

SELF-DECLARED ENVIRONMENTAL PRODUCT DECLARATION

IMPRESSA

FORBO FLOORING SYSTEMS

NATURAL PVC-FREE MODULAR RESILIENT FLOOR COVERING

Impressa

Colour ti9011 "Classic natural oak"



FLOORING SYSTEMS

Impressa has a natural base made from renewable raw materials, which is reinforced by a polyester carrier and has high dimensional stability and indentation resistance. A transparent surface finish ensures easy care against everyday wear and allows a timeless brilliant design effect. Forbo was the first flooring manufacturer to publish a complete Life Cycle Assessment (LCA) report verified by CML in 2000. In addition Forbo is now to publish Environmental Product Declarations (EPD) for all products including full LCA reports. This EPD is using all recognized flooring Product Category Rules and is including additional information to show the impacts on human health and eco-toxicity. By offering the complete story we hope that our stakeholders will be able to use this document as a tool that will translate the environmental performance of Impressa into the true value and benefits to all our customers and stakeholders alike. For more information visit; www.forbo-flooring.com

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This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. **Exclusions:** EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. **Accuracy of Results:** EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. **Comparability:** EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	N.A.
DECLARATION HOLDER	Forbo Flooring B.V. Industrieweg 12 P.O. Box 13 NL-1560 AA Krommenie
DECLARATION NUMBER	N.A.,
DECLARED PRODUCT	Impressa natural PVC-free modular resilient floor covering
REFERENCE PCR	EN 16810 : Resilient, Textile and Laminate floor coverings – Environmental product declarations – Product category rules
DATE OF ISSUE	October 30, 2020
PERIOD OF VALIDITY	5 years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

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Product Definition

Product Classification and description

Impressa is a resilient floorcovering that meet or exceeds all technical requirements in EN 16511 Semi-rigid multilayer modular floor covering (MMF) panels with wear resistant top layer combines sustainable ingredients with state-of-the-art printing techniques for a range of authentic natural looks that are naturally free from PVC, phthalates, synthetic rubber and styrene.

Impressa has a natural base made from renewable raw materials, which is reinforced by a polyester carrier and has high dimensional stability and indentation resistance. A transparent surface finish ensures easy care against everyday wear and allows a timeless matt design effect.

This declaration refers to Impressa of 2.5 mm nominal thickness covering a range of nature inspired decors. Rustic oak, striking pine, subtle beech or warm cherry and walnut looks take on the characteristic grain of their natural counterparts.

Product construction

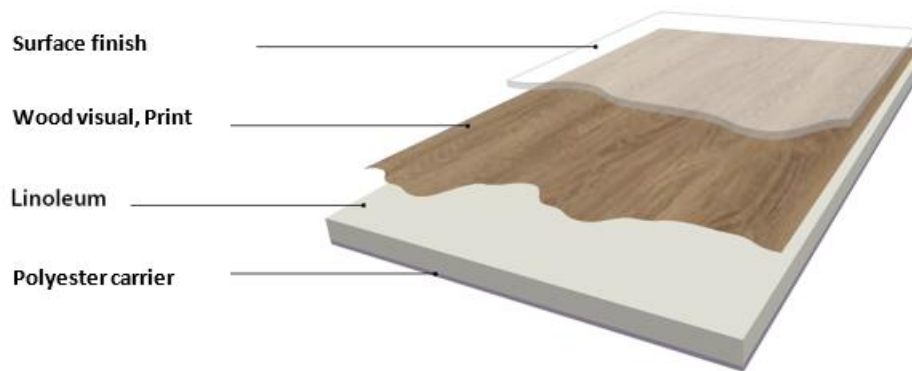


Figure 1: Illustration of Impressa product construction

Impressa is build up in 4 layers as illustrated in the figure 1:

1. **Surface finish:** After printing the natural visual a factory finish is applied to protect the print layer.
2. **Print layer:** This layer gives Impressa its design and color
3. **Natural Linoleum layer:** This layer is made from natural ingredients, of which almost half is from recycled origin, calendared on the backing.
4. **Carrier:** The backing is a woven polyester carrier.

The declaration refers to the declared/functional unit of 1m² installed flooring product.

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Range of application

Impressa is classified in accordance with EN 16511 to be installed in the following use areas defined in EN-ISO 10874:

Area of application	Domestic	Commercial
Impressa		

Product Standard

The products considered in this EPD have the following technical specifications:

- Meets or exceeds all technical requirements in EN 16511 Loose-laid panels - Semi-rigid multilayer modular floor covering (MMF) panels with wear resistant top layer



Impressa meets the requirements of EN 14041

EN 13501-1	Reaction to fire	C _{fl} - s1
EN 13893	Slip resistance	DS: ≥ 0.30
EN 1815	Body voltage	< 2 kV
EN 12524	Thermal conductivity	0.17 W/mK

Accreditation

- ISO 9001 Quality Management System
- ISO 14001 Environmental Management System
- ISO 45001 Occupational Health and Safety Management Systems
- SA 8000 Social Accountability standard

Delivery Status

Table 1: Specification of delivered product

Characteristics	Nominal Value	Unit
Product thickness	2.5	mm
Product Weight	3220	g/m ²
Tiles Length x Width	100 x 25	cm

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Material Content

Material Content of the Product

Table 2: Composition of Impressa

Component	Material	Availability	Amount [%]	Origin
Binder	Linseed oil	Bio based crop	18	USA/Canada/Europe
	Gum rosin	Bio based crop	2	Indonesia/China
	Tall oil	Bio based waste product from paper Industry	9	USA
Filler	Wood flour	Bio based waste product from wood processing	21	Germany
	Calcium carbonate	Abundant mineral	24.5	Germany
	Reused Marmoleum		16	Internal
Print	Print ink		0.95	Germany
Backing	Polyester	Fossil limited	3.8	Europe
Finish	Lacquer/sealer		4.75	Europe

Production of Main Materials

Linseed oil: Linseed oil is obtained by pressing the seeds of the flax plant. After filtering a clear golden yellow liquid remains.

Gum rosin: Rosin is obtained by wounding pine trees. The crude gum is collected and is separated into turpentine and rosin by distillation.

Tall oil: Tall oil is a post-industrial waste product coming from the paper industry and is consisting of vegetable oil and rosin.

Wood flour: Postindustrial bio based soft wood waste from the wood industry, which is milled into flour.

Calcium carbonate: An abundant mineral found in all parts of the world as the chief substance in rocks (i.e., marble and limestone). It can be ground to varying particle sizes and is widely used as filler.

Reused Linoleum: Waste material coming from the Linoleum production which is reused.

Polyester: Polyester fibers woven into a fabric which is used as a substrate.

Lacquer: The factory applied lacquer is a waterborne UV cured double layer factory coating – acrylate hybrid dispersion.

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Production of the Floor Covering

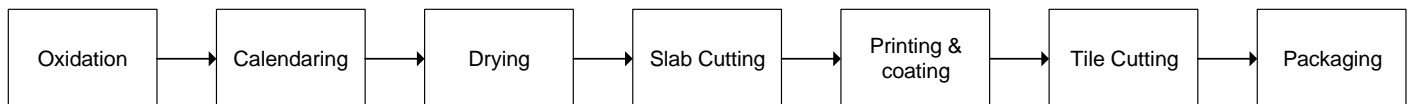


Figure 2: Illustration of the Production process

Impressa is produced in several stages starting with the oxidation of linseed oil mixed with tall oil and rosin. With the influence of oxygen from the atmosphere a tough sticky material is obtained called linoleum cement. The linoleum cement is stored in containers for a few days for further reaction and after this it is mixed with wood flour, calcium carbonate and reused waste. This mixture is calendared on a polyester substrate and stored in drying rooms, to cure till the required hardness is reached. After approximately 14 days the material is taken out from the drying room to the trimming department where the sheet is cut to length into slabs. The slabs are printed with a wood or other natural visual where after a finish is applied on top as protection of the printing layer. The printed slabs are cut into tiles and packaged into cardboard boxes.

Health, Safety and Environmental Aspects during Production

- ISO 14001 Environmental Management System
- ISO 45001 Occupational Health and Safety Management Systems
- SA 8000 Social Accountability standard

Production Waste

Rejected material and the cuttings of the trimming stage are being reused in the manufacturing process. Packaging materials are being collected separately and externally recycled.

Delivery and Installation of the Floor Covering

Delivery

A European distribution by truck is considered. On average every square meter of Impressa is transported as follows:

- Transport distance 40 t truck 350 km
- Transport distance 7.5t truck (Fine distribution) 150 km
- Capacity utilization trucks (including empty runs) 85 %
- Transport distance Ocean ship 0 km
- Capacity utilization Ocean ship 48%

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Installation

Because of the specific techniques used during the installation of Impressa 2% of the material is cut off as installation waste. For installation of Impressa on the floor an average scenario has been modeled (assuming 0.280 kg/m² of adhesive is required). Waste during the installation process may be recycled as floor covering through the manufacturers' facilities or thermally recycled in a waste incineration plant. Since the major part of Impressa is sold in Europe the European electricity grid mix is used in the calculations for the energy recovery during incineration.

Health, Safety and Environmental Aspects during Installation

Forbo flooring recommends using (low) zero emission hard setting adhesives for installing Impressa.

Waste

Waste during the installation process may be recycled as floor covering through the manufacturers' facilities or thermally recycled in a waste incineration plant. Since the major part of Impressa is sold in Europe the European electricity grid mix is used in the calculations for the energy recovery during incineration.

Packaging

Cardboard boxes, PE-film and wooden pallets can be collected separately and should be used in a local recycling process. In the calculation model 100% incineration is taken into account for which there is a credit received.

Use stage

The service lifetime of a floor covering for a certain application on a floor is too widespread to give one common number. For this EPD model the reference service lifetime (RSL) is set to one year. This means that all impacts for the use phase are based on the cleaning and maintenance model for one year. Depending on the area of use, the technical lifetime advised by the manufacturer and the estimated time on the floor by the customer, the service lifetime can be determined. The use phase impacts should be calculated with the foreseen service life to arrive at the total environmental impact.

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Cleaning and Maintenance

Level of use	Cleaning Process	Cleaning Frequency	Consumption of energy and resources
Commercial/Residential/Industrial	Vacuuming	Twice a week	Electricity
	Damp mopping	Once a week	Hot water Neutral detergent

For the calculations the following cleaning regime is considered:

- Dry cleaning with a 1.5 kW vacuum cleaner for 0.21 min/m², twice a week. This equates to 0.55 kWh/m²*year.
- Once a week wet cleaning with 0.062 l/m² water and 0.0008 kg/m² detergent. This result in the use of 3.224 l/m²*year water and 0.04 kg/m²*year detergent. The wet cleaning takes place without power machine usage. Waste water treatment of the arising waste water from cleaning is considered.

The cleaning regime that is recommended in practice will be highly dependent on the use of the premises where the floor covering is installed. In high traffic areas more frequent cleaning will be needed compared to areas where there is low traffic. The use of an entrance mat of at least four steps will reduce the cleaning frequency.

The cleaning regime used in the calculations is suitable for high traffic areas.

Prevention of Structural Damage

All newly laid floor covering should be covered and protected with a suitable non-staining protective covering if other building activities are still in progress. Use protective feet on chairs and tables to reduce scratching. Castor wheels should be suitable for resilient floor coverings.

Health Aspects during Usage

Impressa is complying with:

- o AgBB requirements
- o French act Grenelle: A+
- o Blue Angel

End of Life

The deconstruction of installed Impressa from the floor is done mechanically and the electrical energy needed for this is estimated to be 0.03 kWh/sqm. This amount of energy is taken into account for the calculations.

For the end of life stage no landfilling is taken into account, since the vast majority of the countries in which Impressa is sold are having a non landfill policy. Because of the high calorific value of Impressa the incineration is very profitable as a waste to energy conversion.

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Life Cycle Assessment

A full Life Cycle Assessment has been carried out according to ISO 14040 and ISO 14044.

The following Life Cycle Stages are assessed :

- A1-3 : Product Stage (Raw material acquisition, transportation to Manufacturing and Manufacturing)
- A4-5 : Construction process stage (Transport Gate to User, installation flooring)
- B2 : Use Stage (Maintenance of the floor)
- C1-4 : End of Life Stage (Deconstruction, transport, waste processing, Disposal)
- D : Benefits and loads beyond the system boundary (Reuse, recovery, recycling potential)

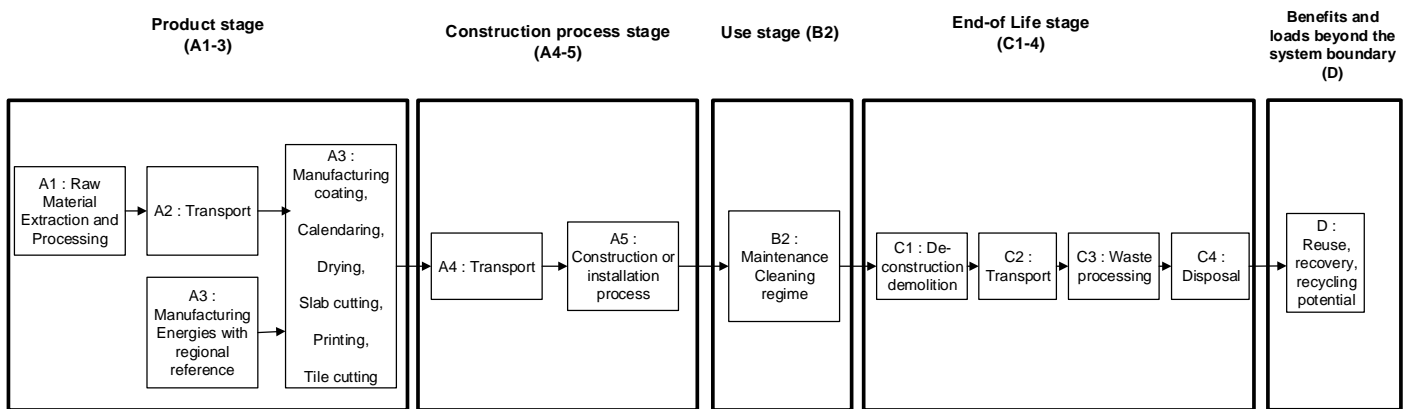


Figure 3: Flow chart of the Life Cycle Assessment

Comparisons of different floor coverings are only allowed, where EN 15804 consistent and/or preverified background data and EN 15804 consistent calculation methods and database versions are used and when the building context is taken into account, i.e. on the basis of the same use-classification (EN ISO 10874), same service life and comparable assumptions for the end of life.

Description of the Declared Functional Unit

The functional unit is one square meter of installed product and the use stage is considered for one year of service life.

Cut off Criteria

The cut-off criteria shall be 1% of renewable and non-renewable primary energy usage and 1% of the total mass of the unit process. The total neglected input flows per module shall be a maximum of 5% of energy usage and mass.

In practice, in this assessment, all data from the production data acquisition are considered, i.e. all raw materials used as per formulation, use of water, electricity and other fuels, the required packaging materials, and all direct production waste. Transport data on all considered inputs and output material are also considered.

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Allocations

In the present study some allocations have been made. Detailed explanations can be found in the chapters below.

Co-product allocation

No co-product allocation occurs in the product system.

Allocation of multi-input processes

The Production and End of Life stage include incineration plants. In these processes different products are treated together within a process. The allocation procedures followed in these cases are based on a physical classification of the mass flows or calorific values.

Credits from energy substitution are allocated to the production stage, because the gained energy from energy substitution is lower than the energy input in this stage. The same quality of energy is considered.

Allocation procedure of reuse, recycling and recovery

The installation waste and end of life waste is fed into incineration processes. Incineration processes include cogeneration processes which give thermal and power energy as outputs. It is assumed that this recovered energy offsets that produced by the European average grid mix and thermal energy generation from natural gas.

Description of the allocation processes in the LCA report

The description of allocation rules in of this LCA report meets the requirements of the PCR.

LCA Data

As a general rule, specific data derived from specific production processes or average data derived from specific production processes have been used as the first choice as a basis for calculating an EPD.

For life cycle modeling of the considered products, the GaBi 9 Software System for Life Cycle Engineering, developed by SPHERA has been used. All relevant LCA datasets are taken from the GaBi 9 software database. The datasets from the database GaBi are documented in the online documentation. To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

Data Quality

The requirements for data quality and LCA data correspond to the specifications of the PCR.

Foreground data are based on 1-year averaged data (year 2019). The reference ages of LCA datasets vary but are

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given in the table in the Appendix. The time period over which inputs to and outputs from the system is accounted for is 100 years from the year for which the data set is deemed representative. The technological LCA of the collected data reflects the physical reality of the declared product. The datasets are complete, conform to the system boundaries and the criteria for the exclusion of inputs and outputs and are geographical representative for the supply chain of Forbo flooring.

For life cycle modeling of the considered products the GaBi 9 Software System for Life Cycle Engineering, developed by SPHERA, is used. All relevant LCA datasets are taken from the GaBi 9 software database. The last revision of the used data sets took place within the last 10 years.

System Boundaries

Production Stage includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues during the product stage.

Transport and Installation Stage includes provision of all materials, products and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the construction stage. These information modules also include all impacts and aspects related to any losses during this construction stage (i.e. production, transport, and waste processing and disposal of the lost products and materials). For the transportation a worldwide distribution is considered.

Use Stage includes provision and transport of all materials, products and related energy and water use, as well as waste processing up to the end-of-waste state or disposal of final residues during this part of the use stage. These information modules also include all impacts and aspects related to the losses during this part of the use stage (i.e. production, transport, and waste processing and disposal of the lost products and materials).

End of Life Stage includes provision and all transports, provision of all materials, products and related energy and water use. It also includes any declared benefits and loads from net flows leaving the product system that have not been allocated as co-products and that have passed the end-of-waste state in the form of reuse, recovery and/or recycling potentials.

Power mix

The selection of LCA data for the electricity generation is in line with the PCR.

The products are manufactured in Assendelft, the Netherlands. The GaBi 9 Hydropower dataset has therefore been used (reference year 2020). The energy supplier is providing Forbo with a certificate every year.

CO₂-Certificates

No CO₂-certificates are considered in this study.

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Life Cycle Inventory Analysis

In table 3 the environmental impacts for one lifecycle are presented for Impressa. In table 4 the environmental impacts are presented for all the lifecycle stages.

Table 3: Results of the LCA – Environmental impacts one lifecycle (one year) – Impressa

Impact Category : CML 2001 – Jan. 2016	Impressa	Unit
Global Warming Potential (GWP 100 years)	7,47E+00	kg CO ₂ -Equiv.
Ozone Layer Depletion Potential (ODP. steady state)	1,69E-08	kg R11-Equiv.
Acidification Potential (AP)	2,54E-02	kg SO ₂ -Equiv.
Eutrophication Potential (EP)	9,97E-03	kg Phosphate-Equiv.
Photochem. Ozone Creation Potential (POCP)	9,53E-04	kg Ethene-Equiv.
Abiotic Depletion Potential Elements (ADPE)	3,14E-06	kg Sb-Equiv.
Abiotic Depletion Potential Fossil (ADPF)	8,21E+01	[MJ]

Table 4: Results of the LCA – Environmental impact for Impressa (one year)

Impact Category : CML 2001 – Jan. 2016		Manufacturing	Installation			Use (1yr)	End of Life			Credits
Parameter	Unit	A1-3	A4	A5	B2	C1	C2	C3	D	
GWP	[kg CO ₂ -Eq.]	9,54E-01	2,12E-01	7,99E-01	2,91E-01	2,48E-01	2,25E-02	5,79E+00	-8,43E-01	
ODP	[kg CFC11-Eq.]	1,45E-08	1,83E-17	3,56E-10	2,06E-09	6,95E-15	3,72E-18	1,06E-15	-1,17E-14	
AP	[kg SO ₂ -Eq.]	2,21E-02	4,08E-04	9,46E-04	7,48E-04	7,04E-04	5,47E-05	1,91E-03	-1,43E-03	
EP	[kg PO ₄ ³⁻ - Eq.]	9,22E-03	1,05E-04	1,50E-04	9,43E-05	6,59E-05	1,37E-05	4,75E-04	-1,55E-04	
POCP	[kg Ethen Eq.]	9,36E-04	-1,61E-04	8,81E-05	5,40E-05	4,47E-05	-1,86E-05	1,23E-04	-1,13E-04	
ADPE	[kg Sb Eq.]	2,96E-06	8,55E-09	8,47E-08	1,03E-07	7,89E-08	1,73E-09	5,69E-08	-1,53E-07	
ADPF	[MJ]	7,57E+01	1,50E+00	8,85E+00	3,53E+00	2,67E+00	3,05E-01	1,46E+00	-1,19E+01	

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources

The relative contribution of each process stage to each impact category for Impressa is shown in figure 4.

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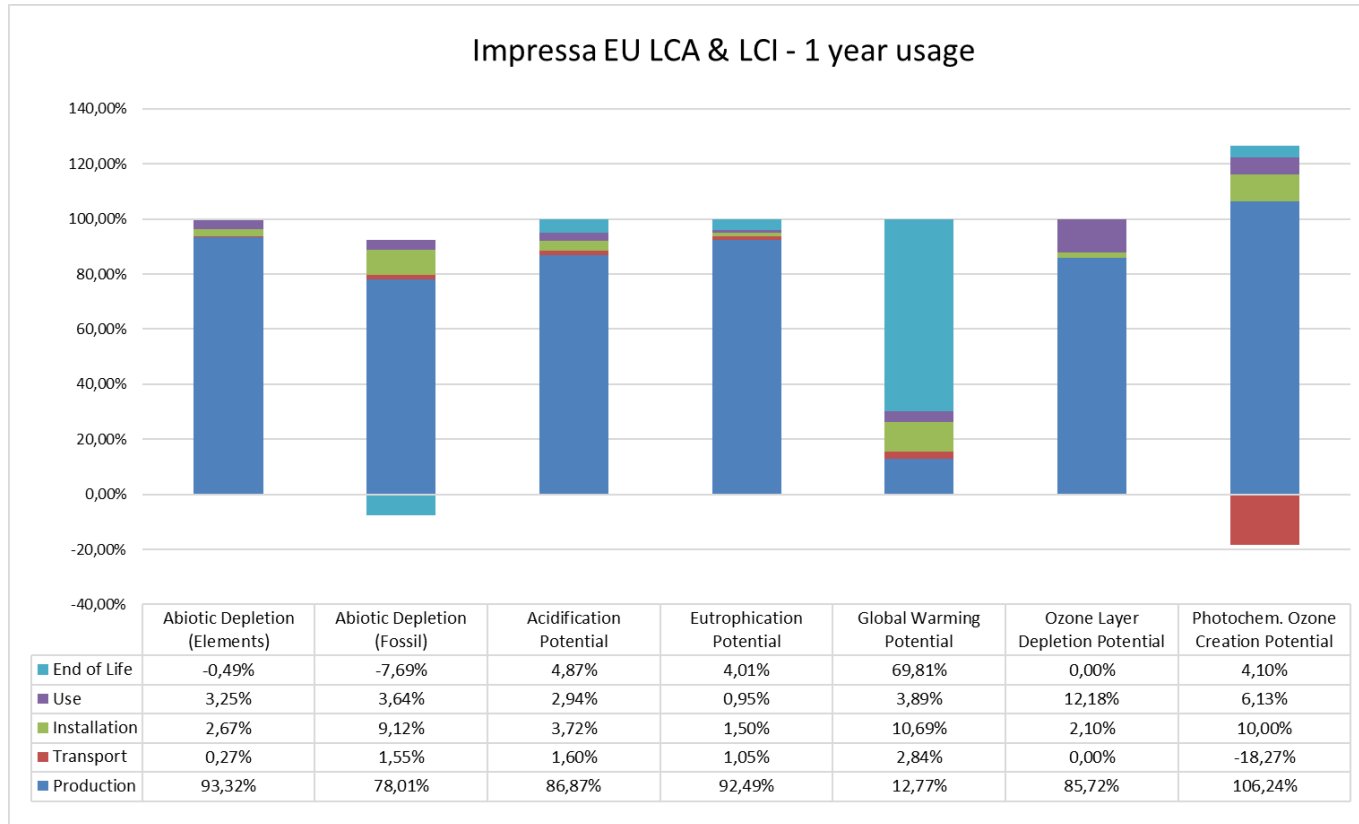
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Figure 4: relative contribution of each process stage to each impact category for Impressa for a one-year usage.



Interpretation

The interpretation of the results has been carried out considering the assumptions and limitations declared in the EPD, both methodology- and data-related for a one-year usage.

The LCA for GWP reflects the use of renewable raw materials for the production of Impressa (linseed oil and gum rosin). Carbon dioxide, a greenhouse gas, is locked in from the atmosphere in the course of the plant growth via photosynthesis and stored during the use stage. This carbon dioxide is not released until the end of life when it is incinerated with energy recovery – this process accounts for the greatest emission of greenhouse gases in the life cycle of the product.

For the production stage of Impressa the uptake of CO₂ is less than the emission of greenhouse gasses and therefore resulting in a number only just above carbon neutral.

In the other 6 impact categories (ODP, AP, EP, POCP, ADPE, ADPF) the production stage has the main contribution

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to the overall impact. For these categories the main contributor in the production stage is the raw material extraction and processing.

Forbo declares in the EPD a European distribution which has a limited effect on most of the impact categories. The negative impact for POCP for the transportation stage is remarkable, but it is assumed that NO and CO reduces the accumulated ozone to NO₂, CO₂ and O₂. This means, that high concentrations of ozone do not often occur near hydrocarbon emission sources. Higher ozone concentrations more commonly arise in areas of clean air, such as forests, where there is less NO and CO.

For GWP, POCP and ADPF the adhesive for the flooring installation has a significant impact of 9-11%. The LCA for the installation is based on an assumption of 280 g/m² adhesive.

The use stage is calculated for one year of service life time with a conservative scenario based on a cleaning regime suitable for high traffic areas. The electricity and detergent used to clean the floor are the main contributors for this life cycle stage.

Energy recovery from incineration and the respective energy substitution at the end of life results in a credit as reported in the End of Life stage for ADPE and ADPF.

Resource use

In table 5 the parameters describing resource use are presented for all the lifecycle stages for a one-year usage.

Table 5: Results of the LCA – Resource use for Impressa(one year)

Parameter	Unit	Manufacturing			Installation		Use (1yr)	End of Life			Credits
		A1-3	A4	A5	B2	C1		C2	C3	D	
PERE	[MJ]	2,01E+01	-	-	-	-	-	-	-	-	-
PERM	[MJ]	4,22E+01	-	-	-	-	-	-	-	-	-
PERT	[MJ]	6,23E+01	8,75E-02	3,55E-01	1,68E+00	1,81E+00	1,77E-02	2,44E-01	-3,04E+00	-	
PENRE	[MJ]	3,63E+01	-	-	-	-	-	-	-	-	-
PENRM	[MJ]	4,24E+01	-	-	-	-	-	-	-	-	-
PENRT	[MJ]	7,87E+01	1,51E+00	9,05E+00	5,34E+00	4,49E+00	3,06E-01	1,67E+00	-1,50E+01	-	
SM	[kg]	4,84E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	
RSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	
NRSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	
FW	[m ³]	3,86E-02	1,48E-04	2,34E-03	2,02E-03	2,13E-03	3,00E-05	1,32E-02	-3,58E-03	-	

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

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Waste categories and output flows

In table 6 other environmental information describing different waste categories and output flows are presented for all the lifecycle stages.

Table 6: Results of the LCA – Output flows and Waste categories for Impressa(one year)

Parameter	Unit	Manufacturing	Transport	Installation	Use (1yr)	End of Life/credits			
		A1-3	A4	A5	B2	C1	C2	C3	D
HWD	[kg]	4,15E-07	8,43E-08	3,73E-09	2,04E-09	2,14E-09	1,71E-08	1,20E-09	-6,16E-09
NHWD	[kg]	4,94E-01	1,23E-04	6,18E-03	6,21E-03	3,27E-03	2,49E-05	4,07E-02	-6,48E-03
RWD	[kg]	1,14E-03	2,05E-06	7,77E-05	6,93E-04	7,22E-04	4,15E-07	8,44E-05	-1,21E-03
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE Power	[MJ]	0,00E+00	0,00E+00	5,17E-01	0,00E+00	0,00E+00	0,00E+00	6,59E+00	0,00E+00
EE Thermal energy	[MJ]	0,00E+00	0,00E+00	9,22E-01	0,00E+00	0,00E+00	0,00E+00	1,17E+01	0,00E+00

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy per energy carrier

Additional Environmental Information

To be fully transparent Forbo Flooring does not only want to declare the environmental impacts required in the PCR, but also the impacts on human health and eco-toxicity

Toxicity

For this calculations the USEtox™ model is used as being the globally recommended preferred model for characterization modelling of human and eco-toxic impacts in LCIA by the United Nations Environment Programme SETAC Life Cycle Initiative.

According to the "ILCD Handbook: Recommendations for Life Cycle Impact Assessment in the European context" the recommended characterization models and associated characterization factors are classified according to their quality into three levels:

- Level I (recommended and satisfactory),
- level II (recommended but in need of some improvements)
- level III (recommended, but to be applied with caution).

A mixed classification sometimes is related to the application of the classified method to different types of substances. USEtox™ is classified as Level II / III, unlike for example the CML impact categories which are classified as Level I.

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Table 7: Results of the LCA – Environmental impacts one lifecycle (one year) – Impressa

Impact Category : USEtox	Impressa	Unit
Eco toxicity	8,18E-03	PAF m3.day
Human toxicity, cancer	5,52E-10	Cases
Human toxicity, non-canc.	7,72E-11	Cases

In the following table the impacts are subdivided into the lifecycle stages.

Table 8: Results of the LCA – Environmental impact for Impressa(one year)

Impact Category : USEtox	Unit	Production	Transport	Installation	Use (1yr)	End of Life
Eco toxicity	PAF m3.day	6,57E-03	3,45E-04	9,04E-04	4,21E-04	-6,71E-05
Human toxicity, cancer	cases	5,51E-10	4,05E-13	1,89E-11	3,01E-11	-4,82E-11
Human toxicity, non-canc.	cases	1,86E-11	1,68E-13	5,83E-11	7,26E-13	-5,76E-13

Interpretation

The interpretation of the results has been carried out considering the assumptions and limitations declared in the EPD, both methodology- and data-related for a one-year usage.

The impact on Eco-toxicity is mostly dominated by the production stage (79%) in which the raw materials are having the biggest impact. Other main contributor of the total life cycle is the adhesive used for installing the floor with 11%.

In the Human toxicity (cancer) the largest contribution is coming from the production stage where the thermal energy and hydropower used in the manufacturing is contributing 75% to the total impact. Other minor contributions come from the Installation (Adhesive) and Use stage (Electricity). For the End of Life stage energy recovery from incineration and the respective energy substitution at the end of life results in a credit.

For Human toxicity (non-canc.) by far the biggest impact of 74% is coming from the installation stage, where the contribution of the adhesive is predominating this life cycle stage. A smaller but significant contribution of 24% to the total impact is coming from the production stage where the main contributor is the raw material extraction and processing.

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GABI 9 2012D	GaBi 9: Documentation of GaBi 9: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2017. http://documentation.gabi-software.com/
UL ENVIRONMENT	UL Environment's Program Operator Rules
PE 2012 ILCD Handbook: General guide for Life Cycle Assessment - Detailed guidance	Description of Selected Impact Categories, Sphera, 2012 European Commission-Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook- Recommendations for Life Cycle Impact Assessment in the European context. First edition November 2011. EUR 24571 EN. Luxemburg. Publications Office of the European Union; 2011
STANDARDS AND LAWS	
DIN EN ISO 14044	Environmental management - Life cycle assessment - Requirements and guidelines (ISO 14044:2006); English version EN ISO 14044
ISO 14025 2006	EN ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures
ISO 14040 2006	Environmental management - Life cycle assessment - Principles and framework (ISO 14040); English version EN ISO 14040
CEN/TR 15941	Sustainability of construction works - Environmental product declarations - Methodology for selection and use of generic data; German version CEN/TR 15941
EN 16810	Resilient, textile and laminate floor coverings - Environmental product declarations - Product category rules
EN 16511	Loose-laid panels - Semi-rigid multilayer modular floor covering (MMF) panels with wear resistant top layer
CPR	REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC
EN-ISO 10874	Resilient, textile and laminate floor coverings – Classification

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Description of Selected Impact Categories

Abiotic Depletion Potential

The abiotic depletion potential covers all-natural resources such as metal containing ores, crude oil and mineral raw materials. Abiotic resources include all raw materials from non-living resources that are non-renewable. This impact category describes the reduction of the global amount of non-renewable raw materials. Non-renewable means a time frame of at least 500 years. This impact category covers an evaluation of the availability of natural elements in general, as well as the availability of fossil energy carriers.

ADP (elements) describes the quantity of non-energetic resources directly withdrawn from the geosphere. It reflects the scarcity of the materials in the geosphere and is expressed in Antimony equivalents. The characterization factors are published by the CML, Oers 2010.

Are fossil energy carriers included in the impact category, it is ADP (fossil). Fossil fuels are used similarly to the primary energy consumption; the unit is therefore also MJ. In contrast to the primary fossil energy ADP fossil does not contain uranium, because this does not count as a fossil fuel.

Primary energy consumption

Primary energy demand is often difficult to determine due to the various types of energy source. Primary energy demand is the quantity of energy directly withdrawn from the hydrosphere, atmosphere or geosphere or energy source without any anthropogenic change. For fossil fuels and uranium, this would be the amount of resource withdrawn expressed in its energy equivalent (i.e. the energy content of the raw material). For renewable resources, the energy-characterized amount of biomass consumed would be described. For hydropower, it would be based on the amount of energy that is gained from the change in the potential energy of water (i.e. from the height difference). As aggregated values, the following primary energies are designated:

The total "**Primary energy consumption non-renewable**", given in MJ, essentially characterizes the gain from the energy sources natural gas, crude oil, lignite, coal and uranium. Natural gas and crude oil will both be used for energy production and as material constituents e.g. in plastics. Coal will primarily be used for energy production. Uranium will only be used for electricity production in nuclear power stations.

The total "**Primary energy consumption renewable**", given in MJ, is generally accounted separately and comprises hydropower, wind power, solar energy and biomass. It is important that the end energy (e.g. 1 kWh of electricity) and the primary energy used are not miscalculated with each other; otherwise the efficiency for production or supply of the end energy will not be accounted for. The energy content of the manufactured products will be considered as feedstock energy content. It will be characterised by the net calorific value of the product. It represents the still usable energy content.

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Waste categories

There are various different qualities of waste. For example, waste can be classed according to German and European waste directives. The modelling principles have changed with the last GaBi4 database update in October 2006. Now all LCA data sets (electricity generation, raw material etc.) already contain the treatment of the waste with very low waste output at the end of the stage. So the amount of waste is predominantly caused by foreground processes during the production phase. This is important for the interpretation of waste amounts.

From a balancing point of view, it makes sense to divide waste into three categories. The categories overburden/tailings, industrial waste for municipal disposal and hazardous waste will be used.

Overburden / tailings in kg: This category consists of the layer which must be removed in order to access raw material extraction, ash and other raw material extraction conditional materials for disposal. Also included in this category are tailings such as inert rock, slag, red mud etc.

Industrial waste for municipal disposal in kg: This term contains the aggregated values of industrial waste for municipal waste according to 3. AbfVwV TA SiedIABf.

Hazardous waste in kg: This category includes materials that will be treated in a hazardous waste incinerator or hazardous waste landfill, such as painting sludges, galvanic sludges, filter dusts or other solid or liquid hazardous waste and radioactive waste from the operation of nuclear power plants and fuel rod production.

Global Warming Potential (GWP)

The mechanism of the greenhouse effect can be observed on a small scale, as the name suggests, in a greenhouse. These effects are also occurring on a global scale. The occurring short-wave radiation from the sun comes into contact with the earth's surface and is partly absorbed (leading to direct warming) and partly reflected as infrared radiation. The reflected part is absorbed by so-called greenhouse gases in the troposphere and is re-radiated in all directions, including back to earth. This results in a warming effect on the earth's surface.

In addition to the natural mechanism, the greenhouse effect is enhanced by human activities. Greenhouse gases that are considered to be caused, or increased, anthropogenically are, for example, carbon dioxide, methane and CFCs. *Figure A1* shows the main processes of the anthropogenic greenhouse effect. An analysis of the greenhouse effect should consider the possible long term global effects.

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The global warming potential is calculated in carbon dioxide equivalents (CO₂-Eq.). This means that the greenhouse potential of an emission is given in relation to CO₂. Since the residence time of the gases in the atmosphere is incorporated into the calculation, a time range for the assessment must also be specified. A period of 100 years is customary.

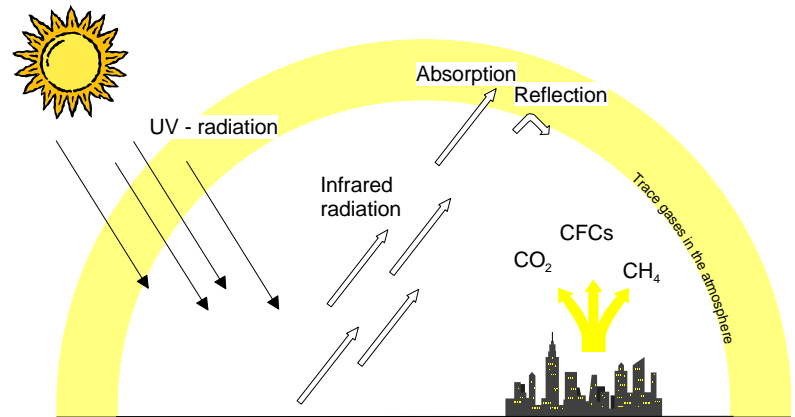


Figure A1: Greenhouse effect (KREISSIG 1999)

Acidification Potential (AP)

The acidification of soils and waters predominantly occurs through the transformation of air pollutants into acids. This leads to a decrease in the pH-value of rainwater and fog from 5.6 to 4 and below. Sulphur dioxide and nitrogen oxide and their respective acids (H₂SO₄ and HNO₃) produce relevant contributions. This damages ecosystems, whereby forest dieback is the most well-known impact.

Acidification has direct and indirect damaging effects (such as nutrients being elutriated from soils or an increased solubility of metals into soils). But even buildings and building materials can be damaged. Examples include metals and natural stones which are corroded or disintegrated at an increased rate.

When analysing acidification, it should be considered that although it is a global problem, the regional effects of acidification can vary. *Figure A2* displays the primary impact pathways of acidification.

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The acidification potential is given in sulphur dioxide equivalents (SO₂-Eq.). The acidification potential is described as the ability of certain substances to build and release H⁺ - ions. Certain emissions can also be considered to have an acidification potential, if the given S-, N- and halogen atoms are set in proportion to the molecular mass of the emission. The reference substance is sulphur dioxide.

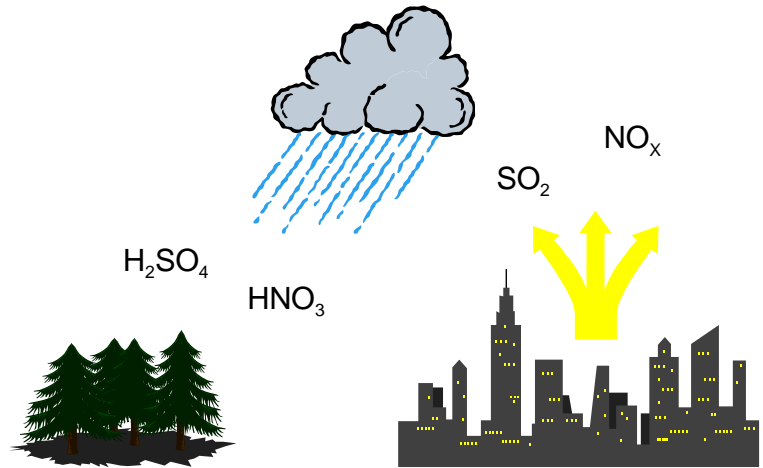


Figure A2: Acidification Potential (KREISSIG 1999)

Eutrophication Potential (EP)

Eutrophication is the enrichment of nutrients in a certain place. Eutrophication can be aquatic or terrestrial. Air pollutants, waste water and fertilization in agriculture all contribute to eutrophication.

The result in water is an accelerated algae growth, which in turn, prevents sunlight from reaching the lower depths. This leads to a decrease in photosynthesis and less oxygen production. In addition, oxygen is needed for the decomposition of dead algae. Both effects cause a decreased oxygen concentration in the water, which can eventually lead to fish dying and to anaerobic decomposition (decomposition without the presence of oxygen). Hydrogen sulphide and methane are thereby produced. This can lead, among others, to the destruction of the eco-system.

On eutrophicated soils, an increased susceptibility of plants to diseases and pests is often observed, as is a degradation of plant stability. If the nutrification level exceeds the amounts of nitrogen necessary for a maximum harvest, it can lead to an enrichment of nitrate. This can cause, by means of leaching, increased nitrate content in groundwater. Nitrate also ends up in drinking water.

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Nitrate at low levels is harmless from a toxicological point of view. However, nitrite, a reaction product of nitrate, is toxic to humans. The causes of eutrophication are displayed in Figure A3. The eutrophication potential is calculated in phosphate equivalents (PO₄-Eq). As with acidification potential, it's important to remember that the effects of eutrophication potential differ regionally.

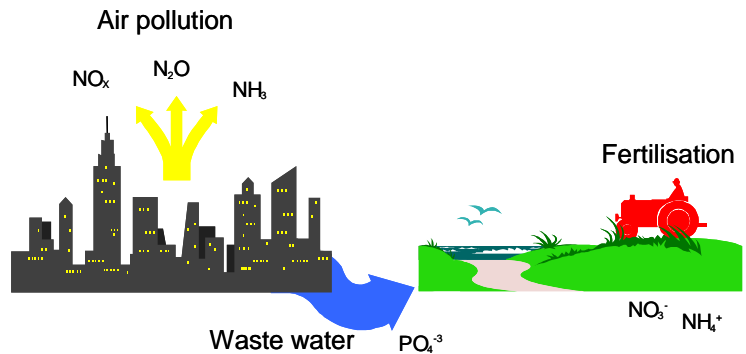


Figure A3: Eutrophication Potential (KREISSIG 1999)

Photochemical Ozone Creation Potential (POCP)

Despite playing a protective role in the stratosphere, at ground-level ozone is classified as a damaging trace gas. Photochemical ozone production in the troposphere, also known as summer smog, is suspected to damage vegetation and material. High concentrations of ozone are toxic to humans.

Radiation from the sun and the presence of nitrogen oxides and hydrocarbons incur complex chemical reactions, producing aggressive reaction products, one of which is ozone. Nitrogen oxides alone do not cause high ozone concentration levels. Hydrocarbon emissions occur from incomplete combustion, in conjunction with petrol (storage, turnover, refueling etc.) or from solvents. High concentrations of ozone arise when the temperature is high, humidity is low, when air is relatively static and when there are high concentrations of hydrocarbons. Today it is assumed that the existence of NO and CO reduces the accumulated ozone to NO₂, CO₂ and O₂. This means, that high concentrations of ozone do not often occur near hydrocarbon emission sources. Higher ozone concentrations more commonly arise in areas of clean air, such as forests, where there is less NO and CO (Figure A4).

In Life Cycle Assessments, photochemical ozone creation potential (POCP) is referred to in ethylene-equivalents (C₂H₄-Eq.). When analyzing, it's important to remember that the actual ozone concentration is strongly influenced by the weather and by the characteristics of the local conditions.

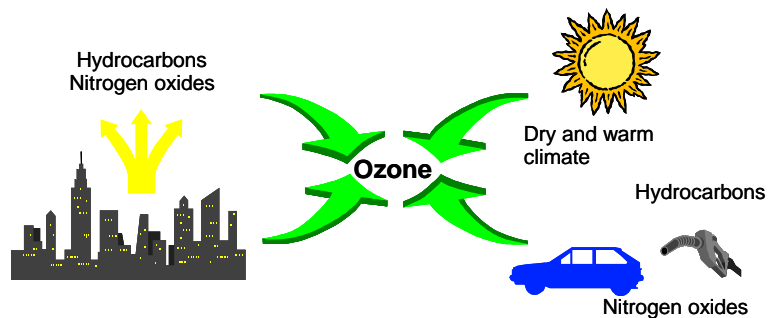


Figure A4: Photochemical Ozone Creation Potential

Ozone Depletion Potential (ODP)

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Ozone is created in the stratosphere by the disassociation of oxygen atoms that are exposed to short-wave UV-light. This leads to the formation of the so-called ozone layer in the stratosphere (15 - 50 km high). About 10 % of this ozone reaches the troposphere through mixing processes. In spite of its minimal concentration, the ozone layer is essential for life on earth. Ozone absorbs the short-wave UV-radiation and releases it in longer wavelengths. As a result, only a small part of the UV-radiation reaches the earth.

Anthropogenic emissions deplete ozone. This is well-known from reports on the hole in the ozone layer. The hole is currently confined to the region above Antarctica, however another ozone depletion can be identified, albeit not to the same extent, over the mid-latitudes (e.g. Europe). The substances which have a depleting effect on the ozone can essentially be divided into two groups; the fluorine-chlorine-hydrocarbons (CFCs) and the nitrogen oxides (NOX). *Figure A5* depicts the procedure of ozone depletion.

One effect of ozone depletion is the warming of the earth's surface. The sensitivity of humans, animals and plants to UV-B and UV-A radiation is of particular importance. Possible effects are changes in growth or a decrease in harvest crops (disruption of photosynthesis), indications of tumors (skin cancer and eye diseases) and decrease of sea plankton, which would strongly affect the food chain. In calculating the ozone depletion potential, the anthropogenically released halogenated hydrocarbons, which can destroy many ozone molecules, are recorded first. The so-called Ozone Depletion Potential (ODP) results from the calculation of the potential of different ozone relevant substances.

This is done by calculating, first of all, a scenario for a fixed quantity of emissions of a CFC reference (CFC 11). This results in an equilibrium state of total ozone reduction. The same scenario is considered for each substance under study whereby CFC 11 is replaced by the quantity of the substance. This leads to the ozone depletion potential for each respective substance, which is given in CFC 11 equivalents. An evaluation of the ozone depletion potential should take the long term, global and partly irreversible effects into consideration.

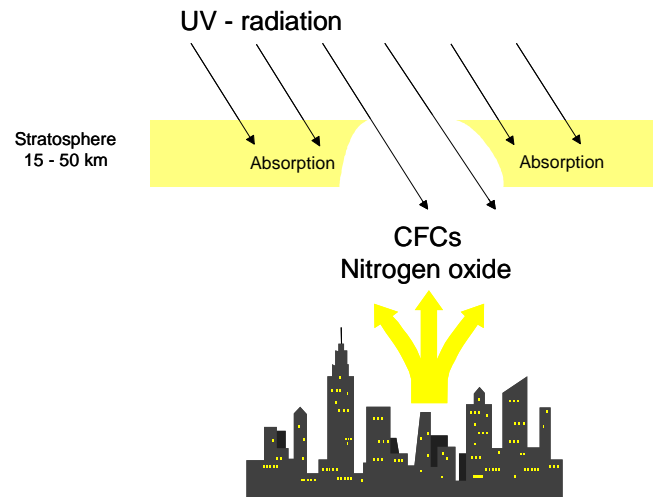


Figure A5:

Ozone Depletion Potential (KREISSIG 1999)