



Zinc Sheet Environmental Profile

Life Cycle Assessment



Zinc Sheet Environmental Profile

Life Cycle Assessment

Introduction

Increasingly the zinc industry is being asked to provide information to downstream users of zinc and zinc-containing products on the environmental footprint of the materials it produces. Material specifiers and product engineers in key end-use markets such as building, construction and transportation are more and more interested in selecting materials that have the best environmental profile while meeting traditional cost, quality and technical performance criteria.

Understanding the environmental footprint of zinc sheet starts with documenting the resource requirements (energy and non-energy) and environmental releases associated with zinc mining and refining, but it also involves understanding the impacts and the benefits of the applications and end-of-life fate of zinc sheet. These benefits can arise in use (e.g. extending the life of roofs made from zinc sheet) and through end-of-life recycling (e.g. RHEINZINK reports that 95% of its products are recycled into new products).

The zinc sheet industry understands that to properly demonstrate the sustainability attributes of its products, data and information is needed that enables users of zinc sheet to evaluate its impacts and benefits across the life cycle (from raw material extraction to end-of-life recycling). This environmental profile was developed to provide information and life cycle data on zinc sheet, and it can be used to understand, and where appropriate, improve the life cycle impacts and benefits of zinc sheet products. The profile is based on a life cycle inventory dataset that can be found in the European Life Cycle Database at <http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm>.

It is important to note that data this profile is based on should be used as a building block in LCA studies where the entire life cycle of a zinc sheet product is considered. Without considering the whole life cycle, meaningful comparisons with other materials are not possible; hence this information on its own should not be used to support comparisons between products.

What is zinc sheet, and how is it used?

Zinc is a naturally occurring metal which is found in large quantities in the form of ore in the earth's crust. Zinc sheet is made by combining zinc with alloying elements (e.g. copper, titanium and aluminum), and it is formed into zinc sheet using a continuous casting/rolling process.

Zinc sheet is used extensively in the building industry for roofing, cladding, flashing and weathering applications. Architectural alloys generally contain copper and titanium and are produced and used in the form of sheet, strip, plate and rods, or cut and formed to desired shapes, such as gutters, cornices and pipes. Zinc sheet is also used in graphic art to make plates, blocks, battery cans and coinage.





What are the sustainability aspects of zinc sheet?

Zinc sheet has a number of attributes that make it desirable for a range of applications. It is durable; for example, roofs made from zinc sheet can last for centuries. It is 100% recyclable, and for major applications such as roofing and wall claddings, the recycling rate reaches 95%. This high recycling rate means when recycled zinc is added to the smelting process, it significantly reduces the impacts of the production of the zinc used in zinc sheet. Zinc is also aesthetically pleasing, which means it is less likely to be replaced before needed.

Zinc sheet has also been shown to provide shielding properties that can reduce electromagnetic radiation exposure.



How is zinc sheet produced?

Zinc sheet is primarily made of zinc, and details on the production of primary zinc are shown in the Zinc Environmental Profile available at www.zincforlife.org.

Today zinc sheet is typically produced by continuous casting and rolling (Figure 1). The main steps are described below.

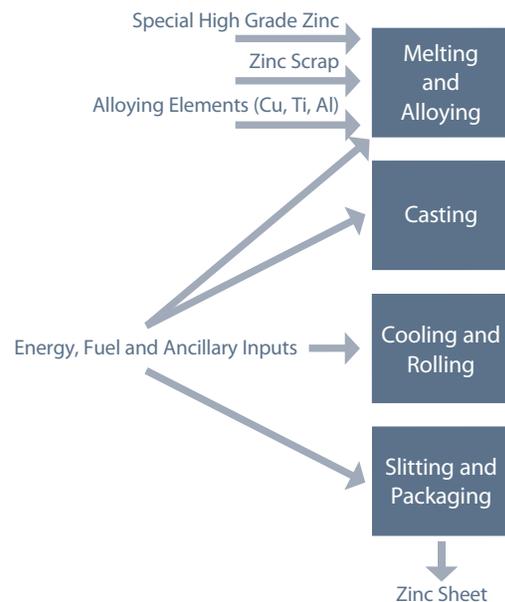


Figure 1:
Zinc Sheet
Production



Alloying

Zinc sheet production consists of melting the pure metal deposited on the cathodes during the electrolysis process and adding a controlled amount of alloying elements (copper, titanium and aluminum) in a series of induction furnaces to produce a liquid alloy.

Casting

The liquid metal is transferred to a casting machine where it is solidified into a slab, about twelve millimeters thick and approximately one meter wide. The controlled cooling process within the machine produces a fine, homogeneous grain structure.

Rolling

Three to five rolling operations are typically performed to reduce the slab to the desired thickness. Throughout this process, temperature, rolling speed and reduction rate are closely monitored and adjusted to obtain the requisite mechanical and dimensional characteristics.

Slitting and Packaging

The final stage involves slitting the rolled zinc into sheets or coils of the requisite weight, width and thickness on specialized finishing lines.

There are four components to a typical LCA study:

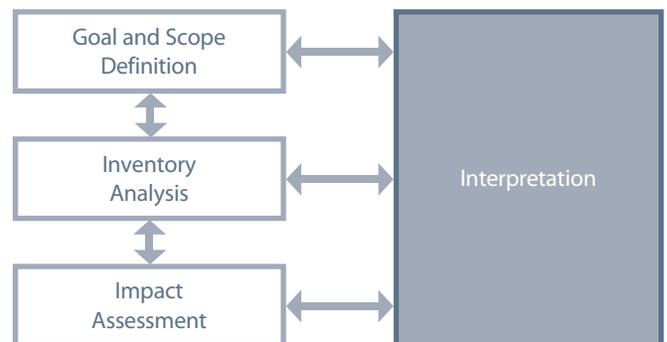
Goal and Scope – where the reference units, scope and boundaries, audience and uses of the study are confirmed;

Life Cycle Inventory – where the physical system is modeled and data is collected on all relevant inputs and outputs to the system;

Life Cycle Impact Assessment – where potential impacts associated with the system being studied are assessed; and

Interpretation – where the results are interpreted to help decision-makers understand where the greatest impacts are and to determine the implications of changes to the system (e.g. what if a different energy supply option or industrial process was used).

Life Cycle Assessment Framework



Life Cycle Assessment

LCA is a decision-making tool used to identify environmental burdens and evaluate the environmental consequences of a material, product, process or service over its life cycle from cradle-to-gate (typical for basic raw materials and commodities) or cradle-to-grave (typical for products and services). LCA has been standardized by the International Organization for Standardization (ISO) and forms the conceptual basis for a number of management approaches and standards that consider the life cycle impacts of product systems (e.g. emerging carbon footprint protocols).

How is LCA used?

Typically LCA is used to evaluate the environmental implications of materials and products (although services have also been studied using this tool). According to the ISO Standard on LCA, it can assist in:

- Identifying opportunities to improve the environmental aspects of product systems at various points in the life cycle;
- Decision-making in industry, governmental or non-governmental organizations (e.g. strategic planning, priority setting, product or process design or redesign);
- Selecting relevant indicators of environmental performance, including measurement techniques; and
- Marketing (e.g. an environmental claim, eco-labeling scheme or environmental product declaration).

Various software tools and databases are available that enable the user to track materials flows, energy flows and pollution from any industrial system. Typically the databases provide generic information on materials, energy supply options, transportation options and end-of-life management. A product manufacturer (often an engineer or product designer) can add in data and put together a comprehensive set of information on the entire product system. Then, scenario analysis can be conducted to determine the implications of changes to the systems (e.g. what if a different material, energy supply option or manufacturing process was used). In some cases, short screening level studies are done that can quickly help the user identify where potential “hot spots” in the product system are.

Zinc for Life

The International Zinc Association launched “Zinc for Life” to provide scientific information about the sustainability performance attributes of zinc. The two complementary components of Zinc for Life are:

- **Methodology and data generation:** focuses on providing up-to-date and scientifically sound life cycle data on zinc and zinc products, as well as examining and contributing to methodology aspects of life cycle assessment of relevance to zinc (e.g. treatment of recycling).
- **Outreach:** involves analyzing sector-specific environmental information needs/requirements and expectations in zinc consuming industries, as well as from other key stakeholders; and establishing appropriate outreach and communication strategies to address these needs.



A key component of the methodology and data generation component of the Zinc for Life program is the generation of robust and representative life cycle data on primary zinc as well as key first tier applications such as zinc sheet. This profile provides an overview and results of the zinc sheet life cycle study.

Zinc sheet LCI overview

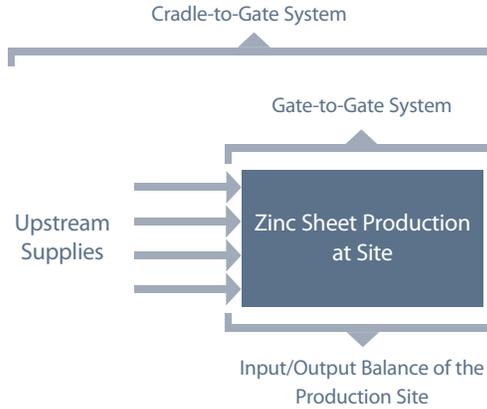
The specific goal of the life cycle inventory (LCI) study was to provide the zinc industry and downstream users of zinc, LCA practitioners and other stakeholders with up-to-date LCI data for rolled zinc sheet production.

The functional unit of the study was the production of 1m² of zinc sheet (base zinc content is the same as super high grade zinc) alloyed with copper, aluminum and titanium. The composition and sheet quality modeled conformed to the European Standard EN 988.

The scope of the study was to build a life cycle inventory of zinc sheet production up to the point at which it left the gate of the facility where it was produced.

In the associated life cycle data set, data were provided both for the gate-to-gate system and the cradle-to-gate system. The gate-to-gate system represented only the zinc sheet production and did not include the primary zinc production. The cradle-to-gate system represented the rolled zinc sheet from mining of primary zinc to the factory gate.

Figure 2: Schematic illustration of the boundaries of the gate-to-gate and the cradle-to-gate systems of zinc sheet production



For zinc sheet production processes, IZA collected primary data from sites of its member companies using electronic questionnaires. Secondary data about background processes outside the operational control of IZA members (e.g. fuel and electricity, auxiliary materials, transportation) were obtained from the GaBi 4 life cycle database, literature and other industry expertise. The LCI dataset came from five sites collectively producing 255,000 tonnes per year of zinc sheet - representing more than 50% of global zinc sheet production in 2006.

Study results

Table 1 shows selected results for the production of zinc sheet on the basis of one 1m² zinc sheet/sheet thickness (0.7mm assumed) produced. These results are based on averaged data.

The analysis of the zinc sheet production process undertaken for the LCI study shows that the resulting environmental burden is

dominated by energy use during zinc sheet production at the sites. (Note: This statement refers only to the direct process inputs to produce the sheets.) This is also true for the LCI's of most other metals. The energy source/composition of the electricity grid mix can significantly influence the associated environmental burdens. To improve the related environmental burden, increased energy efficiencies should be looked for where possible. A reduction in the scrap rate at the different process steps, particularly during rolling and slitting, would also help to reduce the environmental effects by minimizing the gross amount of zinc alloy material needed to produce a kilogram of zinc sheet.

Readers are encouraged to access the LCI results this profile is based on to support studies analyzing the environmental burdens of zinc sheet applications.

It is important to understand that the data set presented here represents averaged information on the industrial process of zinc sheet application.

Selected LCI Parameters of Zinc Sheet	Inventory Results per m ²	Unit
Primary energy demand	266.5	MJ
Non-renewable energy resources	229.1	MJ
Renewable energy resources	37.6	MJ
Carbon dioxide	16.02	kg
Sulphur dioxide	0.05	kg
Selected LCIA Parameters Based on Impact Methodology CML 2001	Inventory Results per m ² of Zinc Sheet	Unit
Global Warming Potential (GWP 100 years)	16.47	kg CO ₂ Equiv.
Acidification Potential (AP)	0.12	kg SO ₂ -Equiv.
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	1.196E-02	kg Phosphate-Equiv.
Photochem. Ozone Creation Potential (POCP)	6.311E-03	kg Ethane-Equiv.
Ozone Layer Depletion Potential (ODP, steady state)	1.817E-06	kg R11-Equiv.

Table 1: Selected LCI parameters representing 1m² of zinc sheet production including the environmental burden of the consumed special high grade zinc





More detailed information is available on the Zinc for Life website at www.zincforlife.org. The site also provides general information on sustainability and zinc, a sustainability report, information on key issues related to the treatment of metals in life cycle studies (e.g. recycling), IZA's sustainability charter and guiding principles. The zinc sheet data is also available from the European Commissions in the European Life Cycle Database at <http://lca.jrc.ec.europa.eu/lcaifohub/datasetArea.vm>.

Image Credits

Front cover, from top to bottom: RHEINZINK; VM Zinc: The Victorian County Court, Melbourne, Australia - Daryl Jackson, Sinclair Knight-Merz, Lyons Pty Ltd; VM Zinc: Airport, Malaga, Spain - GOP Oficina de Proyectos S.A., Bruce S. Fairbanks. Page 2: VM Zinc: 3rd Street Lofts, San Francisco, USA - Stanley Saitowitz. Page 3, from top to bottom: RHEINZINK; VM Zinc: 65 East Goethe, Chicago, USA - Lucien Lagrange. Page 4: VM Zinc: Fire Station, Roanne, France - Keops, Rivolier Architectes, M. Garon. Page 5: RHEINZINK. Page 6: RHEINZINK. Back cover: VM Zinc: Multi-Purpose Hall, Cornailles-en-Parisis, France - Cauris, M. Barrot.