Sustainable development

Taking care of the environment

MARMOLEUM®
ARTOLEUM®

forbo

Contents

Creating better environments

Forbo Flooring core value: we are committed to protecting the environment and investing in a sustainable future by constantly seeking to create more environmentally friendly products and processes.

Environmental responsibility is a core value in our company, and has been so for decades. We believe that being environmentally responsible is both the right thing for us to do as a corporate citizen, and that it is the right thing for our business. With a corporate culture of long-term commitment to the environment, Forbo is the world leader in linoleum.

Our products are associated with beautiful and innovative design, long life and consistently high production quality. Our global brands Marmoleum® and Artoleum® are sold worldwide with a proven track record of over 100 years of continuous production. One of the cornerstones of being the world leader is to be a global leader in environmental responsibility. Not the *marketing* of environmental responsibility, but the *practice* of environmental responsibility.

We are well underway towards getting to an ideal environmental profile. For nearly two decades we have been actively improving our performance. Every year the results are published in an annual environmental report, which can also be downloaded from www.forboflooringNA.com.

Environmental history

1990 Start employment of Health, Safety and Environment Specialists

1992 ISO 9001 Certification

1993 First LCA Study Completed

1995 Second LCA Study Completed

1996 Scandinavian Nordic Swan Label Granted

1997 ISO 14001 Certification

1997 Winner Sequoia Award

1998 Government Granted Self-regulating Company

1998 Received the Netherlands Environmental Quality Mark (Milieukeur)

2000 Given the German TÜV Environmental Label

2000 Third LCA Study Completed

2001 Received the Austrian Eco Label UZ42

2004 German Nature Plus certificate granted

2004 Australian Environmental Choice label received

2005 Received New Zealand Environmental Choice label

What others say

"In comparison to like alternatives, Marmoleum® and Artoleum® display important environmentally preferable attributes related to renewable and non-renewable raw material use, human toxicity, ecotoxicity, environmental loads associated with waste, toxicity of surface treatments and longevity from a flooring product life cycle perspective."
Australian Environmental Labeling Association Inc.

"WWF is concerned about the use of energy, the consequent influence on climate and the threat this presents to wildlife world-wide. Every product that uses less energy and fossil fuel is preferred to alternatives using more. WWF Sweden is encouraging institutional buyers to choose products with less impact on the environment. Together with Forbo Flooring we arrange a competition to reward local authorities using the flooring products with the lowest usage of oil and energy.

The principle for calculating environmental impact of floor covering materials presented by Forbo has been very useful for giving directions and evaluating results.

Another concern for WWF is illegal logging and illegal trade in wood products. In addition, Forbo Parquet is a member of the WWF Sweden Forest and Trade Network; a network for companies committed to responsible forestry and trade. Forbo Parquet's purchasing policy shows our shared values also regarding these issues."
Lena Dahl, WWF Sweden

"The fact that Marmoleum® is known for its ease of maintenance, hygienic properties, extreme durability, environmentally friendly properties and lowest life cycle costings were crucial deciding factors for us."
Austin-Smith:Lord, USA
Architects Office

"As part of our selection process we explore materials and their suitability to a given environment and

Marmoleum® has been selected for all ward areas because of its natural feel and its in-built bacteria resistance.

This quality helps to create a safe environment for the patient by fighting everyday germs and bugs without the excessive use of harmful or toxic cleaning agents."
Jas Dhami,
Building economist for Carillon plc, UK

"Here Marmoleum® blooms anew.

It has been known for years as an ecologically irreproachable, durable and cost effective floor covering.

Now because of its flexibility, it conquers the architecture of "folded surfaces", winding over furniture, seamlessly merging floors, walls and ceiling into a single room envelope."
Wolfram Putz, GRAFT, Berlin, Germany
Architects Office

"In our architecture we always pay attention to its environmental quality, whether on a large scale, such as questions of location, the arrangement of buildings, the linking and form of individual building components, the overall look of the exterior, or in smaller details such as the building materials and building products. The Mülberger-Rieger-Breiden practice deals primarily with larger new build and refurbishment projects in the social infrastructure, especially hospitals. In the selection of floor coverings our builders too are increasingly developing an interest in and responsibility for so-called "lasting products", that is natural products of regenerative materials. After establishing the performance requirements, such as hygiene, conductivity, loading etc and the overall appearance desired, such as the choice of color and design, the question of "the lasting building" must be given equal importance. In this connection an established ecological certification with a suitably reliable quality mark is of great importance for the builder and correspondingly helpful to us as architects."
Mülberger, Berlin, Germany
MÜLBERGER · RIEGER · BREIDEN
Architects Office

Investing in our future

In 2003, Forbo replaced its indoor electric lighting method of "bleaching" linoleum material with an outdoor greenhouse. The greenhouse uses natural sunlight to dissipate the drying room yellowing that naturally occurs on linoleum. This method has not only provided a faster turnaround time for Forbo, but has also resulted in a significant savings in energy consumption.

Forbo Flooring, Hazleton, PA

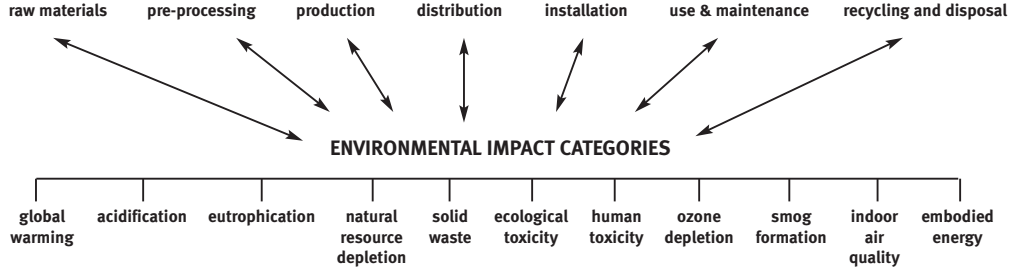
Life Cycle Assessment

The environmental impact of floor coverings can best be measured by carrying out a Life Cycle Assessment (LCA). LCAs chart the environmental impacts of products in every stage of their lives. The exclusion of any elements or impacts invalidates the results.

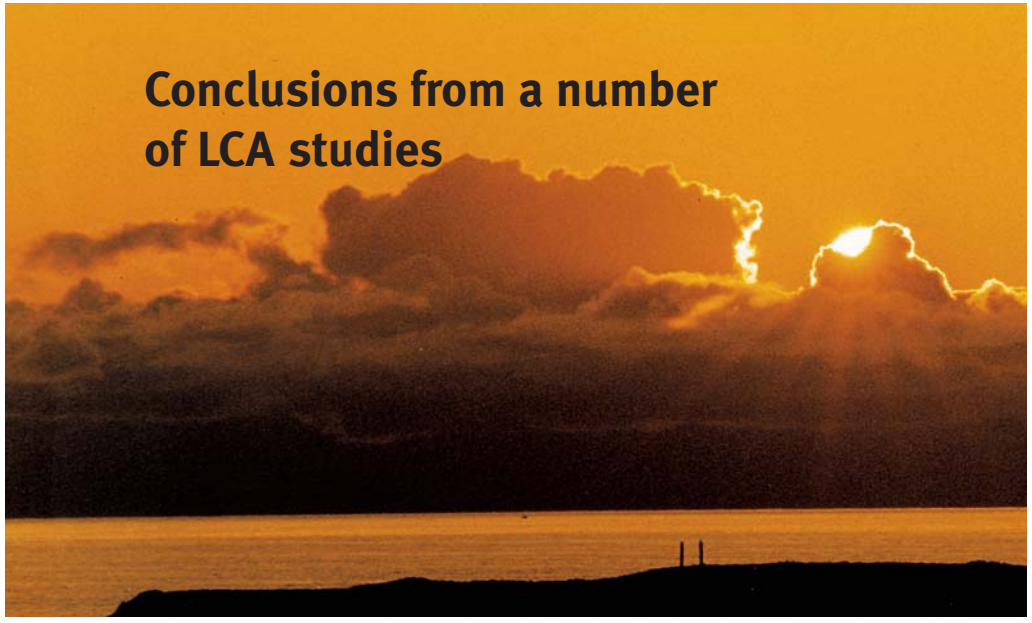
Marmoleum® is one of the first floor coverings to publish independently done, peer reviewed LCA studies.

In order to continually improve our performance, Forbo has participated in or commissioned LCA-based benchmark studies for many years. The results and recommendations of these studies have contributed greatly to our ever improving environmental performance.

PROCESS ELEMENTS (Product Life Cycle)



Conclusions from a number of LCA studies



Environmental LCA of four types of linoleum, vinyl, wool carpets and synthetic carpets (1993)

Utrecht University's Department of Science, Technology and Society (The Netherlands, 1993).
Thanks to the use of natural raw materials, linoleum was clearly the most environmentally compatible floor covering. The researchers concluded
"Comparison shows that linoleum is clearly the best".

Life Cycle Assessment of flooring materials (1995)

Chalmers University of Technology (Gothenburg, Sweden) in collaboration with the vinyl, chemical and linoleum flooring industries and timber and wooden floor suppliers in Sweden.
The conclusion of this LCA states:
"Utilizing the most recent data, linoleum has impact values in two of the three assessments similar to those of traditional environmentally compatible pinewood flooring."

LCA of our linoleum products (2000)

Center for Environmental Science, University of Leiden (the Netherlands, 2000).
The main conclusion is that the environmental impact of our linoleum was very small.
"Potential areas of improvement were identified, and various actions carried through to ensure even more optimal environmental performance."

A downloadable version of this report can be found on:
www.leidenuniv.nl/cml/ssp/publications/lcalinoleum.pdf

Natural raw materials

Natural raw materials, available in abundance.
Environmental issues play a vital role in our day to day business process and are an integral part of our management systems and procedures. This includes a close collaboration with our suppliers to strive for improvement of environmental impact of the products being supplied to us. This of course also contributes to the improvement of the LCA outcome of our linoleum.






Nature provides a great start by providing renewable raw materials to make linoleum. These raw materials are harvested or extracted with relatively little energy consumption.

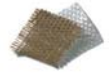
Rosin
Rosin, the key agent in the first steps of producing Marmoleum® and Artoleum®, is tapped from pine trees, without affecting growth. Together with linseed oil, rosin gives Marmoleum® and Artoleum® its strength and flexibility.

Wood flour
Wood flour is used to bind the pigments and to ensure colorfastness. Marmoleum® and Artoleum® thus keep their beautiful, vibrant colors throughout their lifespan. Another reason for using wood flour is that it helps to give an especially smooth surface. We have chosen not to use tropical hardwood flour but wood flour made from timber grown in controlled European forests, where every tree felled is replaced.

Cork flour
Cork flour is made by grinding the bark of the cork oak, which is grown around the Mediterranean. The bark is peeled off every seven to ten years without affecting the tree's growth. Cork flour is used as a raw material in two of our products: Bulletin Board and Corklinoleum.

Linseed oil
Linseed oil, the most important raw material used to make linoleum, is obtained by pressing the seeds of the flax plant. In the past linseed oil was used as cooking oil, as well as for lighting. We add to this Tall oil, a recycled post-industrial by-product of the Kraft paper industry, which optimizes the oxidation process in the production of linoleum.

Limestone
Limestone is found all over the world in enormous quantities. Very finely ground, it is a valuable ingredient of Marmoleum® and Artoleum®.



Jute
From the wide variety of materials available for making the floor covering's backing we prefer natural jute. The yarn for the webbing is spun from jute grown in India and Bangladesh.

Pigments
The most beautiful colors are created by using ecologically responsible pigments that do not contain heavy metals such as lead and cadmium.

As long as the sun shines, and the rain falls,
we can produce **MARMOLEUM®** and **ARTOLEUM®**.

Linoleum production

The Linoleum production process has existed for more than a century. It is a craft which essentially consists of oxidation, mixing, calendering and drying. Potentially the highest environmental impact of linoleum production is the use of energy. For years we have been setting ourselves targets for energy usage reduction. In 2004 we managed an energy saving of 3.2%.

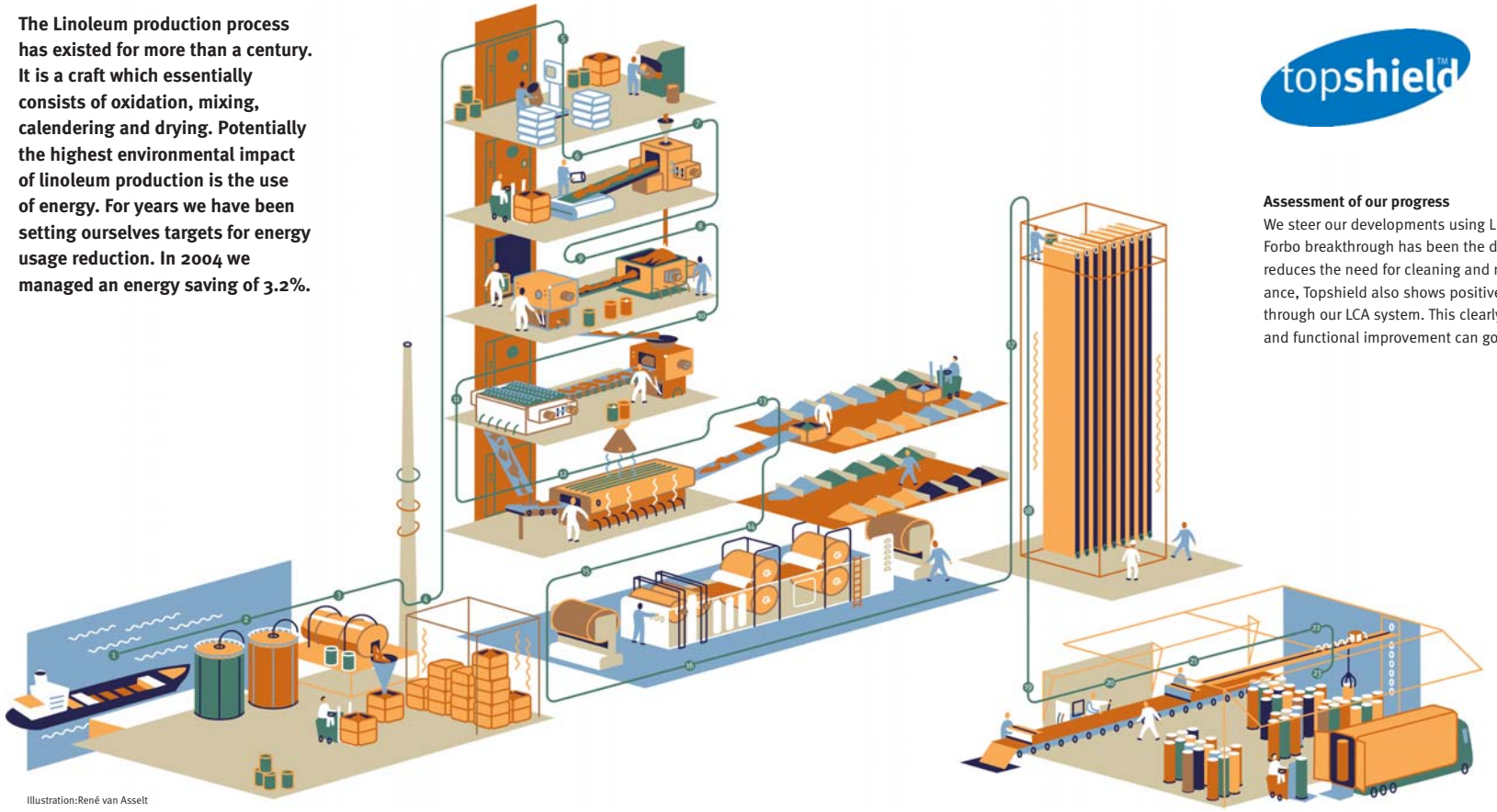
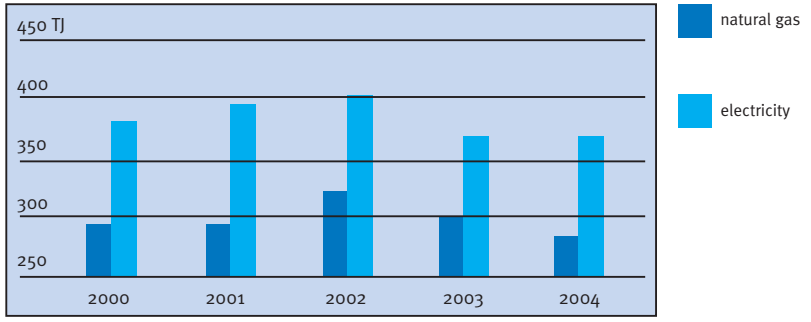


Illustration:René van Asselt

1. Supply of linseed oil
2. Storage of linseed oil and wood flour
3. Oxidation boiler. Supply of air, mixing of linseed oil and rosin
4. Linoleum cement in oxidation room
5. Weighing and mixing of dry substances (wood flour, fillers and pigments)
6. Supply of linoleum cement
7. Mixer
8. Mixing trough
9. Mixer
10. Mixer
11. Scratcher (roller with pins)
12. Cooling shaker
13. Storage on material lofts
14. Supply of linoleum granules to calender
15. Supply of jute
16. Calenders
17. Linoleum ready for drying room
18. Drying room
19. Trimming department
20. Factory finish
21. Cutting to size
22. Wrapping
23. Transport to warehouse

Energy consumption 2000 – 2004

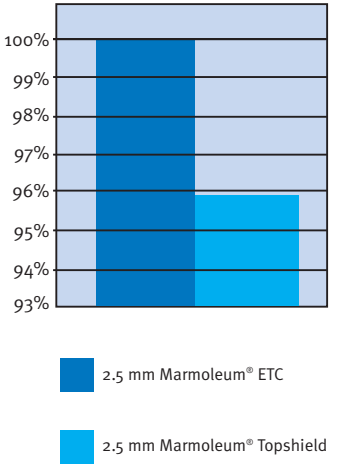


Assessment

Assessment of our progress

We steer our developments using Life Cycle Analysis as a guideline. The most recent Forbo breakthrough has been the development of Topshield. Topshield drastically reduces the need for cleaning and maintenance. Along with this improved performance, Topshield also shows positive effects on environmental impact when calculated through our LCA system. This clearly demonstrates that environmental performance and functional improvement can go hand in hand.

LCA impact scoring*



* LCA system based on LCA by Center for Environmental Science University of Leiden (The Netherlands, 2000)

Environmental labels

Environmental quality standards

In a number of countries, companies can apply for environmental certification of their products. These environmental quality marks are awarded for products that meet the stringent criteria on which certification is based. It is our policy to ensure that our products comply with these eco-labels.

The Netherlands
In 1998 Marmoleum®, Artoleum®, Walton and Corklinoleum received the Netherlands Environmental Quality Mark. This Dutch Eco label covers the whole life cycle. In addition, packaging and product information must all meet strict requirements.

The Netherlands Environmental Quality Mark is an independent, trustworthy hallmark, proving that products carrying this label, such as Marmoleum®and Artoleum®, have a low environmental impact.

Germany
In 2004 Forbo was the first resilient flooring company to obtain the Nature Plus certificate for Marmoleum® and Artoleum®. Nature Plus is a Europe wide environmental product label testing products on environmental, health and functional characteristics. Products can only be approved when they have:

- at least 85% renewable and/or mineral components;
- a building approval and are in compliance with the relevant EN standards (functional suitability);
- no use of substances which are harmful or hazardous to health or to the environment;
- a conservationist and environmentally friendly production (eco-indicators);
- strict laboratory testing of products for hazardous substances and emissions;
- an independent cross-section of society, drawn from within the organization, which checks that the labels are valid and useful.

Scandinavia
The Nordic Swan Label aims to stimulate environmentally minded purchasing behavior by disseminating information among users. Maintaining this label is an indication of continued commitment to ever improving performance, as with each re-certification the performance standard is raised.

Austria
In 2001 Marmoleum® and Artoleum® received the Austrian environmental label UZ 42. By receiving this label we prove that we offer an environmentally friendly option in resilient flooring. For UZ 42 products are evaluated on contents of halogens, heavy metals, bactericides and fungicides and on emissions. The environmental impact during production, use and disposal are also assessed. UZ 42 is only given to products that are amongst the most environmentally friendly alternatives available.

USA
In the USA, Desk Top and Bulletin Board received an environment award in 1997. Desk Top and Bulletin Board were declared winners of the much coveted AWFS Sequoia Award. The Sequoia Award, presented by the Association of Woodworking and Furnishing Suppliers, is granted to organizations within the industry that demonstrate environmental innovation and leadership in conservation techniques, applications and processes. Our linoleum received Buildings Magazine's Innovations Award for 'Environmental Sensitivity' at the Neocon World's Trade Fair in 1998, 1999 and 2001 (Chicago).

Australia
The 'Good Environmental Choice' Ecolabel is awarded to those products that meet or exceed voluntary standards of environmental performance. The verification procedure is managed via a Documented Quality Management System and Certification Program Manuals which have made significant use of the ISO 14 000 series. The program considers key environmental impacts along the product's life cycle and delivers independent product environmental information for a wide range of consumer and building products.

New Zealand
The New Zealand Ecolabeling Trust is a voluntary, multiple specification based environmental label, initiated and endorsed by the New Zealand Government to reduce the environmental impact of products. It provides a credible and independent guide for consumers who want to purchase more environmentally friendly products.

No flooring manufacturer in the world is so highly decorated!

A closer look at global warming

One environmental impact element in the LCA is global warming. Traffic, heating and use of electricity are major causes of global warming. Floor covering is a minor contributory element. It is however still our responsibility to give advice on the best possible use of floor coverings.

The differences between floor coverings are great when it comes to the consumption of oil and the consequent release of carbon dioxide. This conclusion can be drawn from data from the Swedish Council for Sustainable Construction, a mutual organization for companies in real estate, construction and construction materials combined with officially declared product compositions of floor covering products.

The following simple principles have been applied:

- all oil used will sooner or later end up as CO_2;
- PVC as a material consists of 44% oil;
- plasticizers are 100% oil based;
- 80% of electrical energy is produced using fossil fuel;
- plant based materials and energy production make no contribution to carbon dioxide release.

These principles have been confirmed by the specialist consultant company Profu in Gothenburg under the leadership of Professor Johan Sundberg at Chalmers University of Technology, Gothenburg, Sweden.

Results

The use of 1000 m² of floor covering has the following consequences in oil consumption and CO_2 release to the atmosphere.

Oil consumed index kg	Oil consumed index kg	CO_2 released during production kg	Major cause
Marmoleum® 2.0 mm	28	29	Production Process
Marmoleum® 2.5 mm	35	36	Production Process
Cushion Vinyl 3.2 mm	95	95	Production Process
Parquetry 14 mm	100	100	Drying of Wood
Project Vinyl 2.0 mm	132	131	Raw Materials
Rubber 2.5 mm with polyester backing	221	220	Production Process

The same kind of calculation can be made for other materials where data is available. Global warming is just one component of many different categories negatively impacting the environment, like waste, toxicity and recyclability. It is however one of the most critical ones.

Facts

Waste management in our production is improving on all fronts.

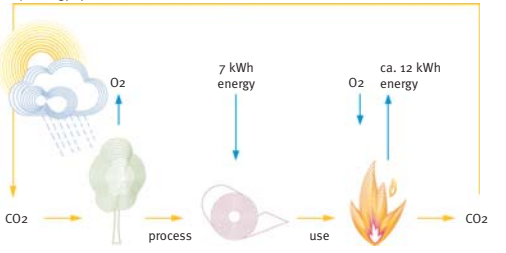
Installation

Being socially responsible also means being proactive. We do not wait until legislation is imposed. For example our assortment of adhesives includes solvent-free products.

Floor care

The most effective method for removing dust and loose dirt is by dry dust wiping. This method has the most positive influence on the environmental performance of our linoleum. Under normal conditions Marmoleum® and Artoleum® floors in healthcare applications do not need significant quantities of disinfectants to be applied. The limited use of water and chemicals contributes very positively to the economic life cycle of the product.

Life energy cycle 1 m² Marmoleum 2.0 mm



End of life

At the end of their life, usually after 25 to 40 years, our floors need to be replaced and disposed of. There are various options:

Incineration

Burnt in an energy-recycling incineration plant, our linoleum products produce a residual calorific value that is comparable to that of coal (18.6 Mj/kg). The amount of CO_2 released during incineration is roughly equivalent to that taken up by the natural raw materials we use (flax plants, trees and jute plants). Therefore, linoleum is a closed loop system: the energy obtained from incinerating linoleum is roughly equivalent to, or even more than, that which is used in production.

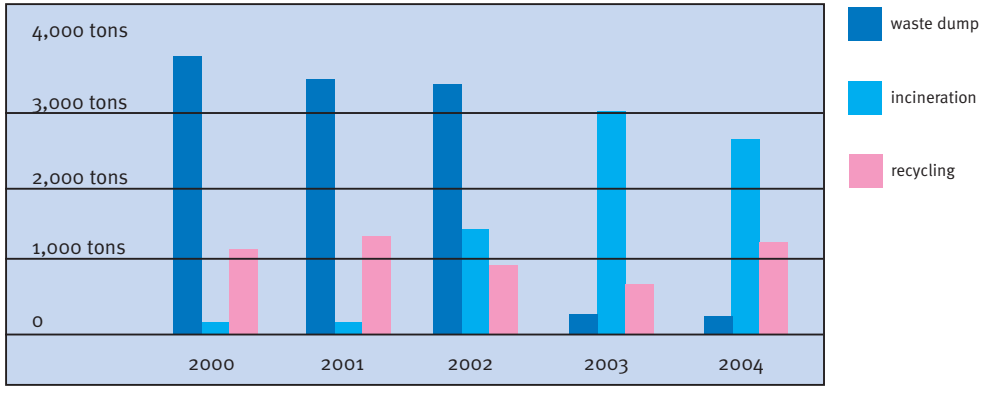
Landfill

Linoleum can be safely added to landfill refuse sites, where natural decomposition takes place. Linoleum is fully biodegradable and does not release harmful substances or gases such as chlorine and dioxins.

As linoleum's raw materials are provided by nature, and decomposition returns linoleum to nature, this is essentially the ultimate form of recycling. An additional advantage is that the recycling of other floor coverings is usually associated with high levels of energy consumption, with very negative implications in an accurate LCA.

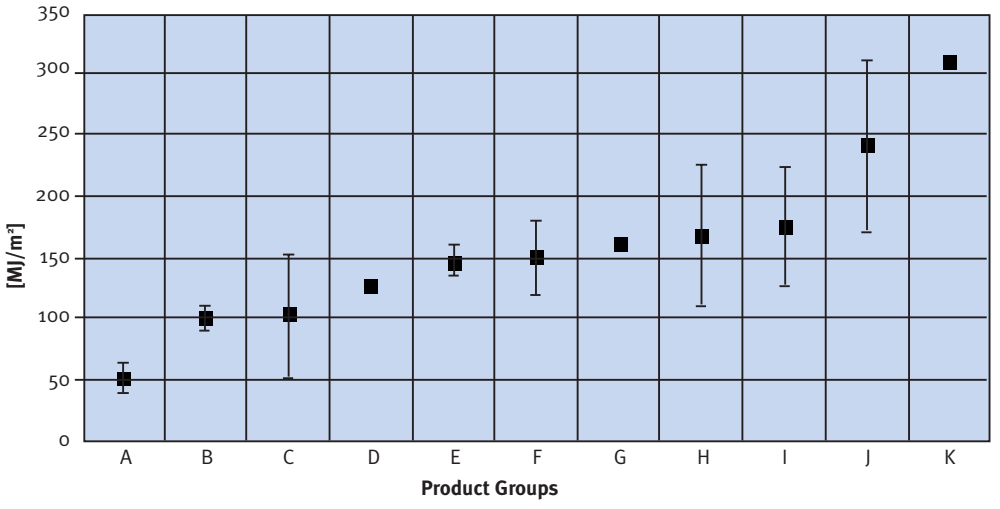
Waste management in our production is improving on all fronts.

Residual waste disposed of in 2000 - 2004



Linoleum in practice – Eco Devis

Mean, maximum and minimum values for the grey energy usage of fully adhered floor coverings



A	B	C	D	E	F	G	H	I	J	K
Woollen carpets, coconut matting or sisal with a backing of natural latex, jute or hemp	Corklinoleum & linoleum	Woolen carpets with a synthetic rubber or polyurethane backing	Cork with wear layer	Homogeneous vinyl floor coverings (PVC)	Smooth rubber floor coverings	Polyolefin rubber floor coverings	Hetergeneous vinyl floor coverings (PVC)	Synthetic carpets in sheet	Textured rubber floor coverings	Synthetic carpets in tiles

Eco Devis

Eco Devis 663 is a Swiss governmental initiative where independent experts assess the environmental impact of floor coverings from production to end of use. Elements looked at are energy usage, solvents used, toxicity of raw materials, emissions and recyclability. Floor coverings are grouped in two categories: the first is ecologically interesting and the second ecologically fairly interesting. Linoleum is grouped in the first category together with products like sisal, wool and coconut matting. Regarding floor coverings in the second category, the researchers give the following statement: the grey energy usage of products in the second category is considerably higher. The above graph shows the outcome for this specific element.

Linoleum in practice – the LEED system

The LEED Green Building Rating System, USA
The United States Green Building Council has developed the LEED (Leadership in Energy and Environmental Design) Green Building Rating System. This system provides a standard for what constitutes a green building. **No single product can obtain a LEED credit. However, using Marmoleum® has helped many projects to obtain their LEED credits.**

The LEED Rating System evaluates products of six categories, in which one can obtain credits:

- Sustainable sites
- Water efficiency
- Energy & Atmosphere
- Materials & Resources
- Indoor Environmental Quality
- Innovation in Design & Process

LEED NC (New Construction)
Category Materials & Resources:
- Credit 4.1 Recycled Content
- Credit 4.2 Recycled Content
- Credit 6 Rapidly Renewable Materials

Category Indoor Environmental Quality:
- Credit 4.1 Low-Emitting Materials

LEED CI (Commercial Interiors)
Category Materials & Resources:
- Credit MRc 4.1 Recycled Content
- Credit MRc 4.2 Recycled Content

Category Indoor Environmental Quality:
- Credit Eqc 4.1 Low-Emitting Materials

LEED EB (Existing Buildings)
Category Materials & Resources:
- Credit 2 Optimize Use of Alternative Materials
- Credit 3 Optimize Use of IAQ Compliant Products

More information on the USGBC and the LEED Rating System can be found at www.usgbc.org

Forbo Linoleum, Inc.
P.O. Box 667
Humboldt Industrial Park
Hazleton, PA 18201
ph: 570-459-0771
1-800-842-7839
fax: 570-450-0258
e-mail: info@fL-NA.com
www.forboflooringNA.com

creating better environments

05/06/80K/MDW