CERCO$_2$: CO_2 EMISSION SIMULATION TOOL FOR THE CERAMIC INDUSTRY

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1. INTRODUCTION

The ceramic sector is a sector of intensive energy consumption (30-40 kWh/m2). 85-90% of the energy it consumes is thermal from natural gas and is mainly used in the drying, spray-dried powder, drying and firing stages (Monfort et al., 2010; Ros-Dosdá et al., 2016). Due to the associated greenhouse gas emissions, the sector is subject to European controls and policies, such as emissions trading (Directive 2003/87/EC, Directive 2009/29/EC), or the Commission's communication to the European Parliament COM (2011) 112 final. The latter establishes targets for the reduction of CO_2 emissions in the industrial, transport and electricity production sectors. Specifically, for all industrial sectors, it sets the goal of reducing emissions compared to 1990 by 40% by 2040 and by 83-87% by 2050 and urges industrial sectors to determine the roadmap to follow with sectoral strategies, thus enabling achievement of these demanding goals.

Certain publications have already noted the stringent requirements of these objectives and affirm that with the application of current technology, these values are very difficult to achieve, as simultaneous implementation of several highly innovative technological alternatives is required, together with changes in the general energy model and in the logistics of the transport of goods (Gabaldon-Estevan et al.2014, 2016; Monfort et al., 2013; CerameUnie, 2012).

2. OBJECTIVES AND METHODOLOGY

In this sense, the ITC-AICE has developed a tool called CerCO2 whose mission is to make available to ceramic tile manufacturers and sectoral associations a support tool for decision making in terms of technological investment aimed at meeting the objectives of the EU regarding climate change.

This tool is capable of estimating CO_2 emissions that a ceramic tile would have after incorporation of certain improvement measures. It enables prospecting so that ceramic tile manufacturers may evaluate, quickly and efficiently, different technological scenarios.

This tool applies the methodology of Life Cycle Analysis (LCA) for the calculation and prospecting of said technological scenarios and may be executed by non-expert personnel in the field.

3. RESULTS: CERCO2 TOOL

CerCO2, based on basic information entered by the user through a free access web questionnaire, calculates and compares two technological scenarios: 1) the initial scenario of the company or sector and 2) a hypothetical scenario of low GHG or low carbon emission.

The initial scenario is described by the user selecting the installed technology and indicating certain starting values such as the type of tile of interest, typical thickness, electrical energy consumption, thermal energy consumption, type of decoration applied, etc.

The hypocarbon scenario to be evaluated is also defined by the user, indicating in the tool the technologies to be evaluated. These involve improvements in the design of the product, improvements in the process and energy improvements.

Specifically, the possible technological alternatives are:

- **Improvements in the design of the product**: modifications in the thickness of the product, quantity of decoration and substitution of raw materials
- **Improvements in the process**: grinding of raw materials in wet or dry, increased energy efficiency of kilns and dryers by 10%, 20% or 30%
- **Energy improvements**: alternatives in thermal energy sources and electric power

With regard to energy improvements, and specifically to electric power sources, the tool has been designed with such flexibility that the user may either apply specific default scenarios for the years 2020 and 2050 or fully customize the technologies of electrical production, selecting the contribution of each. The energy sources anticipated are: natural gas, nuclear, solid fossil fuels, wind, hydroelectric, solar, fuel oil, biomass, waste, biogas, geothermal and other renewable sources.

The tool presents the results in a clear visual report. On the one hand, the technologies included in each scenario (initial and hypocarbon) are presented with

illustrations to facilitate comparison. The quantification of the GHG emissions associated with the life cycle of the ceramic tiles obtained under the technological scenarios defined by the user are shown in absolute values, expressed in kg of CO2 equivalent, in a bar graph. Likewise, CerCO2 also calculates other environmental indicators with results presented in relative values in a radial graph in order to compare both scenarios from a global perspective of the life cycle, so that there is evidence of possible transfer of charges between environmental impacts when they occur. These indicators also evaluate depletion potentials of abiotic resources of fossil and non-fossil origin, acidification, eutrophication, depletion of the ozone layer and formation of photochemical oxidants.

The CerCO2 tool, in addition to serving as a means to perform technological surveys, is also useful for conducting internal monitoring in companies or assisting with compliance with the new approach of ISO 14001: 2015 Environmental Management System, which expands the scope to include lifecycle. Due to the versatility and flexibility of the Life Cycle Analysis model that supports the CerCO2 tool, it may be adapted to the requirements and interests of particular companies and even, adaptable to other ceramic sectors such as structural ceramics or sanitary ware.

4. ACKNOWLEDGEMENTS

This tool has been developed within the framework of the PROMECE Environmental Challenges project, developed by the Instituto de TecnologíaCerámica - Ceramic Industries Research Association thanks to co-financing from the ERDF Operational Program of the Valencian Community, 2014-2020.

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