

**Environmental profile of
1K POLYURETHANE FOAM
packed in pressurised cans**

LCA for the PDR and associated producers

Summary

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SUMMARY

The need for an LCA

PDR (Produkte durch Recycling) recycles used polyurethane (PU) foam cans. Producers throughout Europe are associated to PDR. Millions of PU-foam cans are processed each year obtaining more than 90% recyclable materials. The recovered PU-mixture is sold to the chipboard producers as feedstock. PDR considers it its responsibility as good ownership of PU-products, to obtain a LCA (Life Cycle Assessment).

Goal

PDR wants to obtain *an ecoprofile of PU-foam*.

Important topics for this ecoprofile are:

- representatively for the German market;
- the influence of the recycling process at PDR;
- the influence of the insulation of PU-foam.

Scope

The full life cycle of PU-foam is regarded. It is presented in figure 1. We have distinguished the following life cycle phases:

- production of (raw) materials;
- production of PU-foam;
- transport to application site;
- application;
- maintenance;
- insulation during use;
- PDR-recycling system;
- final waste treatment.

For all these phases we have included the needed materials and processes. Therefore this study can be regarded as a 'full life cycle assessment'.

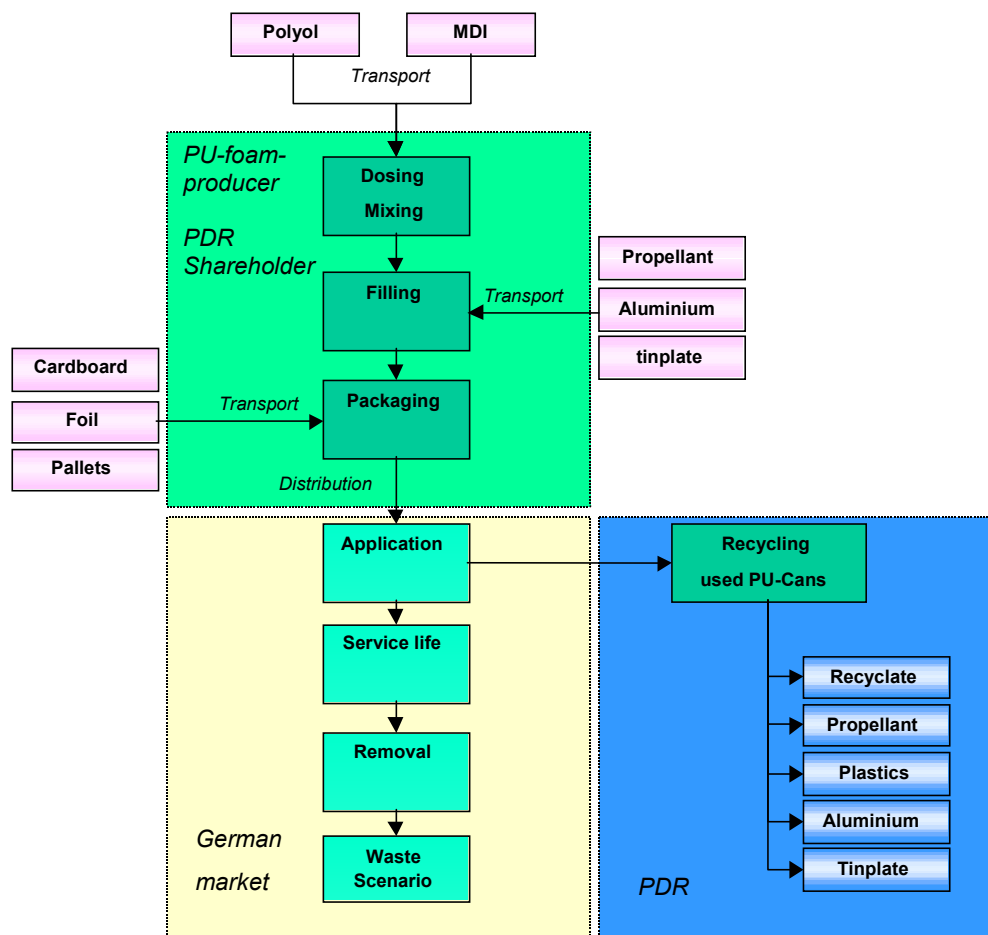
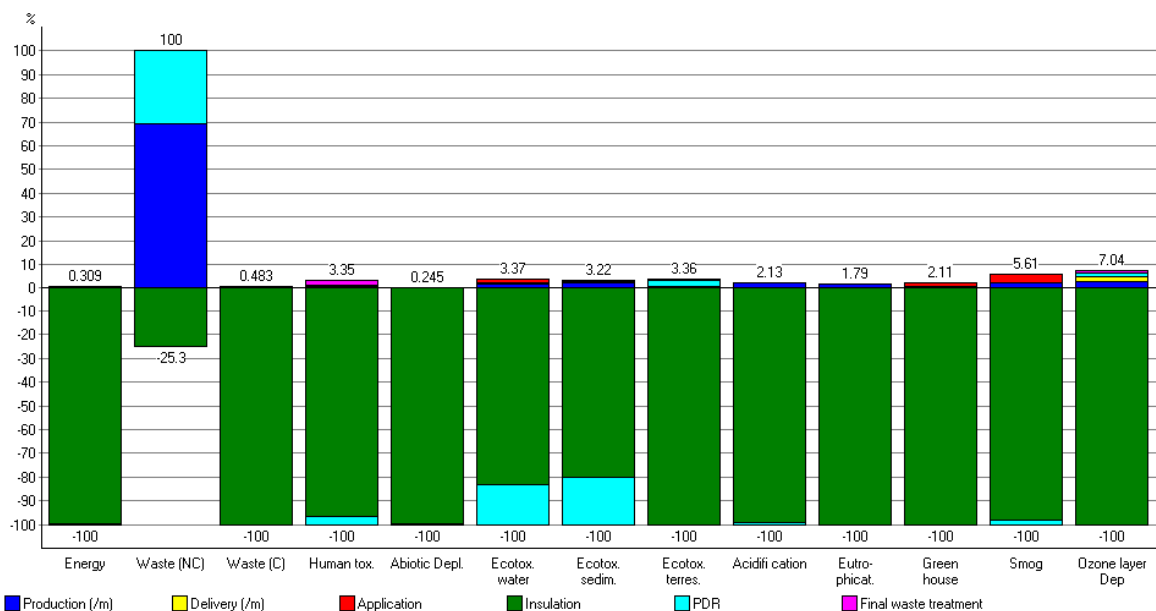


Figure 1 Life cycle of PU-foam products

Results

The environmental profile contains several environmental effects. The ISO requirements from the 14040-series are followed. We have used the most up-to-date and comprehensive impact assessment methodology available: the Dutch CML2 methodology. The overall result is presented in figure 2 and table 1.



Analyzing 1 p life cycle 'PU-foam (/m)'; Method: VLCA plus / CML2 / characterisation

Figure 2. Relative environmental profile of the life cycle of 1K PU-foam in pressurised cans (per m), during 25 years, including insulation and related savings, assumed to be gas 2000

Dark blue: Production Yellow: Delivery Red: Application
 Green: Insulation Light blue: PDR Recycling Purple: Final waste treatment

Table 1. Environmental profile of the life cycle of 1K PU-foam in pressurised cans (per m), during 25 years, insulation and related savings, assumed to be gas, 2000

Impact category	Unit	Total	Production	Delivery	Application	Insulation	PDR	Final waste treatment
Energy	MJ	-1.24E+03	3.64E+00	2.33E-01	0.00E+00	-1.24E+03	-2.95E+00	-3.43E-01
Waste (Non Chemical)	kg	8.49E-01	7.82E-01	4.57E-05	0.00E+00	-2.84E-01	3.51E-01	-1.64E-04
Waste (Chemical)	kg	-2.34E-01	1.09E-03	5.97E-05	0.00E+00	-2.35E-01	-4.22E-04	-7.80E-05
Human toxicity	kg 1,4DB	-1.72E+00	1.03E-02	2.43E-03	6.28E-03	-1.72E+00	-6.74E-02	4.12E-02
Abiotic depletion	kg Sb	-7.64E+00	1.67E-02	2.30E-03	0.00E+00	-7.64E+00	-2.10E-02	-1.05E-03
Ecotoxicity, aquatic	kg 1,4DB	-1.47E-01	2.16E-03	6.13E-04	2.40E-03	-1.26E-01	-2.58E-02	-2.27E-04
Ecotoxicity, sediment	kg 1,4DB	-2.05E-01	4.06E-03	1.05E-03	1.75E-03	-1.69E-01	-4.25E-02	-2.57E-04
Ecotoxicity, terrestrial	kg 1,4DB	-2.37E-02	6.04E-05	2.96E-05	9.28E-05	-2.45E-02	6.08E-04	3.94E-05
Acidification	kg SO2	-5.92E-02	1.17E-03	1.07E-04	0.00E+00	-5.99E-02	-5.98E-04	2.43E-05
Eutrophication	kg PO4--	-1.04E-02	1.49E-04	2.71E-05	0.00E+00	-1.06E-02	-9.94E-07	1.60E-05
Climate change	kg CO2	-7.26E+01	2.40E-01	1.75E-02	1.27E+00	-7.40E+01	-1.51E-01	5.13E-02
Photo-oxidant formation	kg ethene	-7.47E-03	1.54E-04	9.50E-06	2.82E-04	-7.77E-03	-1.48E-04	2.39E-06
Ozone depletion	kg CFC11	-9.91E-07	2.60E-08	2.39E-08	0.00E+00	-1.07E-06	1.77E-08	8.12E-09

Regarding the production of 1K PU-foam cans

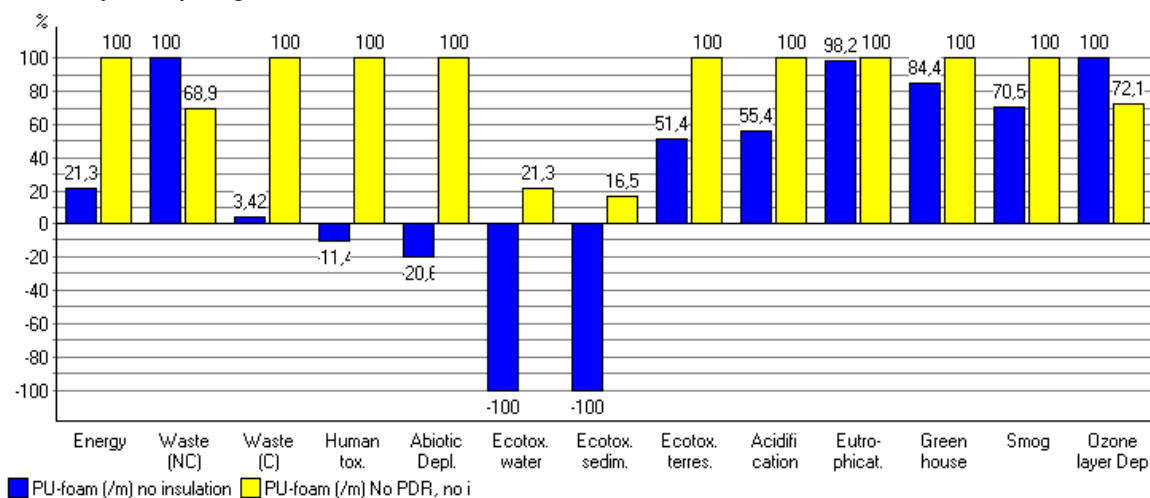
The environmental profile for the production is dominated by the use of PU-foam-precursors and the tinplate can. The use of propellant strongly influences smog and the greenhouse effect. This is important for both the production phase as well as for the application.

Regarding recycling at PDR

Recycling leads to a decrease of the environmental impact. The savings are more important than the investments related to transport and processing at PDR. Savings are directly related to the recovery of materials: tinplate, recycle, aluminium, propellant, cardboard and plastics.

Another way of looking into the benefits of recycling is a comparison of the life cycle including the PDR and excluding the PDR. Without the PDR all materials are not recycled but incinerated. In figure 3, both situations are compared. Blue expresses the life cycle with recycling at PDR and yellow represents the life cycle without recycling at PDR. The insulation properties are excluded in both results.

In both ways, recycling at PDR is beneficial for the environment.



Comparing 1 p life cycle 'PU-foam (/m) no insulation' with 1 p life cycle 'PU-foam (/m) No PDR, no insulation'; Method: VLCA plus / CML2 / characterization

Figure 3. Relative environmental profile of the production of 1K PU-foam in pressurised cans (per m), during 25 years, excluding insulation, for the life cycle including recycling at PDR (blue) en excluding recycling at PDR (yellow) 2000.

Regarding insulation

PU-foam applied as an insulator results directly in energy savings. This improves the ecoprofile. The result is an almost overall net saving for the environment.

The LCA is based on the following assumptions for the insulation properties:

- a temperature difference of 10°C;
- a joint with a length of 1m width of 20 mm and a depth of 100mm;
- use for 25 years;
- 80% efficiency of use of energy-content as warmth for heating.

The saving will decrease for smaller temperature differences, the joint itself or the lifespan. To assess the influence the energy score has been studied. Without insulation the total energy input is less than 1 MJ and with insulation approximately -1230 MJ. A decrease of the three mentioned factors by half still renders a net saving of 205 MJ.

The saving can be expressed in different ways. The 1230 MJ is equal to approximately 45 m³ of natural gas, 38 l of fuel oil and/or 90 kg of wood. In kg CO₂ this equals to approximately 90 kg CO₂ for gas, 110 kg CO₂ for fuel oil and 150 kg for wood.

Full report

A copy of the full report is available upon request. Please contact PDR Thurnau.