Lifecycle assessment of paint

Lifecycle assessment of paint. Summary of IVL Report B 1338-A.

Paint has a positive effect on the environment by prolonging the life of products, providing aesthetically appealing surfaces, and thereby saving resources both from an environmental and economic perspective. Lifecycle assessments, LCAs, provide knowledge of the way painting, paint undercoat and different paints and their ingredients collectively affect the environment.

Sveriges Färgfabrikanters Förening (Sveff) [the Swedish Paint & Printing Ink Makers' Association] has carried out lifecycle assessment of various types of paint within the framework of its environmental work. The work has been carried out by Institutet för Vatten och Luftvårdsforskning (IVL) [the Swedish Environmental Research Institute] in collaboration with Trätek [the Swedish Institute for Wood Technology Research], Institutet för Verkstadsteknisk Forskning (IVF) [the Swedish Industrial Research and Development Corporation] and Kungliga Tekniska Högskolan (KTH) [the Royal Institute of Technology]. This brochure presents an overall description of the analyses and the results of the report, Lifecycle Assessment of Paint, IVL B 1338-A, which is available to order from Sveff.

What is a lifecycle assessment?

A lifecycle assessment is a method by which the environmental loading of products and services can be described and quantified during all stages in their lifecycle "from cradle to grave". It is made up of the following parts:

- Definition of objective and scope
- An inventory in which data about raw materials and processes are gathered and compiled
- An assessment of environmental impact in which conceivable environmental effects are evaluated
- An interpretation of the results and proposals for improvements

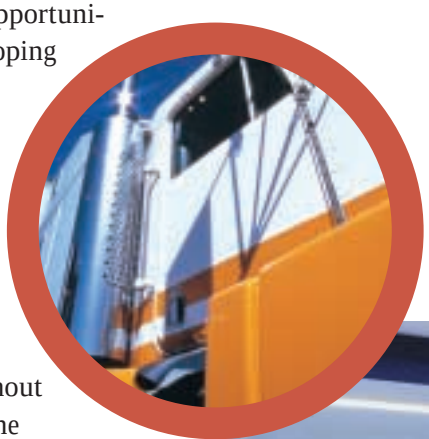
LCAs can be used as a tool in identifying the factors – raw materials, manufacture, use of transportation and waste – by which a product has its greatest impact on the environment.

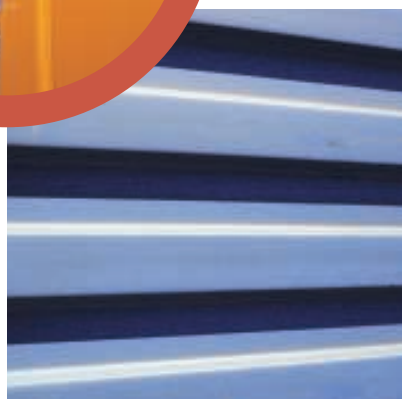
Three objectives of this project

The "Lifecycle Assessment of Paint" project has had three objectives.

- To build up a knowledge database about paint and its raw materials.
- To disseminate knowledge about the way paint influences the environment throughout its entire lifecycle.
- To create basic data for developing more environmentally-adapted products, from a holistic perspective.

Increased knowledge provides the paint industry with better opportunities for developing products and methods of production which show the greatest amount of consideration to the environment without influencing the positive effects of the paints, as a beautifier, protector and life-extender.








Data inventory for major product groups

An inventory of data was made for the product groups below. In the project, three product groups were selected for the lifecycle assessment. The databank as a whole can be used by the companies in their own lifecycle analyses.

Products for the industrial surface treatment of timber

Solvent-based varnish

Water-based wood-stain

Solvent-based wood-stain

Products for industrial surface treatment of metal

Water-based paint

Solvent-based paint

Powder paint

Painting and decorating products

Solvent-based alkyd paint

Water-based acrylic paint

Water-based alkyd paint

Water-based acrylic/alkyd hybrid paint

Linseed oil paint

Solvent-based alkyd primer

The first part – lifecycle assessment up to and including ready-to-deliver paint

The first part of the study contains an inventory and a report of the resource consumption and emissions that occur up to the point at which the paint is ready-to-deliver.

For this, solvent-based varnish, powder paint and solvent-based alkyd were chosen.

The second part – the entire lifecycle up to and including the painted product

The second part of the study is the lifecycle assessment linked to the painted product during its entire lifecycle. A painted shelf made of metal, timber weatherboarding and a painted kitchen cabinet door were selected as objects.

Summary

The most important conclusions are summarised below.

- It is environmentally advantageous to extend the working life of products by surface-treating them with paint.
- For solvent-based paint, the solvent, binding agent, pigment and manufacture are responsible for approximately equal proportions of environmental loading within the different areas of greenhouse effect, low-level ozone, acidification and eutrophication.
- For powder paint, the picture is more diffuse - the greenhouse effect is affected most by binding agents. Low-level ozone originates mainly in the binding agents and the eutrophication effect is caused almost entirely by filler.
- In all cases, transportation accounts for negligible environmental loading.

Raw materials, production,

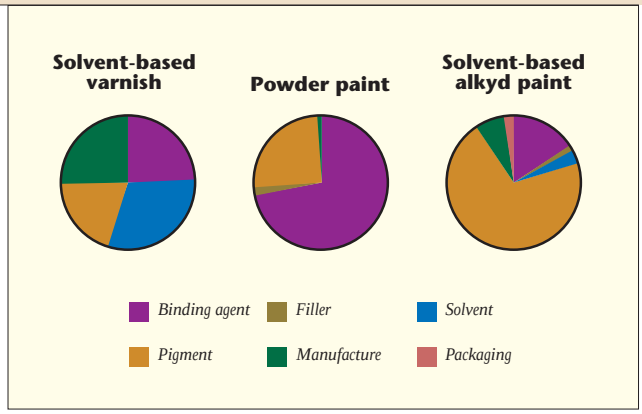
The first part of the study contains an inventory and a report of the consumption of resources and the emissions that occur up to the point at which the paint is ready-to-deliver. For practical reasons, the functional unit, i.e. the one used for comparison, was chosen to be 1 kg of liquid paint. The unit can be used for reporting on the environmental loading of the surface treatment system, up to and including the paint factory gate. The energy consumption and solvent emissions that occur during the application of the paints and which are of greatest importance from a lifecycle perspective, are not reported with this choice of functional unit. Transportation is, in all cases, negligible, which is why there is no particular comment on this. Note that the solvent's environmental effect is not dominant in the preparation of raw material and production since the solvents only evaporate once the paint is used.

The paints included in the report are:

- Solvent-based varnish for the industrial treatment of timber (acid-cure primer plus clear varnish).
- Powder paint for industrial treatment of metal.
- Solvent-based alkyd paint for outdoor use.

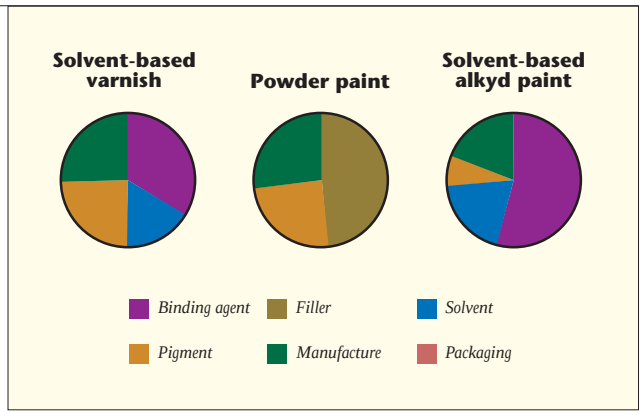
Greenhouse Effect Unit: g CO_2 equ.

For solvent-based varnish, the environmental impact is split fairly evenly between binding agents, solvents, pigment and manufacture. The binding agents dominate the impact for powder paint. The total impact of powder paint on the greenhouse effect is very small, however. For solvent-based alkyd paint, the pigment has the greatest environmental impact.

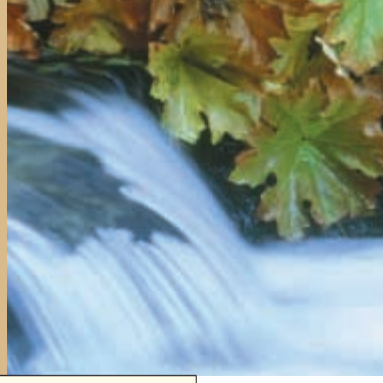


Low-level ozone Unit: g ethene equ.

Here, the binding agents are responsible for the major part of the environmental impact of solvent-based varnish. Manufacture and pigment are each responsible for a quarter, while the solvents are in fourth place. For the powder paint, the filler is responsible for almost half, while manufacture and pigment share the remainder.
For solvent-based alkyd paint, binding agents dominate.

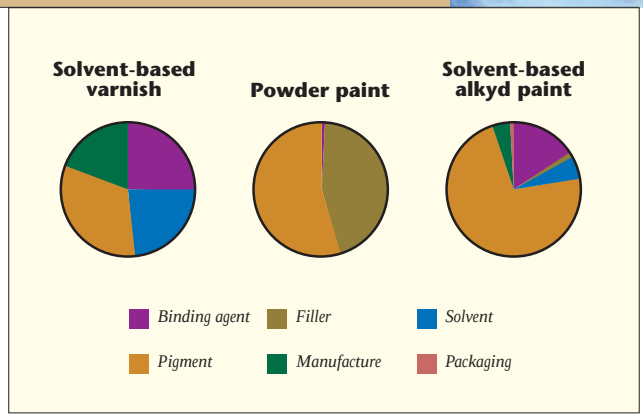


usage, waste.



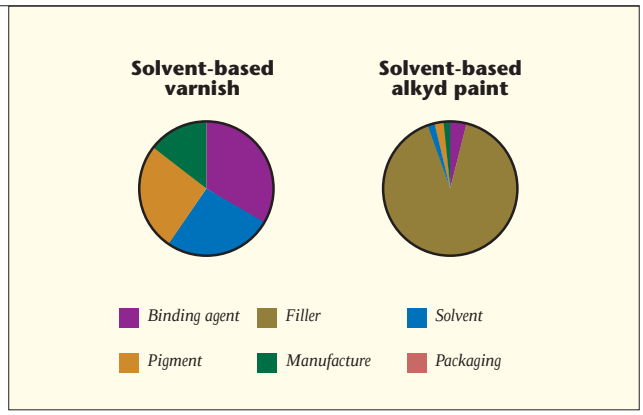
Acidification Unit: g SO_x equ.

For solvent-based varnish, the pigment is the major acidification factor, while solvents and binding agents are responsible for a quarter each.
For powder paint, pigment and filler share the acidification effect.
The pigment is responsible for three quarters of the acidification effect for solvent-based alkyd paint.



Eutrophication Unit: g phosphate equ.

The binding agents have the greatest share of the eutrophication effect, followed by pigment, solvents and manufacture.
The filler is responsible for almost the entire acidification effect as regards solvent-based alkyd paint.
(No analysis has been made of the eutrophication effect of the powder paint.)



The table below shows the analysis results in more detail:

Solvent-based varnish *(acid-cure primer plus clear varnish)*	**Impact on the greenhouse effect** *Unit: g CO_2 equ.*	**Low-level ozone** *Unit: g ethene equ.*	**Acidification** *Unit: g SO_x equ.*	**Eutrophication** *Unit: g phosphate equ.*
Binding-agent	881,6	4,2	7,4	0,9
Solvent	1145,7	2,1	6,8	0,7
Pigment	731,4	3,0	9,6	0,7
Manufacture	936,7	3,1	5,6	0,4

Powder paint	**Impact on the greenhouse effect** *Unit: g CO_2 equ.*	**Low-level ozone** *Unit: g ethene equ.*	**Acidification** *Unit: g SO_x equ.*	**Eutrophication** *Unit: g phosphate equ.*
Pigment	1,1	5,0	5,2	00,00
Filler	0,1	9,9	4,3	00,00
Binding agent	3,2	0,003	0,04	00,00
Manufacture	0,1	5,5	0,01	00,00

Solvent-based alkyd paint	**Impact on the greenhouse effect** *Unit: g CO_2 equ.*	**Low-level ozone** *Unit: g ethene equ.*	**Acidification** *Unit: g SO_x equ.*	**Eutrophication** *Unit: g phosphate equ.*
Binding agent	283,4	0,8	3,2	0,3
Filler	25,3	0,01	0,3	8,3
Solvent	63,9	0,3	1,0	0,1
Pigment	1293,9	0,1	14,5	0,2
Manufacture	138,8	0,3	0,9	0,1
Packaging	44,5	0,001	0,1	0,01

Paint and varnish are everywhere around us.

In the home alone, there are hundreds of examples of painted surfaces: kitchen cabinet doors, furniture, flooring, ceilings, refrigerators, toys. But paint is not just for making things beautiful and giving out signals. It is just as much a matter of protecting the various products.

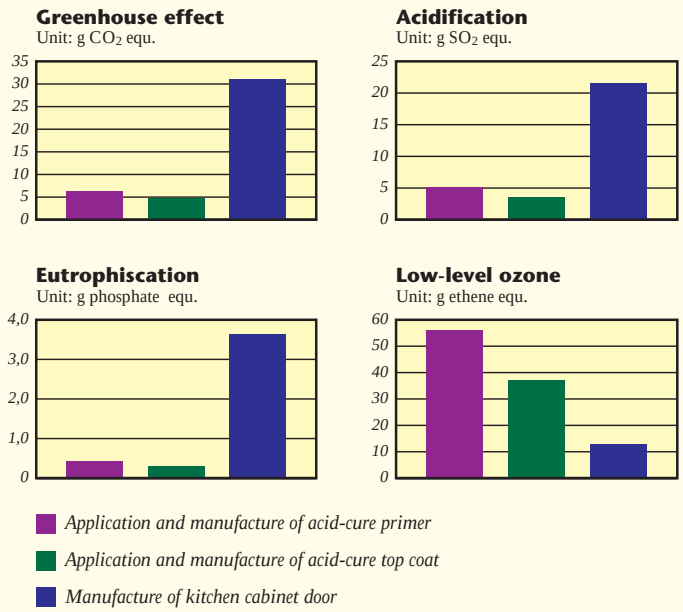
The second part of the study is a lifecycle assessments in which the benefit is linked to the painted product throughout its lifecycle.

The study has primarily been analysed with regard to the categories that influence the environment –the greenhouse effect, acidification, eutrophication and low-level ozone. Paint applied to a kitchen cabinet door, for example, is examined to see whether the environmental impact of the paint is significant to the overall environmental impact of the painted product.

Example:

Painted kitchen cabinet door

A kitchen cabinet door, here made of Medium Density Fiberboard (MDF), which is painted with acid-cure primer and acid-cure top coat. As regards the greenhouse effect, acidification and eutrophication, the paint has little effect on the environment in comparison with the cabinet door itself. For low-level ozone, the relationship is the reverse. Estimated life - 15 years. The units in the diagram apply to 1m² kitchen cabinet door.



When choosing a paint it is important to consider its lifespan. The colour system has to last a long time and you don't want a paint that will soon need changing because it has become unfashionable. It is also important to factor in the financially sustainable aspect of surface treatment or painting.

Example:

Metal shelving

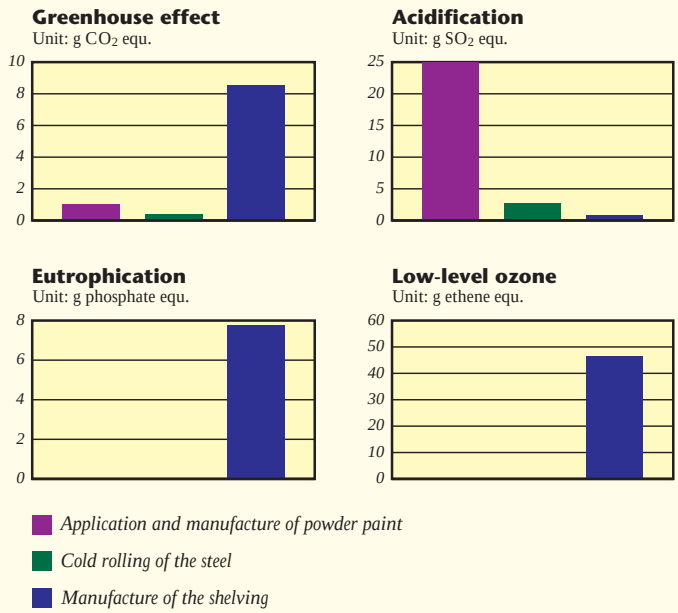
The shelving is made of 1 mm metal sheeting, surface treated with 50 µm powder paint.

In three out of four categories, it is the manufacture of the shelving that has the completely dominant effect on the environment.

The powder paint produces the greatest acidification effect. Estimated lifespan: 15 years.

The units in the diagram apply to 1m² shelving.

Note that the environmental impact of production of the metal is not included.



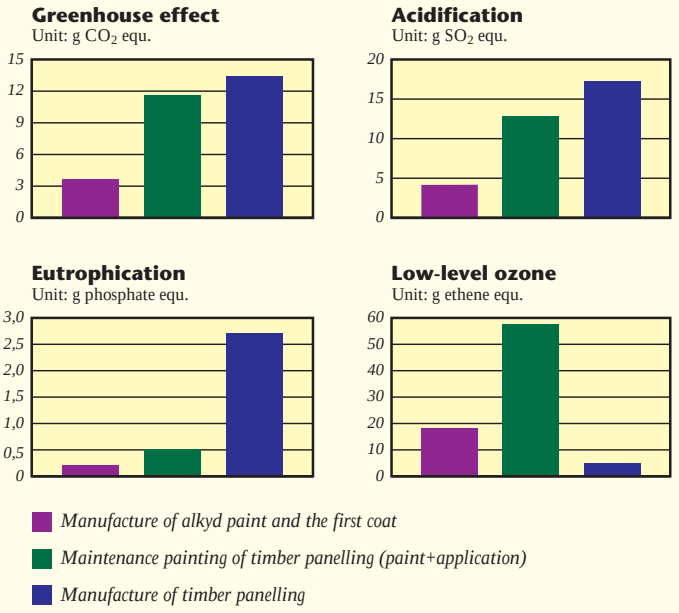
Example:

Timber weatherboarding

Weatherboard panelling is made of timber with an assumed lifespan of 50 years. This entails the panelling regularly being maintenance-painted. The surface treatment is done using a solvent-based alkyd paint.

Here, too, the manufacture of the panelling has the greatest environmental impact.

The exception is low-level ozone, where it is the maintenance-painting which is, above all, the major environmental loading. The units in the diagram apply to 1m² of timber panelling.



Conclusion

The general conclusion of the study is that the greatest part of the environmental impact originates in the actual object which has been painted in most cases, e.g. shelf, kitchen cabinet doors or timber weatherboarding. This applies to most categories for environmental impact. At the same time, the paint's environmental impact cannot be ignored when the environmental impact of a surface-treated product is analysed.

Lifecycle assessment of paint

- a project with a broad foundation

Here are the companies that are participating in the project:

- Akzo Nobel Decorative Coatings AB
- Akzo Nobel Industrial Coatings AB
- Akzo Nobel Nippon Paint AB
- Alcro-Beckers AB
- Becker Acroma KB
- Becker Industrifärg AB
- Bona Kemi AB
- Tikkurila AB
- Flügger AB
- AB N Haglund Färgindustri
- Du Pont Performance Coatings AB
- Herdins Färgverk AB
- Jotun Sverige AB
- Rohm and Haas Nordiska AB
- AB Rötmotaverken
- Teknos Tranemo AB
- Wedevåg Färg AB

The following organisations have formed the management and scientific base for the project:

- the Swedish Paint & Printing Ink Makers' Association
- the Swedish Environmental Research Institute
- the Swedish Industrial Research and Development Corporation
- the Swedish Institute for Wood Technology Research
- the Royal Institute of Technology

The Swedish Paint & Printing Ink Makers' Association (Sveff) is the trade organisation for companies that manufacture, import and market paint products in Sweden. Sveff takes care of the paint industry's interests, answers referrals and has contacts with the public authorities. Sveff also works with the European trade organisation, CEPE, as well as with other national and regional trade organisations.

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