About Swan labelled

Floor Coverings

Draft background Document

2006-04-13

Nordic Ecolabelling

1 Introduction

Nordic Ecolabelling (the Swan ecolabel) is a voluntary, positive ecolabel for products in the Nordic region. Nordic Ecolabelling was established by the Nordic Council of Ministers in 1989. Nordic Ecolabelling has offices in the Nordic countries that have independent boards/committees with representatives on the Nordic Ecolabelling Board.

The ecolabelling criteria for floor coverings have been drawn up based on assessment of the environmental impact of a product's entire life cycle. Nordic Ecolabelling develops criteria from a life-cycle perspective. Producers and resellers of floor coverings can apply to ecolabel products. If, following an assessment by the ecolabelling body, the product criteria are fulfilled, the applicant is awarded a license permitting the use of the Swan label on the specific product.

1.1 Criteria for floor coverings

The criteria document is a draft of the ecolabelling criteria for floor coverings. Please submit your comments regarding the requirements stipulated for the ecolabelling of floor coverings.

The revised criteria shall replace "Ecolabelling of Floorings" version 3, valid until 14 December 2007.

1.2 Differences between version 3 and the draft criteria

An evaluation of version 3 of the criteria established that the following points should be reviewed:

- Differential requirements, in particular with regard to the energy requirement of different flooring types, since the product group is varied.
- Revision of the chemical requirements regarding for which materials these are used for.
- Update of forestry requirements in accordance with the evaluation from 2005.
- Evaluation of the flooring market with special interest for the ecolabelling of the floor covering types not covered by version 3 of the criteria. Assessment of special carpeting.

New requirements in the draft:

- Requirement that at least 50% by weight of the floor covering must comprise renewable raw material. This was not a requirement in version 3, but a limit for the product group.
- Revision of forestry requirements. The exemption has been removed.
- The requirement on the use content of biocides in wool fibres has been tightened.
- Requirements on synthetic fibres (polyester, polyamide and polypropylene).
- Broadening of requirements on auxiliary chemicals used for textile fibres.
- Energy requirements now include several parameters for different flooring types.

2 What can carry the Swan label?

The floor covering must be intended for indoor use and suitable for a concrete, timber joist or similar sub floor. Examples of floor coverings that can be Swan labelled include solid wood, parquet, laminate, linoleum and textile carpet (wall-to-wall or fitted carpet). The floor covering shall not have a supporting function. Nordic Ecolabelling has chosen to limit the criteria for the specific floor covering and not the underlying carrying floor structure. Floor coverings with integrated heating cannot be Swan labelled. Nordic Ecolabelling has chosen not to ecolabel floor coverings with integrated heating since Nordic Ecolabelling can not control the consumer's choice of energy for the heating. Nordic Ecolabelling can therefore not control the environmental impact for the energy used to the heating. Seamless floor coverings that are applied as a curing liquid are not covered by these ecolabelling criteria. Seamless floor coverings normally consist of a chemical product that hardens and is usually used in industrial environments.

The floor covering product group is highly varied. A floor covering can comprise of several types of material and combinations vary considerably. The product group definition of which floor coverings can be Swan labelled is changed from the definition in version 3. In version 3 the product group covered floor coverings that comprised at least 50 % by weight of renewable raw materials. This requirement is now moved to the criterias from the definition of product group.

Synthetic carpets, stone flooring and ceramic flooring such as clinker can not be ecolabelled in this draft criteria. Stone and clinker can be ecolabelled according to the European Flower ecolabel. Floor coverings applied as a liquid, which often comprise two components that chemically harden, are also excluded from the criteria.

This leaves solid wood flooring, parquet flooring, laminate flooring, linoleum, carpeting (wall-to-wall) and other floor types made of natural fibres. Nordic Ecolabelling has drawn up criteria in the aim to ecolabel the most environmentally suitable floor coverings of these types. Rugs and non-fitted carpets can be ecolabelled according to the Swan or Flower criteria for textiles.

3 Environmental impact of floor coverings

Floor coverings are manufactured from a variety of materials and the production processes used vary greatly. A short presentation of the production processes used for the flooring types that can be awarded the Swan label is provided in Appendix 1 to this background document.

Raw materials

Solid wood and laminate floorings primarily comprise wood raw materials. Forestry has an impact on the environment and sustainable forestry is a central goal. From a life-cycle viewpoint, forest management is an important aspect of a wood product's environmental impact. Unfortunately, not all forest management today is sustainable, which can lead to negative impacts such as a reduction in biodiversity, soil erosion and the repression of the indigenous population. These problems arise in the boreal forests the northern hemisphere and the rain forests of the southern hemisphere. Tropical forests are currently being felled at a high rate. Each year, roughly 150,000 square kilometres of forest are lost, an area equivalent to one third of the size of Sweden. There is a real danger that by the next generation, the tropical forests will have been lost for all time since these cannot be recreated through planting[1].

Annual crops are often cultivated with the use of pesticides. Flax cultivation, which supplies linseed oil for linoleum floor coverings, involves the use of pesticides, though crops are not generally sprayed each year. Flax cultivation that is pesticide free does exist but flooring manufacturers buy linseed oil on commodity exchanges and it is therefore difficult to trace the origin of the oil. Unlike organic cotton production, there is no system in place to enable this. Linoleum manufacturers cannot at present purchase certified organic or non-sprayed linseed oil.

Carpets are made of wool, plant fibres and synthetic fibres such as polyester, polyamide and polypropylene. Wool can contain residues of biocides with which the livestock have been treated to improve fibre quality. The most significant environmental impact from synthetic fibres is that the raw materials used consume finite oil resources. Nordic Ecolabelling limits the scope of using oil-based products by requiring that the floor covering contains at least 50% renewable raw materials.

Energy consumption in flooring production

Energy consumption in production varies widely between different types of floor covering. There are even variations between floor coverings of the same type. The choice of fuel impacts on the environment. Nordic Ecolabelling wishes to reduce the amount of energy used per area of floor covering and also the amounts of fossil fuels used.
Wood floor coverings require energy to dry the wood raw material to a suitable level of moisture and for processing. Air-drying can reduce the energy required for drying. Linoleum floor coverings require energy for processing of raw materials and

[1] Source: Website of the Swedish Society for Nature Conservation, www.snf.se

drying/curing the floor covering. In general, the consumption of purchased energy can be reduced by minimising waste in production and using waste materials for on-site energy production.

Chemicals

The surface treatment of wood floor coverings can involve the use of large quantities of volatile organic compounds (VOC) which have a significant environmental impact, such as the generation of ground ozone. VOCs are also a health hazard.

Use phase

The environmental impact of the floor covering during the use phase varies depending on the type of covering. Hard and resilient floor coverings require cleaning and carpets require vacuum cleaning. The floor covering's durability determines whether the floor covering is long or short-lived. Nordic Ecolabelling sets durability requirements to ensure that the ecolabelled flooring has a long service life.

Waste

The reuse of material or a product is prioritised over energy recovery. Energy recovery is an ultimate recycling method that utilises the embodied energy in the material. Sending waste products to a landfill site is the worst possible scenario since the resources in the floor covering's raw materials are not utilised in any way. Products that contain chlorine are difficult to recycle and reuse and thus an environmental problem during the waste management phase.

3.1 Requirements on renewable raw materials

Nordic Ecolabelling defines a sustainable society as one in which nature is not subjected to the systematic concentration of substances from the bedrock or society (see Nordic Ecolabelling's environmental philosophy). Non-renewable resources cause such concentrations when they are not recycled or reused.

The projected 50 % growth of the global population over the next 50 years will put a significant pressure on the environment. Most of the growth will be in the developing countries, which will contain 85 % of the world's population within a couple of decades. Most of the developing countries are in the phase of early industrialisation, when the building of infrastructure and heavy industry results in high demand for materials and energy and leads to environmental degradation. Moreover, their rapidly growing population will require more goods and services to support their needs. This trend will affect the use of resources and environmental pressures on a global scale[2]. In the European Commission "Green book of Integrated Product Policy" guidelines for product design are presented to promote lifecycle thinking. The guidelines are adapted to promote a more environmentally friendly design that integrates environmental aspects in the product development phase. Among other construction concepts states "design for use of renewable materials" as a road towards making

[2] Sustainable use and management of natural resources, European Environment Agency 2005

products that save resources and reduce waste, pollutants and products risks[3]. It also states design for reuse and recycling as a good construction concept.

Nordic Ecolabelling wants to promote the use of renewable raw material because the non-renewable raw materials are finite and the reuse and recycling of the non-renewable raw materials are difficult and close to nonexistent.

The collection and recycling of synthetic non-renewable floor coverings is presently very limited and in practice only carried on in small-scale trials. Polyamide recycled from carpets goes primarily to other types of products than new carpets[4]. The recycling of plastic products (including floor coverings) of PVC in Stignæs, Denmark, has been closed. This test of recycling was managed by the company RGS 90, with support from the European Commission. This justifies Nordic Ecolabelling's requirement for renewable raw materials in the ecolabelled floor coverings. Once the recycling of synthetic floor coverings is well established in the Nordic region, Nordic Ecolabelling can reappraise the requirement.

Nordic Ecolabelling has chosen the requirement of 50 % renewable resources and not 100 % since linoleum flooring contains mineral materials such as stone dust, and carpeting can contain synthetic fibres to improve durability. Nordic Ecolabelling goal is to promote renewable raw material but for this types of floor coverings it is not possible to require solely renewable raw materials.

3.2 Wood raw materials

Nordic Ecolabelling wishes to promote sustainable forestry and rewards wood raw materials derived from forests that are certified according to a forestry standard that covers economic, environmental and social aspects. Nordic Ecolabelling considers the certification of forests to be a useful tool in the transition of forest management to a more sustainable system. By combining rational forestry with new methods that better respect biodiversity, we can create forests that can be used for both production and recreation.

Nordic Ecolabelling does not have the prerequisites or resources to develop its own forestry criteria but instead requires the use of existing standards and certification systems. Requirements are placed on the process used to develop the forestry standard. Requirements are also placed on the certification system and certification body that administrate certification in accordance with the forestry standard. The overall requirements regarding standards, certification systems and certification bodies are unaltered from version 3.

In the criteria, Nordic Ecolabelling prohibits the use of wood raw material that is derived from forest environments that merit protection due to their high biological and/or social value. The licensee must know from where the wood raw material comes and declare this to the ecolabelling body. This is a so-called catch requirement,

[3] GREEN PAPER ON INTEGRATED PRODUCT POLICY, European Comission, COM (2001) 68
[4] http://www.uyseg.org/greener_industry/pages/nylon/8nylonPM3.htmhttp://www.uyseg.org/greener_industry/pages/nylon/8nylonPM3.htm

which means that Nordic Ecolabelling may revoke a licence if it becomes evident that the wood raw materials in the ecolabelled flooring are derived from protected forest environments.

If the floor covering contains more than 10 % by weight of wood raw material, at least 30 % of the annual quantity of purchased wood raw material must come from certified sustainable forests. An exemption is made for Swan-labelled chipboard and fibreboard used in the flooring since the criteria for these require 30 %. However, Swan-labelled panels can contain recycled wood raw material instead of wood from certified forests.

Furthermore, wood raw material is included as a parameter in the environmental matrix in Section 3 of the criteria. If a floor manufacturer uses more than 30% wood raw material from certified forests, this is awarded with a higher points score.

The availability of certified forest has increased over the last five years. In 2000, approximately 1.6 % of the world's forests were certified according to forest management standards. In 2005, this figure was 6 %[5]. The availability of certified wood raw material varies greatly however for different types of wood. Large areas of forest in the Nordic and Baltic countries are now certified. The Nordic countries primarily produce spruce and pine. The availability of certified hardwood is small in comparison. The majority of the certified forest can presently be found in Europe and the Nordic region, but future increases will mostly come from Russia and North America. The requirement of 30 % certified wood raw material applies to all types of wood despite the variation in supply.

Version 3 of the criteria included an exemption from forest standards and certification systems if the applicant could document that any non-certified wood raw materials came from forests fulfilling the same requirements as certified forests. This requirement has not been used by any producer of Swan-labelled floor coverings and has been removed due to the increased supply of certified wood.

3.3 Textile fibres

Requirements on plant fibres – emission of oxygen demanding substances

The production of plant fibres often involves significant emissions into wastewater of oxygen demanding substances. Nordic Ecolabelling therefore requires that the emission of oxygen demanding substances shall be reduced for plant fibres (flax, hemp, coconut and similar) and wool fibres. The content of oxygen demanding substances in wastewater shall be measured in COD or TOC by the flooring manufacturer or raw material supplier. This requirement is unchanged in this revision.

Requirements on wool fibres – biocides

The requirements on wool fibres have been tightened in version 4. The limit values for biocide residues in the wool fibres has been lowered and harmonised with the

[5] Indufor 2000 and Indufor 2005

German GUT ecolabel value. The aim of harmonisation is to simplify application for carpet producers who already use the GUT label. GUT is testing textile carpets in independent test institutions. The GUT Ecolabelling is a third party certification of carpets[6].

Requirements on synthetic carpet fibres

This draft includes additional requirements on the recycling of synthetic fibres and requirements regarding polyester, polypropylene and polyamide. The Nordic Ecolabelling criteria only cover floor coverings that comprise at least 50 % renewable raw materials, but since carpets often contain a mixture of synthetic fibres and wool, Nordic Ecolabelling has decided to set requirements for these fibres. The requirements on polyester and polyamide are taken from the European Flower textile criteria, and the requirement on polypropylene comes from both the Swan requirements for hygiene products and Flower textile criteria.

The synthetic fibre must contain at least 50 % recycled material to increase the recycling of plastics. There are existing plastic collection systems, such as monitored packaging collection, which provides a high-quality, clean recycled raw material. Recycled plastic refers to plastic derived from used products or packaging. Recycling plastics reduces the use of oil and energy in the production of new polymers, and also reduces the quantity of plastic waste produced. The environmental gains depend on the type of plastic, how clean the plastic is and how much washing is required. They also depend on the recycling system used. Energy and chemical recovery remove the plastic from the cycle, while material recycling means that the plastic can be used several times before it is sent for energy recovering or splitting.

Recycled plastics are used in several product areas in the Nordic region. Recycled polyamide is, for example, used in carpeting from Interface. Recycled materials are however uncommon among carpeting manufacturers. Nordic Ecolabelling has chosen to require a level of 50 % to allow the addition of virgin material, which may be necessary for strength and durability.

Some manufacturers that Nordic Ecolabelling has spoken with say that it would be advantageous to relax the quality requirement on recycled plastics to reduce the degree of sorting. An increase in the thickness of plastic products can provide economic and environmental gains due to the physical properties of recycled plastics. According to a report from the Association of Plastics Manufacturers in Europe (APME), 2000 saw a 17 % increase in mechanically recycled used plastic products in Europe. This increase is said to be a result of higher commodity prices and better collection systems. Nordic Ecolabelling does not consider internal production waste to be a source of recycled plastic.

No requirements are set as to the content of heavy metals or other ecotoxic substances in the recycled plastic. The spread of brominated flame retardants through recycled plastics is a point of discussion in the industry. However, there are no regular analyses of recycled plastics to monitor the content of toxic and ecotoxic substances.

[6] Information from GUT homepage (http://193.201.162.104/index.asp).

Requirements on polyamide, polyester and polypropylene

Requirements have been added for the three fibres types normally found in fitted carpets. The requirements on polyester and polyamide are taken from the European Flower textile criteria. The requirements on polypropylene come from Flower textile criteria and the Swan requirements for hygiene products (emission of NO_x and SO_2).

Polyester fibres in ecolabelled floor coverings must be produced with limited amounts of antimony. Antimony is a toxic semimetal that is used as a catalyst. The polyester fibre must contain less than 260 ppm of antimony. Antimony-free polyester fibre exists, but the supply is currently so low that Nordic Ecolabelling cannot demand the use of such polyester.

Nordic Ecolabelling sets requirements limiting the emission of nitrogen dioxide (N_2O) from polyamide production. Nitrogen dioxide is a greenhouse gas that is 270 times more damaging than carbon dioxide. Nitrogen dioxide also depletes the ozone layer. The two greatest industrial sources of N_2O are the production of nitric acid (HNO_3) and adipic acid. Adipic acid is created in a two-stage process where HNO_3 is used in the second stage and is the cause of the N_2O emissions. Adipic acid is primarily used in the production of polyamide. Emissions of N_2O have been reduced in recent years through thermal and catalytic cracking, especially in the production of adipic acid. In the next revision, it will be evaluated whether it is possible to set requirements on caprolactam and other volatile organic compounds used in the production of polyamide.

For polypropylene, Nordic Ecolabelling requires low emission levels of nitrous oxides (NO_x) and sulphur dioxide (SO_2).

Auxiliary chemicals

Version 4 of the floor covering criteria includes tightened requirements on which auxiliary chemicals may be used in the production of carpeting. In previous requirements, Alkylphenolethoxylates (APEO), alkylbenzen sulfonates (LAS) and ethyl diamine tetracetate (EDTA) were prohibited. Version 4 stipulates that neither these chemicals nor di(hydrogenated tallow alkyl) dimethyl ammonium chloride (DHTDMAC), distearyldimethyl ammonium chloride (DSDMAC), ditallow dimethyl ammonium chloride (DTDMAC), and diethylene triamine pentaacetate (DTPA) may be used or be an ingredient in any preparation or substance that is used. Cleaning using organic solvents is also prohibited in version 4. The requirements have been harmonised with European Flower criteria.

Requirements on foam rubber

Foam rubber may be used as a backing on carpets. There are two common types of backing: foam rubber and woven textile. The greater part of the carpets that are sold in the Nordics countries have a backing of woven polypropylene or polyester. When foam rubber is used, latex foam or polyurethane is used. According to contact with carpet producers latex is usually used as backing when foam rubber is used in the Nordic countries, but it is not common. There are carpets in USA that have polyurethane as backing. There are environmental issues connected with production of latex and polyurethane and it is therefore justified to set environmental

requirements, such as in the Flower criteria for mattresses. However, a latex backing can make the use of at least 50% renewable fibre (wool) difficult. Subsequently, the requirement on latex is unlikely to have any effect on the product group.

Nordic Ecolabelling requires low emissions of oxygen demanding substances during foam rubber production. The content of 1,3-butadiene in latex must be low. 1,3-butadiene is a volatile hydrocarbon used as an industrial monomer in the production of synthetic rubber. 1,3-butadiene is classed as carcinogenic. CFC, HCFC, HFC and methylene chloride must not be used for foaming of the polyurethane. These substances are stable organic compounds that intensify the greenhouse effect and deplete the ozone layer. It is also suspected that methylene chloride is carcinogenic (Carc.3 and R40).

3.4 Requirements on chemical products

Chemical products that are classified as carcinogenic, toxic for reproduction or mutagenic must not actively be added to the floor covering. A content of 0.1% is sometimes sufficient for a chemical product to be classified accordingly, but a floor covering is not a chemical product and cannot be classified according to European regulations. The ecolabelling criteria for floor coverings also include limit values for the quantities of substances added to the floor covering that are classified as ecotoxic or allergenic. Nordic Ecolabelling aims to limit the quantities of ecotoxic and toxic substances in the floor covering.

Flame retardants

There are several types of substance that can help prevent the floor from catching fire. According the Danish Environmental Protection Agency, there are 40 commercial groups of brominated flame retardants, of which 13 are used in Denmark. The most common are tetrabromobisphenol A (TBBPA), polybrominated diphenylether (PBDE), polybrominated biphenyls (PBB) and hexabromocyclododecane (HBCD).

Different brominated flame retardants have varying effects on health and the environment. Some substances are long lived and suspected to cause heritable genetic damage. The Danish Environmental Protection Agency lists PBB and PBDE as the most problematic substances. The European Union prohibited the use of penta-BDE and octo-BDE as of 1 July 2004.

There are alternative flame retardants that are used by several manufacturers. The majority of flame retardants are used in electronic products, but also in textiles, furniture and floor coverings (especially carpets)[7].

Version 3 of the floor covering criteria prohibited the addition of halogenated flame retardants and polybrominated diphenylethers. Polybrominated diphenylethers (PBDE) are however also halogenated flame retardants and thus unnecessary to name separately.

[7] Sources include: Environmental Project 494, 1999, “Brominated Flame Retardants”, Danish EPA. Environmental Project 568, 2000, “Brominated flame retardants; Toxicity and Ecotoxicity” Danish EPA and www.mst.dk.

Chloroparaffins are used as flame retardants but also as process plastic softeners. This requirement is unchanged.

Phthalates

In addition to the requirements on substances known to be toxic, requirements are set of substances that are suspected to have harmful effects. The aim of ecolabelling is t to impose stricter limits than legislated. Phthalates are suspected to have harmful effects. Industrial stakeholders have pointed out that DINP and DIDP should be accepted since these are not classified according to EU regulations.

Heavy metals

Above certain concentrations, heavy metals are toxic to plants, animals and humans. This applies especially to mercury, cadmium and lead. Several of these substances can accumulate in living tissue and remain there for very long periods of time.
A basic principle is that ecolabelled floor coverings should not contain heavy metals. However, raw materials may contain impurities. These impurities are not added actively and are difficult to avoid[8].

Persistent and long-lived organic substances

Nordic Ecolabelling has added a requirement in this draft criteria. Organic substances that are very persistent, highly bioaccumulating or persistent, bioaccumulating and toxic should not be added to the floor covering. This requirement should be certified by the supplier of chemical products. This requirement is harmonized with the Swedish BASTA systems requirement. The Swedish construction sector has agreed on a common definition of the substance properties for the decision as to whether a product is to be accepted or not. The purpose of the BASTA system is to eliminate hazardous substances from building materials. The burden of proof in the BASTA system is put on the supplier, who has to confirm whether the product meets the criteria or not. A system of self-declaration of this kind needs to be supplemented by a quality assuring auditing[9].

Azo dyes

Azo dyes include several types of substances. Some may cause environmental problems, such as substances that degrade forming carcinogenic arylamines and substances that are harmful to the aquatic environment. Azo dyes are primarily used for colouring textiles, but also plastics and leather. Azo pigments are primarily used in the painting/coating industry, graphic production and plastic industry (Source: ”Survey of azo-colorants in Denmark”, Danish Technological Institute, published by the Danish Environmental Protection Agency, 1999). Subsequently, requirements are only set for azo dyes used for textile fibres.

The use of azo dyes is controlled by EU regulations. Several azo substances are prohibited for products that are in prolonged contact with the skin. The same azo colourants are prohibited by Nordic Ecolabelling from use in floor coverings.

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[8] Golvbranschens Riksorganisation, Sweden, 1993.

[9] Information from Swedish construction sectors phase out-of hazardous substances (http://www.bastaonline.se)

Formaldehyde

The emission of formaldehyde from products affects the environment and health and should therefore be avoided or minimised. Adhesives in panels and coatings are the primary sources of formaldehyde in wood products. Products containing formaldehyde have in the past been used on carpets, but this is no longer the case. There are no satisfactory alternatives to formaldehyde adhesives for fibreboards. A previous alternative has been isocyanate adhesives, but these also have negative health effects. It is however possible to limit the emission of formaldehyde from the fibreboards.

All the Nordic countries require low formaldehyde emissions from fibreboards. The requirement set by Nordic Ecolabelling applies to the entire floor covering.

If the only source of formaldehyde is a fibreboard (e.g. chipboard, plywood or MDF) it is sufficient to document the emissions from the board.

Organic solvent emissions (varnish)

Organic solvents give rise to volatile organic compounds (VOC) which in turn produce ground ozone. Ground ozone is produced by a photochemical reaction between volatile hydrocarbons and nitrous oxides. Ozone is one of several photochemical oxidants. Ground ozone is harmful to vegetation, materials and human health. The American Environmental Protection Agency (EVA) estimates that damage to crops in the USA caused by ground ozone total several billion dollars each year.

The most significant source of VOCs from floor covings is the emission of solvents from surface treatments (varnish and oil). Solvent-based varnishes contain 70-80% VOCs, water-based varnishes 0-10% VOCs and UV-hardened varnishes 0-5% VOCs. The emission of VOCs can be reduced through the selection of surface treatment product or purification. Nordic Ecolabelling’s requirements are flexible. For some producers it may be simplest to declare the content of the surface treatments. A requirement formulated in grams per square meter enables the use of surface treatments containing varying amounts of solvents.

Documentation for chemical products

In most cases, a data sheet detailing the properties of the chemical product is required. The producer or supplier of the chemical product must supply this data sheet. In the European Union, the producer must always supply customers with a material safety data sheet.

This data sheet has different names in the Nordic countries: “16 punkts sikkerhedsdatablad” in Danish, “16 punkters varuinformationsblad” in Swedish and “Material Safety Data Sheet” in English. Nordic Ecolabelling assumes that the material safety data sheet is up to date.

3.5 Requirements on raw materials and energy

Nordic Ecolabelling has revised the energy requirements in version 3.
In version 3, the energy consumption requirement was specified as a formula containing the weighted consumption of fuel and electricity.

$$E = \frac{\text{Purchased electricity}}{10\ \text{kWh/m2}} + \frac{Fuel}{20\ \text{kWh/m2}}$$

Limits were also set for CO_2 emissions and the sulphur content of fuel to limit the use of fossil fuels.

A matrix or formula provides greater flexibility for the flooring manufacturer. If opportunities to limit electricity consumption are limited, fuel consumption can be reduced instead. Several other parameters have been added into the formula above and additional requirements have been defined for different types of floor covering. Since different floor coverings require different amounts of energy and different raw materials, it is only logical to set different requirements.

Nordic Ecolabelling wishes by this to enable the ecolabelling of the environmentally best floor coverings within each floor covering type: solid wood, laminate, linoleum and carpeting. In addition to the aforementioned environmental parameters (fuel and electricity), the use of renewable fuels, wood raw material from certified forests and recovered wood raw material in wood and laminate flooring are encouraged. For linoleum and carpeting, the use of renewable fuel and renewable raw materials are encouraged. The use of recycled non-renewable raw materials is also rewarded.

The formula for the new requirement is given below. An example of the energy consumption of various floor covering types is given at the end of Appendix 1.

Solid wood and laminate floor coverings

$$P = \frac{\text{A}}{25} + \frac{B}{25} + \frac{C}{25} + (4 - \frac{D}{5}) + (4 - \frac{E}{12.5})$$

Requirement: P = 11.5

Environmental parameter	Requirement
A = Wood from certified, sustainable forest[1] (%)	Min. 30%
B = Proportion of recycled wood raw materials[2] (%)	
C = Proportion of renewable fuels[3] (%)	
D= Electricity consumption (kWh/m^2)	Max. 20 kWh/m^2
E= Fuel consumption (kWh/m^2)	Max. 50 kWh/m^2

[1] Annual proportion of wood raw material from certified forests
[2] Recycled wood raw materials = Residual products from other industry and post-consumer materials
[3] Renewable fuel = Fuels other than fossil fuels and peat.

Linoleum floor coverings:

$$P = \frac{A}{25} + \frac{B}{25} + (4 - \frac{C}{5}) + (4 - \frac{D}{12.5}) \qquad \textbf{Requirement: P = 9.0}$$

Environmental parameter	Requirement
A = Proportion of renewable raw materials and recycled non-renewable raw materials (%)	Min. 50%
B = Proportion of renewable fuels (%)	
C= Electricity consumption (kWh/m^2)	Max. 20 kWh/m^2
D= Fuel consumption (kWh/m^2)	Max. 50 kWh/m^2

Textile floor coverings:

$$P = \frac{A}{25} + \frac{B}{25} + (4 - \frac{C}{5}) + (4 - \frac{D}{12.5}) \qquad \textbf{Requirement: P = 9.0}$$

Environmental parameter	Requirement
A = Proportion of renewable raw materials and recycled non-renewable raw materials (%)	Min. 50%
B = Proportion of renewable fuels (%)	
C= Electricity consumption (kWh/m^2)	Max. 20 kWh/m^2
D= Fuel consumption (kWh/m^2)	Max. 50 kWh/m^2

Example of calculations for a wooden floor covering:

Wood from certified, sustainable forest: 55%.

Recycled wood raw materials: 0%.

Proportion of renewable fuels: 95%.

Electricity consumption: 5 kWh/m^2.

Fuel consumption: 15 kWh/m^2.

$P = \frac{55}{25} + \frac{0}{25} + \frac{95}{25} + (4 - \frac{5}{5}) + (4 - \frac{15}{12,5})$ = 11.8 The floor covering fulfils the requirement

3.6 Requirements on waste management

The waste management requirement aims to ensure that waste material from production is recycled as energy if not recycled as raw material. The floor covering must not produce special waste or require special waste handling in any Nordic country. This requirement is changed in this revision.

Soft PVC is to be treated on landfill in Denmark when it is a waste. There are systems for recycling but it is only in small scale. The plant in Stigsnæs in Denmark that was

supposed to recycle PVC in Denmark has been closed. PVC is considered as a problem waste in Denmark and is not wanted for energy recycling. This is supported in the “Green Paper- Environmental Issues of PVC” the European Commission 2000. Approximately 50 % of the chloride ion from incineration plants in Europe comes from PVC. The biggest problems with PVC in incineration plants are: 1) emissions of dioxins and 2) generation of depositions from hydrochloric acid-neutralization. A few incineration plants have technology that recycles hydrochloric acid, but most of the incineration plants in Europe can not recycle hydrochloric acid and must neutralize it with lime. The neutralization with lime creates a big waste problem. The waste is sometimes bigger than the originally PVC waste.

3.7 Requirements on durability

The durability of the flooring is of great significance for the use of resources and the service life of the floor covering. Wear resistance should however be suited to the intended area of use of the floor covering. The floor covering should offer good general wear resistance since the use of rooms in houses can change over the flooring’s service life. The surface of flooring varies greatly, which is reflected by different test and limits for different types of floor covering.

The durability requirement is unchanged in this revision. The classification for the test method of varnished wood flooring has been updated.

APPENDIX 1 Flooring production methods

1 WOOD FLOORING

There follows a short description and simplified flow diagrams.

- Wood flooring can vary in its structure:
- Solid wood flooring made of one type of wood and with a varnish or oil surface treatment.
- Several solid wood types glued together and with or without a varnish or oil finish.
- Laminate flooring, of which the top layer is plastic with various fillers and pigments. The structure is made of chipboard or fibreboard, solid wood or a combination.

The production of solid wood flooring is relatively simple (Figure 23). However, trees require planting, growing, thinning and felling, the ground cultivation and replanting or natural regeneration. After felling, the logs are transported to sawmills for barking, sawing and drying (Jonsson *et al*, 1997).

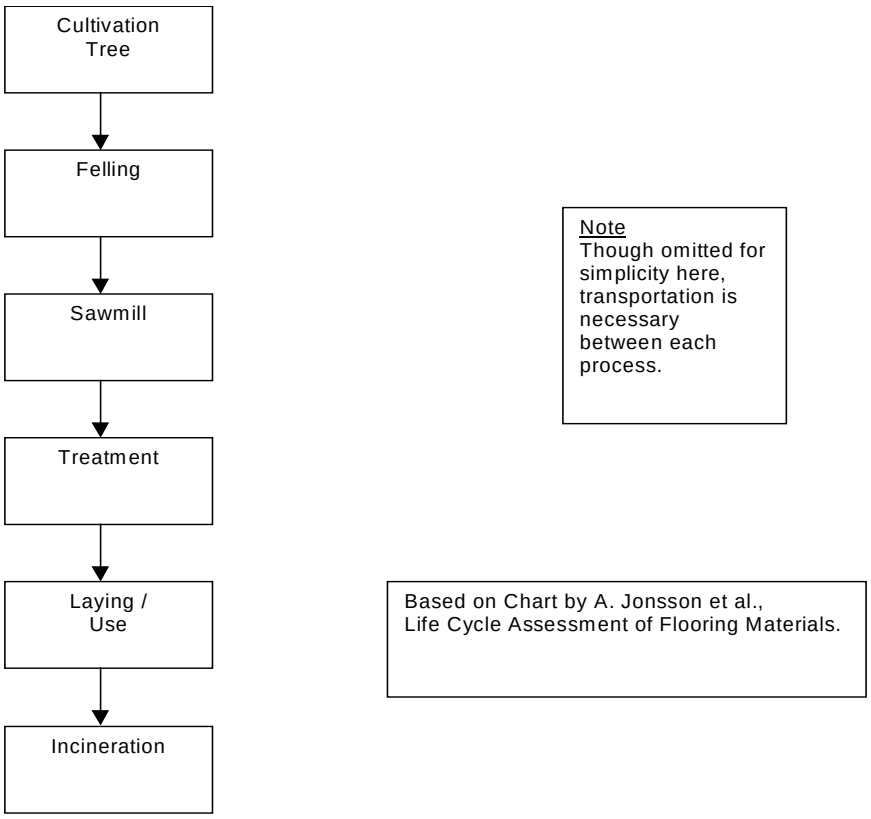
At certain times of the year, felled trees risk attack from pests and fungi. In Danish and other Nordic forests, coniferous trees are attacked by beetles and deciduous trees by fungi (blue-stain). In this past, this has been combated with chemicals and pesticides. This is no longer done, partly since the use of these preparations is now forbidden. Instead, the logs are transported soon after felling (during high-risk periods) to the sawmills and dried. Beetles destroy the wood, while the effect of the blue-stain fungus is only cosmetic. (G. Jensen, 1999)

The energy consumption of forest management for felling and transport is estimated in by A Evald (1993) to 0.213 – 0.380 MJ/kg raw wood (0.059 – 0.106 kWh/kg). A Norwegian evaluation cited by Evald estimates the total energy consumption to be 0.12 GJ/m3 raw wood, which is equivalent to 0.245-0.279 MJ/kg for spruce and pine.

Drying the wood is energy consuming. Air drying is uncommon in the Nordic region but does occur. It is often possible for a sawmill to cover its energy requirement with waste and excess wood. A Norwegian investigation states that drying requires 365 kWh/m3 (1.31 GJ/m3) (Norsk Treteknisk Institut, cited from A Evald 1993). For spruce this figure is 0.849 kWh/kg and for pine 0.745 kWh/kg. This investigation covered wood for construction purposes.

The type of solid wood floor described by Jonsson et al (1997) is not treated further, simply transported to the customer and fitted. Several types of wood flooring require an intermediate process step. This may include coating with oil or varnish. (J C. Powell et al.)

Figure: Flowchart for solid wood flooring production (excluding surface treatment)



Processing and coating of wood flooring.
Wood flooring may be untreated, luted, varnished or oiled.
The upper surface of the floor covering is sanded. The sawdust from sanding must be extracted to ensure a good working environment. The sawdust can be incinerated and the energy recovered.

The most significant use and emissions of VOCs come from the surface treatment of the flooring (varnishing, oiling). Oxygen-curing varnish and polyurethane (PUR) contain 55-70% VOCs and nitrocellulose varnish 70-80% VOCs. UV-curing varnishes (normally acrylic) generally contain 0-5% VOCs and water-based coatings 0-10%.

3.7.1 References

A Evald. ”Miljøforhold ved træbaserede produkter”. dk-TEKNIK. Work report from the Danish Environmental Protection Agency no. 3, 1993.
Å Jönsson. ”Life Cycle Assessment of Flooring Materials”. Chalmers University of Technology, Sweden. Report 1995:3
J Potting and K Blok. Life-cycle assessment of four types of floor covering. Utrecht University, The Netherlands. August 1994 (published 1995?)
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“Feasibility study of wall and floor coverings with a view to establishing EU eco-labelling criteria”, issued 22.3.2000.
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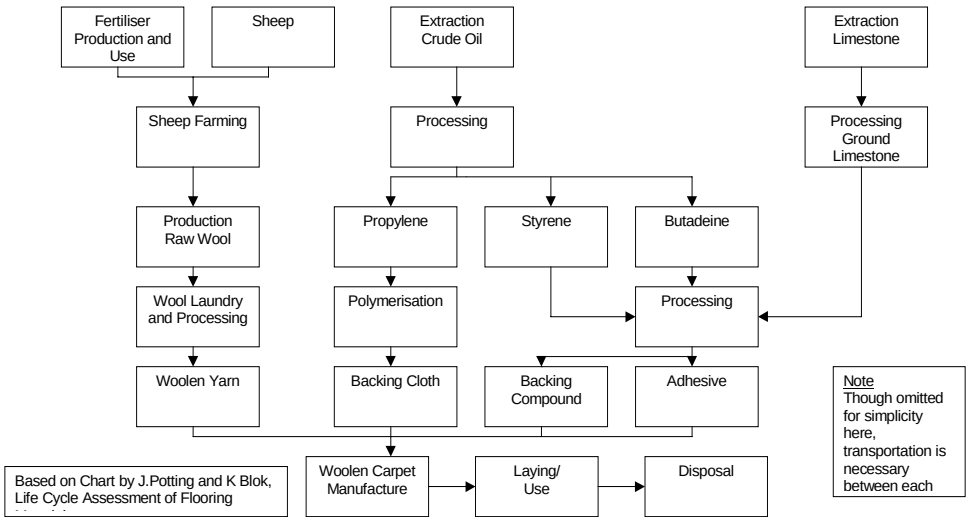
Georg Jensen. Danish Forest and Nature Agency, Danish Ministry of the Environment. February 1999. Personal communication.

2 CARPETS

Roughly 85% of floor carpets are tufted with a polyamide or woollen yarn. Polypropylene is used for the backing weave and styrene butadiene rubber (SBR) mixed with limestone/chalk used as a non-slip foam backing. The production of tufted carpets can be divided into three processes: tufting, dying and backing. The tufting process employs a tufting machine with many needles that are used to attach the yarn to the backing weave. The product is then dyed unless the yarn was previously dyed. The backing weave is then coated with adhesive and foam or a secondary backing. Figure 1 and 2 provide a flowchart for the production process. Carpets with a polyamide pile weigh roughly 600 g/m^2 and wool carpets 950 g/m^2. (J C. Powell et al.)

Special additives may be added to the carpet. In a test of English carpets, Permethrin (a pesticide against mites) was found in three of eight samples and brominated flame retardants (BDE-209) in one. Two carpets contained organic tin compounds, probably to combat bacteria, mites, mould and suchlike. (Greenpeace, 2000)

Figure: Flowchart of wool carpet production
(J C. Powell et al.)



3.7.2 References

Å Jönsson. ”Life Cycle Assessemnt of Flooring Materials”. Chalmers University of Technology, Sweden. Report 1995:3

J Potting and K Blok. Life-cycle assessment of four types of floor covering. Utrecht University, The Netherlands. August 1994 (published 1995?)

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Greenpeace Research Laboratories, University of Exeter, UK. ”Poison Underfoot – Hazardous Chemicals in PVC Flooring and Hazardous Chemicals in Carpets” November 29 2000.

3 LINOLEUM

Linoleum comprises a resilient layer of linoleum compound on a jute backing. Fibreglass backing is used for linoleum tiles to offer better form stability. The compound is a mixture of linseed oil (27 %), colophony (resin from coniferous trees) (8 %), limestone (10 %), wood meal (10 %), cork meal (10 %) and pigment (5 %). Jute weave makes up roughly 10% by weight, depending on the thickness of the flooring. Linseed oil and colophony are oxidised (aerated) and then mixed with the other ingredients (Potting & Blok, 1995). Titanium dioxide is the most commonly used pigment (Jonsson *et al*, 1997). The mixture is pressed with a metal roller onto a woven backing or jute and then dried. Drying is performed in large kilns and takes roughly one hour. After drying, the flooring is finished with an acrylate dispersion (Potting & Blok, 1995). Offcuts are recycled to varying degrees in production. A flowchart of production is provided in Figure 16. Domestic linoleum weighs roughly 2300 g/m^2.

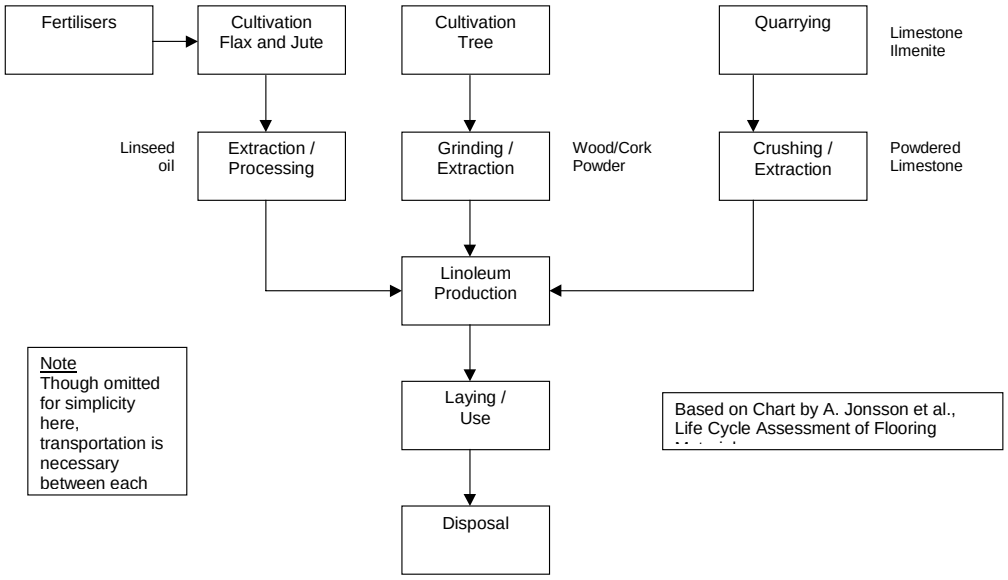

Figure: Flowchart of linoleum production

References

J C. Powell, I Lorenzoni and O White.
"Feasibility study of wall and floor coverings with a view to establishing EU eco-labelling criteria", issued 22.3.2000.
The centre for social and economic research on the global environment; School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK.

Energy consumption in flooring production	Ceramic CCHöganäs (S) [1] glazed/unglazed	Ceramic CCHöganäs (S) [13]	Ceramic Tiles [14] glazed/unglazed	Linoleum Forbo [2]	Solid wood [2] Siljan Trägolv	Parquet Beech [10]	Parquet [12] Beech, solid	Plastic/PVC Tarkett [2] (Ronneby)	Carpet [6] Wool	Carpet [6] Polyamide
Total energy, kWh/m^2 flooring:	81.1/ 80.7	99	17.2 - 44	11.5 [3]	13.7 [4]	422.2 [11]	78.8	12.4	23.6 [7]	46.1 [8]
- Electricity consumption, kWh/m^2 flooring	?	21	?	4.5 [3]	2.3	?	17.9	5.1	approx. 0 [9]	approx. 0 [9]
Fuel consumption (oil, gas, coke, etc.) kWh/m^2 flooring	?	78	?	6.9[3]	11.3	?	66.8	7.36	23.6	46.1
- % biofuel or other renewable energy source	approx. 0	0	approx. 0	72 %	?	?	approx. 100%	0	?	?

Notes:
Data taken from generally available reports and similar:

1) CC Höganäs Byggkeramik AB, Ekeby, Sverige, data sheet, building material declaration. June 1999.
Ceramic tiles: Glazed: Raw material extraction: 1.1 kWh/m2, Production (moulding and firing): 80 kWh/m^2.
Unglazed Raw material extraction: 0.7 kWh/m^2. Production (moulding and firing): 80 kWh/m^2.
Energy sources: Diesel, oil and electricity - no specification of processes and quantities.
See also note 13.
2) Source: Licentiate report from Chalmers University of Technology: "Life Cycle Assessment of Flooring Materials", Åsa Jönsson, 1995.
3) Total 41.3 MJ/m2. Embodied energy: 45.2 MJ/m2 (feedstock energy 28.8 MJ/m2)
Raw materials: Linseed oil: 3.87 MJ/kg = 1.1 kWh/kg. Distribution: 0.54 MJ electricity, 0.65 MJ diesel, 2.68 MJ oil.
Production: Natural gas is used for the production of steam in the flooring's production process (13.5 MJ/m2), electricity: 6.5/m^2. Thickness 2 mm.
4) Total: 49.2 MJ/m^2. Embodied energy 126 MJ/m2 (feedstock energy 113 MJ/m2)
Raw materials: Fossil fuels for felling and transportation: 5.39 kWh/m2 = 1.5 kWh/m2
Production: Sawmill: electricity: 8.37 MJ/m2 (= 2.3 kWh) and biofuels from the sawmill: 35.4 kWh/m2 (= 9.8 kWh/m2)
5) Total: 44.7 MJ/m^2. Embodied energy: 27.3 MJ (feedstock energy 16 MJ/m2)
Raw materials: Monomer oil and gas: 26.5 , PVC polymerisation: 5.46 MJ/m^2.
Production: electricity: 33.3 kWh/m2 (= 9.2 kWh/m2)
6) Source: Utrecht University, Department of Science, Technology and Society. "Life-cycle assessment of four types of floor covering". José Potting and Kornelis Blok. 1994.
7) Embodied energy of 48.4 MJ/m2 not included.
8) Embodied energy of 154.3 MJ/m2 not included.
9) In the summary inventory, electricity consumption is listed as negative. The article is very brief and the reason is not clearly explained. Possibly since embodied energy that is recovered is included in the calculation. However, feedstock energy is specified separately.
10) Source: www.trae.dk/leksikon Energiforbrug i træs livscyklus. CowiConsult, Dec. 1998
11) Total energy consumption specified as 6.6 GJ/m^3. Assumed that 0.23 m^3 is used per m^2. This includes waste that should be used for other items. No specification as to the distribution of energy sources. No details of the source of production data.
12) "Livscyklusvurdering af gulvmaterialer – bøgeparket og laminatgulv" Special course. Study report. Institute of product development, Technical University of Denmark, T L Hansen and AL Niemann, 1999.
13) CC Höganäs Byggkeramik AB, Ekeby, Sverige. Environmental report. Internal address: www.cchoganas.se. Dec. 1996. Unpublished.
14) ANPA (Italian EPA), 1993. Quoted from [1] Source:
"Feasibility study of wall and floor coverings with a view to establishing EU eco-labelling criteria", issued 22.3.2000.
J C. Powell, I Lorenzoni and O White. The centre for social and economic research on the global environment; School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK.
Energy given as: 62-158 MJ/m^2.