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European Life Cycle Assessment on Plasterboard: European Environmental Declaration – Explanatory Note

DATE: 16 JUNE 2010

Background

This environmental product declaration of plasterboard is based on the data provided to the International Life Cycle Platform and was performed by PE international. This assessment is in compliance with ISO 14040.

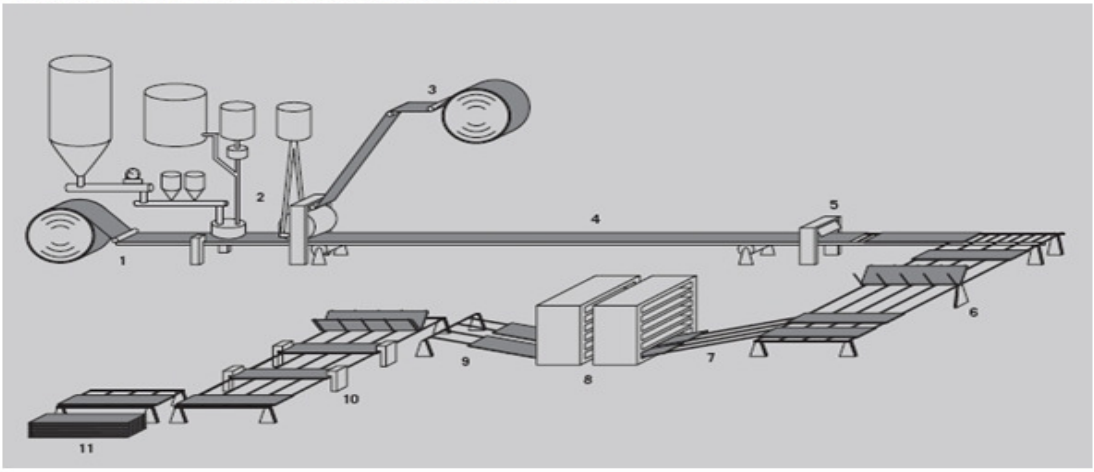
The Life cycle inventory data are available in the Life Cycle Platform data base. Please see http://lca.jrc.ec.europa.eu/lcainfohub/datasetList.vm?topCategory=Systems&subCategory=Construction

The values of the different impacts were calculated using the software GABI 4.

The functional unit is 1 m^2 of plasterboard

The production of plasterboard can be represented as follows:

Schema of plaster board production line



1 Feed card board (bottom)
2 Feed gypsum (β-hemihydrate & water)
3 Feed card board (top)
4 Setting of plaster
5 Cutting of plaster boards
6 Turn-over of plaster boards
7 Intake dryer
8 Dryer
9 Dryer discharge
10 Edge trimming
11 Bundling of boards

Source: Gips-Datenbuch, Bundesverband der Gipsindustrie e.V., http://www.gips.de/, Darmstadt, 2006

System boundaries

Cradle to gate inventory including the impacts related to raw material extraction, transport of raw materials and production. End-of-life recycling stage is not included.

Assumptions:

The raw materials for gypsum plasterboards are gypsum, cardboard and additives (starch, lignin sulphonate, fibres etc.).

Transportation processes for all raw materials are included in the model.

Gypsum

The gypsum used for plasterboard production is originated either from mined gypsum, gypsum from flue-gas desulphurization in coal power plants, so called FGD gypsum, other synthetic gypsum or recycled gypsum. Mined gypsum is mainly gained from open cast mining. To assess the impacts of the production of FGD gypsum from coal power plants the electricity consumption for the dehydration and purification of the gypsum slurry is considered, i.e. not the complete electricity consumption of the FGD as well as no lime consumption is considered for the FGD gypsum production.
The reason therefore is the fact that the desulphurization is done for legal or environmental reasons but not to produce gypsum. Energy consumption for the recycling process of gypsum products as well as waste flow treatment is considered.

The provenance of calcium dihydrate used for plasterboards is different in the included countries depending on the availability of natural gypsum stone, FGD gypsum and other synthetic gypsum. In Germany approximately 50% of both FGD gypsum and gypsum stone are produced and used in the gypsum industry. For the plasterboard production the same share was used. France does not produce any significant amounts of FGD gypsum due to the small use of coal power plants and therefore uses 100% natural gypsum stone. In the UK 38% of imported gypsum stone, 51.6% FGD gypsum (one third imported), 5.6% titanogypsum and 4.8% recycled gypsum are used for plasterboard production.

Calcination of gypsum

All kinds of gypsum (dihydrate) are dried and then calcined. In the calcination process calcium sulphate dihydrate is turned into beta-hemihydrate gypsum (0.5 molecules of chemically combined water). The calcination mainly needs thermal energy.

Cardboard

The used cardboard in the model is assumed to be made from recovered paper. Additives: Necessary data for additives have been approximated by available processes in GaBi 4 database.

Plasterboard production

Paper faced plasterboard consists of two sheets of cardboard between which a mixture of beta-hemihydrate gypsum and water is continually feed. By mixing hemihydrate gypsum and water a setting reaction starts resulting in a rehydration of the hemihydrate gypsum to dihydrate gypsum. After the setting reaction the plasterboard is cut to the wished size. The excess water which is necessary for technical reason and to avoid a too fast setting reaction is removed in a dryer oven.

Background system

Electricity, thermal energy

The electricity and thermal energy used is modelled according to the individual country-specific situation. The country-specific modelling is achieved on multiple levels.

- the individual power plants in service are modelled according to the current national grid. This includes net losses and imported electricity.
- the national emission and efficiency standards of the power plants are modelled.
- the country-specific fuel supply (share of resources used, by import and / or domestic supply) including the country-specific properties (e.g. element and energy contents) are accounted for.
- the import, transport, mining and exploration processes for the energy carrier supply chain are modelled according to the specific situation of each power-producing country.

Transports

All relevant and known transport processes used are included.

Energy carriers

Coal, crude oil, natural gas and uranium are modelled according to the specific import situation.

Refinery products

Diesel, gasoline, technical gases, fuel oils, basic oils and residues such as bitumen are modelled via a country-specific, refinery parameterized model.

Data set

The data set covers all relevant process steps / technologies over the supply chain of the represented cradle to gate inventory with a good overall data quality. The inventory is mainly based on industry data and is completed, where necessary, by secondary data. End-of-life recycling stage is not included in the cradle-to-gate inventory. The recycled content of the products used in this dataset is 35.9% taking into account recovered paper as well as post-consumer recycling of plasterboard and FGD gypsum (fluegas desulphurisation gypsum) both replacing natural gypsum stone. This indicator specifies the advantages of the use of recycled material on resource depletion and land use not integrated in the mandatory assessments under the ISO 14040 series.

Representativity of data

For the calculations the data used comes from three different countries, UK, France and Germany.

The process shows the average plasterboard production of Germany, France and Great Britain representative for the EU-27 region.

These three countries cover more than 53% of market volume in the EU-27 region.
The average is weighted according to the country specific production volumes (DE: 363 million m2 ==> 38 %, F: 312 million m2 ==> 32.7 %, GB: 284 million m2 ==> 29.3 %) (Roskill Information Services Ltd., The Economics of Gypsum & Anhydrite).

Life cycle inventory analysis

Calculation procedures.

The calculation was done using the software GaBi4.

LCIA data per m^2	
CO_2 [kg/m^2]	1.8
CO [kg/m^2]	0.00063
NOX [kg/m^2]	0.00278
SO2 [kg/m^2]	0.00289
N2O [kg/m^2]	0.00007
CH4 [kg/m^2]	0.00403
NMVOC Non methane volatile organic compound [kg/m^2]	0.00062
PM Particulate matter [kg/m^2]	0.00023
Primary energy [MJ/m^2]	34
Primary energy renewable. [MJ/m^2]	1.9
Water [kg/m^2]	11.77
LCA data per m^2	
ADP Abiotic depletion potential [kg Sb-eq./m^2]	0.01483
FAETP Freshwater Aquatic Ecotoxicity [kg DCB-eq./m^2]	0.00347
MAETP Marine Aquatic Ecotoxicity [kg DCB-eq./m^2]	55.5
EP Eutrophication potential [kg PO4-eq./m^2]	0.00080
HTP Human Toxicity Potential [kg DCB-eq./m^2]	0.06203
ODP Ozone depletion Potential [kg R11-eq./m^2]	1.6E-07
POCP Photochemical Ozone Creation Potential [kg ethene-eq./m^2]	0.00044
TETP Terrestrial Ecotoxicity [kg DCB-eq./m^2]	0.00335
GWP Global warming potential [kg CO2-eq./m^2]	2.14
AP Acidification Potential [kg SO2-eq./m^2]	0.0050

Table 1: LCIA and LCA results

Recommendation on the use of the information in this note and the European LCA database

Preference on generic European data
The database enables the possibility to give generic European data instead of national generic data or producer / site specific data. Eurogypsum has chosen this approach because plasterboard production is technically comparable throughout Europe and the relevance in evaluation schemes on single construction products will not need a diversified analysis taking the range of variations accepted by standards like the ISO 14040 series into account. Furthermore the market is ruled by European harmonization of the product characteristics (EN 520) and a common European market.

As a cautionary note it has to be pointed out that the application and acceptance of European data for construction products still is in an early stage.

Environmental Product Declaration
LCA data are part of the information needed for **Environmental Product Declarations** (EPD, ISO 14025). Depending on the programme operator the scope of parameters to be included might be different. LCA results can be taken from Table 1 as generic data representative for the European plasterboard production. Please be aware that the results cover only life-cycle-stages from "cradle-to-gate" i.e. the production process. Therefore this data can be use as an input to further EPD including other stages in the life cycle. Eurogypsum intends to do this exercise in a near future

Note: Following ISO 14025 this data only can be used to compare product to product if a peer review