ENVIRONMENTAL METRICS REPORT

YEAR 2010 DATA

FINAL v1.1

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Critical Review

by

Prof. Dr. Walter Klöpffer

LCA CONSULT & REVIEW

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General

The report reviewed here is based on the IAI Aluminium Life Cycle data for the year 2010, critically reviewed by the author and Rolf Frischknecht [1] according to the rules by ISO 14040 and 14044 [2,3]. This report contains most data directly relevant in the global life cycle of aluminium, but not the generic data needed additionally for a full Life Cycle Inventory (LCI) study, not to speak about a Life Cycle Assessment (LCA) study. The purpose of the 2010 Al data, published 2013 [4], is to use them in LCA studies of aluminium containing products which necessarily have to be enriched by specific data (e.g. about production, use and recycling of the product studied) and/or generic data, depending on the product system to be studied.

The present study, called "Environmental Metrics Report", is based on the idea that the Aluminium data collected may contain more information than the data tables alone can provide. Therefore, a "cradle-to-gate" (partial) LCA was created, where the gate is defined as an ingot of primary aluminium ready for transformation into other forms (e.g. sheets) and applications. As basis for all calculations, 1 kg of the primary Al is taken as functional unit within the limits of the study, i.e. no comparison with other product systems should be performed.

The generic data missing in the data collection (e.g. electricity production, cathode carbon production, NaOH production etc., see "Unit Process Flow Chart" in the 2010 data report [4]) are completed in this study with data out of a well known generic data collection (PE GaBi version 6).

With these data added it is possible to calculate truncated LCAs from which important information can be deduced with regard to most steps in the inventory (LCI) and impact assessment (LCIA) of primary aluminium. Two scenarios were calculated in this study: A global scenario including China (GLO) and a "Rest of the World" (RoW) scenario without China. Since China is by far the largest and fastest growing aluminium producer and user it is interesting to know the influence of this country on the results which can be deduced from GLO and RoW scenarios.

Although foreground data about the aluminium production in China is scarce (the 2010 data therefore do not contain specific data for China), background information about the electricity supply is available. As well known, electricity is a key factor in Al-production and clean electricity generation (especially hydropower) is attempted in most countries. The Chinese

electricity generation is mostly based on coal, however, leading to a very high contribution of CO_2 emissions, as well as SO_2 and NO_x. Comparing the results of the two scenarios in this report shows clearly the high improvement potential, mostly with regard to electricity generation in China. In RoW there is still a (declining) fraction of the more polluting Soederberg electrodes in use, whereas in China the more recent and less polluting prebake electrodes are used. This improvement in Chinese technology cannot compensate the drawback of the electricity production, however.

The performance of this critical review during November/December 2014 was characterized by an intense cooperation with the IAI office, especially Sammy Jones during her last weeks in London and Chris Bayliss, assisted by Wu Linlin. Several versions of the final metrics report were provided by IAI in which numerous suggestions for improvements were included to my full satisfaction. In the following discussion, therefore, only the important requirements posed by ISO are dealt with.

Discussion

In critical reviews of LCA studies it is useful to structure the discussion according to the main requirements of the ISO standard 14044 [3]:

"The critical review process shall ensure that:

1. *the methods used to carry out the LCA are consistent with this International Standard;*
2. *the methods used to carry out the LCA are scientifically and technically valid;*
3. *the data used are appropriate and reasonable in relation to the goal of the study;*
4. *the interpretations reflect the limitations identified and the goal of the study; and*
5. *the study report is transparent and consistent."*

The **first 2 items** can be answered positively, if the comments made in the previous section are taken into account. The study is not a full LCA and should not be used for comparisons of aluminium containing products. Such a use is not possible for cradle-to-gate system boundaries. In this study, the gate is defined as the first aluminium "product", the Al-ingot leaving the raw aluminium production. The results are still meaningful for comparing the most important environmental impacts used for quantification:

- Acidification potential
- Depletion of fossil energy resources
- Eutrophication potential
- Global warming potential
- Ozone depletion potential
- Photo-oxidant creation potential, and
- Water scarcity footprint

These are the most frequently used life cycle impact categories plus the only recently standardized impact category "water scarcity" (ISO 14046 [5]). For a few more categories important for Aluminium production there are not yet suitable LCI models and data [1,4]. According to the report reviewed here, there is work coordinated by IAI going on so that future updates may provide LCI data and models for land use and toxicity. Hopefully, other major material producers work along similar lines so that data asymmetries will not occur in comparative LCA studies, such as those with regard to Benzo[a]pyrene (BaP) and other poly-cycled aromatic hydrocarbons (PAH) reported by the aluminium producers and users.

The **data** (3rd item) are a strong point of this study. The basis is formed by the 2010 data collection (RoW) published 2013 [1]. This has been supplemented with data reported yearly.

Furthermore, available data from the Chinese electricity production have been used to create approximate worldwide (GLO) LCI datasets for the first time. The third improvement in the data set was achieved by adding generic GaBi data for the processes not included in the previous data sets.

The supplemented data have been used to compare the Life Cycle Impacts for the RoW and GLO scenarios. Thus, the influence of the Chinese emissions on the total emissions was demonstrated, as already discussed in the section "General".

If during the next data collection (reference year 2015) more detailed original data from China will be available, a first truly global balance will be available in a few years.

Interpretation/limitations and goal of the study (4th item). Although a great progress toward the extension of the product system and the methodology has been achieved in this study, no exaggerated claims have been made in the goal & scope phase and in the interpretation phase. As mentioned already, the use of the results in comparative LCAs has clearly been excluded.

The **transparency and consistency of the study report** (item 5) is given, although it is a relatively short report. The knowledge of the 2010 data report [1] is presupposed. The new "Unit Process Flow Diagram and LCI Data" (Appendix A), if compared with the "Unit Process Flow Chart" of the 2013 report [1] shows clearly the enlargement of the system and the data base. The new diagram refers to the functional unit of this report (1 kg), whereas the older one refers to 1 metric ton (1000 kg). This should not be a problem for the careful reader. The diagrams are in colour. The processes responsible for the main contributions to the impact categories are clearly indicated in bar diagrams.

All in all, this report is still an adjunct to the 2010 data report report [1]. This may change in the future, if –as announced in section 4.4 "conclusions" – when yearly updates of some key data and GaBi data should indicate any progress made. This would make IAI the leading environmental data provider among the big material producers.

References

[1] Klöpffer, W.; Frischknecht, R. (2013): Global Life Cycle Assessment Inventory Data for the primary Aluminium Industry 2010 Data. Final Report August 2013: Critical Review Report (8 pp.)

[2] International Standard Organization TC 207/SC 5: Environmental management – Life cycle assessment – Principles and framework. ISO 14040:2006

[3] International Standard Organization TC 207/SC 5: Environmental management – Life cycle assessment – Requirements and guidelines. ISO 14044:2006

[4] International Aluminium Institute (IAI) (2013): Global Life Cycle Inventory Data for the Primary Aluminium Industry. 2010 Data. May 2013

[5] International Standard Organisation ISO/TC 207/SC5/Life Cycle Assessmment: Environmental Management- Water Footprint – Principles, requirements and guidelines. ISO 14046:2014, Geneva

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Prof. Dr. Walter Kloepffer
Editor-in-chief, Int. Journal of
Life Cycle Assessment
LCA Consult & Review
Am Dachsberg 56E
D-60435 Frankfurt am Main
Germany

Tel.: (+49 (0) 69) 54 80 19 35
Email: walter.kloepffer@t-online.de
Web: http://www.kloepffer.de