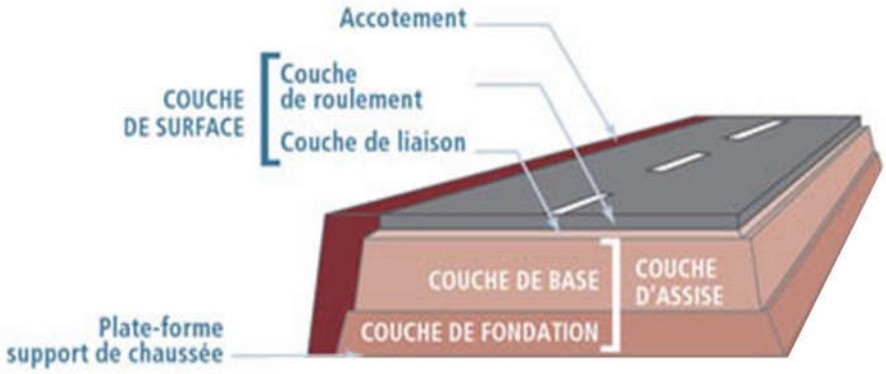
USIRF
Routes de France

Environmental and Health Product Declaration (FDES)

Environmental and health product declaration

Hot mix asphalt pavement representative of the French market



January 2016 – audited version by independent third-party

Partners:

Period: 01.06.2014 - 31.05.2017 - Coordinator: USIRF - Total budget: 1,311,980€ - EU contribution: 655,990€

European Commission

The SustainEuroRoad' Project is co-financed by LIFE Programme 2013

Warning

The information in this declaration is provided under the responsibility of USIRF (Union of French Road Industry Associations) (issuer of the FDES) in accordance with NF EN 15804+A1 and its national supplement XP P01-064/CN.

Any use of the information provided herein, in whole or in part, must be accompanied as a minimum, by a complete reference to the original FDES and to its issuer, who can deliver a complete copy.

CEN standard EN 15804+A1 defines the Product Category Rules (PCR). This FDES is also compliant with the requirements of standard ISO 14025 on Type III environmental declarations.

NOTE: The literal translation of EPD (Environmental Product Declaration) in French is DEP (Déclaration Environnementale de Produit). The commonly used term in France is FDES (Environmental and Health Product Declaration), which includes both the Environmental Product Declaration as well as health information for the product covered by the FDES. Accordingly, the FDES is an EPD supplemented by health information.

Reading guide

The display of inventory data meets the requirements of standard NF EN 15804+A1.

Results display format:

1.78E-06 shall read: 1.78×10^{-6} (scientific writing)

Used units:

- Kilogramme – “kg”
- Gramme – “g”
- Litre – “L”
- Kilowatt hour – “kWh”
- Megajoule – “MJ”
- Cubic metre – “m^3”

Abbreviations:

- LCA: Life Cycle Analysis
- RSL: Reference Service Life
- FU: Functional Unit
- LHV: Lower Heating Value
- MTHB: Materials Treated with Hydraulic Binders

Precautions when using the FDES for product comparison

FDES declarations of construction products may not be comparable if they don’t comply with standard NF EN 15804+A1.

In its section 5.3 Comparability of EPD of construction products, standard NF EN 15804+A1 defines the conditions under which construction products can be compared, on the basis of information provided by the FDES:

“*Comparison of the environmental performance of building products using EDP information should be based on the use of the products and their impacts on the building, and must take into account the complete life cycle (all the information modules).*”

Table of Contents

1. General information

- **Name and address of manufacturers**

The companies whose products are covered by the FDES are road companies that are members of USIRF and/or one of the 20 Regional Professional Unions of the Road Industry (SPRIR) [1].

- **Entity representing the companies for which the FDES is representative**

Union of French Road Industry Associations (USIRF), 9, Rue de Berri, 75008, Paris

- **FDES type**

Collective FDES (representative of the average products placed on the French market by USIRF members), from cradle to grave (over the entire life cycle of the product)

- **Rules of use**

The data in this FDES are provided under the responsibility of USIRF. Only the above-mentioned member companies are authorised to submit these data.

- **Publication date**

January 2016

- **End of validity date**

January 2021

- **Commercial reference of the product**

Hot mix asphalt pavement representative of the French market, based on a standard SETRA catalogue structure ref. TC4 PF3, 30 years of October 1998.

- **Verification**

CEN standard EN 15804+A1 defines the Product Category Rules (PCR).
Independent declaration verification, in accordance with EN ISO 14025: 2010 ☐ Internal ■ External
Verifier's name: Sébastien Lasvaux **Verification programme:** AFNOR INIES **www.base-inies.fr**

[1] See: http://www.usirf.com/usirf/organisation/organisation-20-sprir/

2. Description of the functional unit and the product

- **Description of the functional unit**

Providing an area of 1m² of hot mix asphalt pavement representative of the French market, based on a reference lifespan of 100 years

- **Product description**

The assessed product is hot mix asphalt pavement ref. TC4 PF3 - 30 year (Catalogue of SETRA structures, October 1998).

This type of pavement is used on departmental and local roads, which are the most typical roads in France in terms of running length and traffic[2].

The pavement consists of different layers of hot mix asphalt:

- The wearing course, which is the surface layer, and
- The base and sub-base layers, which are the structural road layers.

Hot mix asphalt is a mixture of aggregates (such as gravel, fillers, etc.) and a bituminous binder (bitumen), produced in asphalt plants at temperatures between 130°C to 180°C.

The initial structure and maintenance data were calculated according to the French design method defined in standard NF P 98 086 "Structural Design of Road Pavements - Application to New Pavements".

The materials forming the pavement are compliant with the requirements of standard NF EN 13108 “Bituminous mixtures. Material specifications.” Parts 1, 2 and 7 for bituminous mixtures.

Earthwork and construction of the capping layer serving as road subgrade were not included in this study, since they are not an integral part of the pavement.

- **Material specifications.”, Parts 1, 2 and 7 for bituminous mixtures.**

Hot-mix asphalt pavement intended for departmental roads.

- **Other technical characteristics not included in the functional unit**

Not applicable

- **Description of the main components and/or materials of the product**

Parameter	Unit	Value
Wearing course (6 cm of asphalt concrete)	t/m²	1.41E-01
Tack coat (bitumen emulsion)	t/m²	5.00E-04
Base course (9 cm of gravel bitumen 3)	t/m²	2.12E-01
Tack coat (bitumen emulsion)	t/m²	5.00E-04
Sub-base course (9 cm of gravel bitumen 3)	t/m²	2.12E-01
Tack coat (bitumen emulsion)	t/m²	5.00E-04
Distribution packaging	-	Not applicable
Losses during application	%	Not applicable
Complementary products for application	-	Not applicable

[2] According to the Transport Data Book “Memento des Transports”, 2014 edition (for 2012), departmental and local roads account for 98% of the length of the French road network and for 66% of vehicle mileage

- **Clarification concerning the list of candidate substances in accordance with the REACH regulatory framework (if having a mass greater than 0.1%)**

The product does not contain any substance in the candidate list according to the REACH regulatory framework.

- **Description of the reference service life**

Parameter	Unit	Value
Reference service life	Years	100 The selected principle is to assume by default a pavement lifespan of 100 years and take into account the necessary maintenance work to ensure its functions over this lifespan.
Declared product properties (at factory gate) and finishes, etc.	-	Compliant with the requirements of standard NF EN 13108 “Bituminous mixtures. Material specifications.”, Parts 1, 2 and 7
Theoretical application parameters	-	Compliant with Standard NF P 98 150-1 “Hot mix asphalts - Laying of pavement bases, binder and wearing courses”
Assumed quality of work	-	In accordance with the current state of the art and practice
External environment	-	French climate
Internal environment	-	Not applicable
Conditions of use	-	Asphalt mixes and bituminous pavements are designed according to the bearing capacity of earthwork and traffic, as defined in Standard NF P 98 086 "Structural design of road pavements – Application to new pavements"
Maintenance scenario	-	Maintenance planned at about 13 year intervals by planing and/or addition of asphalt concrete or high-modulus asphalt (EME2) and tack coat

3. Life cycle stages

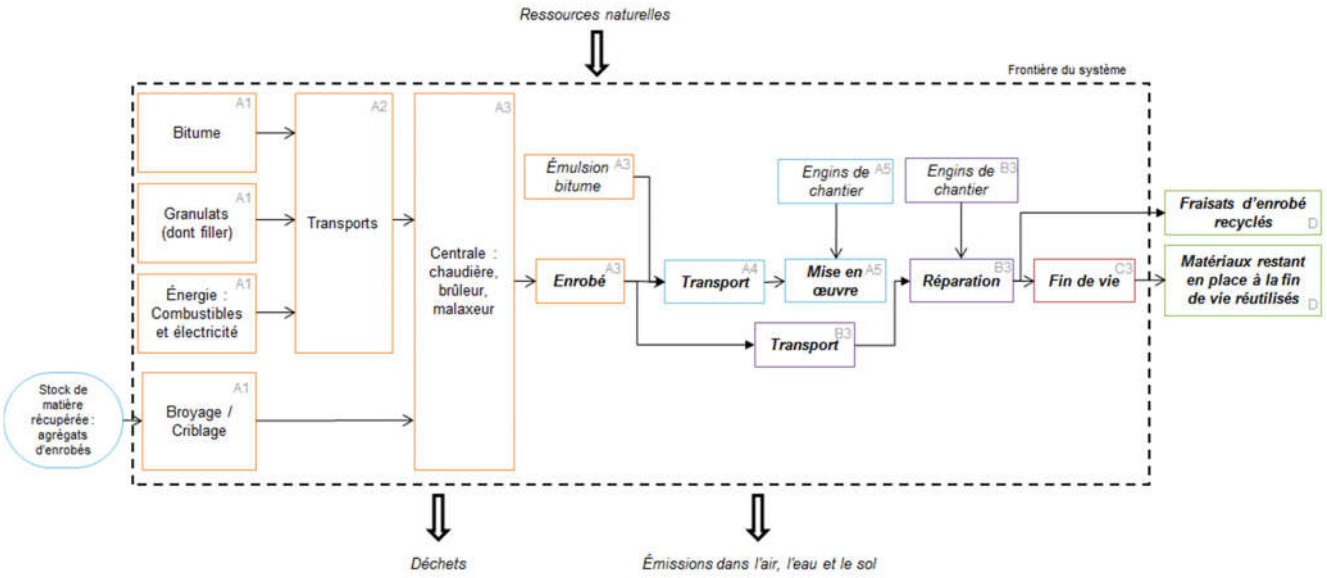


Figure 1 – Simplified life cycle diagram of the product

3.1. Production stage – modules A1-A3

The production stages (A1-A3) include:

- extraction and treatment of raw materials used in the production of asphalt (A1):
  - bitumen,
  - aggregates (hard rock and alluvial aggregates),
  - reclaimed asphalt,
- transportation of raw materials to asphalt production sites (A2),
- production of the asphalt mix (A3), including:
  - energy consumption at the burner-dryer, at boiler for binder materials, the asphalt plant, and the operation of machinery, as well as emissions into the air,
  - water consumptions and discharges, as well as emissions into the water,
  - use of consumables (oils and lubricants, tyres, metal, non-stick agents and dust filters),
  - use of infrastructures,
  - transport of waste of and waste disposal,
- Production transport of materials and products forming the other pavement layers (bitumen emulsion) (A3).

3.2. Construction stage – modules A4-A5

The transport stage (A4) includes:

- Transport of the asphalt and bitumen emulsion to the site, including the truck travel and the bitumen fume emissions during truck loading.

Parameter	Unit	Value
Scenario description	-	Asphalt transport: The asphalt mix is delivered to the site in EURO 4 type trucks with a payload of 16 to 32t. They have been modelled based on the CIMAROUT database. Bitumen emulsion transport: The bitumen emulsion follows the same logistic route as the asphalt.

Parameter	Unit	Value
Type of fuel and vehicle consumption or type of vehicle	-	The considered vehicles are EURO 4 type trucks having a payload of 16 to 32 t. The transport has been modelled based on the average conditions of use defined in the Ecoinvent database.
Distance to the site	km	30
Capacity use	%	Fill rate close to 100% according to mass on delivery
Bulk density of the transported products	kg/m^3	Not applicable. Trucks are loaded to their maximum mass capacity.
Coefficient of utilisation of the volume capacity	-	<1
Direct emissions to ambient air (due to the release of bitumen fumes during the application of materials)	kg/m²	6.34E-06

The laying stage (A5) includes:

- Use of construction equipment for application of the various layers of asphalt,
- Emissions into the air caused by bitumen fumes generated by heating asphalt mixes during their application.

Parameter	Unit	Value
Scenario description	-	The asphalt mix is unloaded at the site. Several construction machines are used: a paver, a V1 tandem vibratory roller and a sweeper.
Auxiliary inputs at placement		**Not applicable**
Use of water	m^3	**Not applicable**
Use of energy	-	**See above**
Paver (15 to 20 t) – consumption of DFO	MJ/m²	4.17
V1 tandem vibratory roller – consumption of DFO	MJ/m²	3.68
Suction sweeper – consumption of diesel fuel	MJ/m²	4.16
Use of other resources	-	**Not applicable**
Waste generated at the construction site before treatment of the waste generated by product placement	-	**See above**
Sweepings sent to the storage centre	kg/m²	2.00
Materials produced by the treatment of the waste at the construction site	**-**	**Not applicable**
Direct emissions to ambient air (due to the release of bitumen fumes during the application of materials)	kg/m²	0.149

3.3. Service life stage – modules B1-B7

The use stage (B1-B7) comprises maintenance of the surface course (B2), including:

- Production, transport and application of asphalt concrete and bitumen emulsion,
- Emissions into the air due to bitumen fumes released during truck loading and during asphalt application,
- Use of site machinery: paver, V1 tandem vibratory roller, 2m to 2.2m paver and suction sweeper,
- Treatment of generated waste, i.e., sweepings and asphalt planings, the latter being recycled at a later stage. In accordance with standard NF EN 15804+A1, system boundaries do not include any environmental benefit or impact related to the recycling of these planings and situated beyond the “end-of-waste” status

In contrast, no process takes place during the utilisation stages except for maintenance (B1 and B3 to B6).

Parameter	Unit	Value
Scenario description		At 13 years: addition of 2.5 cm of asphalt concrete + 1 tack coat At 26 years: planing of 8.5 cm, addition of 8 cm of high-modulus asphalt (EME2)[3] + 2.5 cm asphalt concrete + 1 tack coat At 39 years: planing of 2.5 cm, addition of 2.5 cm of asphalt concrete + 1 tack coat At 52 years: planing of 2.5 cm, addition of 6 cm of asphalt concrete + 1 tack coat At 65 years: addition of 2.5 cm of asphalt concrete + 1 tack coat At 78 years: planing of 2.5 cm, addition of 2.5 cm of asphalt concrete + 1 tack coat At 91 years: planing of 2.5 cm, addition of 2.5 cm of asphalt concrete + 1 tack coat
Maintenance processes		Calculated according to the French design method defined in standard NF P 98 086 “Structural Design of Road Pavements - Application to New Pavements”.
Inspection processes		Not applicable
Maintenance cycle	Years	13
Energy input during maintenance	-	**See above**
Paver (15 to 20 t) – consumption of DFO	MJ/m²	5.06
V1 tandem vibratory roller – consumption of DFO	MJ/m²	4.45
Suction sweeper – consumption of diesel fuel	MJ/m²	4.16
2 m to 2.2 m planer – consumption of DFO	MJ/m²	8.49
Auxiliary inputs	-	**Not applicable**
Waste generated during repair	-	**See above**
Sweepings sent to the storage centre	kg/m²	44
Asphalt planings send to recycling	kg/m²	435
Consumption of fresh water during repair	m^3/m^2	Not applicable
Quantities of materials produced for road repair during the product’s life cycle	-	**See above**
Asphalt concrete	kg/m²	682
Bitumen emulsion	kg/m²	4.0
Direct emissions to ambient air due to the release of bitumen fumes during the transport and laying of materials	kg/m²	0.18

[3] Since the composition of high-modulus asphalt (EME2) (in particular the bitumen content)is very close to that of asphalt concrete (AC), for purposes of this FDES, high-modulus asphalt (EME2) has been assimilated to asphalt concrete.

3.4. End of life stage – modules C1-C4

This scenario assumes that the pavement will remain in place beyond the 100-year period taken into consideration and can be reused for a future roadway. It can therefore be considered a material intended for reuse. In accordance with standard NF EN 15804+A1, no environmental benefits or impacts related to the recycling of this waste beyond the "end-of-waste" status is taken into account within the system boundaries

Apart from this, no processes occurring during the various end of life stages are factored in.

Parameter	Unit	Value
Scenario description	-	The pavement will remain in place beyond the considered 100-year period. It can be reused as support for a future roadway
Quantity collected separately	kg/m²	-
Quantity collected together with mixed construction waste	kg/m²	-
Quantity intended for reuse (amount of pavement left in place at end of life)	kg/m²	811
Quantity intended for recycling	kg/m²	-
Quantity intended for energy recovery	kg/m²	-
Quantity of product discharged as landfill waste	kg/m²	-

3.5. Potential for recycling / reuse / recovery D

This study assumes that the road base courses will remain in place beyond the 100-year period taken into consideration. After their end of life, part of the pavement will be reused. In addition, the road planing (module B2) generates asphalt planings intended for recycling.

With regard to the asphalt planings, the planing operations are included in the service life stage and are unrelated to the fate of the planings. The regulations concerning the end of waste status of these materials are still being developed by professional groups and public authorities as of the preparation of this study. Nevertheless, we have adopted a prospective scenario position where the case of asphalt planings is being handled. In accordance with the CEREMA guideline "Acceptability of Deconstruction Materials for Road Construction" (under publication), such materials must undergo compliance tests to demonstrate that they do not contain any hazardous substances, such as asbestos or tar. As these substances have not been used in road construction for several decades, we consider that the tests are conclusive and the planings can be reused. Since the mass of the tested materials is low, we will also consider that the transport involved in this procedure is negligible. In order to be reused, the planings must still undergo grinding and screening operations.

For the materials remaining in place at end of life, no impacts related to recycling or recovery processes are being considered.

Module D is calculated based on the net flows (output secondary materials minus input secondary materials). The following table describes the modelled scenario for asphalt planings recycling.

Parameter	Unit	Value
Description of the asphalt planings recycling scenario		We consider that the asphalt planings produced during planing will serve as substitutes for bitumen and aggregate. To enable reuse, the planings are subjected to a grinding and crushing stage (electricity and diesel consumption).
Replaced materials	-	Replacement of the constituent materials of "virgin" bituminous asphalt (100% "virgin" bituminous asphalt = bituminous asphalt exclusively consisting of aggregate and bitumen)
Net output flows	kg/m²	3,20E+02

The recommendations of the standard concerning the “materials”-based approach in calculating the benefits of module D have been adapted according to the specific characteristics of the studied system. Thus, the materials that remain in place at end of life preclude the production, transport and application of “virgin” road base courses. Therefore, we have selected a “functional” approach. The following table presents the assumptions made in this approach.

Parameter	Unit	Value
Description of the scenario for recycling the materials left in place at end of life.		It is assumed that the materials remaining in place at roadway end of life will replace the production (A1-A4), transport (A4) and the application (A5) of “virgin” road base courses.
Replaced materials	-	Production of the replaced materials (A1-A3) - Production of gravel bitumen for the road base - Production of gravel bitumen for the sub-base course - Production of two tack coats based on bitumen emulsion Transport of replaced materials - Transport of the road base courses and tack coats by truck - Bitumen fume emissions Application of the replacement materials - Bitumen fume emissions - Use of machinery (sweeper, paver, V1 tandem vibratory roller) - Transport of sweepings to the treatment site and their treatment;
Net output flows	kg/m²	Not applicable

4. Information serving to calculate the life cycle analysis

Information serving to calculate the Life Cycle Analysis	
Used PCR	NF EN 15804+A1 and its national supplement XP P01-064/CN
System boundaries	System boundaries observe the limits imposed by standard NF EN 15804+A1 and its national supplement XP P01-064/CN. No substances that are highly toxic, toxic, harmful or hazardous to the environment are used in bituminous asphalt manufacturing. Cut-off threshold of 99% of the mass of input flows: The consumptions of additional filler, colourants and additives represent less than 0.1% of the composition of asphalts in mass percent.
Sources of data and data collection method	Basic data on the production of asphalt and the life cycle of pavements were retrieved from a previous USIRF LCA study on hot mix asphalt pavements dating from 2014. **Basic asphalt production data:** - Energy consumption: data were compiled based on a group of plants that account for approximately 77% of French production - Data of emissions into the air: are based on measurements made in 73 plants. It can be estimated that these 73 plants account for about 15% of French production - Other data: survey within the previous LCA study carried out in 2014 at 8 plants located throughout France and having an annual production of 1Mt of asphalt, i.e., approximately 3% of French production. Given the uniformity of asphalt types and manufacturing processes used in France, USIRF considers that these 8 plants are representative for the currently-operated stationary plants in France. **Baseline data of the pavement life cycle**: - Pavement lifespan: Estimate of the USIRF Steering Committee - Initial structure and maintenance of pavements over their lifespan: Calculation performed by the USIRF Steering Committee based on standard NF P 98 086 - Transport distance between asphalt plants and work sites: Estimate of the USIRF Steering Committee - Emission of bitumen fumes during transport and application: CIMAROUT - Use of machinery for application: USIRF SEVE system - Pavement end of life: Assumption of the USIRF Steering Committee **Environmental data** (life cycle inventories, FDES or information modules): - Environmental information modules, UNPG 2011, - Bitumen production: Eurobitume inventory, 2011, - Other processes: the Ecoinvent database, v. 3.1, 2014.
Geographical, temporal and technological representativeness of data	**Geographical representativeness:** - The basic data are representative for the situation in France (mainland France). - Environmental data: France for the LCI of aggregate production and consumption of electricity. Europe for bitumen production and ICVs based on the Ecoinvent database. **Temporal representativeness:** - Basic data: current situation (2011 for the majority of data), - Ecoinvent database, as updated in 2014, aggregate and bitumen data from 2011. **Technological representativeness:** - Basic data: the data are representative of the technologies used by French road industry professionals. - Environmental data: the data are representative of the technologies used in France and in Europe
Allocations	There was no allocation between coproducts. Concurrent production of hot-mix asphalts and warm-mix asphalts by the plants participating in data collection. The proportion of warm-mix asphalts is very small (less than 5% of total production), so that they could be assimilated to hot-mix asphalts. However, allocations were used in preparing the ICV of bitumen in the Eurobitume study.
Variability of results	The variability of results was calculated only for energy consumption data of burner-dryers. The variability of the CO_2 flow emitted into the air during combustion is between 7% and 9% relative to the average, and only for the item “Energy consumption during production”. When related to the asphalt production system or pavement life cycle, this variance is therefore correspondingly lower.

5. Results of the life cycle analysis

Environmental impacts for 1 m² of hot mix asphalt pavement

FU: Providing an area of 1m² of hot mix asphalt pavement representative of the French market, based on a reference lifespan of 100 years

Impacts environnementaux	Étape de fabrication	Étape de mise en œuvre			Étape de vie en œuvre								Étape de fin de vie					Total cycle de vie de vie	D Bénéfices et charges au-delà des frontières du système
	Total A1-A3 Production	A4 Transport	A5 Installation	Total mise en œuvre	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	Total vie en œuvre	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	Total fin de vie		
Réchauffement climatique kg CO2 eq/UF	**2,51E+01**	2,86E+00	1,25E+00	**4,11E+00**	0,00E+00	4,29E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**4,29E+01**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**7,21E+01**	-2,54E+01
Appauvrissement de la couche d'ozone kg CFC 11 eq/UF	**3,68E-06**	5,24E-07	2,48E-07	**7,72E-07**	0,00E+00	6,65E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,65E-06**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,11E-05**	-3,48E-06
Acidification des sols et de l'eau kg SO2 eq/UF	**1,22E-01**	1,16E-02	9,16E-03	**2,08E-02**	0,00E+00	2,19E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,19E-01**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**3,62E-01**	-1,40E-01
Eutrophisation kg $(PO_4)^{3-}$ eq/UF	**1,64E-02**	1,97E-03	1,90E-03	**3,87E-03**	0,00E+00	3,27E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**3,27E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**5,29E-02**	-1,94E-02
Formation d'ozone photochimique kg Ethene eq/UF	**8,18E-03**	4,98E-04	1,55E-02	**1,60E-02**	0,00E+00	3,11E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**3,11E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**5,53E-02**	-2,04E-02
Épuisement des ressources abiotiques (éléments) kg Sb eq/UF	**3,01E-05**	9,30E-06	5,09E-07	**9,81E-06**	0,00E+00	5,96E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,96E-05**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**9,94E-05**	-3,41E-05
Épuisement des ressources abiotiques (fossiles) MJ/UF	**1,41E+03**	4,35E+01	1,98E+01	**6,34E+01**	0,00E+00	2,13E+03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,13E+03**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**3,60E+03**	-1,74E+03
Pollution de l'eau m3/UF	**9,90E+00**	1,01E+00	4,85E-01	**1,49E+00**	0,00E+00	1,69E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,69E+01**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**2,83E+01**	-1,12E+01
Pollution de l'air m3/UF	**2,93E+03**	4,17E+02	8,77E+03	**9,18E+03**	0,00E+00	1,47E+04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,47E+04**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**2,68E+04**	-9,84E+03

Use of resources for 1 m² of hot mix asphalt pavement

FU: Providing an area of 1m² of hot mix asphalt pavement representative of the French market, based on a reference lifespan of 100 years

Utilisation des ressources	Etape de fabrication	Etape de mise en œuvre			Etape de vie en œuvre								Etape de fin de vie					Total cycle de vie de vie	D Bénéfices et charges au-delà des frontières du système
	Total A1-A3 Production	A4 Transport	A5 Installation	**Total mise en œuvre**	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	**Total vie en œuvre**	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	**Total fin de vie**		
Utilisation de l'énergie primaire renouvelable, à l'exclusion des ressources d'énergie primaire renouvelables utilisées comme matières premières MJ/UF	**6,09E+00**	5,44E-01	1,45E-01	**6,89E-01**	0,00E+00	9,51E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**9,51E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,63E+01**	-5,75E+00
Utilisation des ressources d'énergie primaire renouvelables en tant que matières premières MJ/UF	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	0,00E+00
Utilisation totale des ressources d'énergie primaire renouvelables (énergie primaire et ressources d'énergie primaire utilisées comme matières premières) MJ/UF	**6,09E+00**	5,44E-01	1,45E-01	**6,89E-01**	0,00E+00	9,51E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**9,51E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,63E+01**	-5,75E+00
Utilisation de l'énergie primaire non renouvelable, à l'exclusion des ressources d'énergie primaire non renouvelables utilisées comme matières premières MJ/UF	**4,91E+02**	4,43E+01	2,02E+01	**6,44E+01**	0,00E+00	8,00E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**8,00E+02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,36E+03**	-4,99E+02
Utilisation des ressources d'énergie primaire non renouvelables en tant que matières premières MJ/UF	**9,82E+02**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	1,41E+03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,41E+03**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**2,39E+03**	-1,30E+03
Utilisation totale des ressources d'énergie primaire non renouvelables (énergie primaire et ressources d'énergie primaire utilisées comme matières premières) MJ/UF	**1,47E+03**	4,43E+01	2,02E+01	**6,44E+01**	0,00E+00	2,21E+03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,21E+03**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**3,75E+03**	-1,80E+03
Utilisation de matière secondaire kg/UF	**5,37E+01**	0,00E+00	2,49E-02	**2,49E-02**	0,00E+00	6,49E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,49E+01**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,19E+02**	2,80E+02
Utilisation de combustibles secondaires renouvelables MJ/UF	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	0,00E+00
Utilisation de combustibles secondaires non renouvelables MJ/UF	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	0,00E+00
Utilisation nette d'eau douce m3/UF	**1,19E-01**	9,10E-03	4,73E-03	**1,38E-02**	0,00E+00	1,96E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,96E-01**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**3,28E-01**	-1,37E-01

Production of waste for 1 m² of hot mix asphalt pavement

FU: Providing an area of 1m² of hot mix asphalt pavement representative of the French market, based on a reference lifespan of 100 years

Catégorie de déchets	Etape de fabrication	Etape de mise en œuvre			Etape de vie en œuvre								Etape de fin de vie					Total cycle de vie de vie	D Bénéfices et charges au-delà des frontières du système
	Total A1-A3 Production	A4 Transport	A5 Installation	**Total mise en œuvre**	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	**Total vie en œuvre**	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	**Total fin de vie**		
Déchets dangereux éliminés kg/UF	**3,42E-01**	2,73E-02	1,77E-02	**4,50E-02**	0,00E+00	5,84E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,84E-01**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**9,71E-01**	-3,92E-01
Déchets non dangereux éliminés kg/UF	**5,09E+00**	2,27E+00	2,10E+00	**4,37E+00**	0,00E+00	5,57E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,57E+01**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**6,51E+01**	-7,64E+00
Déchets radioactifs éliminés kg/UF	**2,19E-03**	2,97E-04	1,40E-04	**4,38E-04**	0,00E+00	3,89E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**3,89E-03**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**6,51E-03**	-2,11E-03

Output flows for 1 m² of hot mix asphalt pavement

FU: Providing an area of 1m² of hot mix asphalt pavement representative of the French market, based on a reference lifespan of 100 years

Flux sortants		Etape de fabrication	Etape de mise en œuvre			Etape de vie en œuvre								Etape de fin de vie					Total cycle de vie de vie	D Bénéfices et charges au-delà des frontières du système
		Total A1-A3 Production	A4 Transport	A5 Installation	**Total mise en œuvre**	B1 Usage	B2 Maintenance	B3 Réparation	B4 Remplacement	B5 Réhabilitation	B6 Utilisation de l'énergie	B7 Utilisation de l'eau	**Total vie en œuvre**	C1 Déconstruction/ démolition	C2 Transport	C3 Traitement des déchets	C4 Décharge	**Total fin de vie**		
Composants destinés à la réutilisation kg /UF		**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	8,11E+02	0,00E+00	**8,11E+02**	**8,11E+02**	0,00E+00
Matériaux destinés au recyclage kg/UF		**1,14E-01**	0,00E+00	6,73E-02	**6,73E-02**	0,00E+00	4,35E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**4,35E+02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**4,36E+02**	-1,36E-01
Matériaux destinés à la récupération d'énergie kg/UF		**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	0,00E+00
Energie fournie à l'extérieur (par vecteur énergétique) MJ/UF	Electricité	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	0,00E+00
	vapeur	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	0,00E+00
	Gaz de process	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	0,00E+00

6. Additional information on the release of hazardous substances into indoor air, soil and water during the use phase

6.1. Product characteristics contributing to the sanitary quality of indoor air

Not applicable.

The product has no direct or indirect contact with a building interior. Accordingly, it is not directly concerned by indoor air control.

6.2. Product characteristics contributing to the sanitary quality of water

Not applicable.

NO PROBLEM!" published in Bitume.info No. 26 of September 2011). NO PROBLEM!"[4]).

In addition, a study carried out by the École Supérieure d'Ingénieurs des Travaux de la Construction (Graduate School of Building Engineering – ESITC) of Cachan on behalf of USIRF in 2011 has demonstrated that "the amounts of pollutants released in leachate are low for MTHBs and extremely low for bituminous asphalt". For the latter, the concentrations of all the elements in solution are almost systematically below the limits of quantification."

[4] Can accessed at the following address http://www.bitume.info/articlespdf/313.pdf

7. Contribution of the product to quality of life inside buildings

7.1. Product characteristics contributing to hydrothermal comfort in buildings

Not applicable

7.2. Product characteristics contributing to acoustic comfort in buildings

Not applicable

7.3. Product characteristics contributing to visual comfort in buildings

Not applicable

7.4. Product characteristics contributing to olfactory comfort in buildings.

Not applicable