BETie, a toll for environmental quality of buildings

J.M. POTIER

Abstract

Created in 1964, the **Syndicat National du Béton Prêt à l'Emploi** (SNBPE), [National Union for Ready-Mixed Concrete] is attentive to the needs of firms, advises them as a partner, defines the profession's policies, represents and promotes the ready-mixed concrete sector. It counts 200 members representing 80% of ready-mixed concrete production.

In December 2004 France publish NF P 01-010 standard for "FDES" (Fiches de déclaration environnementales et sanitaires / Environmental and sanitary product declaration)
This standard gave the format of EPD in France. This format is for a functional unit (i.e. a square meter of concrete wall) and not for a m3 of concrete.

In 2006, SNBPE create its first FDES (m² of a concrete wall 16 cm thick), then between 2007 and 2009 12 other FDES (Post, beam, slab…) But all of them with a "reference concrete"
The need for more precise FDES becoming more and more important, because of environmental certification of buildings, SNBPE create a toll (BETie) giving a FDES depending of the real concrete composition, the distance of transportation of materials and concrete, and the size and type of the declared unit and its reinforcement.

Keywords

Sustainability, environment, indicators.

Biographical notes

J.M. Potier is a civil engineer.

1980/1998: various contractors: projects of civil engineering in West Indies, Algeria, Somalia, Reunion Island and Switzerland.
Technical manager in concrete road construction in France.
1998/2005: Civil engineering sales manager Vicat cement France.
From 2005: Technical manager SNBPE (French Ready Mix Association)

1. INTRODUCTION

In December 2004 France publish NF P 01-010 standard for “FDES” (Fiches de déclaration environnementales et sanitaires / Environmental and sanitary product declaration)
This standard gave the format of EPD in France.
The “FDES” cover all the life cycle of the product (from cradle to grave), so it is only possible to establish a “FDES” for a functional unit (i.e. a square meter of concrete wall) and not for a m3 of concrete.

In 2006, SNBPE create its first FDES, the definition of functional unit was the following :
“The function is ensured by a wall in reinforced ready-mixed concrete, 0.16 m x 1 m x 1 m in size. The concrete is XF1 exposure class, with a minimum compressive strength of 25 MPa measured on a cylinder or 30 MPa measured on a cube, manufactured in accordance with the NF EN 206-1 standard.”

Then between 2007 and 2009, 12 other FDES (Post, beam, slab…) were created, including some with self compacting concrete, but all of them were on the basis of standard concrete composition and average values.

During this period, SNBPE published, in liaison with CIMbéton (The French cement association) a guide on the answers of concrete to High Environmental Quality (HQE), then in 2010 a study comparing various solution for housing, this study was called QEB (Environmental Quality of Buildings).

The need for more precise FDES becoming more and more important, because of environmental certification of buildings, SNBPE create a toll (BETie) giving a FDES depending of the real concrete composition, the distance of transportation of materials and concrete, and the size and type of the declared unit and its reinforcement.

2. The result of “QEB” study

The “QEB” study was realised by an independent body and submitted to a critical review by representatives of other materials. It compares the impacts during all life cycle of a typical house 100 m² built with various materials. It shows:

- That concrete permits to fulfil the new French thermal regulation (< 50 kWh/m²/year)
- All materials, with a convenient conception of the building, are very closed compared on the total life cycle of a building (100 years), including on climate change indicator
- The use phase is three times more impacting than construction stage.

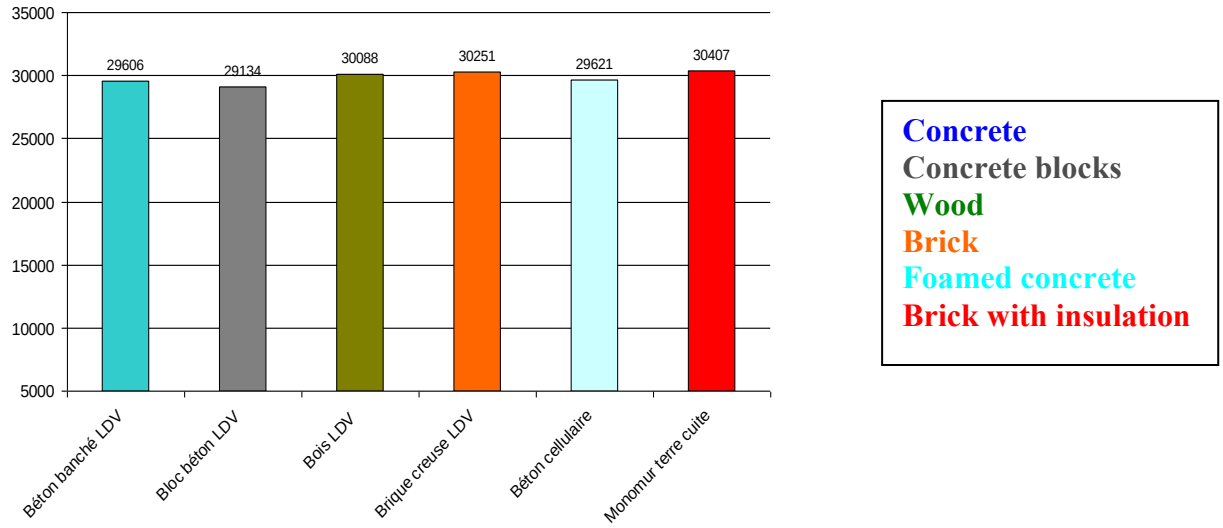


Figure 1: Energy consumption

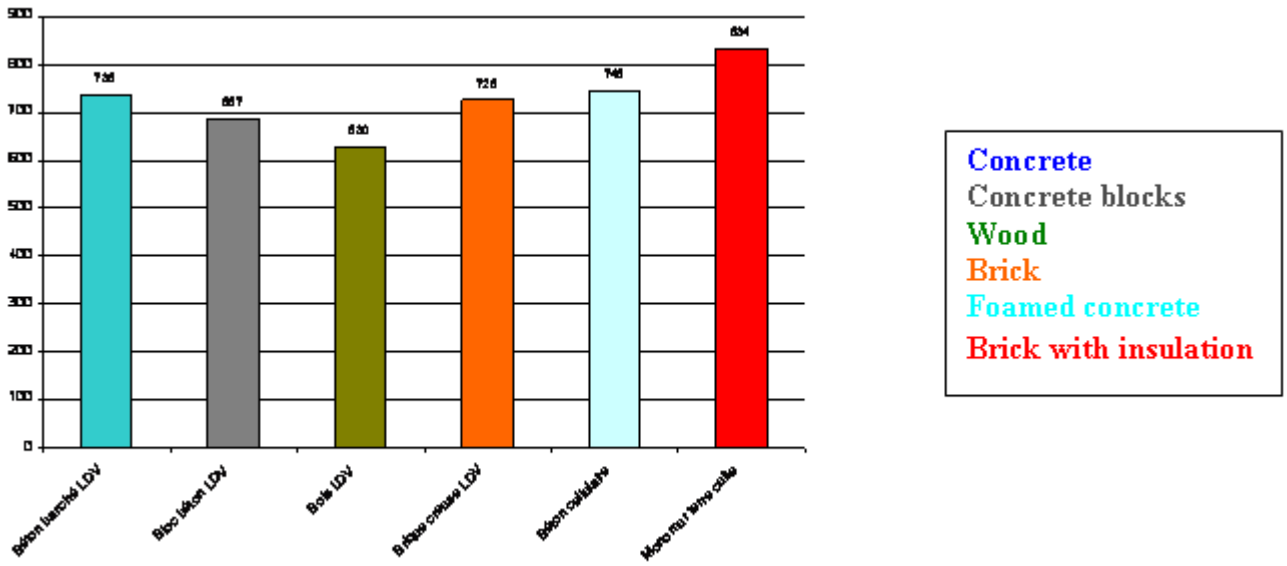


Figure 2: CO_2 emissions

3. FDES and building design

3.1 A new approach of building design

In France, including environmental aspects into building design (eco-design of buildings) has, in particular, given rise to a High Environmental Quality practice called the "HQE® Approach". This practice is the result of a consensus at French level of the best building eco-design practices. At an international level, the generic term Environmental Quality of Buildings is used when designating the incorporation of environmental concerns into building design.
FDES data aim to answer certain questions posed by the "HQE® Approach", i.e. within the framework of the ready-mixed concrete wall, showing its contributions to the approach's 14 environmental targets.
Studies like "QEB" are based on environmental impact of each materials given by "FDES"
The NF P 01 010 standard makes it mandatory to supply health data to help building eco-designers in their work.

3.2 Environmental communication using the NF P 01 010 standard

Powered by industrialists and the European Commission, there is a growing tendency to communicate environmental information on products. With a view to ensuring the credibility of communicated data, the International Standards Organisation (ISO) has produced standards which stipulate communication methodology. At French national level, the French Standardisation Association (AFNOR) is working along the same lines.

The FDES is in line with the general framework for "type III" eco-labels which are drawn up with the help provided by the ISO 14025 document. Consequently, the FDES contains two major types of information: quantified data concerning the life cycle of the ready-mixed concrete under study as well as health data.

Quantified data concerning the ready-mixed concrete life cycle

So as to provide data concerning the life cycle of the ready-mixed concrete wall, information was collected on a "cradle to grave" basis from extraction of raw materials to the end of ready-mixed concrete life, including in particular:

- production of components (aggregates, cement and steel frameworks among others),

- production of consumables and energy sources,
- use of components, consumables and energy sources for producing ready-mixed concrete,
- processing and use stage,
- end of product life,
- all forms of transportation between the different stages.

The advantage of taking into account all aspects of the life cycle is that none of the essential factors which have environmental impacts on the ready-mixed concrete wall is omitted.

The accounting method used to carry out the study on the life cycle of the ready-mixed concrete wall is the **Life Cycle Assessment** (referred to in the rest of the document as "LCA"). The LCA is an inventory method for environmental flows, standardised in accordance with ISO 14040. This standard which dates from 1998 (currently being reviewed when this booklet was published) forms the basis for the environmental product accounting method, which is the result of the synthesis of best practices in the field at international level.

Like ISO 14025, the NF P 01 010 standard refers explicitly to LCA practice in accordance with ISO 14040 and makes it mandatory. This confers credibility on the practice and guarantees the results obtained. FDES data can consequently be used within the scope of building LCAs.

In the future, France will implement EN 15804 (EPD) but FDES will be usable till 2017.

4. The BETie tool

4.1 What is BETie

BETie stands for **BET**on (Concrete) **i**mpact **e**nvironnemental (Environmental Impact)
2 different options exist depending of the user:

For the concrete producer member of SNBPE

BETie create FDES of a concrete element taking into account:

- The distance and mean of transport of materials from their production site to the concrete plant (cement, aggregates, additions, admixtures…)
- The exact concrete formula
- The distance between the plant and the job site
- The dimension of the functional unit
    - Thickness of a wall or a slab (functional unit = 1 m²)
    - Section of a post or a beam (functional unit = 1 linear metre)
    - Reinforcement quantity
- The method of placing concrete (concrete pump, crane or directly from the truck mixer)

For any other user

The user gives the following information:
Concrete compression strength
Exposure class
Type of cement and addition (if any)
Consistency
Type of aggregates

Then BETie takes into account:

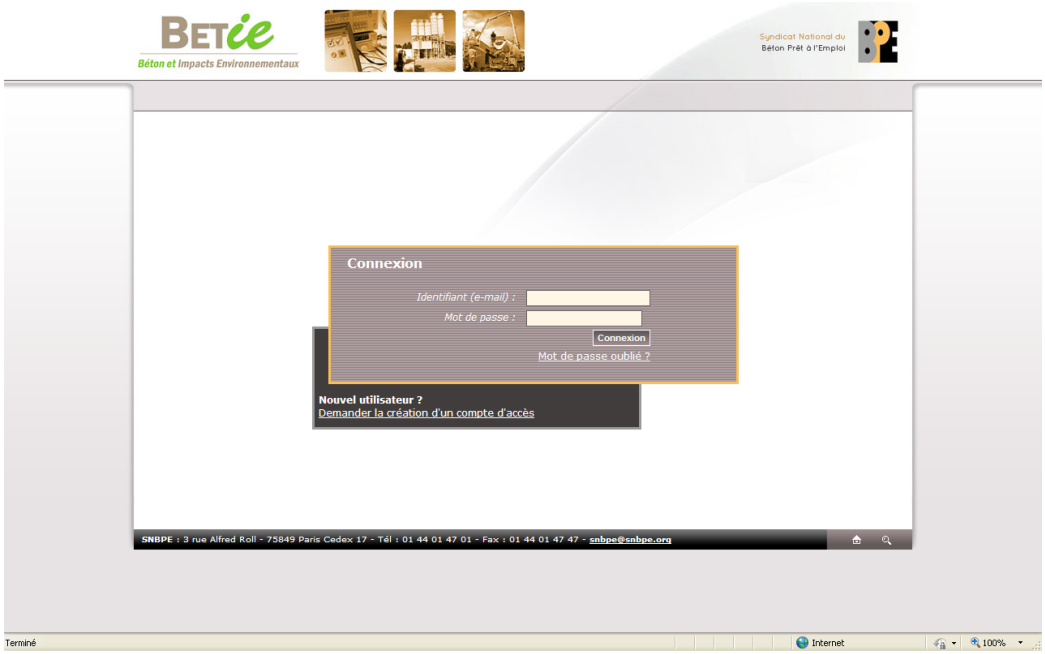
- The average distance and mean of transport of materials from their production site to the concrete plant (French average distance for each type of constituent)
- A predetermine formula (out of 164 different one) depending of the above information

- *The other information are the same that for the "SNBPE" tool*
- The distance between the plant and the job site
- The dimension of the functional unit
    - Thickness of a wall or a slab (functional unit = 1 m²)
    - Section of a post or a beam (functional unit = 1 linear metre)
    - Reinforcement quantity
- The method of placing concrete (concrete pump, crane or directly from the truck mixer)

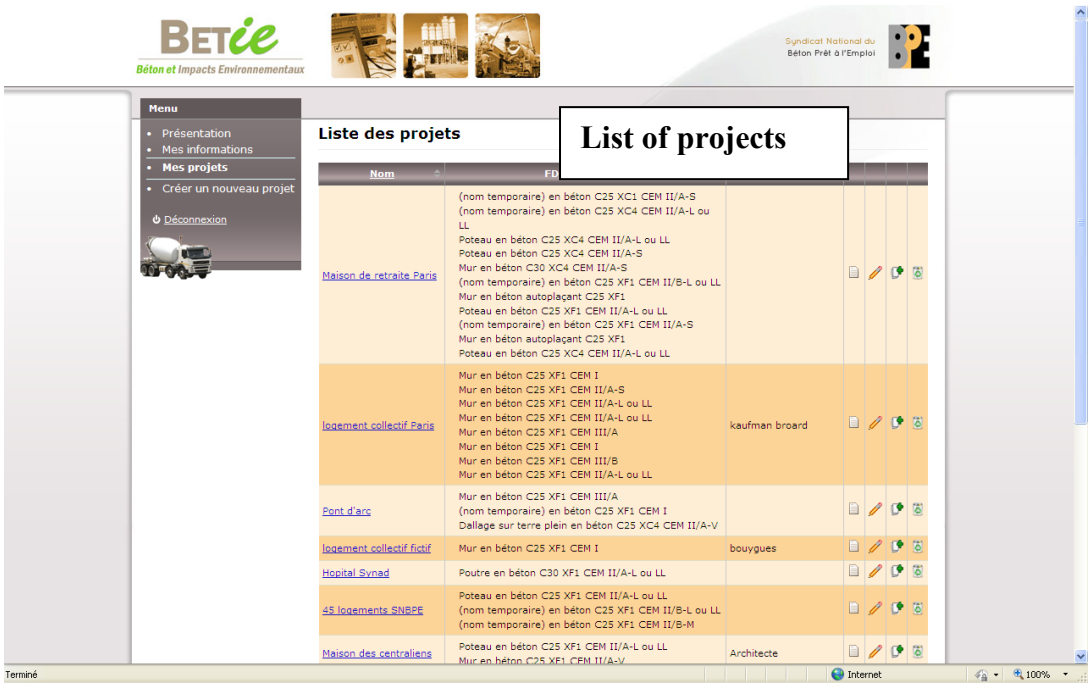
The toll was verified by an independent third party certified by AFNOR.

4.2 Use of BETie tool

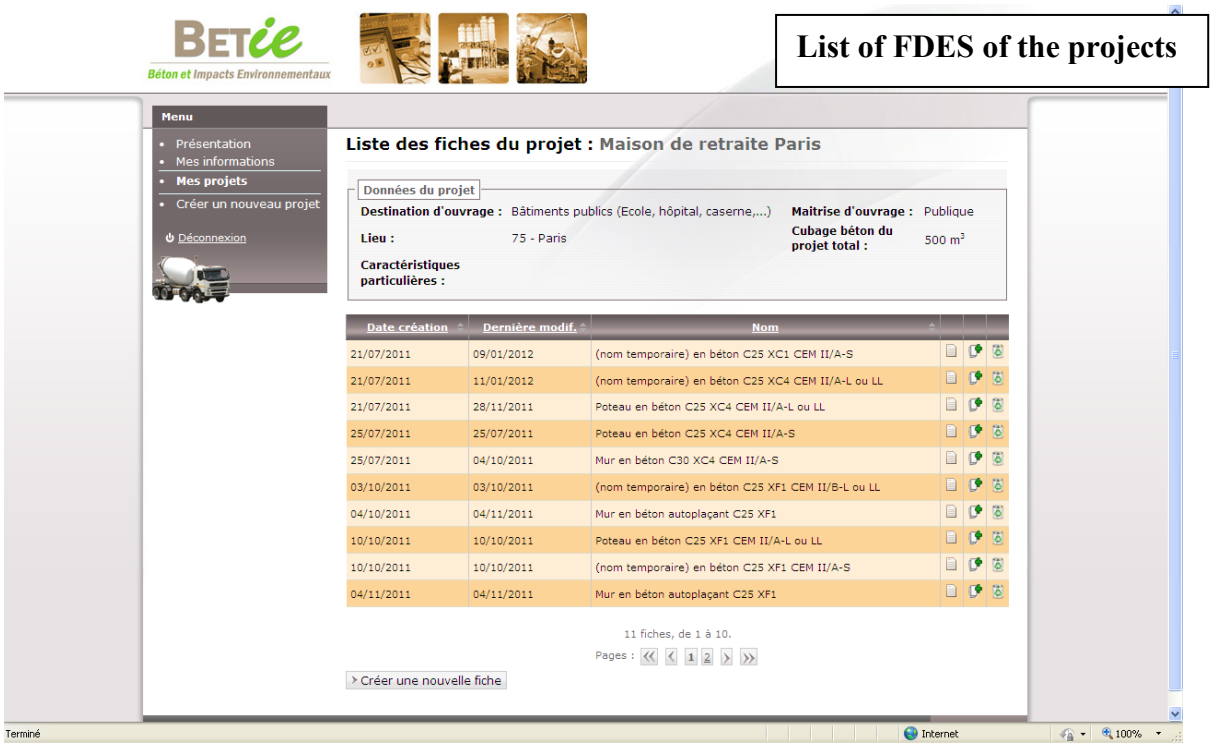
- Access to the tool via a password to protect your data



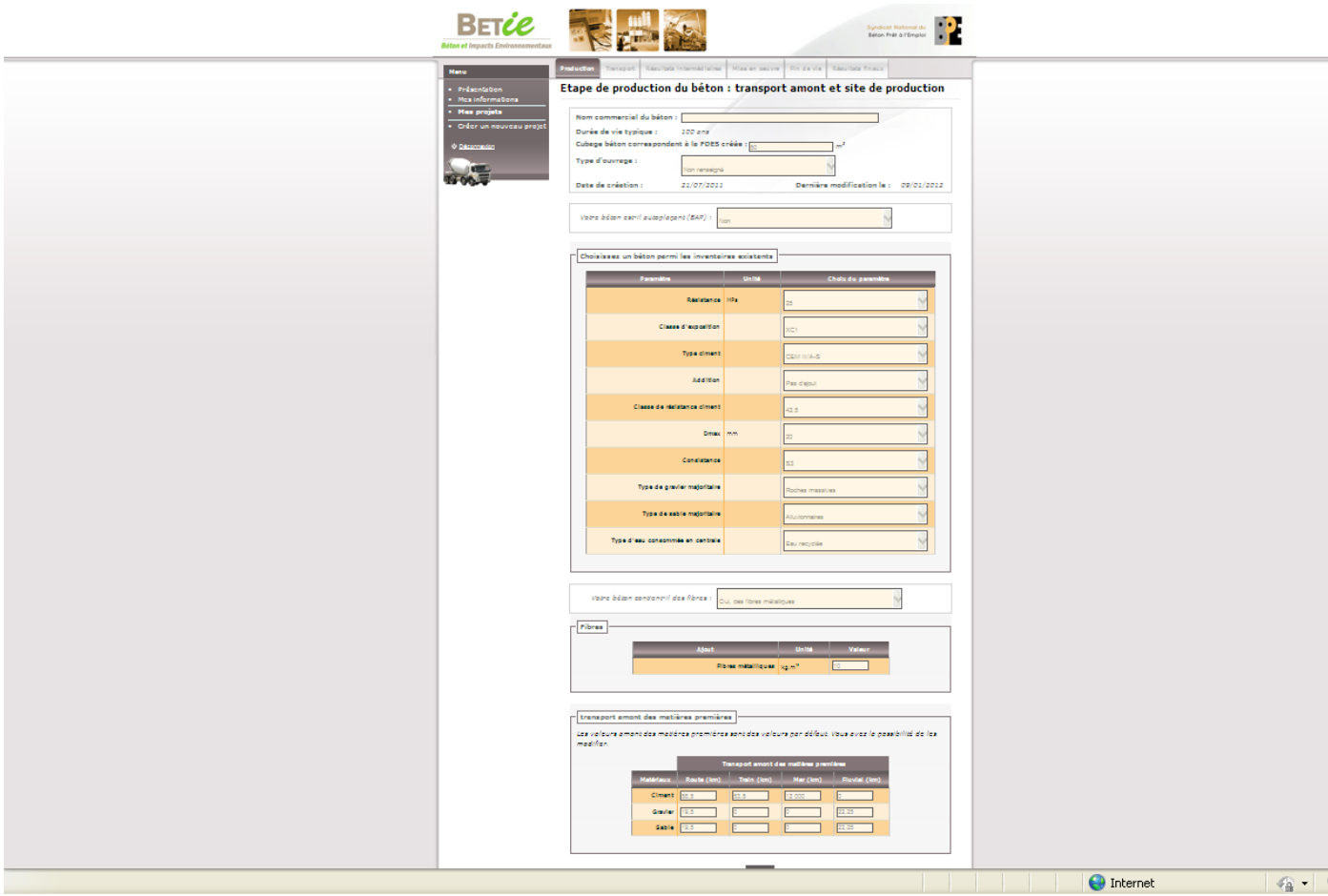
- Data organised by "projects" (i.e. Maison de retraite Paris)



- In each project, one ore more FDES (i.e. Concrete wall, beam, slab…..)



Information to be filled: Concrete resistance, exposure class, type of cement, consistency, …



- Two types of data available

CRADLE TO GATE

CRADLE TO GRAVE

COMPANY EDITING THE DATA SNBPE

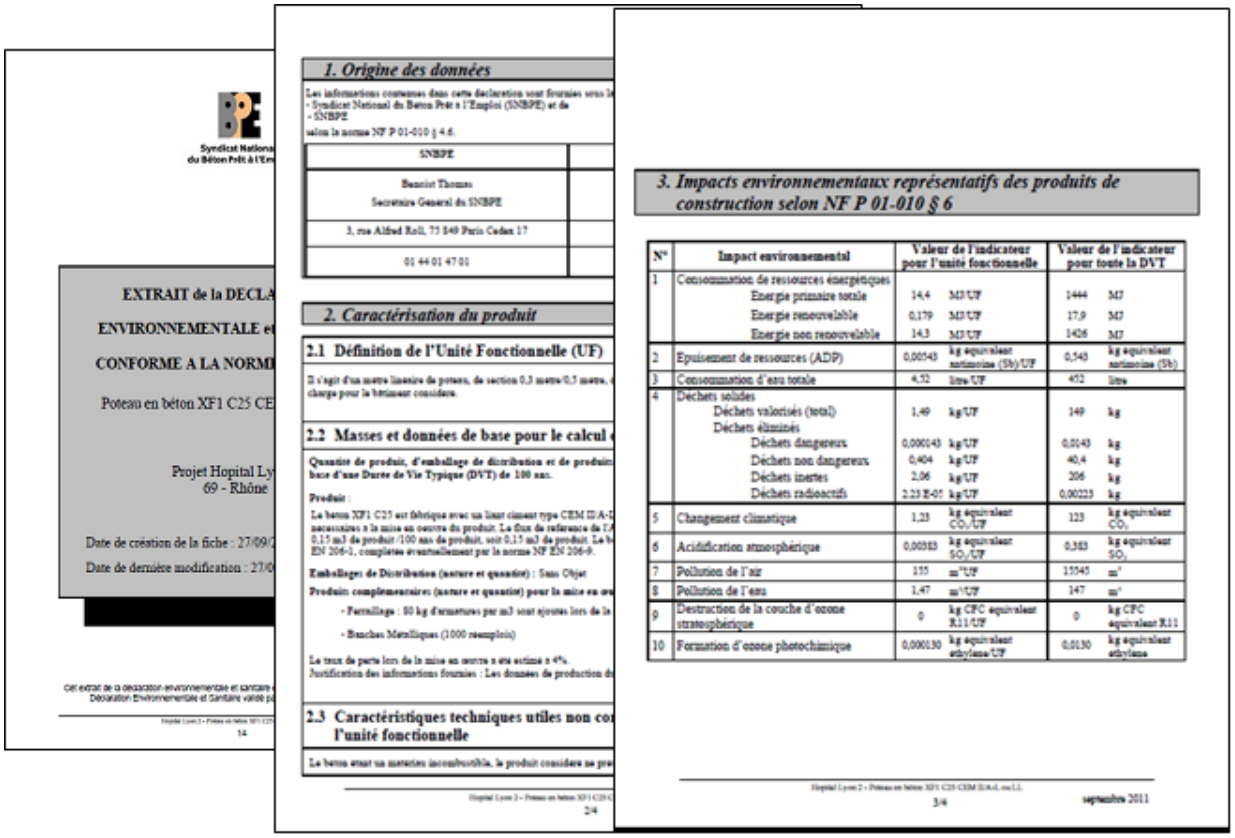
DATE 11/05/12

FUNCTIONNAL UNIT CUBIC METER OF C 25 XF 1 CEM II A-S

COMMERCIAL NAME SUPER BETON

Type	Flow	Units	Cycle de Vie					
			Total	Production	Transport	Mise en œuvre	Vie en œuvre	Fin de vie
Inputs:	(a) Particulates (unspecified)	g	1960	1960				
	(r) Antimony (Sb, ore)	kg	1,055E-12	1,055E-12				
	(r) Barium Sulphate (BaSO4, in ground)	kg	0,00491398	0,00486179	5,2186E-05			
	(r) Basalt (in ground)	kg	0,00017848	0,00017848				
	(r) Bauxite (Al2O3, ore)	kg	0,86985349	0,86980363	4,9858E-05			
	(r) Bentonite (Al2O3.4SiO2.H2O, in ground)	kg	0,00076171	0,00075679	4,9276E-06			
	(r) Borax (B4Na2O7, ore)	kg	6,8546E-09	6,8546E-09				
	(r) Cadmium (Cd, ore)	kg	3,013E-08	3,013E-08				
	(r) Calcium Sulphate (CaSO4, ore)	kg	4,69039371	4,69038459	9,118E-06			
	(r) Carbon (in ground)	kg	1,5251E-07	1,5251E-07				
	(r) Cerium (Ce, ore)	kg	-2,2573E-20	-2,2573E-20				
	(r) Chromium (Cr, ore)	kg	0,0007926	0,00079259	1,003E-08			
	(r) Chrysotile (in ground)	kg	1,1082E-08	1,1082E-08				
	(r) Clay (in ground)	kg	14,7178725	14,7178021	7,0422E-05			
	(r) Coal (in ground)	kg	4,08961641	4,08800971	0,0016067			
	(r) Cobalt (Co, ore)	kg	6,9769E-10	6,9769E-10				
	(r) Colemanite (CaB3O4(OH)3-H2O, in ground)	kg	3,8513E-06	3,8513E-06				
	(r) Copper (Cu, ore)	kg	0,00071071	0,00071066	5,1022E-08			
	(r) Diatomite (in ground)	kg	1,4155E-11	1,4155E-11				
	(r) Dolomite (CaCO3.MgCO3, in ground)	kg	6,7964E-05	6,7964E-05	1,4686E-12			
	(r) Feldspar (ore)	kg	4,9614E-09	4,9614E-09				
	(r) Ferromanganese (Fe, Mn, C; Ore)	kg	2,257E-07	2,257E-07	2,0176E-15			
	(r) Fluorspar (CaF2, ore)	kg	6,0039E-05	6,0039E-05				
	(r) Gadolinium (Gd, ore)	kg	-3,4187E-22	-3,4187E-22				
	(r) Gallium (Ga, in ground)	kg	1,4955E-12	1,4955E-12				
	(r) Gas (mine, off-gas, process, coal mining)	kg	0,00051804	0,00051804				
	(r) Gold (Au, ore)	kg	5,0178E-08	5,0178E-08				
	(r) Granite (in ground)	kg	4,7035E-09	4,7035E-09				
	(r) Gravel (unspecified)	kg	950,103142	950,101896	0,00124576			
	(r) Gypsum (CaSO4.2H2O)	kg	7,56	7,56				
	(r) Helium (He, in natural gas, in ground)	kg	3,6688E-11	3,6688E-11				
	(r) Indium (In, in ground)	kg	5,7514E-10	5,7514E-10				
	(r) Iron (Fe, ore)	kg	0,37149925	0,3713326	0,00016665			

Figure 3: Extract from data of one m3 of concrete (cradle to gate)



1. Origine des données

2. Caractérisation du produit

2.1 Définition de l'Unité Fonctionnelle (UF)

2.2 Masses et données de base pour le calcul

2.3 Caractéristiques techniques utiles non co l'unité fonctionnelle

3. Impacts environnementaux représentatifs des produits de construction selon NF P 01-010 § 6

N°	Impact environnemental	Valeur de l'indicateur pour l'unité fonctionnelle		Valeur de l'indicateur pour toute la DVT	
1	Consommation de ressources énergétiques				
	Energie primaire totale	14,4	MJ/UF	1444	MJ
	Energie renouvelable	0,179	MJ/UF	17,9	MJ
	Energie non renouvelable	14,3	MJ/UF	1426	MJ
2	Epuisement de ressources (ADP)	0,00543	kg équivalent antimoine (Sb)/UF	0,543	kg équivalent antimoine (Sb)
3	Consommation d'eau totale	4,52	litre/UF	452	litre
4	Déchets solides				
	Déchets valorisés (total)	1,49	kg/UF	149	kg
	Déchets éliminés				
	Déchets dangereux	0,000143	kg/UF	0,0143	kg
	Déchets non dangereux	0,404	kg/UF	40,4	kg
	Déchets inertes	2,06	kg/UF	206	kg
	Déchets radioactifs	2,23 E-05	kg/UF	0,00223	kg
5	Changement climatique	1,23	kg équivalent CO_2/UF	123	kg équivalent CO_2
6	Acidification atmosphérique	0,00383	kg équivalent SO_2/UF	0,383	kg équivalent SO_2
7	Pollution de l'air	155	m^3/UF	15545	m^3
8	Pollution de l'eau	1,47	m^3/UF	147	m^3
9	Destruction de la couche d'ozone stratosphérique	0	kg CFC équivalent R11/UF	0	kg CFC équivalent R11
10	Formation d'ozone photochimique	0,000130	kg équivalent éthylène/UF	0,0130	kg équivalent éthylène

Figure 4 : Extract of a FDES created by BETie

5. Conclusion

BETie is the first French tool of creation of FDES conforming to NF P 01-010.

It gives the possibility to the prescriber to optimise the environmental impact of his building.

It shows the implication of the ready mix concrete industry in sustainable development.

More information on :

http://www.snbpe.org//developpement_durable/calculette

http://ns381308.ovh.net/ecobilan/login.html