

CARBON FOOTPRINT (CF) OF THE BIONICTILE® PORCELAIN TILE CLADDING AS EXTERNAL FAÇADE CLADDING

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1. THE CARBON FOOTPRINT: THE CERAMIC TILE ECO-LABEL

Ceramic tile has been one of the 4 eco-labels selected in the project “**EU Eco-label – Tools for measuring the carbon footprint**” – A service contract aimed at providing the European Commission with tools to allow eco-label carbon to be measured in the EU.

The Carbon Footprint (CF) is the total amount of carbon dioxide (CO_2) and other greenhouse gases (GHG) – *e.g. N_2O nitrous oxide*-, associated with a product throughout its entire life cycle. The CF is measured by converting all the GHGs to emissions with a “ CO_2 equivalent” added value, which represents the Global Warming Potential (GWP). This way, we are providing a value to establish the contribution that the product in question makes to the climatic change.

The most significant results generated by the project are **CF measuring instruments**: software developed (standardized database and Microsoft Excel®). The set of guidelines and tools are based on the focus of the Life Cycle Analysis (LCA).

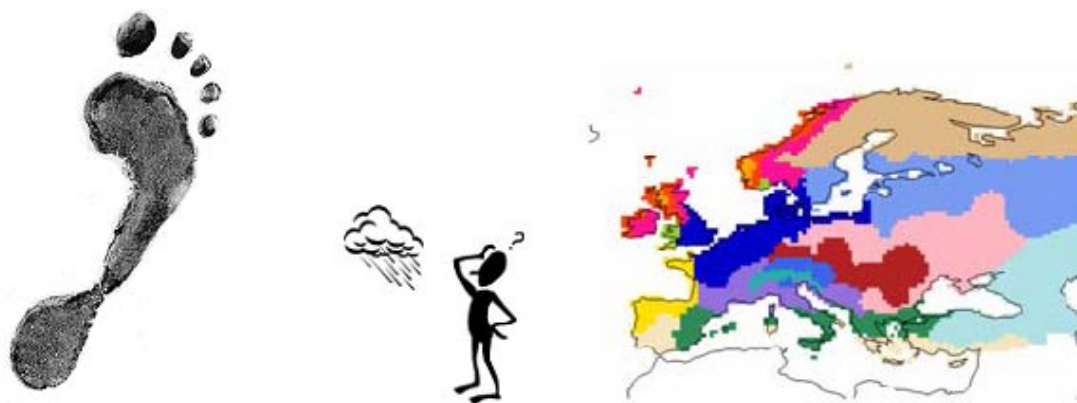


Figure 1.

2. PHOTOCATALYTIC CERAMIC CLADDING –NO_x REDUCTION

The NO_x (nitrogen oxides) represent a family of 7 chemical compounds, including N_2O (nitrous oxide), which pollute the air. The main sources of the nitrogen oxide, NO_x, emissions are currently automobiles, public transport and other mobiles sources (40% of pollution), thermoelectric plants and incineration plants (20% of pollution) and other sources such as chemical plants and factories, industrial boilers, oil refineries, etc. (30% of pollution). The emission of nitrogen oxides (NO_x) into the atmosphere produces a variety of public health problems, as well as negative environmental effects on the planet.

CERACASA and FMC-FORET have managed to develop a porcelain tile cladding (H_2O absorption less than 0.5%) with photocatalytic activity, thanks to a special glaze made up of TiO_2 and potentiators. Thus, through being illuminated by

sunlight, it continuously transforms the NO_x from the atmosphere into innocuous water-soluble nitrates (NO_3^-), regenerating the active centres by natural washing during rainy periods or periods with environmental humidity.

In order to demonstrate the environmental contribution that this effect represents, we shall compare the carbon footprint (CF) of a conventional porcelain product with that obtained in this porcelain cladding with photocatalytic properties, in both cases, analysing their use in ventilated façades.

3. CARBON FOOTPRINT OF A PORCELAIN TILE CLADDING

The EU tool for **measuring the Carbon Footprint of a PORCELAIN cladding** installed as a **ventilated façade** construction solution has been used. By means of this tool, we assess the impacts throughout its entire life cycle.

We do not take the use stage into account, since it is considered that significant impacts are not produced during this stage.

The data obtained refer to the following scenarios and ASSIGNMENT RULES:

- **PRODUCT:** PORCELAIN TILE VENTILATED FAÇADE.
- **FUNCTIONAL UNIT:** 1 kg.
- **USEFUL LIFE:** 50 years.

data per 1 kg		of which			
kg CO ₂ equivalent	Total	Direct	Indirect	Electricity Use	Biomass
Total	4.44	4.23	0.13	0.09	-0.01
Raw materials and Packaging	0.08		0.09		-0.01
Production	4,37	4.23	0.05	0.09	
Use	0.00	0.00	0.00	0,00	0.00
End of life	-0.01		-0.01		
Transportation	0.00		0.00		

Table 1. Porcelain tile in ventilated façade.

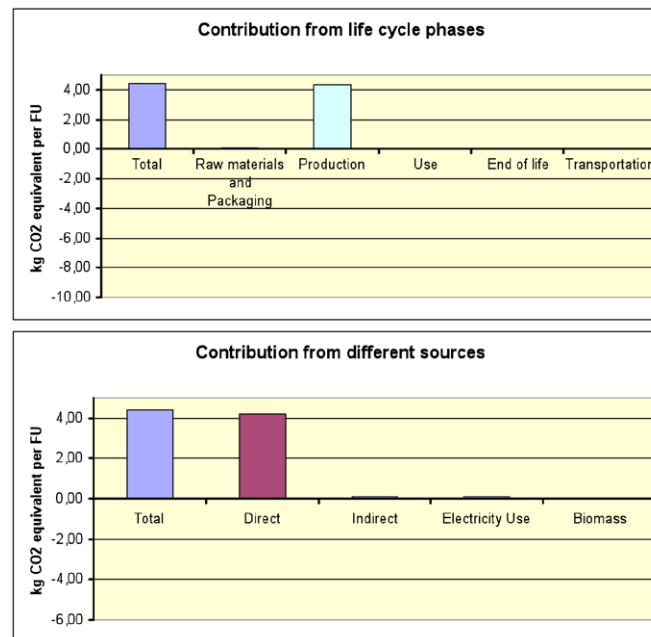


Figure 2. Porcelain in ventilated façade.

4. CARBON FOOTPRINT OF A PORCELAIN TILE CLADDING WITH PHOTOCATALYTIC PROPERTIES

Since **BIONICTILE®** has the capacity to reduce environmental NO_x and, therefore, has a positive impact in the building's use stage, the calculation of this stage has been included.

When this product is installed on façades and envelopes in polluted city centres, it chemically reduces the NO_x (*nitrogen oxides*) produced by vehicles and industries to innocuous water-soluble nitrites and nitrates (atmospheric humidity), continuously eliminating them from the air. Therefore, this is an important contribution to the carbon footprint during the building's use stage.

The data obtained refer to the following scenarios and ASSIGNATION RULES:

- **PRODUCT:** PORCELAIN TILE VENTILATED FAÇADE.
- **FUNCTIONAL UNIT:** 1 kg.
- **USEFUL LIFE:** 50 years.

The **USE STAGE** has been calculated using the following data and assumptions:

- The elimination value of NO_x is 3.63 mg of NO_x per m² and hour. This information was obtained in tests carried out by the Polytechnic University of Valencia CSIC-ITQ according to standard ISO 22197-1:2007 E (NO_x concentration = 6 ppm).

- An average daily insolation of 12 hours/day is assumed.
- A product useful life of 50 years is assumed.
- Conversion factor of NO_2/CO_2 eq = 310 kg CO_2 eq/kg NO_2 .

data per 1 kg		of which			
kg CO_2 equivalent	Total	Direct	Indirect	Electricity Use	Biomass
Total	-4.98	-5.19	0.13	0.09	-0.01
Raw materials and Packaging	0.08		0.09		-0.01
Production	4.37	4.23	0.05	0.09	
Use	-9.42	-9.42			
End of life	-0.01		-0.01		
Transportation	0.00		0.00		

Table 2. Photocatalytic porcelain tile in ventilated façade.

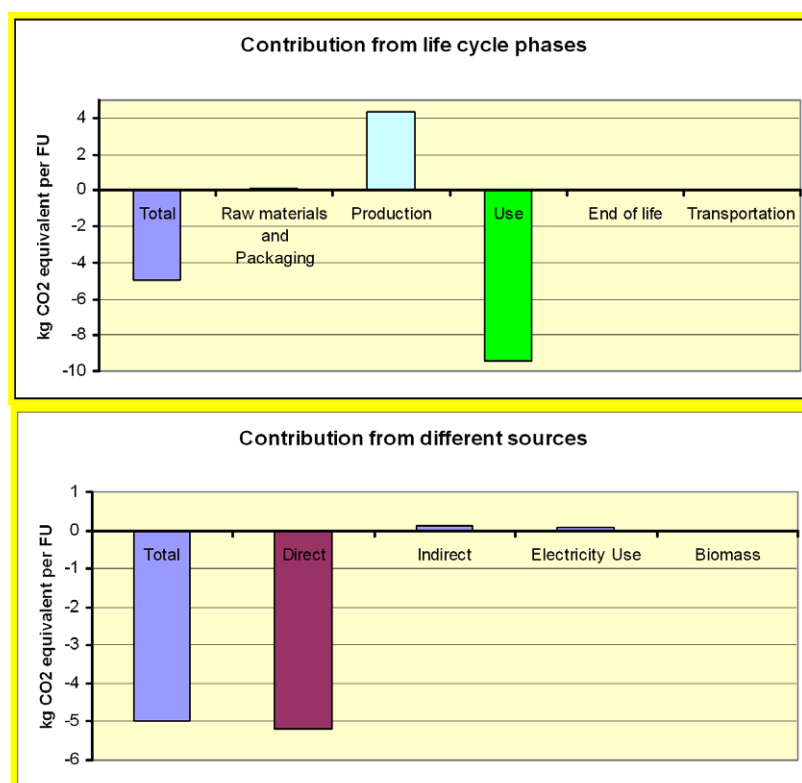


Figure 3. Photocatalytic porcelain tile in ventilated façade.

5. CONCLUSIONS

The CF calculating tool for ceramic claddings is very basic, and focuses on the input and output flows that create the greatest impacts.

Given the capacity that this product displays for reducing the atmospheric NO_x, and the associated positive impact during the building's use stage, the calculation of this stage's contribution has been included in the tool itself.

When comparing the Carbon Footprint obtained for a conventional porcelain tile cladding with the one obtained for our porcelain tile cladding with photocatalytic properties, always for the same functional unit, the same use, the same assignment criteria and considering a useful life of 50 years, the following result was obtained:

CONVENTIONAL PORCELAIN TILE CF: **4,44 kg equivalent CO₂ /kg**

BIONICTILE® PORCELAIN TILE CF: **-4,98 kg equivalent CO₂ /kg**

Note: Although the unit with which we are most familiarized for giving a quantitative measure of ceramic products is the m², in this case the functional unit with which the tool used works in this calculation exercise (kg) has been respected.

The data shown reflect the benefit that an improvement of this calibre, applied to all the buildings that include this range of products in their external cladding, can represent with regard to the impact on the climatic change.

REFERENCES

- [1] website the public can use a calculation tool in order to evaluate its personal footprint.: <http://www.ibgebim.be/Templates/Particuliers/Informer.aspx?id=1768&langtype=2060>
- [2] Commission Carbon footprint database: The LCA platform: http://ec.europa.eu/environment/ecolabel/pdf/other/jrc_cf.pdf
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- [5] Hojas de datos EPA. Técnicas de control de contaminantes de datos. Óxidos de Nitrógeno.
- [6] ISO 22197-1:2007 Fine ceramics (advanced ceramics, advanced technical ceramics) -- Test method for air-purification performance of semiconducting photocatalytic materials -- Part 1: Removal of nitric oxide.