UNIVERSIDAD DE CHILE
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CENTRO DE INVESTIGACION MINERA Y METALURGICA
Dirección de I & D

"Life Cycle Assessment as a Process Comparison Tool in the Chilean Copper Production"

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Workshop on LCA and Metals. Montreal, April 2002.

LCA and the Mining Industry

The environmental sustainability of mining industry, nowadays very questioned, must be analyzed in a global context.

Life Cycle Assessment (LCA) is a well accepted tool to calculate, evaluate and improve the environmental performance of products and production systems. The resulting eco-indicators allow us to assess and compare quantitatively alternative production processes, on the base of their own characteristics and site-specific conditions.

Nevertheless, there is still little experience in the application of LCA to mining and metallurgical processes. This situation is specially relevant in some developing countries, like Chile, where major mining activities take place.

LCA in Developing Contries

In developing countries, LCA is a new concept and is not yet well understood by both industrial and public organizations. There is a poor understanding about its future implications on sustainability evaluation of mining industry; moreover in the context of an increasing globalized world.

Specific Characteristics of Mining Area in Chile

Chile's specific geography, climate, population's density and geological characteristics, should be taken into account when building a LCA.

The northern part of the country, where the main copper mining and metallurgical activities take place (Chuquicamata, RT, Potrerillos) is a very dry and desert area of low human population density (3 inhabitants/km^2).

Due to the geological and climatic characteristics of the area, arsenic is naturally present at high concentrations in soil, water and air and consequently, even in areas unaffected by mining activities, concentrations arsenic higher than those usually considered as toxic or dangerous are observed.

Research Project of University of Chile / CIMM

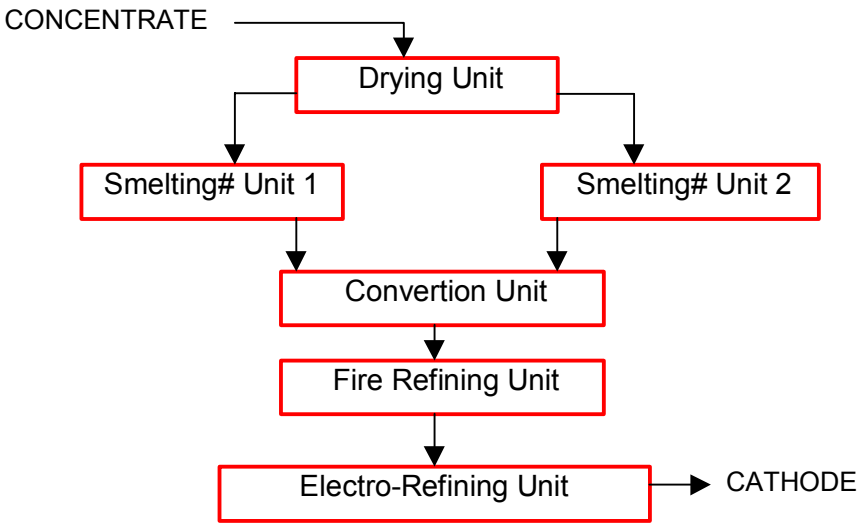
The present work represents one of the first attempts to apply the LCA methodology to mining and metallurgical processes in a developing country.

The objective was to study the application of LCA in mining and metallurgical processes in Chile, to define methodological rules for this type of processes and to identify the most important parameters in the evaluation of the global environmental impacts.

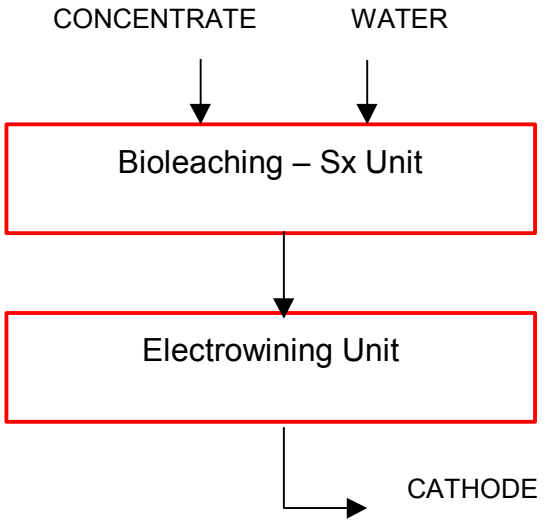
Main local and global environmental aspects and impacts were identified, evaluated and compared for two alternative processes of production of copper cathodes in the north of Chile.

The corresponding sequences of Smelting/Electro-refining for the traditional pyrometallurgical process and Bioleaching/Solvent Extraction/Electro-winning for the new Biocop® process, were evaluated using SIMAPRO 5® software.

Flowsheets of the Evaluated Processes



Process units for the simulation of Smelting/ER process



Process units for the simulation of Bioleaching process

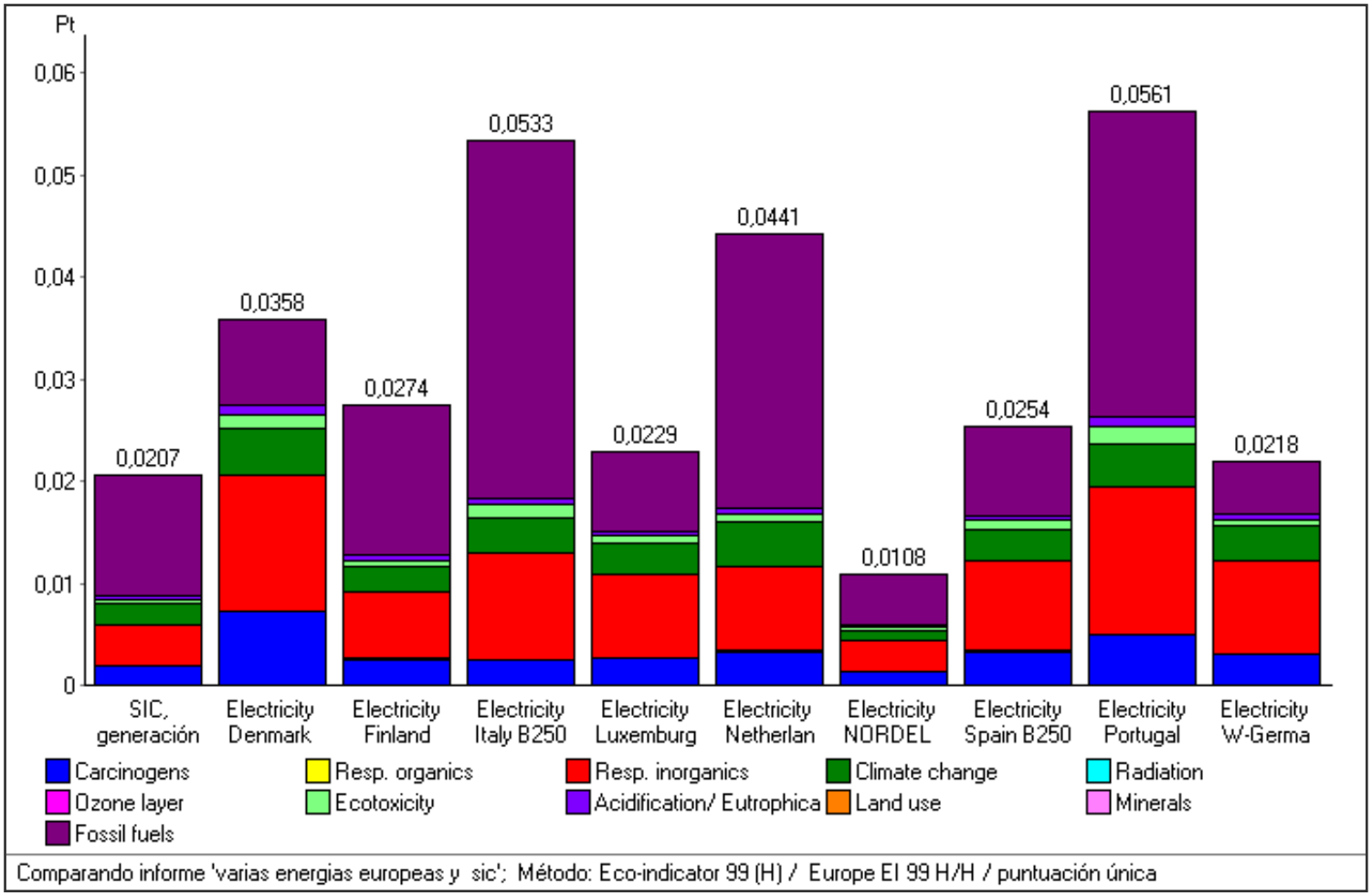
Results

This project was useful to introduce the LCA methodology in mining and metallurgical processes in Chile. It was a starting point.

One of the most interesting results was to demonstrate that the available databases of SIMAPRO, used to calculate the environmental impact and designed for European context, don't represent very well the Chilean context. This was evident for the generation of electricity, one of the most important input in mining and metallurgical processes.

In Chile, as well as in European countries included in SimaPro databases, electricity is distributed through an interconnected system (interconnected central system, SIC). Electricity is produced by the combination of different types of plants and technologies. Then, the structure of each particular system depends on the relative contribution of the technological elements to the global production and it could vary with time.

These results ratify the importance of the site-specific conditions in the evaluation of global environmental impacts.



Environmental impacts comparison between SIC and the energy production in different European countries. Environmental impacts of Chilean SIC are among the lowest.

Conclusions

LCA must take into account local characteristics and regional specificity. There are enormous differences between developing countries and those industrialized countries where this methodology has been designed and developed, particularly in terms of social, economic, geographical and industrial conditions.

This is very relevant for copper mining and metallurgical processes, because most of the primary copper production takes place in the developing countries.

The methodologies used in LCA, including the Ecoindicator 99, should be reviewed and modified according to the specific local conditions, in order to better evaluate global environmental impacts of processes located in Chile or in others developing countries.