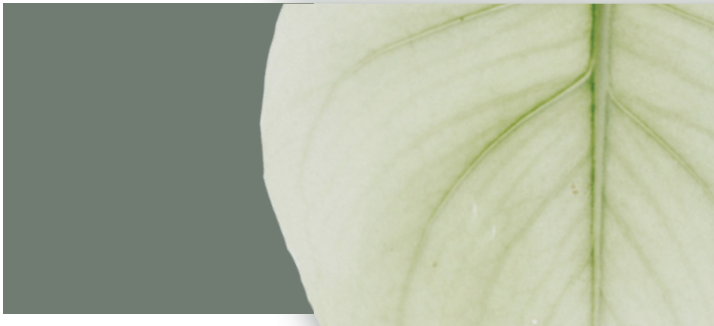
LCA

LIFE CYCLE ANALYSIS

Evaluation of product lines LM 60 X 120 and LM 120 X 120



Roca Brasil | Cerámica

Roca | Incepa

Roca Brasil Cerámica is the 1st national ceramic tile industry to invest in **Life Cycle Analysis (LCA)**, a very important study to monitor the impacts of its processes and products on the environment. The Analysis mapped the stages of raw material extraction, transportation of inputs and production of the coatings produced at the Campo Largo plant (PR).

With **LCA**, professionals who use certain **Roca Cerámica** or **Incepa** products can obtain scores for sustainable certifications, such as LEED Certification. In addition, it meets the growing desire of professionals and consumers for brands that value transparency and sustainable development.

INTRODUCTION

One of the ways to demonstrate transparency within the industry is by presenting the carbon footprint and other environmental impacts resulting from the manufacture of a given product.

In addition to promoting brand transparency, knowing the environmental impacts of your product can serve as a starting point for setting sustainable goals and, in this way, a company can continuously improve processes in addition to contributing to the Sustainable Development Goals (SDGs), promoted by the United Nations (UN).

To quantify environmental impacts, one of the tools indicated is the Life Cycle Assessment (LCA).

The life cycle of a product ranges from its conception to its return to the environment. It is a set of 5 steps, which are:

_ Extraction of raw materials;

_ Transport;

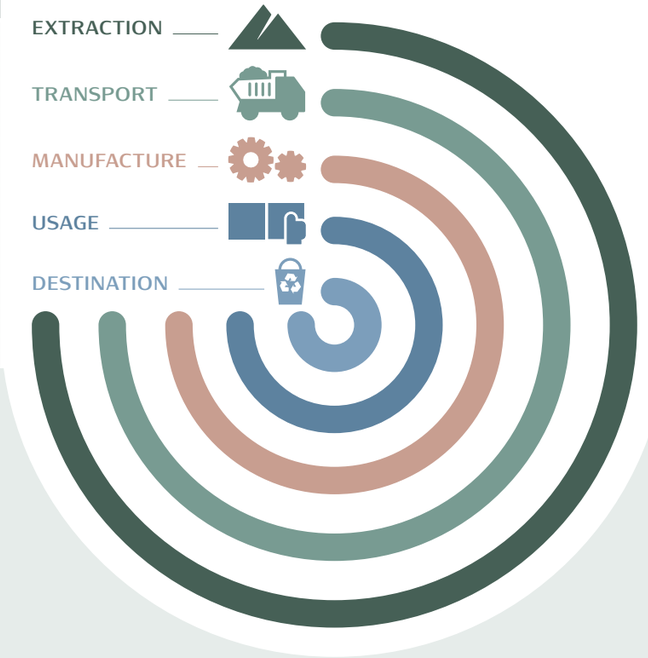
_ Manufacture;

_ Usage;

_ Destination.

LCA is a technical methodology standardized by ISO 14040 and ISO 14044, and is therefore an internationally recognized and practiced methodology. This is a study whose objective is to quantify the possible environmental impacts resulting from the life cycle of a product.

PRODUCT LIFE CYCLE



DEFINITION OF PURPOSE AND SCOPE OF ROCA BRASIL

During 2019/2020, Roca voluntarily opted to undergo this Life Cycle Analysis that has been carried out so far for the porcelain tiles produced at Roca's Factory 1. The purpose of this work was to meet first a demand from customers already interested in transparency, sustainable certifications, projects specifying sustainable products and the international market that is stuck with products that bring this level of transparency regarding their impacts.

SCOPE

Production of porcelain lines **LM 60 x 120 and LM 120 x 120** of Roca Brasil Cerámica's Factory 1.

CONTROL VOLUME

Cradle at the gate (Cradle-to-Gate), since the use and disposal of porcelain tiles has a negligible environmental impact.

REFERENCE STANDARDS

ISO 14040 Environmental management - Life cycle assessment - Principles and framework.

ISO 14044 Environmental management - Life cycle assessment - Requirements and guidelines.

EN 15804 Product category rules - Construction products and construction services.

EN 17160 Sub PCR to PCR 2012:01 - Ceramic Tiles.

FUNCTIONAL UNIT

Cover 1 square meter of surface.

REFERENCE FLOW

1 square meter of porcelain tiles produced.

ALLOCATION PROCEDURES

Allocation procedure is the distribution of inflows and outflows between products when several products are being produced simultaneously. In addition to the allocation procedures included in the information taken from the database used, no other allocation procedures were used.

TEMPORAL COVERAGE

January to June 2019.

DATA QUALITY

All data related to the manufacturing process (number of inputs used, fuel consumption, gaseous emissions and effluents) were collected by Roca. Data related to the stages of extraction of raw materials, processing of inputs (for materials that are manufactured, such as paints) and transport were extracted from the Ecoinvent 3.6 database.

This study includes the lines of porcelain tiles **LM 60 x 120 and LM 120 x 120**, produced at Fábrica 1 da Roca, located in Campo Largo - PR. The table above gathers information on the scope of this LCA study.

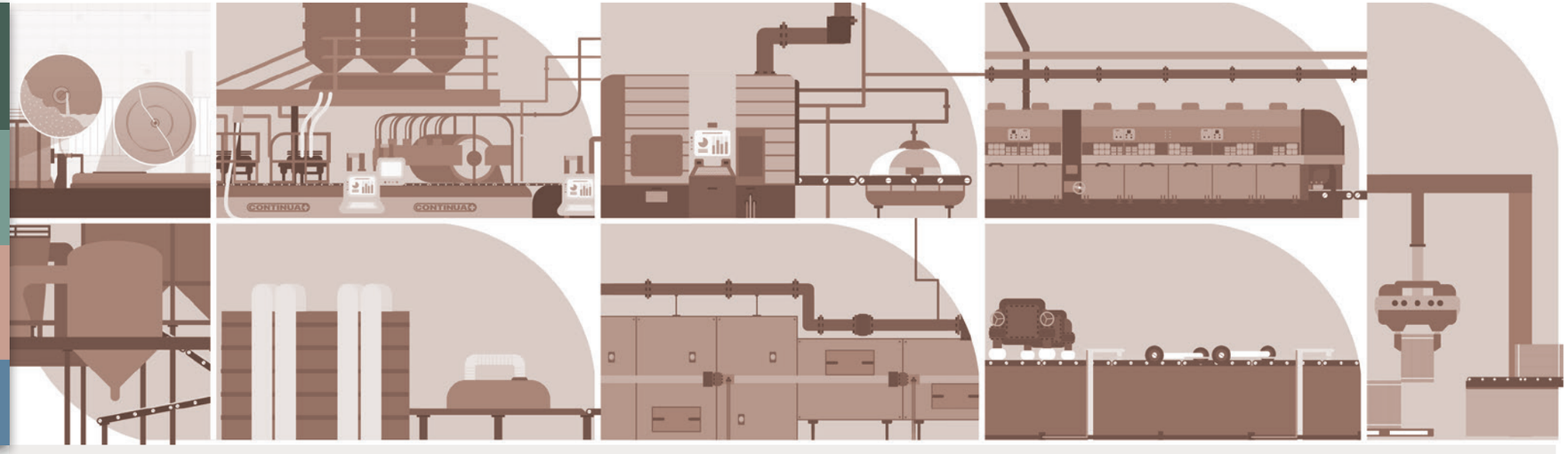
The following figure shows the system studied in this LCA, using the cradle to the gate approach, since the stages of use and disposal of porcelain tiles have environmental impacts that can be neglected.

1 RAW MATERIAL SUPPLY
_ extraction/processing RM
_ fuel extraction/processing
_ electricity generation

2 TRANSPORT TO FACTORY

3 MANUFACTURE
The manufacturing process is subdivided into the steps in the illustration opposite.

4 PORCELAIN



1. MILLING 2. COLORING 3. ATOMIZER 4. STORAGE 5. PRESS AND CUT 6. DRYER
7. ENAMELING AND DIGITAL PRINTING 8. FURNACE 9. POLISHING AND GRINDING 10 . CLASSIFICATION AND SHIPMENT

LIFE CYCLE INVENTORY ANALYSIS

Mineral raw materials

In this LCA item, the quantities of materials needed for the production of the studied parts are considered in the proportion of 1 m^2, this information is provided by Roca.

The information regarding the extraction and transportation processes (prior to the manufacturing process) were extracted from an approved international database.

As examples of mineral raw materials used in the production of porcelain tiles we can mention clays and rock minerals.

Transport

In this category, it is necessary to consider all distances covered by any raw material used in the process of creating the products. To define the parameters of all trucks involved in this category, we use the Brazilian standard PROCONVE P7. The loading capacity of the trucks was informed by Roca Brasil Cerámica.

For products whose distances were not specified by the manufacturers, the consultancy validated using tools such as Google Maps® (GOOGLE INC., 2019) and Sea Routes® (SEAROUTES SAS, 2019).

Energy and fuels

The quantities of fuel and electricity used were collected through documents provided by Roca. Information on these fuels prior to the manufacturing process was extracted from the international database. Emissions of petroleum and natural gas coke were measured by third-party companies, while diesel and LPG oil emissions were estimated by the consultancy.

Water

Sustainable water consumption is a very sensitive item in the production of porcelain tiles. Roca has an internal commitment to measure and constantly evolve with savings within the process. The analysis of effluents was also included in this LCA and the data are collected by a third-party company.

Quantities

The following tables show the quantities of materials used for the production of 1 m² of the **LM 60 x 120 and LM 120 x 120** porcelain lines, respectively.

Quantities of materials used in greater quantity per m² produced - **LM 60 x 120**

Material	Quantity	Unit
Clay	12,18	Kg
Feldspar	11,09	Kg
Electricity	6,64	KWh
Petroleum coke	0,74	Kg
Natural gas	2,16	m³
GLP	0,03	Kg
Diesel	0,01	L
Water	6,55	L

Quantities of materials used in greater quantity per m² produced - **LM 120 x 120**

Material	Quantity	Unit
Clay	12,02	Kg
Feldspar	10,95	Kg
Electricity	6,26	KWh
Petroleum coke	0,90	Kg
Natural gas	2,07	m³
GLP	0,03	Kg
Diesel	0,01	L
Water	6,41	L

LIFE CYCLE IMPACT ASSESSMENT

The impact categories of this LCA were chosen based on the norm **EN 15804**, which delimits the impact categories that must be evaluated for civil construction products. In addition to the categories required by the regulations, Water Depletion was also assessed.

Since the impact categories chosen could not be assessed by the same indicator, more than one indicator was used.

The **CML 2001** indicator was used to quantify the following impact categories:

- Soil and Water Acidification (acidification potential, generic) - potential increase in the pH of soils and waters, which affects the regional ecosystem;
- Climate change (climate change, GWP100a) - potential temperature increase due to the emission of anthropic gases;
- Eutrophication (eutrophication potential, generic) - potential deposition of nutrients in ecosystems (mainly aquatic) that generates an imbalance in the regional ecosystem;
- Photochemical oxidation (phochemical oxidation (summer smog), high NOx POCP) - potential increase in the concentration of ozone in the lower layer of the atmosphere;
- Depletion of the Ozone Layer (stratospheric ozone depletion, ODP 40a) - reduction in the ozone layer and potential increase in the infiltration of ultraviolet rays.

The **ILCD 2.0 2018** midpoint indicator was used to quantify the following impact category:

- Depletion of non-fossil resources (resources, mineral and metals) - consumption of non-fossil resources.

The **ReCiPe Midpoint indicator (E)** was used to quantify the following impact category:

- Water depletion - water consumption.

Finally, the **Cumulative Energy Demand** indicator was used to quantify the following category of impact:

- Fossil Depletion (fossil, non-renewable energy resources, fossil) - consumption of fossil resources.

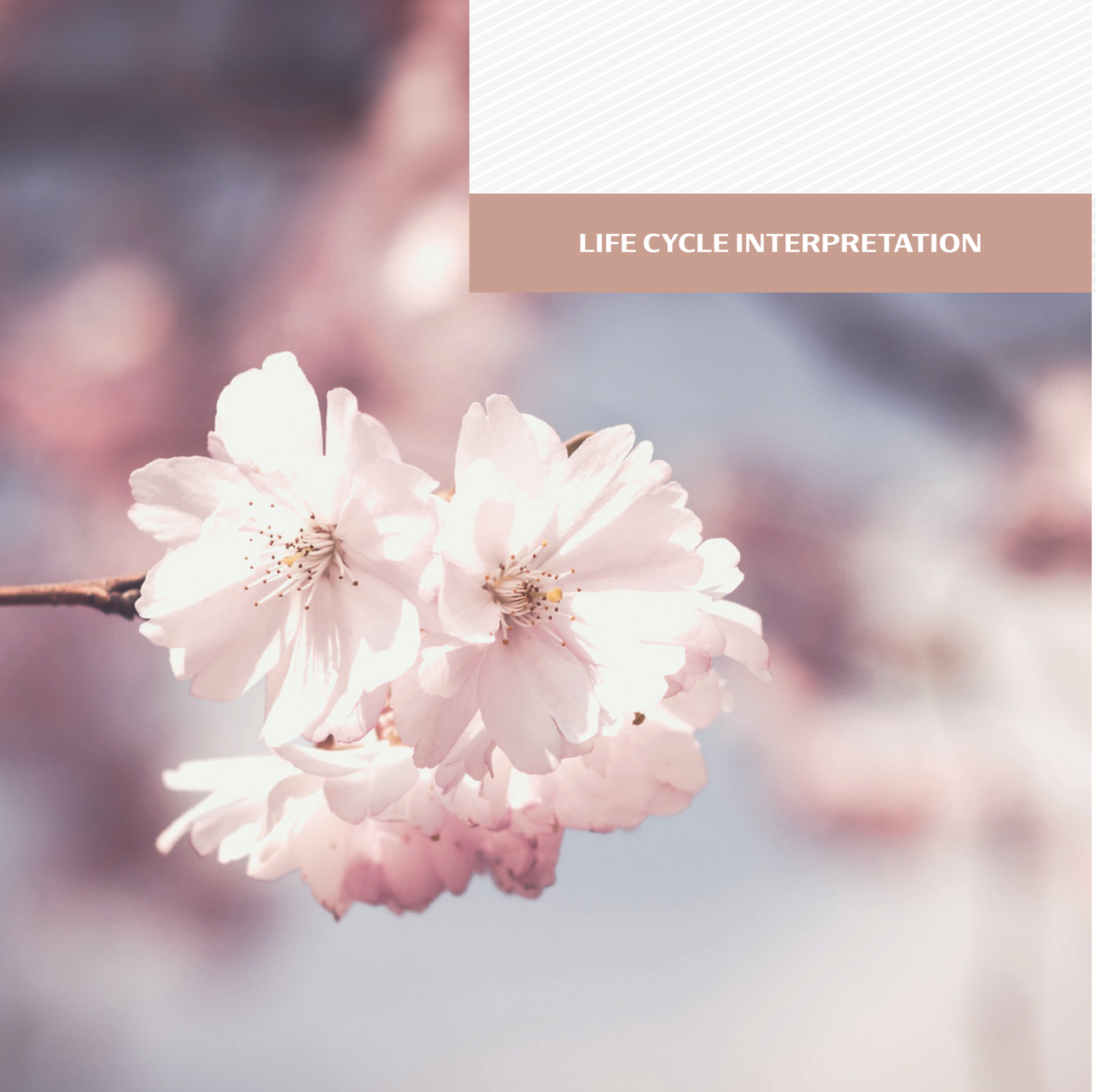
The environmental impacts resulting from the production of 1 m^2 of the **LM 60 x 120 and LM 120 x 120** porcelain lines are shown in the tables below, respectively.

Environmental impacts for the production of 1m^2 of the LM 60 X 120 porcelain line

Impact category	Value	Unit
Climate changes (kg CO_2)	9,96	Kg CO_2 eq
Fossil Depletion (MJ eq)	147,22	MJ eq
Depletion of the Ozone Layer (kg CFC-11 eq)	1,60E-06	kg CFC-11 eq
Photochemical Oxidation (kg etileno eq)	2,37E-03	Kg etileno eq
Soil and Water Acidification (kg SO_2)	9,18E-02	kg SO_2 eq
Eutrophication (kg PO_4^{3-} eq)	1,49E-02	Kg PO_4 eq
Depletion of Non-Fossil Resources (kg SB eq)	9,76E-05	kg Sb eq
Water Depletion (m^3)	5,71E-02	m^3

Environmental impacts for the production of 1m^2 of the LM 60 X 120 porcelain line

Categoría de impacto	Valor	Unidad
Climate changes (kg CO_2)	10,03	Kg CO_2 eq
Fossil Depletion (MJ eq)	148,17	MJ eq
Depletion of the Ozone Layer (kg CFC-11 eq)	1,62E-06	kg CFC-11 eq
Photochemical Oxidation (kg etileno eq)	2,50E-03	Kg etileno eq
Soil and Water Acidification (kg SO_2)	1,07E-01	kg SO_2 eq
Eutrophication (kg PO_4^{3-} eq)	1,68E-02	Kg PO_4 eq
Depletion of Non-Fossil Resources (kg SB eq)	8,89E-05	kg Sb eq
Water Depletion (m^3)	5,51E-02	m^3



LIFE CYCLE INTERPRETATION

Among the main contributors to the environmental impacts of products, the burning of natural gas and petroleum coke stands out.

The consumption of natural gas has a great influence on the impact categories Climate Change, Depletion of the Ozone Layer, Photochemical Oxidation and Fossil Depletion. In Climate Change, the main contributory emission is carbon dioxide. Although monoxide is more harmful, the conversion from natural gas to dioxide is much greater. In Depletion of the Ozone Layer, the highlights are the emissions of methane and ethane derivatives during the supply and transport of natural gas. The main contributory emission for Photochemical Oxidation is the sulfur dioxide released during the supply of natural gas. This gas is considered a clean source when compared to other non-renewable fuels, as it is the only fuel used in ovens and dryers. In addition, Roca is concerned with the emissions released into the atmosphere and the emissions resulting from the burning of natural gas are up to 10 times lower than those required by law.

Petroleum coke has a major contribution in the impact categories Climate Change, Soil and Water Acidification, Eutrophication and Photochemical Oxidation. In Soil and Water Acidification, the largest contributions are due to NOx and SO_2 emissions, respectively. The emission of nitrogen oxides is also the main influencing factor in Eutrophication. The main contributory emission for Photochemical Oxidation is sulfur dioxide resulting from the burning of coke in manufacturing.

Other inputs that contribute a lot to environmental impacts are mineral raw materials. This is due to the large volume consumed and, for some of them, the transported distance. These raw materials are the main contributors to the Depletion of Non-Fossil Resources, among which are feldspars and clays; depending on the metals contained in the extracted minerals. In Climate Change, the emission of carbon dioxide in the production of feldspars, as well as in the transport of various raw materials, stands out. Again, in Depletion of the Ozone Layer, the main contributors are the emissions of methane and ethane derivatives during the production of the raw materials, as well as in their transport. Mineral raw materials are the main inputs that make up porcelain tiles, in order to minimize the impacts resulting from the transport of these inputs to the factory, Roca gives priority to nearby deposits, with more than 60% of these ores coming from Paraná - the state in which the factory that was studied in this LCA is located.

CONCLUSIONS

The main function of porcelain tiles is to coat a certain surface area, in addition to several secondary functions - such as aesthetic and safety purposes due to the non-slip surface. In this study, the only function evaluated was the main one, therefore, environmental impacts in several impact categories were calculated for the production of 1 (one) square meter of porcelain.

The choice of impact categories was made in accordance with the EN 15804 standard, which delimits the impact categories that must be quantified in an Environmental Product Declaration for civil construction products, such as porcelain tiles.

Roca is the first porcelain tile producer in Brazil to carry out a LCA, a study that is already a trend in other places, such as Europe, and is a very important step to evolve in sustainability. In addition, carrying out the LCA contributes to the SDGs, such as objectives 12 (Ensure sustainable production and consumption patterns) and 13 (Take urgent measures to combat climate change and its impacts).

NOTES

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