

2024

**LIFE CYCLE ASSESSMENT OF ALUMINIUM SLUGS
AND DISCS BY ALUMAN S. A.**



Life cycle assessment (LCA) is a method used to evaluate the environmental impact of a product or service through its life cycle encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal. LCA includes emissions to air, water and land as well as the consumption of energy and other material resources. LCAs can be used for decision making towards optimization of a product or a process.

Scope

The scope of the study is to calculate the environmental performance of the production of aluminium slugs and discs associated with the upstream and core processes (from cradle-to-gate). The LCA study has been performed in accordance with the requirements of ISO 14040:2006 and ISO 14044:2006.

Discs and slugs are treated as a single product category, as their manufacturing processes and material compositions are nearly identical. The primary differences lie in the surface treatment and the cutting-into-shape stages.

LCA Information

- Allocation

Allocation rules have been performed in accordance with the requirements of ISO 14044:2006. Wherever possible, allocation was avoided by dividing the unit process to be allocated into two or more sub-processes and collecting the input and output data related to these sub-processes. Where allocation cannot be avoided, the inputs and outputs of the system were partitioned between its different products or functions in a way that reflects the underlying physical or economic relationships between them. If a physical relationship between the inventory data and the delivery of co-products cannot be established, the inventory data should be allocated between the co-products in a way that reflects other relationships between them.

- Time representativeness

Data for calendar year 2024 were used

- Cut-off criteria

The cut-off criteria adopted is as stated in ISO 14044:2006. The cut-off criteria for initial inclusion of inputs and outputs and the assumptions on which the cut-off criteria are established shall be clearly described. Several cut-off criteria are used in LCA practice to decide which inputs are to be included in the assessment, such as mass, energy and environmental significance. A cut-off rule of 1% is applied. In other words, the included inventory data (not including inventory data of processes that are explicitly outside the system boundary) shall together give rise to at least 99% of the results of any of the environmental impact categories. Also, 99% of the mass of the product content and 99% of the energy use of the product life cycle shall be accounted for. The cut-off rule was applied in different wastes generated through the manufacturing process.

- Assumptions

For this LCA, the main assumptions applied concern:

- ✓ Transportation
- ✓ Raw material Production

- System Boundary

The scope of the study is set to be cradle to gate, including upstream and core processes.

Impact categories and impact assessment methods

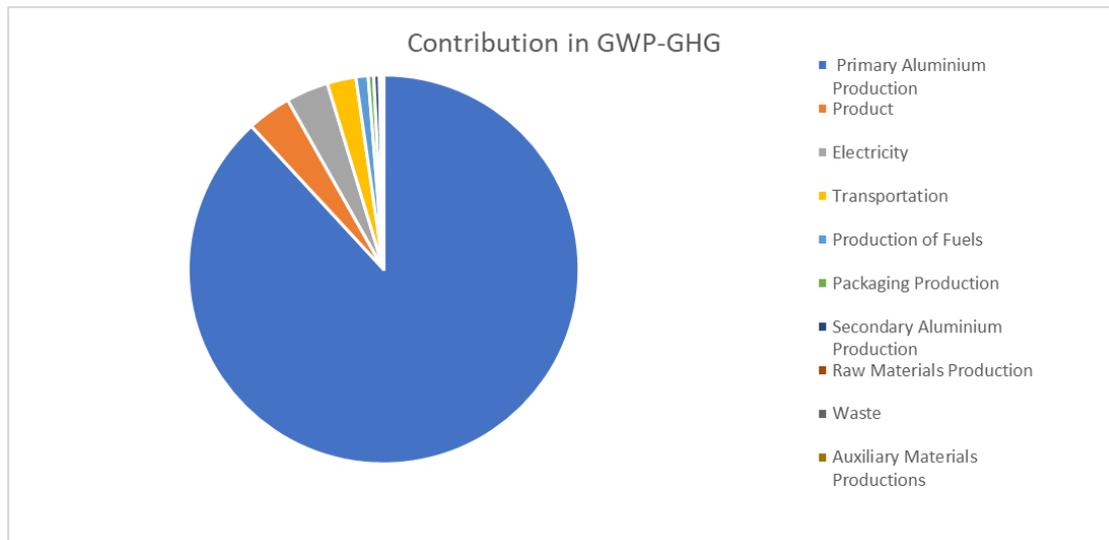
The following environmental performance indicators are chosen to be studied in order to evaluate the environmental impact of the production of aluminium slugs and discs.

The Core Environmental Impact Categories included in the study are:

- Global Warming Potential total (GWP-total)
- Global Warming Potential fossil (GWP-fossil)
- Global Warming Potential biogenic (GWP-biogenic)
- Global Warming Potential land use and land use change (GWP-luluc)
- Ozone Depletion Potential (ODP)
- Acidification Potential (AP)
- Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)
- Eutrophication Potential fraction of nutrients reaching marine end compartment (EP-marine)
- Eutrophication potential, Accumulated Exceedance (EP-terrestrial)
- Formation potential of tropospheric ozone photochemical oxidants (POCP)
- Abiotic depletion potential for non-fossil resources (ADPe)
- Abiotic depletion potential for fossil resources (ADPf)
- Water deprivation potential (WDP)

Sensitivity analysis

The figure below indicates that aluminium production is the primary contributor to the environmental impact associated with the manufacturing of slugs and discs. Consequently, a sensitivity analysis was performed on the recycled content of the aluminium input. In addition, a sensitivity analysis on electricity consumption was conducted to validate the assumption that the two products—slugs and discs—can be modeled as a single product, given that their main difference lies in the energy required for the cutting process.



As presented in above, primary aluminium production is the dominant contributor to the GWP-GHG indicator, accounting for 88.2% of total impacts. Product manufacturing (direct CO₂ emissions) and electricity generation follow with 3.7% and 3.5% accordingly. Transportation of raw materials represents 2.4%, and the production of energy sources (diesel, NG) account for 1.0%. For the rest of raw materials production (alloys, secondary aluminium) and packaging, the contribution results in 1.1% aggregately. Waste management, water use, and auxiliary materials production present contribution below 1.0%.

Results

The results of life cycle assessment for 1 kg of aluminium slugs and discs are presented.

ENVIRONMENTAL IMPACTS	Unit	Upstream	Core	Total
GWP-GHG	kg CO2 eq.	8.53E+00	3.75E-01	8.90E+00
GWP-total	kg CO2 eq	8.54E+00	3.64E-01	8.91E+00
GWP-fossil	kg CO2 eq	8.42E+00	3.73E-01	8.79E+00
GWP-biogenic	kg CO2 eq	-3.82E-02	-9.15E-03	-4.74E-02
GWP-luluc	kg CO2 eq	1.62E-01	2.76E-04	1.62E-01
ODP	kg CFC-11 eq	1.32E-07	1.43E-09	1.34E-07
AP	mol H+ eq	6.62E-02	3.66E-04	6.66E-02
EP-freshwater	kg P eq	2.83E-03	3.78E-05	2.87E-03
EP-marine	kg N eq	9.20E-03	8.90E-05	9.29E-03
EP-terrestrial	mol N eq	9.48E-02	8.35E-04	9.57E-02
POCP	kg NMVOC eq	3.43E-02	2.82E-04	3.46E-02
ADPe	kg Sb eq	2.18E-05	1.93E-06	2.37E-05
ADPf	MJ	9.06E+01	7.95E-01	9.14E+01
WDP	m3 eq	6.55E+00	2.78E-02	6.57E+00

RESOURCE USE	Unit	Upstream	Core	Total
PERE	MJ	5.75E+01	1.19E+00	5.87E+01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	5.75E+01	1.19E+00	5.87E+01
PENRE	MJ	9.06E+01	7.95E-01	9.14E+01
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	9.06E+01	7.95E-01	9.14E+01
SM	kg	-1.81E-01	-8.80E-03	-1.89E-01
RSF	MJ	1.37E-02	1.94E-03	1.56E-02
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00
FW	m3	1.27E-01	1.61E-03	1.28E-01

GWP-total	Global Warming Potential total
GWP-fossil	Global Warming Potential fossil
GWP-biogenic	Global Warming Potential biogenic
GWP-luluc	Global Warming Potential land use and land use change
ODP	Ozone Depletion Potential
AP	Acidification Potential
EP-freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-marine	Eutrophication Potential fraction of nutrients reaching marine end compartment
EP-terrestrial	Eutrophication potential, Accumulated Exceedance
POCP	Formation potential of tropospheric ozone photochemical oxidants
ADPe	Abiotic depletion potential for non-fossil resources
ADPf	Abiotic depletion potential for fossil resources
WDP	Water use
PERE	Use of renewable primary energy excluding resources used as raw materials

PERM	Use of renewable primary energy resources used as raw materials
PERT	Total use of renewable primary energy resources
PENRE	Use of non-renewable primary energy excluding resources used as raw materials
PENRM	Use of non-renewable primary energy resources used as raw materials
PENRT	Total use of non-renewable primary energy resources
SM	Use of secondary material
RSF	Use of renewable secondary fuels
NRSF	Use of non-renewable secondary fuels
FW	Use of net fresh water

The critical review was assigned to Mrs. Myrto Xynogala by the LCA commissioner, being a person independent of the Life Cycle Assessment (LCA) conduction and an internal expert with extended technical knowledge and experience on the company's Environmental Management System and Principles and being familiar with ISO 14040 and ISO 14044. The project under review is the LCA of the company's aluminium profiles and the reporting period was 01/01/2024-31/12/2024. The critical review was conducted concurrently with the LCA study, according to the requirements of ISO 14044:2006, ISO 14044:2006 and ISO/TS 14071, including an assessment of the LCI model and the analysis of individual data sets.