets.

Table 5: Results for Hot-mopped, M/M system, per 1 m^2 of installed roof

Indicator	Unit	Production (A1-A3)	Transport (A4)	Installation (A5)	EOL (C1-C4)
TRACI 2.1 Impact Categories					
Global warming potential	kg CO_2-eq	6.04	0.509	1.67	0.485
Acidification potential	kg SO_2-eq	0.0210	0.00243	0.00625	0.00230
Eutrophication potential	kg N-eq	0.00150	2.26×10^{-4}	3.18×10^{-4}	1.32×10^{-4}
Smog formation potential	kg O_3-eq	0.332	0.0775	0.128	0.0462
Ozone depletion potential	kg CFC-11-eq	6.37×10^{-10}	3.44×10^{-12}	3.72×10^{-9}	9.66×10^{-12}
Total Primary Energy Consumption					
Nonrenewable fossil	MJ (HHV)	272	7.56	137	8.01
Nonrenewable nuclear	MJ (HHV)	5.62	0.0300	0.562	0.188
Renewable (solar, wind, hydro, geo)	MJ (HHV)	4.70	0.114	0.444	0.464
Renewable (biomass)	MJ (HHV)	0.141	-	-0.0848	-

Indicator	Unit	Production (A1-A3)	Transport (A4)	Installation (A5)	EOL (C1-C4)
Material Resources Consumption					
Nonrenewable material resources	kg	12.0	0.0278	1.46	2.49
Renewable material resources	kg	2900	0.213	236	239
Water consumption (Net fresh water)	L	20.5	1.43	1.52	1.19
Non-hazardous waste generated	kg	5.08×10^{-5}	9.03×10^{-9}	2.89×10^{-6}	1.43×10^{-8}
Hazardous waste generated	kg	0.714	2.38×10^{-4}	0.610	0.104

Additional Environmental Information

Sustainable Roofing

Some have promoted sustainable roofing by focusing on green roofs and reflective roofs only. Roof design for sustainability entails more than membrane selection and detailing. It means to incorporate materials and details that extend the service life of the roof system beyond its currently accepted service life expectancy and provide future rehabilitation options to minimize consumption of new resources and delay demolition. Design for sustainable recovery from premature failure must be part of the original concept. It has to be realistically expected that a portion of a roof will eventually fail at some point for some reason. Sustainable recovery minimizes damage impact, reduces material waste and consumption of new materials. It also facilitates repair and renews roof performance.

Modified-bitumen membranes allow for recovering or resurfacing at the end of their service life. Once the waterproof integrity of the membrane in place has been verified, or minor repairs have been performed to it if needed, the addition of a SBS-modified cap sheet to the system can be done easily.

That is not to say that “cool roof” principles should be overlooked. Mitigation of urban heat islands should guide the design and specification of roof assemblies, just as energy conservation, durability, resiliency, raw materials consumption and waste reduction.

There are reflective roof options available for virtually any roof and any building. Because of asphalt roofs’ longevity, asphalt-based products provide excellent value for homeowners and building owners. Modified bitumen membranes provide options for varying levels of reflectivity and have proven to retain high reflectivity levels over their service life (per the Cool Roof Ratings Council, www.coolroofs.org).

Individual Component Results

The material resource consumption, primary energy demand, environmental impacts, and waste generation results associated with each individual component (excluding ancillary materials used during installation) of the roofing system are presented below for the production stage (A1-A3).

Table 6: Production stage (A1-A3) impact results for each system component, per 1 m² of individual component

Impact Category	Units	Base sheet (M)	Cap sheet (M)
TRACI 2.1 Impact Categories			
Global warming potential	kg CO_2-eq	2.02	3.11
Acidification potential	kg SO_2-eq	0.00707	0.0112
Eutrophication potential	kg N-eq	5.43×10^{-4}	7.68×10^{-4}
Smog formation potential	kg O_3-eq	0.107	0.182
Ozone depletion potential	kg CFC-11-eq	2.32×10^{-10}	3.24×10^{-10}

Impact Category	Units	Base sheet (M)	Cap sheet (M)
Total Primary Energy Consumption			
Nonrenewable fossil	MJ (HHV)	95.7	142
Nonrenewable nuclear	MJ (HHV)	2.04	2.87
Renewable (solar, wind, hydro, geo)	MJ (HHV)	1.71	2.39
Renewable (biomass)	MJ (HHV)	0.0479	0.0754
Material Resources Consumption			
Nonrenewable material resources	kg	3.18	7.28
Renewable material resources	kg	961	1,570
Water consumption (Net fresh water)	kg	7.31	10.6
Non-hazardous waste generated	L	0.161	0.462
Hazardous waste generated	kg	9.43×10^{-8}	4.42×10^{-5}

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LCA Development

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