Update of Life Cycle Assessment of ETICS End of Life Treatment of Expandable Polystyrene

Nicole Kambeck, BASF SE
Life Cycle Assessment (LCA) of ETICS End-of Life treatment

- LCA is a technique to assess the potential environmental impacts of products or processes throughout their entire life cycle – including production, use and end of life


- Scope of the study: provide a comparative LCA for the end of life treatment options
  - Energy recovery (status quo)
  - PSLoop

of 1 ton of EPS coming from External Thermal Insulation Composite System (ETICS) from dismantling of houses in Germany, Austria and Switzerland

→ Economic feasibility is so far not covered by this LCA!
Timeline: LCA incl. critical review panel 2016 - 2017

1. Kick-off and definition of system boundaries
2. Data collection
3. LCA calculation and presentation of first results
4. Critical review panel

Prof. Kind, Karlsruhe
1. Kick-off and definition of system boundaries
Masses of installed ETICS components to this day

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>adhesive</td>
<td>31.6%</td>
</tr>
<tr>
<td>EPS</td>
<td>10%</td>
</tr>
<tr>
<td>plaster</td>
<td>32.2%</td>
</tr>
<tr>
<td>fabrics</td>
<td>1.5%</td>
</tr>
<tr>
<td>finishing coat</td>
<td>24.2%</td>
</tr>
<tr>
<td>dowels</td>
<td>0.6%</td>
</tr>
</tbody>
</table>

Source:
Definition of system boundaries*

Thus both systems consider the same amount of electricity, heat, polystyrene and bromine production (same performance).

*These are preliminary results. LCA calculation is still in progress. A critical panel review is currently taking place in order to check the ISO 14040/14044 conformity. These results are based on environmental impact and are not including a total cost assessment.
2. Data collection
Incineration/ Landfill

Flow Chart: PS Loop Process 1/2*

Construction site: Dismantling ETICS

Transportation

Treatment: Separation of EPS and remaining components

- e.g. metal
- e.g. plastics
- Unusable components like coat and impurities

Transportation

Compaction

Transportation

Shredding

Incineration/ Landfill

Transportation

CreaSol®

Solvent

Soft water, Cooling water

Nitrogen

Steam

Electricity

Transportation

Unusable components like coat

Transportation

Landfill

Transportation

Incineration

Transportation

Landfill

Transportation

Incineration

Transportation

Landfill

Transportation

Waste water treatment

Heat production

Electricity production

BRU

System Expansion

Unusable components like coat and impurities

*These are preliminary results. LCA calculation is still in progress. A critical panel review is currently taking place in order to check the ISO 14040/14044 conformity. These results are based on environmental impact and are not including a total cost assessment.
Flow Chart: PS Loop Process 2/2*

*These are preliminary results. LCA calculation is still in progress. A critical panel review is currently taking place in order to check the ISO 14040/14044 conformity. These results are based on environmental impact and are not including a total cost assessment.
Assumptions 1/2*

- Energy demand for demolition and separation: 0.2 MJ/kg (TÜV Rheinland).
- Quality of recycled polystyrene (CreaSolv® Process) and bromine (Bromine Recovery Unit) are equal to virgin material.
- Composition of solvent for CreaSolv® process reflects a worst case assumption (EPC).
- Incineration of EPS and further ETICS components (rough estimation) is based on generic datasets.
- Location of Enf of Life process is Europe.
- Transport distance from deconstruction to separation plant: 100 km
- Transport distance from pre-treatment to CreaSolv®: 250 km
- Transport distance from CreaSolv® to incineration plant: 100 km

*These are preliminary results. LCA calculation is still in progress. A critical panel review is currently taking place in order to check the ISO 14040/14044 conformity. These results are based on environmental impact and are not including a total cost assessment.

**CreaSolv® is a registered trademark of CreaCycle GmbH
Assumptions 2/2*

Assumptions concerning end of life treatment:

<table>
<thead>
<tr>
<th>Process</th>
<th>Material</th>
<th>Treatment</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current process, demolition</td>
<td>Material mix A</td>
<td>87.9% incineration of inert matter 12.1% incineration of polystyrene</td>
<td>FH Münster</td>
</tr>
<tr>
<td>PS Loop</td>
<td>Material mix B (87.4%)</td>
<td>100% incineration of inert matter</td>
<td>FH Münster</td>
</tr>
<tr>
<td></td>
<td>EPS (12%)</td>
<td>100% recycling (CreaSolv® process)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Plastics (0.1%)</td>
<td>100% incineration</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Metals (0.5%)</td>
<td>90% recycling/10% landfill</td>
<td>-</td>
</tr>
</tbody>
</table>

*These are preliminary results. LCA calculation is still in progress. A critical panel review is currently taking place in order to check the ISO 14040/14044 conformity. These results are based on environmental impact and are not including a total cost assessment.
3. LCA calculation and presentation of first results
Climate Change – Overall*

Climate change [kg CO₂-eq/FU] CO₂ equivalents

* These are preliminary results. LCA calculation is still in progress. A critical panel review is currently taking place in order to check the ISO 14040/14044 conformity. These results are based on environmental impact and are not including a total cost assessment.

*Current status quo: Material mix A 87.9% incineration of inert matter, 12.1% incineration of polystyrene

PS Loop: Material mix B 87.4% incineration of inert matter, Plastics 0.1% incineration, Metals 90% recycling/10% landfill
In following impact categories PolyStyrene Loop has a **lower overall environmental impact** compared to the current status quo (energy recovery):

- Climate change
- Eutrophication, freshwater
- Summer smog
- Resource depletion
- Human- and eco-toxicity

For the impact categories “Acidification” and “Eutrophication, marine” PolyStyreneLoop perform slightly better than energy recovery.

System expansion (especially production of polystyrene) influences the results. The pre-treatment has only a small impact on the overall results.

The overall impacts of transportation steps are not relevant for both alternatives. A slightly higher impact for PS Loop occurs caused by a lower utilization rate.

Higher share of EPS (e.g. flat roof applications) leads to no significant changes in this impact category “Climate Change”.

*These are preliminary results. LCA calculation is still in progress. A critical panel review is currently taking place in order to check the ISO 14040/14044 conformity. These results are based on environmental impact and are not including a total cost assessment.*
4. Critical review panel
Task of the Critical review panel

- Review of the LCA with regard to ISO 14040 and 14044 conformance
- Compilation of comments from the reviewers (face-to-face meeting)
- Revision/ adaption of the LCA calculations accordingly
- Preparation of final review report and review statements
Feedback from the reviewers

- The form of the study is appropriate and conform with ISO standards, however, study has been calculated as **best case**

- Lack of data quality → data only an estimate for a plant to be built

- How to deal with losses of product and solvent?
  - e.g. yields of CreaSolv® and BRU, solvent loss during HBCD extraction
  - e.g. recovery of solvent
  - e.g. residual moisture content of extracted solid (SDS?)
  - e.g. input specification for CreaSolv®
  - e.g. quality of PS and Br

- Additional calculations and analysis were proposed by the review team
  - Geographical scope/ transport scenarios
    - Distance of 100 km feasible?
  - Scope of the study
    - e.g. who is the target group?
    - e.g. Basis for decision-making?
  - Technology
    - e.g. energy recovery → what is meant by this? state of the art?
    - PolyStyreneLoop → data based on simulations coming from trials on laboratory scale

→ **Outcome: second calculation is needed**! As consumption data are based on simulations small deviations can be expected during operation of the pilot plant
Simulation of material balance by providing flow diagrams (sensitivity analysis)

Determination of break-even points

Better explanation of system expansion

Further input data were provided by EPC, Sunpor and ICL
- Chart of detailed mass flows
- Data from pilot plant (laboratory scale)
- Worst-case scenario (e.g. plant shut down)

Next review panel call: Friday, 10th November

→ Expected finalization of the review: December 2017

Source: EPC, additional information for LCA 08-23-2017