INTEGRATING THE RECYCLING POTENTIAL INTO THE ENVIRONMENTAL ASSESSMENT OF BUILDING MATERIALS

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Abstract
Building components are often assessed based on system boundaries from "cradle-to-gate". In this setting material recycling is commonly reflected by a supply mix blended with primary and secondary material. Being constant, this supply mix makes no difference between differing recycling potentials of individual construction parts. In a study, a Swiss eco-label was analysed and extended by a value corrected substitution, including recycling in the valuations scope. Only parts from aluminium were considered. The recycling potential of each individual aluminium part was determined and the system boundaries were expanded for value corrected substitution of primary materials. The result is indicate an improved rating for components with a high recycling potential. The method proved to be able to include recycling options into the focus of the assessment, giving an incentive for closing material cycles in the building industry.

Aluminium production usually is modelled with generic supply mix and "cut-off"-approach. Individual recycling lies outside system boundary. The material is regarded as a blend consisting of (virgin) primary and (recycling) aluminium with a fixed ratio reflecting the average global or regional production. At the end of the life time the metal leaves the system without environmental burdens ("cut-off") as secondary material source for forthcoming generations (fig. 1). With this mental model, no difference is made between a part with eg. 90% recycling potential and a compound with no recycling potential at all.

Value corrected substitution models the end-of-life options explicitly, thus including individual recycling into focus of life cycle assessment. Primary material is substituted by the anticipated recycling of the part (fig. 2). Since the application range of recycling aluminium is limited to the respective part of primary aluminium, a value correction is applied as proposed in Werner (2005). In this way the degree and quality of recycling is included within the scope of the valuation. High recycling potential is regarded as saving primary resources.

RESULTS 1: The mass of aluminium element determines the degree of recovery. The results show the dominant role of the mass of an individual element. The bigger the element, the better the collection recovery and the recycling potential (fig. 4). Smaller elements are more easily lost during the recycling process and occur often in a mixed fraction with an additionally smaller total recovery.

Conclusions
- The market shows that the method is suitable to include the recycling potential of construction parts from aluminium into the scope of the valuation.
- Big construction parts which occur in large quantities and that are of high quality alloy have a high recycling potential.
- The value corrected substitution of virgin aluminium with the recycled metal leads to a reduction of the impacts assessed by the valuation by GE.
- The results indicate a markedly improved assessment for components with a high recycling potential. This gives an incentive for the design and use of components with good recycling abilities.

Recycling as Special Case of Allocation: "Cut-off" and "Value Corrected Substitution"

Aluminium part

Total Aluminium Recovery
For each individual aluminium element the potential total recovery was calculated based on its properties (fig. 3). Recovery degrees were classified into categories with an estimated recovery rate. These estimates were taken from surveys with experts and literature (e.g. Boin & Houwelingen (2004); Rombach (2002); Werner (1999); Wolf S. (2000)). The total recovery indicates the amount of the material reused in a next product life cycle.

Value Correction
Reflects the possibly limited application range of a secondary material. A correction of 80% has been done, according to the ratio of the long-term averages in the quotation of virgin and recycling aluminium at the London Metal Exchange (Werner (2005)). No correction has been applied for elements like façade tiles which occur in big amounts and a high quality.

Recycling Potential
The recycling potential - as defined in this study - equals "total recovery rate \* value correction". It indicates the amount of substituted virgin material.

Integrating the Recycling Potential of Aluminium into a Swiss Eco-Label

fig. 1. "Cut-off"-approach

fig. 2. Value corrected substitution

fig. 3. Recycling potential derived from composite recovery rates

fig. 4. Recycling potential of aluminium elements (≥ degree of substituted virgin aluminium)

fig. 5. Reduction of GE with VCS-approach compared to the approach used in eco-devis.

fig. 6. Reduction of GE with VCS-approach compared to the approach used in eco-devis.

Figures:
- Recycling aluminium
- Primary aluminium
- Aluminium part
- Energy
- System boundary
- "cut-off" 10%
- Disposal of non-recyclable waste
- Recycling aluminum remelting generations

Table:

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Sources