

Chemical requirements for other articles – a screening



Study commissioned by:
The Consumer Council at the Austrian Standards Institute
and funded by
the Austrian Ministry of Labour, Social Affairs and Consumer Protection

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Final report
26 NOVEMBER 2014

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Introduction

The current regulatory framework in the European Union to protect consumers from chemicals contained in consumer articles has been found insufficient in previous review studies commissioned by The Consumer Council at the Austrian Standards Institute (ASI) and funded by the Austrian Ministry of Labour, Social Affairs and Consumer Protection.

In this introduction, a summary of these studies will be presented and their conclusions will be compared to the European Commission's future intentions for chemicals in products.

1.1 Conclusions from former studies

1.1.1 Summary of ASI Consumer Council studies part I and II

The aims of the two former studies prepared for the ASI Consumer Council (Part I and II (Poulsen et al., 2010; Poulsen and Strandesen, 2011)) were to (ANEC Position Paper, 2011):

- Review the chemical requirements in selected product legislation (19 different in all). Some of them were:
 - General Product Safety Directive
 - REACH
 - Toy Safety Directive
 - Personal Protective Equipment Directive
 - RoHS
 - Food Contact Materials legislation
 - Packaging and Packaging Waste Directive
 - Ecodesign requirements for Energy-related Products Directive
- Identify and discuss the gaps in this European legal framework.
- Review in greater detail the provisions of REACH with respect to consumer products/articles.
- Provide recommendations for addressing chemicals in products in a consistent manner through changes in the European regulatory framework.

The two studies revealed common deficiencies in the selected consumer products regulation. These common deficiencies are listed in the box below.

- 1. In general few chemical requirements in consumer product regulation**

When it comes to chemical restrictions in the European consumer products regulation, they are either non-existent or limited to a few chemicals or general statements. Of the 19 reviewed legislations the Food Contact Materials regulation is the only regulation relating to articles which establishes a positive list system.

The Toy Safety Directive is not sufficiently ambitious (e.g. a high content of CMR substances is allowed and several other categories of dangerous substances are not even mentioned).

In REACH consumer articles are hardly addressed.
- 2. Use of weak phrases instead of specific limit values**

Weak phrases such as 'must be safe' are often used. This is a problem since companies have difficulties in understanding how they should secure compliance.
- 3. Ad hoc based regulation**

Meaning that chemicals are only regulated when they *have proven* to be problematic. The reverse approach – i.e. the use of positive lists – is encouraged.
- 4. Only a small number of products/chemicals covered by regulations**

Existing regulation only covers a small amount of the products/chemicals on the market. This is partly due to the fact that creating/amending regulations is a time-consuming task.
- 5. Insufficient market surveillance of consumer products**

A more efficient market surveillance system is needed – i.e. a system that not only checks for compliance, but also reports back to decision makers how to amend the regulations.
- 6. Multiple exposures not considered in all cases**

Some directives, e.g. the Toys Directive, take into account that exposures to the same substance may occur from other products as well. This is often done by using a fraction of the Tolerable Daily Intake value. However, in general multiple exposures are not considered in the selected regulations. This creates a significant underestimation of the risk associated with the amount of chemicals in the different products.
- 7. Combination effects are not considered**

Combination effects are not considered, however, this issue is even more complex than multiple exposures since it requires the knowledge of how chemicals interact with each other. This information is not available.
- 8. Lack of information on chemicals in consumer products**

Today we only have profound knowledge of very few of the more than 110,000 chemicals used in today's manufacturing practices. This will slowly change as REACH is implemented, but for many years to come our toxicological knowledge of the majority of chemicals is limited.
- 9. Nanosubstances are currently not regulated properly**

A large number of challenges are related to the use and regulation of nanosubstances; among these the lack of suitable measurement methods and proper toxicological evaluations is found. This makes it difficult to regulate nanosubstances in a proper manner.
- 10. Limitations in the regulatory frame**

A major limitation in the regulatory framework is the general lack of comitology procedures that allow for a quick and easy amendment of requirements in the different Directives. Only the new Toy Safety Directive and the revised RoHS Directive make use of comitology procedures, however, only in certain areas. For example, the Toy Safety Directive has a comitology procedure in place but only for toys intended to be used by children below the age of 36 months and for mouthed toys. When a comitology procedure is not in place, the amendment of the Directive becomes a long and tedious process.

The aforementioned studies thus demonstrated that the current European legal framework concerning chemicals in products is insufficient. There is a lack of insurance for a high level of safety to consumers. These studies concluded that the adoption of a new regulatory framework – or serious amendment of the existing - for chemicals in consumer products is necessary.

The following options for the changes in the regulatory framework were discussed:

- a. Expand/revise existing product directives to (adequately) cover chemicals in all relevant consumer products.
- b. Introduce specific chemical legislation for every sector following the RoHS model with legislation targeted the sector of the electronic products sector.
- c. Adopt a horizontal directive for chemicals in products.
- d. Extend REACH to address chemicals in consumer products in a comprehensive way.
- e. Extend the Energy-Related Products (ERP) Directive to include generic and specific chemical restrictions, in principle, for all product groups.

It was concluded that the option of expanding the ERP Directive to cover restrictions for chemicals in all products represented the best possibility of combining a horizontal approach for chemicals and other environmental aspects with a product specific dimension. However, it is an option that requires significant changes of the existing legislation, but this would be the case for any option chosen. The other framework suggestions discussed would either require an entire new Directive/Regulation or major changes in existing Directives, having no comitology procedures in place. Both of these aspects would result in very lengthy procedures.

The main conclusions were to:

- Generally strengthen the chemical requirements in product legislation as chemical requirements are few or in some cases non-existent.
- Use a horizontal approach for setting chemical requirements, i.e. generic chemical requirements, by the use of, for example, positive lists, and at the same time, allow for exemptions if a risk assessment conducted by a scientific committee, e.g. SCHER, considers the use of a specific substance in a specific product/material for safe.
- Introduce a comitology procedure in all product legislations so it will be possible to quickly adopt new chemical requirements or alter existing limit values when new information is available.
- Strengthen the market surveillance of consumer products.

1.1.2 Summary of ASI Consumer Council study part III

The first two ASI Consumer Council studies “Chemical requirements for consumer products” Part I and II were followed by a third study – Part III (Strandesen and Poulsen, 2012). The purpose of this study was a first attempt to propose chemical requirements for eight different consumer products areas:

- Materials in contact with drinking water
- Food contact materials
- Packaging materials
- Emissions to indoor air from indoor materials

- Personal protective equipment
- Clothing
- Products for children
- Electric and electronic equipment
- Flame retardants in various products

As several product areas were covered, there was no in-depth investigation of each area but more general suggestions were made for requirements (limit values) for different chemicals.

It was once again emphasised that the following elements should be used to strengthen the product regulation in general:

- Introduce a comitology procedure in all product legislations.
- Strengthen the market surveillance of consumer products.
- Generally strengthen the chemical requirements in product legislation.

1.1.3 Summary of ASI Consumer Council study part IV

In order to go more in depth with chemical requirements for products for children, the Consumer Council at the Austrian Standards Institute (ASI) first commissioned a study (funded by the Austrian Ministry of Labour, Social Affairs and Consumer Protection) on “Chemical requirements for toys” (Poulsen, 2013). The aim of this project was to investigate chemical requirements for toys in details and use existing risk assessments of chemicals to suggest new chemical requirements for toys for several chemicals. This study was among other things commissioned because the chemical requirements for toys have been discussed intensely in recent years and also after adoption of the new Toy Safety Directive (2009/48/EC). Improvements in the form of more and stricter chemical requirements were made in some areas, where the new Toy Safety Directive has been criticised for not being strict enough.

In this project “Chemical requirements for toys”, new limits were suggested for existing restricted chemicals in toys as well as new chemicals restrictions. This was done by a review and a discussion of the available scientific literature on the ‘necessary or needed’ levels of requirements of specific chemicals to ensure the safety of children when using toys.

1.1.4 Summary of ASI Consumer Council study part V

The Consumer Council at the Austrian Standards Institute (ASI) later commissioned a second study (funded by the Austrian Ministry of Labour, Social Affairs and Consumer Protection) on products for children that should cover child use and care articles, i.e. non-toy related products. The project was named “Chemical requirements for child use and care articles” (Poulsen & Strandesen, 2014). The aim of this project was to investigate the chemical requirements (or lack of chemical requirements) set for child use and care articles and suggest new chemical requirements for these articles for several chemicals. The chemical requirements suggested for toys in the ASI Consumer Council study part IV on toys were used as a basis.

1.1.5 General conclusions from all studies

The conclusions from the previous studies clearly indicate that in general there is a lack of chemical requirements for many different types of consumer products. In some areas (especially toys and food contact materials (but mainly for plastics)), several chemical requirements do exist, but even here, risk assessments indicate that these requirements should be strengthened in order to protect especially children from hazardous chemicals.

This present study will look at the consumer products areas that have not been discussed yet in the previous ASI Consumer Council studies and will review the actual chemical requirements for a selection of these consumer products.

1.2 Future intentions for chemicals in products

In October 2013, the European Parliament has adopted a proposal for a decision of the European Parliament and of the Council on a General Union Environmental Action Programme to 2020 called “Living well, within the limits of our planet”. This 7th Environment Action Programme is based on the precautionary principle and preventive actions. One of the priority objectives listed is “Priority objective 3: To safeguard the Union’s citizens from environmental-related pressures and risks to health and well-being”. The following statements are listed (European Parliament, 2013):

- “Horizontal chemicals legislation (REACH and CLP Regulations), as well as legislation on biocidal products and plant protection products provides baseline protection for human health and the environment... **However, there is still uncertainty about the full impacts on human health and the environment of combined effects of different chemicals (mixtures), nanomaterials, chemicals that interfere with the endocrine (hormone) system (endocrine disruptors) and chemicals in products...** The Union will further develop and implement approaches to address combination effects of chemicals and safety concerns related to endocrine disruptors in all relevant Union legislation.... **The Union will also set out a comprehensive approach to minimising exposure to hazardous substances, including chemicals in products**”.
- “In order to safeguard the Union’s citizens from environment-related pressures and risks to health and wellbeing, **the 7th Environmental Action Programme shall ensure that by 2020**” (six points are listed – one of them is):
 - **“the combination effects of chemicals and safety concerns related to endocrine disruptors are effectively addressed in all relevant Union legislation, and risks for the environment and health, in particular in relation to children, associated with the use of hazardous substances, including chemicals in products, are assessed and minimised. Long-term actions with a view to reaching the objective of a non-toxic environment will be identified”.**
- “This requires, in particular:” (six points are listed – one of them is):
 - “Developing by 2018 a Union strategy for a non-toxic environment that is conducive to innovation and the development of sustainable substitutes including non-chemical solutions, building on horizontal measures to be undertaken by

2015 to ensure: ... (4) **the minimisation of exposure to chemicals in products, including inter alia imported products, with a view to promoting non-toxic material cycles and reducing indoor exposure to harmful substances**".

According to this adopted proposal, it is the intention of the European Parliament to minimise the adverse effects of chemicals in products. In order to reach the intentions described in the adopted proposal, actions need to be taken to make sure that in general the chemical requirements in consumer products are strengthened.

All in all, this adopted proposal illustrates that it is the intention that the European product legislation should be strengthened in the future.

This project is, as well as the previous ASI Consumer Council projects, an attempt to screen which product areas where a strengthening of the chemical requirements may be needed when it comes to the protection of the human health of consumers (and especially children).

2 Purpose of this study

The previous studies have given several examples of areas/consumer articles where the content of chemicals is not regulated sufficiently. Many products are mainly covered by the General Safety Directive, which only contains general safety requirements and does not address chemicals in particular (other than be the general phrase “products must be safe”).

The purpose of this study is to perform a screening for articles that have not been covered or discussed yet in the previous reports (Part I to V).

For a selection of these articles/areas, a review of the existing legislation regarding chemicals, eco-labelling requirements and chemical requirements in potential relevant standards will be listed. Whilst regulation is the primary target of the project, the outcome is also intended to support standardization work.

3 Screening – search for other articles

This chapter describes how the screening – the search for other consumer articles/areas that have not been covered yet by the previous studies – has been performed and the result of the screening.

3.1 Methodology used

The methodology used for the screening, i.e. the search for other articles/areas that have not been covered yet by the previous studies, has been carried out by use of the following elements:

- Listing the consumer product legislation excluded from the previous review studies.
- Listing the consumer product legislation and consumer products that have been reviewed in the previous studies in order to be able to identify which areas that have not been covered yet by the previous studies.
- Using lists of ecolabelled products in order to identify areas that have not yet been covered.
- Listing different materials as an alternative approach to see if specific products made of specific materials have not been covered yet.
- Using Combined Nomenclature (CN) Codes in order to identify areas or articles that have not been covered yet.
- General brainstorm to identify missing areas.

The first two points are described in more details in section 3.2 and 3.3 below. The last four bullet points are not described in details – instead the new identified areas are listed in Table 3: List of consumer articles/areas not yet covered” in section 3.4. Finally, five areas/consumer articles to be reviewed in more depth are chosen in section 3.5.

3.2 List of consumer product legislation not prioritised for review by the previous projects

In ASI Consumer Council study Part II, a search for relevant consumer product legislation was made. However, only a selection of the relevant consumer product legislation found in this search was reviewed in the study. Some of the consumer product legislation was not prioritised for a more in depth review because of minor contact or minor use by consumers. In Table 1 below the product legislation not selected for review in the ASI Consumer Council study Part II is listed and the reasons for not including the legislation in the previous review are listed as well.

Table 1: List of consumer product legislation not prioritised for review in the previous ASI Consumer Council studies (see table 2-1 and table 2-2 in Poulsen & Strandesen, 2011)

Legislation no.	Legislation title	Products covered (examples)	The reason for not reviewing the legislation
2000/9/EC	Cableway installations designed to carry persons	Cableway installations designed to carry persons (skiing lifts, etc.)	Lifts are used regularly by consumers. However, less direct contact.
93/15/EEC	Explosives for civil uses	Explosives, however not explosives intended for use by the armed forces	Direct contact, however, probably not on a daily basis.
95/16/EC	Lifts	Normal lifts	Used often, however, limited direct contact.
2006/42/EC	Machinery safety	Machinery in general. An assembly of linked parts or components, at least one of which moves. For instance machines used for packaging. Mostly industrial machinery, but also machinery used by consumers	Probably limited direct contact with consumers.
2004/22/EC	Measuring instruments	Water meters, gas meters, heat meters, automatic weighting instruments, taximeters, dimensional measuring instruments etc.	May be relevant for consumers, but not all are used on a daily basis
90/385/EEC	Active implantable medical devices	Devices inserted into the human body	Very close contact (into) the human body, but not relevant for most consumers.
97/23/EC	Pressure equipment	Vessels to contain fluids under pressure, piping, safety accessories, and pressure accessories. Safety valves, relief systems, etc. Max allowed pressure: 0.5 bar	Some workers might have direct contact on a regular basis. However, in general consumers are not in regular contact.
Reg. 3922/91	Harmonization of civil aviation requirements and procedures	Design, manufacture, operation, and maintenance of aircraft	Relevant for consumers, but not on a daily basis. No close contact.
96/98/EC	Marine equipment	Equipment used/installed on board ships	Relevant for some consumers, but not on a daily basis. Not necessarily close contact.
2006/40/EC	Emissions from air conditioning systems in motor vehicles	Systems must not emit GHG with a Global Warming potential above 150	The word 'health' is not mentioned in the Directive.

3.3 List of consumer articles covered by the previous projects

In Table 2 below, the consumer articles (or general legislation) that have been covered by the previous ASI Consumer Council studies are listed.

Table 2: List of consumer articles which have been covered by the previous ASI Consumer Council studies

ASI CC Study	Legislative area covered	Consumer articles/area covered
Part I	REACH Regulation 1907/2006	Chemicals and chemical products
	General Product Safety Directive 2001/95/EC	All consumer articles
	Toy Safety Directive 2009/48/EC	Toys
	RoHS Directive 2002/95/EU	Electric and electronic equipment
	Energy related products Directive 2009/125/EC	Energy related products
	Personal protective equipment Directive 89/886/EEC	Personal protective equipment
	Construction products Directive 88/106/EEC	Construction products
	Transversal areas	Nanosubstances
Part II	Appliances burning gaseous fuels Directive 2009/142/EC	Appliances burning gaseous fuels
	Placing of pyrotechnic articles on the market Directive 2007/23/EC	Pyrotechnic articles
	Electrical equipment designed for use within certain voltage limits Directive 2006/95/EC	Low voltage electric equipment
	Radio equipment and telecommunication terminal equipment Directive 1999/5/EC	Radio and telecommunications terminal equipment
	Medical devices Directive 93/42/EEC	Medical devices
	Packaging and packaging waste Directive 94/62/EC	Packaging
	Food Contact Materials Regulation 1935/2004	Materials and articles in contact with food
	Simple pressure vessels Directive 2009/105/EC	Pressure vessels
	Recreational crafts Directive 94/25/EC	Recreational crafts
	Framework Directive 2007/46/EC on approval of motor vehicles and trailers and components intended for such vehicles	Motor vehicles, trailers and similar components
Regulation 661/2009 concerning type approval requirements for the general safety of motor vehicles, trailers and components intended therefore	Motor vehicles, trailers and similar components	
Part III	No general EU legislation	Materials in contact with drinking water
	Food Contact Materials Regulation 1935/2004	Materials and articles in contact with food
	Packaging and packaging waste Directive 94/62/EC	Packaging

ASI CC Study	Legislative area covered	Consumer articles/area covered
	No general EU legislation	Emissions to indoor air from indoor materials
	Personal protective equipment Directive 89/886/EEC	Personal protective equipment
	No general EU legislation	Clothing
	General Product Safety Directive 2001/95/EC	Products for children
	RoHS Directive 2011/65/EU	Electric and electronic equipment
	Transversal areas	Flame retardants in various products
Part IV	Toy Safety Directive 2009/48/EC	Toys
Part V	General Product Safety Directive 2001/95/EC	Child use and care articles

3.4 List of consumer articles not yet covered

The information listed in Table 2 has been compared with the gross list of areas/articles found through the search elements listed in the beginning of the chapter (section 3.1 “Methodology used”):

- Listing consumer product legislation not prioritised for review by the previous projects (Table 1).
- Using lists of ecolabelled products (the Nordic Swan, the EU Flower and the Blue Angel) in order to produce a list of consumer articles not yet covered (but ecolabelled).
- Using Combined Nomenclature (CN) Codes. The total list of CN codes has simply been read in order to identify areas or articles that have not yet been covered.
- Finally, a materials approach has been used. Different types of materials (wood, metal, glass etc.) have been listed in order to identify specific products made of specific materials that have not yet been covered.

Table 3: List of consumer articles/areas not yet covered

Consumer articles/area	Comment	Identified by
Cosmetic products	Covered by their own product legislation	Ecolabelled products
Chemical products such as paints, cleaning products, hobby articles, car care products, glue etc.	Covered by legislation such as REACH and CLP, as well as other more specific legislation such as regulation of VOCs in paints etc.	Ecolabelled products Brainstorm
Other chemical products such as fertilizers, photographic chemicals	Covered by REACH	CN codes
Chemical construction products	Construction products have been reviewed, but not chemical construction products. These are, however, covered by REACH and CLP	Ecolabelled products
Writing utensils		Ecolabelled products
Furniture including mattresses	Furniture made of textiles may partly be covered by “clothing”	Ecolabelled products
Flooring		Ecolabelled products
Furnishing fabrics including towels, table cloths, carpets, curtains etc.	These products may be covered by “clothing”	Ecolabelled products Brainstorm

Consumer articles/area	Comment	Identified by
Wood products such as flooring, furniture and chip boards		Ecolabelled products
Woodburning stoves		Ecolabelled products
Hygiene products	Including diapers, toilet paper, tampons	Ecolabelled products
Paper products	Such as kitchen rolls, paper tissues, writing paper, envelopes, wall paper, newspaper, magazines, books etc.	Materials approach
Jewelleries		Brainstorm
Light bulbs	Covered by RoHS, i.e. indirectly discussed previously	Ecolabelled products
Batteries	Covered by RoHS, i.e. indirectly discussed previously	Ecolabelled products
Candles	Result in indoor climate problems	Ecolabelled products
Garden tools and other tools	Electric tools are covered by RoHS	Ecolabelled products
Shoes and other footwear		Ecolabelled products
Leather products such as shoes, clothing, bags, watch straps etc.		Materials approach
Plastic products	The most interesting products are soft plastic products e.g. for indoor use	Materials approach
Rubber products (e.g. tires, handles, hoses, gloves)	The most interesting products may be rubber handles on e.g. bicycles, garden tools etc. Rubber teats on nursing bottles are covered by child care articles	Materials approach
Glass products	Some products are covered by FCM Regulation	Materials approach
Metal products and metal alloy products	Limited exposure, and some products are covered by FCM Regulation	Materials approach
Cement products, cement tiles	Limited direct contact and exposure	CN codes
Ceramic products	Limited direct contact and exposure and some products are covered by FCM Regulation	CN codes
Umbrellas and other sunshade products	Limited direct contact. These products may be covered by "clothing" if made of textiles	CN codes
Musical instruments		CN codes
Sport equipment like rackets, balls, golf clubs, fishing gear, etc.		CN codes
Cableway installations	Limited direct contact	Previously deselected
Lifts	Limited direct contact	Previously deselected
Explosives for civil uses (pyrotechnic articles)	Direct contact, but not on a daily basis	Previously deselected
Machinery	Limited contact by consumers, mostly work-related	Previously deselected
Measuring instruments	Not used on a daily basis	Previously deselected
Active implantable medical devices	Very close contact (into) the human body, but not relevant for most consumers	Previously deselected
Pressure equipment	Consumers are not in regular contact, mostly work-related	Previously deselected
Civil aviation	Not relevant for most consumers	Previously deselected
Air conditioning systems of motor vehicles	No direct contact by consumers, inhalation issues	Previously deselected

The five articles/areas suggested for further review (chapter 4) is marked with **bold** in Table 3.

3.5 Selection of consumer articles to review

The five articles/areas suggested for further review (chapter 4) are marked with **bold** in Table 3.

These five areas have been chosen in collaboration with ASI Consumer Council for the following main reasons:

- Knowledge about the “chemical problems” on the specific areas.
- Lack of chemical requirements in legislation.
- Possible close contact/exposure of consumers and/or emissions to indoor environment resulting in indirect exposure of the consumers.

Furniture including mattresses have been chosen as one of the five areas to investigate further, as furniture may emit volatile organic chemicals to the indoor environment (especially wooden furniture), and because the use of flame retardants has been discussed for this product group. Furthermore, consumer exposure to furniture is an every day exposure and a long time exposure. Legal requirements regarding chemicals mainly exist for the biocide dimethyl fumerate (DMF) and for specific chemicals in textiles and/or leather (e.g. flame retardants, organic tin compounds, PFOS, azodyes).

Hygiene products have been chosen as one of the five areas, as it is a product group with very close consumer contact and an exposure that may be present 24 hours a day. The legal requirements regarding chemicals in this area are few and are limited to the biocide DMF and organic tin compounds.

Paper products have been chosen as one of the five areas, as it is a product group with repeated consumer contact (skin exposure). The legal requirements regarding chemicals on this area are few and are limited to the biocide DMF and organic tin compounds.

Leather products have been chosen as one of the five areas, as it is a product group that has been discussed intensely due to the presence of the sensitizing chromium (VI). Furthermore, leather products may be in close contact with skin for long periods of the day. The legal requirements regarding chemicals mainly exist for the biocide DMF, azodyes and organic tin compounds; however, a chemical requirement regarding chromium (VI) is on its way.

Softened plastic products have been chosen as one of the five areas, as it is a product group that has been discussed due to the presence of several additives in plastic products like e.g. the use of plasticizers in softened plastic products. The phthalate plasticizers are a group of substances that have been discussed intensely especially in products for children. For products used indoor the product group contributes to the indirect phthalate exposure in the indoor environment, and the legal requirements are non-existing when it comes to products imported from the outside of the EU – except for a restriction on cadmium in specific types of plastic.

4 Screening review of selected areas

This chapter reviews the five selected areas with respect to e.g. information on hazardous chemicals found in these product groups and legal requirements regarding chemicals on these areas. The list of hazardous chemicals found in these product groups primarily covers examples of problematic chemicals found in the specific consumer products that (primarily) are not illegal, meaning that there are no restrictions on these substances for the described consumer products.

The five selected areas reviewed in this chapter are:

- Furniture including mattresses
- Hygiene products
- Paper products
- Leather products
- Plastic products (softened plastic products for indoor use)

4.1 Methodology used

The methodology used for the screening review of the selected areas has been carried out by use of the following elements:

- Examples of hazardous chemicals found in the five selected areas have been listed.
- The consumer products legislation that exists on these five areas has been reviewed – with a focus on the chemical legislation.
- The existing eco-labelling requirements for the EU Flower and Nordic Swan on the five selected areas have been reviewed.
- Possible chemical requirements in relevant standards have been listed (if any).

The review of each of the selected product areas is described in separate chapters covering the three aspects listed above (examples of hazardous chemicals found, legislation, existing eco-labelling requirements on the area and possible chemical requirements in relevant standards).

The examples of hazardous chemicals found in the five selected consumer products categories have been identified by use of following sources:

- Survey on chemicals in consumer products, Danish EPA (www.mst.dk¹).
- Danish consumer council (www.taenk.dk).
- Danish Information centre on environment and health (www.forbrugerkemi.dk)².
- Swedish Chemicals Agency (www.kemi.se).
- The Ecology Center, USA (www.healthystuff.org).
- The German consumer magazine Oeko-test (www.oekotest.de).

¹ <http://eng.mst.dk/topics/chemicals/consumers-consumer-products/>

² This Danish information centre has now been closed and the web site is no longer available

- Information on chemicals in different product groups from the Norwegian website '*Is it dangerous?*' (www.erdetfarlig.no).
- A general Google search on the specific product categories.

For consumer product legislation relevant for the five selected areas, relevant EU legislation has been listed. Specific national legislation has not been listed.

Concerning eco-label requirements, it is only the relevant eco-label requirements of the Nordic Swan and the EU Flower that have been listed.

A search has been made in order to identify possible chemical requirements in relevant standards. However, it has not been possible within the budget frame of this project to go into details with each of these standards. Instead a general search for standards on the selected areas has been made, and an assessment has been made whether the standards – on the basis of the title and description of the standards - include chemical requirements or not.

4.2 Furniture (including mattresses)

The product group 'furniture' includes all kind of furniture irrespective of materials, i.e. wooden, metallic, leather and textile furniture is all included in this product group. Furniture for both indoor and outdoor use is included in this product group.

As described in the European Flower criteria document for wooden furniture (Commission Decision 2009/894/EC), the overall product group 'furniture' can be defined as free-standing or built-in units, which are used for storing, hanging, lying, sitting, working and eating, either for domestic use or professional use. In this report, the term 'furniture' includes mattresses as well, but flooring is excluded.

The product group 'bed mattresses' is defined in the EU Flower criteria document as products consisting of a cloth cover that is filled with materials and that can be placed on an existing supporting bed structure or designed for free standing in order to provide a surface to sleep or rest upon for indoor use (Commission Decision 2014/391/EU).

4.2.1 Examples of chemicals found in furniture

A literature search for chemicals found in furniture including mattresses resulted in the following examples (see Table 4), which are described in more details in the text below.

Table 4: Literature describing chemicals found in furniture and mattresses

Furniture and mattresses	Source	Year	Chemicals found
Flame retardants in furniture	Danish EPA	2014	Flame retardants (TCPP and TDCPP)
Crib and toddler bed mattresses	Healthystuff, The Ecology Center	2013	Elements (chlorine, bromine, antimony)
Test of 10 cribs	Danish Consumer Council (Taenk)	2013	Elements (lead, chromium) Phthalates (DBP, DiBP and DEHP)

Furniture and mattresses	Source	Year	Chemicals found
Children's Furniture	Oakland CA - CEH	2013	Flame retardants (Firemaster 550), TCPP, TDCPP and butylated triphenyl phosphate)
Phthalates in products with large surfaces - leatherette furniture	Danish EPA	2010	Phthalates (DiBP, DBP, BBP and DEHP)
Indoor textiles such as bed linens, towels, curtains and furniture fabric.	www.erdetfarlig.no	2014	No direct tests, but it is stated that the following chemicals may be found in furniture fabric: Elements (lead, silver, chromium) Brominated flame retardants, TCEP Phthalates (DEHP) Chlorinated paraffins Octyl/nonyl phenols Perfluorinated compounds (PFOS / PFOA / PFCA) Dimethyl fumarat (DMF)
Mattresses	www.erdetfarlig.no	2014	No direct tests, but it is stated that the following chemicals may be found in mattresses: Elements (arsenic, lead, chromium) Brominated flame retardants, TCEP Phthalates (DEHP) Octyl/nonyl phenols Amines Latex
Textile shower curtains	Öko-test 1	2009	Dibutyltin (DBT) and other organotin compounds, chlorinated compounds
MDF boards, chipboards and other wooden boards	Öko-test 4	2011	Elements (lead) Formaldehyde VOC (aldehydes, terpenes, delta-3-carene)
IKEA furniture	Öko-test 11	2013	Formaldehyde VOC (not stated exactly which) Plasticizers (not stated which kind) Flame retardants (TCPP) Halogenated organic solvents
Furniture and furniture textiles	Kemi, Sweden	2014	Phthalates (DBP, DEHP, DIDP, DINP) Nonylphenoethoxylat Flame retardant (HBCDD) Decobromediphenylether

4.2.1.1 Flame retardants in furniture (2014) – Danish EPA

The Danish EPA tested in 2013/2014 different textile furniture for the content of flame retardants. In all 15 pieces of furniture were tested for the content of flame retardants and the flame retardants TCPP and TDCPP were found in three of the tested upholstered chairs. The concentrations measured were between 0.07 and 0.46% for TCPP and between 0.13 and 0.9% for TDCPP. A risk assessment of the individual products did not find any health risks related to the content of the flame retardants (Andersen et al., 2014).

4.2.1.2 Crib and toddler bed mattresses (2013) – Test (healthystuff.org, The Ecology Center)

The American homepage healthystuff.org, the Ecology Center (researching toxic chemicals in everyday products), tested a baby mattress from the brand Baby Sealy. The product was tested for lead, chlorine, cadmium, arsenic, mercury, bromine and tin. High amounts of chlorine (114 – 206 ppm) and low amounts of bromine (1 – 2 ppm) were found. Antimony was also detected in the product. The overall exposure level was categorised as “High” according to the Ecology Center (The Ecology Center, 2013).

4.2.1.3 Test of 10 cribs (2013) – Test (Danish Consumer Council)

The Danish Consumer Council tested in 2013 ten different cribs. In two of the cribs, small amounts of lead released were measured and in one crib a release of chromium was measured. The paint from the cribs was also analysed and here traces of the phthalates DBP, DiBP and DEHP were found in all ten cribs. However, the total amount was below 0.05 % as required by Danish legislation on phthalates in children’s products (Danish Consumer Council, 2013).

4.2.1.4 Flame retardants in children’s furniture (2013) – Oakland, CA Center for Environmental Health (CEH)

Independent tests commissioned by the Center for Environmental Health carried out in 2013 on children’s furniture purchased in different American and Canadian stores. Four different flame retardant chemicals (including mixtures of multiple flame retardants) were found in 38 out of 42 tested pieces of furniture. The flame retardants found were Firemaster 550 (a mixture of four chemicals), TCPP, TDCPP and butylated triphenyl phosphate (Center for Environmental Health, 2013).

4.2.1.5 Phthalates in products with large surfaces, leatherette furniture (2010) – Danish EPA

In 2009 the Danish EPA investigated various products with large surfaces for the content of phthalates. Here a large selection of leatherette furniture was analysed and the phthalates DIBP, DBP, DBP and DEHP were all detected in the furniture. 12 out of 15 of the analysed pieces of furniture contained one or more of the four phthalates. In total nine of the pieces of furniture contained more than 1% (w/w) DEHP. The highest amount of DEHP (39% (w/w)) was found in a dining chair. In one piece of furniture more than 1% of DiBP was found (Tønning et al., 2010a).

4.2.1.6 Indoor textiles such as bed linens, towels, curtains and furniture fabric (2014) - Erdetfarlig.no

The Norwegian website “www.erdetfarlig.no” (translated: “is it dangerous”) has listed, which chemical substances that are present in different consumer products. The list is not based directly on tests, but on experiences with chemicals found in different consumer products. For products such as indoor textiles such as bed linens, towels, curtains and furniture fabric the following chemicals are listed: Elements (lead, chromium, silver), brominated flame retardants, TCEP, phthalates (DEHP), chlorinated paraffin, octyl/nonyl phenols, perfluorinated compounds (PFOS/PFOA/PFCA), and dimethylfumarat (DMF).

4.2.1.7 Mattresses (2014) - Erdetfarlig.no

The Norwegian website “www.erdetfarlig.no” (translated: “is it dangerous”) has listed, which chemical substances that are present in different consumer products. The list is not based directly on tests, but on experiences with

chemicals found in different consumer products. For products such as mattresses, the following chemicals are listed: Elements (arsenic, lead, chromium), brominated flame retardants, TCEP, phthalates (DEHP), octyl/nonyl phenols, amines, and latex.

4.2.1.8 Textile shower curtains (2009) - Öko-Test

The German test magazine Öko-Test tested 20 different textile shower curtains for the content of problematic chemicals. The shower curtains were tested for dibutyltin and other organotin compounds, which were found in eight of the 20 shower curtains. No problematic dyes were found, but halogenated organic compounds were detected in two of the 20 shower curtains. In general, the test does not mention the specific concentrations measured for the different chemicals (Öko-Test 1, 2009).

4.2.1.9 MDF boards, chipboards and other wooden boards (2011) - Öko-Test

The German test magazine Öko-Test tested 24 different types of wooden boards for the emission and content of problematic chemicals. The wooden boards were tested for the emissions of formaldehyde, emissions of VOC, emissions of halogenated organic compounds, and the content of problematic elements. Elevated emission levels of formaldehyde were found for most of the MDF boards and chipboards. The following VOCs were emitted from the wooden boards: aldehydes, terpenes, delta-3-carene. Furthermore, lead was found in three of the 24 wooden boards. In general, the test does not mention the specific concentrations measured for the different chemicals (Öko-Test 4, 2011).

4.2.1.10 IKEA furniture (2013) - Öko-Test

The German test magazine Öko-Test has tested 20 different pieces of furniture from IKEA for the content of problematic chemicals. As many pieces of furniture are made of glued wood, tested for formaldehyde and volatile organic compounds was made. Furthermore, the content of plasticizers and halogenated organic compounds was investigated. Upholstered furniture was examined for content of flame retardants. The test results showed about half of the furniture emitted formaldehyde and VOCs, however, only for three pieces of furniture the levels were considered to be 'high' or 'elevated'. Organophosphorus flame retardants (TCPP) were found in an upholstered chair (armchair) and plasticizers were found in the coating of a bed. Finally, halogenated organic solvents were found in a table (Öko-Test 11, 2013).

4.2.1.11 Furniture, textile furniture (2014) - Kemi, Sweden

Kemi, the Swedish Chemicals Agency, tested 74 different samples from furniture. The samples they analysed were based on the following materials: wool, cotton, viscose, polyester, polypropylene, polyamide, polycarbonate, acrylic, imitation leather, EPS (EPS pellets for filling of e.g. bean bags). The samples were tested for the content of azodyes, brominated flame retardants (HBCDD, PBB, PBDE), nonylphenoxyethoxylates/nonylphenol, organic tin compounds, short chained chlorinated paraffins and perfluorinated compounds (PFOS and PFOA). The following chemicals were found: Phthalates were found in two samples – both were made of imitation leather. DBP and DEHP were found in one sample and DIDP and DINP in the other imitation leather sample. The concentrations of phthalates were in both cases above 0.1%. Nonylphenoxyethoxylate was found in 11 textile samples, but not in concentrations above 0.1%. The flame retardant HBCDD was found in a concentration of 0.37% in one sample made of EPS pellets.

Decabromodiphenylether (decaBDE) was found in an imitation leather sample in a concentration of 23% (Kemi, 2014a and 2014b).

4.2.2 Review of existing legislation relevant for furniture

Chemical requirements for furniture and mattresses in existing legislation are limited primarily to the restriction of certain flame retardants (mainly in textile articles), DMF (mainly present in leather and natural textile articles), organostannic (organic tin) compounds, azodyes, PFOS and certain elements in specific situations. These chemical requirements are listed in more details below.

The following flame retardants are restricted:

- TRIS (tris(2, 3-dibromopropyl)) – must not be used in textiles intended to come into contact with the skin. Limited via REACH annex XVII entry no. 4.
- TEPA (tris (1-aziridinyl) phosphin oxide) – must not be used in textiles intended to come into contact with the skin. Limited via REACH annex XVII entry no. 7.
- PBB (polybrominated biphenyls) – must not be used in textiles intended to come into contact with the skin. Limited via REACH annex XVII entry no. 8.
- OctaBDE (octabrom diphenylether) – limit value of 0.1% in articles (products). Limited via REACH annex XVII entry no. 45.
- PentaBDE (pentabromo diphenylether) – limit value of 0.001% in articles (products). Limited via the Stockholm Convention³.

The following organostannic compounds are restricted:

- Tributyltin (TBT) compounds, triphenyltin (TPT) compounds, dibutyltin (DBT) compounds and dioctyltin (DOT) compounds must not be used in articles in levels over 0.1% by weight. Limited via REACH annex XVII entry no. 20.

The following elements are restricted (or on its way to be restricted):

- Nickel in articles intended to come into direct and prolonged contact with skin. The release of nickel is limited to 0.2 µg/cm²/week. Limited via REACH annex XVII entry no. 27. However, it is debatable whether e.g. nickel coated buttons on a chair will be considered as direct and prolonged contact with skin.
- Chromium VI concentrations in leather articles must not exceed 0.0003% by weight. Limited via REACH annex XVII entry no. 47, but will not apply to leather articles on the market before 1 May 2015⁴.

The following dyes are restricted:

- Azodyes, that by reductive cleavage of one or more azogroups may release one or more of a list of 22 aromatic amines⁵, must not be found in detectable concentrations (0.003% by weight) in textile and leather

³ <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02004R0850-20120710&rid=1>

⁴ http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOL_2014_090_R_0001_01&from=EN

⁵ Appendix 8 of REACH – contains 22 specific aromatic amines listed by CAS number.

articles intended to come into direct and prolonged contact with the human skin. Limited by REACH annex XVII entry no. 43.

The following biocides are restricted:

- Dimethyl fumarate (DMF) must not be used in any articles in concentrations greater than 0.1% by weight. Limited via REACH annex XVII entry no. 61.

PFOS and similar compounds are restricted:

- The use of PFOS and its derivatives are restricted in textile articles (limit value of 0.1% by weight or 1 µg/m²). Limited via the Stockholm Convention⁶.

PAHs are on its way to be restricted:

- The use of 8 specific PAHs (as listed in REACH Annex XVII entry no. 50) in rubber and plastic components that are in direct as well as prolonged or short-term repetitive contact with the human skin or oral cavity under normal or reasonably foreseeable conditions of use. The limit value is 1 mg/kg (0.0001%) by weight of the component of any of the listed PAHs. This restriction will not apply to articles placed on the market before 27 December 2015⁷.

Furthermore, some chemicals like e.g. the flame retardants HBCDD, TCEP and several phthalates that may be used in artificial leather are on the REACH Candidate list. This means that there is a duty of disclosure (REACH Article 33) in the supply chain, if products contain more than 0.1% of these substances. On the other hand, if the products are sold to consumers, there is only a duty to disclose the content of these substances, if consumers demand this information.

It should be noted that some of the above-mentioned restrictions only are valid for direct and prolonged contact with the human skin. Therefore the restriction will not apply for e.g. curtains, but it is debatable whether the restriction will apply for e.g. mattresses (bed linen usually used in between human skin and the mattress). However, the restrictions should apply for sofas and chairs where direct and prolonged contact with the textile could happen.

Finally, it should be mentioned that some relevant restrictions are discussed as future REACH Annex XVII restrictions. These are:

- The use of nonylphenol and nonylphenol ethoxylates in textile articles or textile parts of articles. The limit value suggested is 0.01% by weight, and the restriction is suggested to cover interior textiles as well, if they consist of at least 80% by weight of textile fibres. RAC (Committee for Risk Assessment) and SEAC (Committee for Socio-economic Analysis) have prepared a draft opinion⁸ regarding this restriction proposal, but the final adoption and decision to adopt the restriction are missing (as of September 2014)⁹.

⁶ <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02004R0850-20120710&rid=1>

⁷ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:328:0069:0071:EN:PDF>

⁸ <http://echa.europa.eu/documents/10162/92b9634c-8d8e-4866-b9fe-11892e1fdc39>

⁹ <http://echa.europa.eu/previous-consultations-on-restriction-proposals/-/substance/4507/search/+/term>

- The use of decaBDE in articles and any parts thereof. The limit value suggested is 0.1% by weight. A restriction report has been prepared¹⁰ and the restriction proposal is now (as of September 2014) open for comments in the public consultation process¹¹.
- The use of lead in articles (or accessible parts of articles) which can be placed in the mouth by children (i.e. one dimension is smaller than 5 cm or has detachable parts of that size). The limit value suggested is 0.05% by weight. RAC and SEAC have prepared and adopted an opinion¹² regarding this restriction, but discussions are still ongoing and the final decision to adopt the restriction is missing¹³ (as of September 2014).

4.2.3 Review of existing eco-labelling requirements for furniture

A review has been made of the existing chemical requirements in the eco-labelling criteria for furniture and mattresses. The review only comprises the EU Flower and the Nordic Swan. The following eco-labelling criteria exist which are relevant for furniture and mattresses:

- EU Flower: Wooden furniture (Commission Decision 2009/894/EC)
- EU Flower: Bed mattresses (Commission Decision 2014/391/EU)
- EU Flower: Textile products (Commission Decision 2014/350/EU)
- Nordic Swan: Furniture and fitments (Nordic Swan: Furniture and fitments, 2014)

These chemical requirements in the eco-labelling criteria are described in the table below. The criteria that focus on the content of chemicals in the finished products are listed in the table below.

Table 5: Chemical requirements in Eco-labelling criteria relevant for furniture and mattresses

Furniture and mattresses				
Chemical compound	EU Flower: Wooden furniture	EU Flower: Bed mattresses	EU Flower: Textile products	Nordic Swan: Furniture and fitments
CMRs and other hazardous chemicals				
Azodyes		Shall not be used	Shall not be used	
CMR compounds (category I and II)				Must not contain
CMR dyes		Shall not be used	Shall not be used	
SVHCs (Substances of Very High Concern)			Shall not be present in the final textile product in concentrations higher than 0.10% by weight	
Bisphenol A compounds				Must not contain
Formaldehyde		Shall not exceed 20 ppm or 0.005 mg/m ³	Shall not exceed 16 ppm (direct contact), 75 ppm (limited contact)	Up to 0.2 % by weight
Butadiene		Shall not exceed 1 ppm		
Nitrosamines		Shall not exceed 0.0005 mg/m ³		

¹⁰ <http://echa.europa.eu/documents/10162/a3f810b8-511d-4fd0-8d78-8a8a7ea363bc>

¹¹ <http://echa.europa.eu/restrictions-under-consideration/-/substance/4301/search/+/term>

¹² <http://echa.europa.eu/documents/10162/10a7006f-1342-40ad-8aa3-c28365d0faca>

¹³ <http://echa.europa.eu/previous-consultations-on-restriction-proposals/-/substance/1402/search/+/term>

Furniture and mattresses				
Chemical compound	EU Flower: Wooden furniture	EU Flower: Bed mattresses	EU Flower: Textile products	Nordic Swan: Furniture and fitments
N,N-Dimethylacetamide			Must not be used in elastane and acrylic	
Aziridine	Must not contain			Must not contain (add. polyaziridines)
Alkylphenols, alkylphenoethoxylates or alkylphenol derivatives Nonylphenol and octylphenols			Must not be used Must not be used	Must not contain
Phthalates and other plasticizers				
PVC/phthalates			Shall not be used (list of 8 specific phthalates)	
Elements				
Antimony		Shall not exceed 0.5 ppm	Antimony level in polyester fibres shall not exceed 260 ppm Shall not exceed 30 ppm	
Arsenic		Shall not exceed 0.5 ppm	Shall not exceed 0.2 ppm (baby products)	
Lead		Shall not exceed 0.5 ppm	Shall not exceed 0.2 ppm (baby products)	
Cobalt		Shall not exceed 0.5 ppm	Shall not exceed 1.0 ppm (baby products)	
Cadmium		Shall not exceed 0.1 ppm	Shall not exceed 0.1 ppm	
Chromium (total)		Shall not exceed 1.0 ppm	Shall not exceed 0.5 ppm (baby products)	
Copper		Shall not exceed 2.0 ppm	Shall not exceed 25 ppm (baby products)	
Mercury		Shall not exceed 0.02 ppm	Shall not exceed 0.02 ppm	
Nickel		Shall not exceed 1.0 ppm	Shall not exceed 0.5 ppm (baby products)	
Pigment and additives based on: -lead, cadmium, chrome (VI), mercury and their compounds Arsenic, boron and copper	Must not contain		Lead based pigments shall not be used in polypropylene Dyestuffs classified with certain H sentences shall not be used	Must not contain
Impurities in dyes		Shall not exceed: Ag 100, As 50, Ba 100, Cd 20, Co 500, Cr 100, Cu 250, Fe 2500, Hg 4, Mn 1000, Ni 200, Pb 100, Se 20, Sb 50, Sn 250, Zn 1500 (all in ppm)		
Impurities in pigments		Shall not exceed: As 50, Ba 100, Cd 50, Cr 100, Hg 25, Pb 100, Se 100, Sb 250, Zn 1000 (all in ppm)		
Chrome mordant dyeing		Not allowed	Shall not be used	

Furniture and mattresses				
Chemical compound	EU Flower: Wooden furniture	EU Flower: Bed mattresses	EU Flower: Textile products	Nordic Swan: Furniture and fitments
Metal complex dyes			If based on copper, chrome and nickel shall only be used for wool and polyamide fibres	
<i>Sensitizing substances</i>				
Potentially sensitizing dyes		Shall not be used	Shall not be used	
<i>Flame retardants</i>				
Flame retardants (exclusive additive flame retardants)	Must not contain		Flame retardants classified with certain H sentences shall not be used Furthermore HBCDD, PeBDE, OcBDE, DecaBDE, PBBs, TEPA, TRIS, TCEP and SCCP must not be used	Must not contain
<i>Halogenated compounds</i>				
Halogenated organic binding agents	Must not contain			Must not contain
Halogenated carriers			Must not be used to dye synthetic fibres	
Optical brighteners Chlorine agents			Optical brighteners classified with certain H sentences shall not be used Chlorine agents must not be used for bleaching	
PFOA PFOS			Fluoropolymer membranes must be used, but must not be based on PFOA	Must not contain
<i>Preservatives and biocides</i>				
Isothiazolinones				Must not exceed 0,05 % by weight
Kathon ¹⁴				Must not exceed 0,0015 % by weight
Biocides chlorophenols and dimethylfumarate (DMF)		Salt and esters of chlorophenols must not exceed 0,1 ppm except mono- and fr-chlorinated phenols must not exceed 1 ppm	Must not be incorporated into the fibres	Must not contain
Pesticides			A list of certain pesticides must not be used in cotton (shall not exceed 0.5 ppm in total)	
Ectoparasiticides			A list of certain ectoparasiticides must not be used in wool	
Organic tin compounds	Must not contain		Must not be used to manufacture the fibres	
<i>Nanomaterials</i>				
Nano particles				Must not be actively added

¹⁴ The mixture (3:1) of CMIT/MIT (5 chloro-2-methyl-4-isothiazolin-3-one CAS. No. 247-500-7; 2-methyl-4-isothiazolin-3-one CAS. No. 220-239-6

Furniture and mattresses				
Chemical compound	EU Flower: Wooden furniture	EU Flower: Bed mattresses	EU Flower: Textile products	Nordic Swan: Furniture and fitments
<i>Other chemicals</i>				
Auxilliary chemicals used in processing			Auxilliary chemicals used in processing of the textiles classified with certain H sentences may not be present in the final textile product	
Volatile organic compounds (VOC)		Shall not exceed 0.5 mg/m ³	A maximum of 5% allowed in printing pastes	Must not exceed 3 % by weight in glue

All-in-all, the EU Flower and Nordic Swan criteria for furniture and bed mattresses restrict the following groups of chemicals:

- Elements
- Halogenated organic compounds
- Organic tin compounds
- Azodyes
- Sensitizing or CMR dyes
- Flame retardants
- Brighteners
- PFOA/PFOS
- Bisphenol A
- Biocides/pesticides – e.g. DMF and chlorophenols
- PVC/phthalates
- Kathon and other isothiazolinones
- Alkylphenol/alkylphenoethoxylates
- Volatile organic compounds
- Formaldehyde
- Nano particles
- Butadiene
- Nitrosamines
- N,N-dimethylacetamide
- SVHCs and CMR substances

This long list of different chemicals limited in eco-labelled furniture products illustrates that many different hazardous chemicals may exist in furniture and mattresses.

When comparing the list of eco-label requirements with the restricted chemical substances it can be seen that it is only a part of the listed substances in eco-labelling which is restricted by the existing legislation – even though several specific substances are restricted. However, the restrictions are only in specific situations, such as in textiles in prolonged and close contact with human skin. For some pieces of furniture, prolonged and close contact will not occur (e.g. mattresses are used with bed linen) whereas the restrictions should apply for sofas and chairs where direct and prolonged contact with the textile could happen.

On the other hand, it is not the intention that all eco-label requirements should be converted to restrictions in legislation, as the intention and purpose of eco-labelling is that only about the best 10-30% of the products should be able to live up to all the chemical requirements. However, the number of

available pieces of furniture on the market with an eco-label illustrates that it is possible to avoid these dangerous chemicals in the furniture.

4.2.4 Review of possible chemical requirements in relevant standards for furniture

A search on the CEN (European Committee for Standardization) webpage on 'furniture' reveals 91 standards prepared by the Committee CEN/TC 207 "Furniture". It has not been possible to go into detail with each of these standards. However, overall, from the titles of these standards, it can generally be concluded that these standards concern safety requirements (physical and mechanical safety), test methods, surface resistance, strength and durability – and not the content of hazardous chemicals in furniture.

A few of the standards concerns the ignition of the furniture (especially for textile furniture). These standards list certain requirements regarding ignition time for the furniture if exposed to heat or fire from e.g. a cigarette. It is, however, not a requirement that flame retardants are used, but this may often be the easiest solution. Therefore, the anti-flammability requirement in these standards for furniture may indirectly cause the use of hazardous flame retardants in the furniture.

Standards under the committee CEN/TC 207 on "Furniture" reveal standards that concern surface resistance on furniture and therefore not the content of dangerous chemical substances.

A standard under the committee CEN/TC 248 on "Textile and textile products" – EN 14362-3:2012 concerns the method for determination of certain aromatic amines derived from azocolourants. This is the standard for test of the restriction on aromatic amines in textiles and leather listed in REACH Annex XVII entry no. 43.

A standard under the committee CEN/TC 248 on "Textile and textile products" is under approval. This upcoming standard FprCEN/TR 16741 "Textiles and textile products - Guidance on health and environmental issues related to chemical content of textile products intended for clothing, interior textiles and upholstery" will contain different recommendations concerning the content of chemicals, but no requirements.

All-in-all, it can therefore be concluded that the chemical requirements in standards concerning furniture are non-existing.

4.2.5 Discussion

The examples of chemicals found in furniture and mattresses (especially flame retardants, heavy metals and phthalates) illustrate that hazardous chemicals may be present in furniture and mattresses. This is further supported by the long list of requirements for hazardous chemicals in eco-labelling criteria for furniture and mattresses (and textiles).

Furniture (especially regarding textiles) is one of the areas where a range of chemical restrictions already exists. However, some of these restrictions are only valid for (mostly) textiles and/or leather, which means that restrictions concerning e.g. wooden furniture and metal furniture are non-existing.

Furthermore, in some cases the restrictions are only valid if the exposure with the textile is direct and prolonged. This will not be the case for many of the products within the category 'furniture', but may be relevant for e.g. sofas and chairs where direct and prolonged contact with the textile could occur.

Even though the furniture does not have direct contact with the human skin, most chemicals found in furniture will be found in the indoor climate (indoor air or indoor dust). The chemical burden in the furniture may therefore contribute to the indirect chemical exposure from the indoor climate, thus there may be a need for further restriction of chemicals in this product area.

If further restrictions on chemicals should be set in this area, it is suggested to focus on the following type of chemicals for furniture in general:

- Elements
- Phthalates (in artificial leather products)
- Formaldehyde
- VOC

It should be noted that these chemicals are only a suggestion that is based on this screening of the product group prepared in this project. These chemicals are chosen because they have been identified in the products in this product group, are restricted in other areas, are considered to be hazardous, may contribute to the total indoor environment and may contribute to the total burden/exposure through various types of consumer products. It will of course be necessary in future work in this area to go into much more details about the exposure and risk of these types of chemicals in this product group to determine if restrictions should be made for these groups of chemicals and if so which limit values to use.

Another approach could also be to set different requirements based on the different materials of which the furniture is made. For furniture made of leather, the chemicals listed in section 4.5 "Leather products" would be relevant to set requirements for. For the textile parts of the furniture, it would be relevant to focus on the suggested additional chemical requirement for textiles (clothing) as proposed in the former ASI Consumer Council study "Chemical requirements for consumer products – Part III" (Strandesen and Poulsen, 2012).

4.3 Hygiene products

The product group 'hygiene products' includes all kind of hygiene related products such as toilet paper, tissue paper, diapers, tampons etc. No product group under the EU or Nordic ecolabelling corresponds directly to 'hygiene' products so a combination of the categories "Sanitary products" and "Tissue paper" will be used as a definition.

The product group "Sanitary products" from the Nordic Swan criteria document encompasses disposable products such as breast pads, children's diapers, incontinence care products (panty-liners, formed diapers and diapers with tape strips), sanitary towels (pads and panty-liners), tampons, cotton buds, cotton wool, toothpicks, underlays, draw sheets, bed linen, washcloths and surgical gowns (Nordic Swan: Sanitary Products, 2013).

In this report, hygiene products are defined as the consumer related products defined as in “Sanitary products” from Nordic Ecolabelling, e.g. the listed products but excluding surgical gowns and professional underlays, draw sheets, bed linen etc. Furthermore, tissue paper is included in the group of hygiene products as described in the EU Flower/Nordic Swan criteria document for tissue paper (Commission Decision 2009/4596/EC; Nordic Swan: Tissue Paper, 2014).

4.3.1 Examples of chemicals found in hygiene products

A literature search for chemicals found in hygiene products resulted in the following examples (see Table 6), which are described in more details in the text below.

Table 6: Literature describing chemicals found in hygiene products

Hygiene products	Source	Year	Chemicals found
Chemical substances in diapers (2-year-old)	Danish EPA	2009	Formaldehyde Sensitizing fragrances (limonene)
Chemical substances in toilet paper	Danish EPA	2003	Hydrocarbons Fragrances Softeners Colophonium Elements (copper, magnesium, zinc)
Chemical substances in tampons	Danish EPA	2002	Glycerol tricaprilate and an isomer Oleyl alcohol
Chemical substances in sanitary towels	Danish EPA	2002	Acetophenone, isopropylaurate, diisooctyladipate, 2,4-bis(1,1dimethylethylphenol, glycerol tricaprilate, and an isomer of this. Unidentified phthalates Ethanolamines, diethanolamines and triethanolamine
Toilet paper	Öko-test 5	2008	Formaldehyde Halogenated organic compounds Optical brighteners
Tissue paper	Öko-test 1	2008	Formaldehyde Halogenated organic compounds Optical brighteners
Tissue paper	Öko-test 1	2014	Halogenated organic compounds Optical brighteners
Diapers	Öko-test 1	2014	Optical brighteners UV absorbers Lotion based on petroleum/paraffin oils
Toilet wipes	Öko-test 2	2014	Formaldehyde Halogenated organic compounds Fragrances

4.3.1.1 2-year-olds' exposure to chemical substances (2009) – Danish EPA

In the period 2008 – 2009, the Danish EPA investigated 2-year-olds' exposure to chemical substances in different products; amongst others diapers. Only chemical substances with known endocrine disruptive effects were investigated in the project. Five diapers were chosen for chemical analysis and a small amount of formaldehyde was detected in three diapers. The perfume substance limonene was also detected in three of the products. The detected chemicals and amounts in diapers were not considered as being

a health risk for 2-year-olds', however, the risk of allergenic effects was not discussed in the project (Tønning et al., 2009).

4.3.1.2 Chemical Substances in Paper Handkerchiefs and Toilet Paper (2003) – Danish EPA

In 2001, the Danish EPA investigated the content of chemical substances in sanitary towels. The focus was on hygiene products because they represent products that are close to the skin and in some cases with long exposure times. In the screening analysis, the total level of hydrocarbons was detected in toilet paper at levels from 4 to 330 mg/kg; other substances occurred in concentrations below 30 mg/kg. Paper towels without balsam or menthol had a total concentration of hydrocarbons in the interval from 35 to 250 mg/kg. The total concentration of hydrocarbons in paper towels with menthol or balsam was in the interval 30 mg/kg to 19,000 mg/kg, and the highest concentration was in paper towels with balsam. In the paper towels with perfume and softener added, perfume and softeners were detected in concentrations up to 770 mg/kg and 2.3 g/kg, respectively. No PCB, PAH, nitrosamines, EDTA, DPTA or acrylamide were found in any of the tested products. Polyethoxylates were found in one of the analysed paper towels. Small amounts of colophonium were measured in one toilet paper product and one paper towel product.

Among metals, only copper, magnesium and zinc were identified. In all products, concentrations of magnesium were considerably higher than the concentrations of the other two metals. Concentrations of copper were highest in the coloured products (Abildgaard et al., 2003).

4.3.1.3 Chemical substances in tampons (2002) – Danish EPA

In 2001, the Danish EPA investigated different consumer products with one focus on chemicals found in tampons. A variety of products was analysed for the content of chemical substances. The focus was on tampons because they represent products that are close to the skin and with long exposure times. Five tampons were analysed and they were tested for 27 different kinds of pesticides but none of the pesticides was detected. Chemicals detected were glycerol tricaprylate and an isomer of this chemical, and the compound oleyl alcohol (Pors & Fuhlendorff, 2002a).

4.3.1.4 Chemical substances from sanitary towels (2002) – Danish EPA

In 2001, the Danish EPA investigated chemical substances in sanitary towels. The focus was set on sanitary towels because they represent products that are close to the skin and with long exposure times. A total of eight sanitary towels and panty liners was investigated in the project. A total of eleven 11 components/groups was detected, whereof several of the components could be identified (acetophenon, isopropylaurate, diisooctyladipate, 2,4-bis(1,1dimethylethylphenol), glycerol tricaprylate, and an isomer of this). The group of biphenyl- and indene compounds originated primarily from the back of the towel for two of the products. It was concluded that the components may originate from the glue on the back of the towel. In the same two products unidentified phthalates were detected, and these could not be quantified. Likewise, these phthalate compounds originated primarily from the back of the sanitary towels and most probably from the glue on the back of the towel. Ethanolamines and diethanolamines were detected in one product at a level between 8 and 13 mg/kg, while triethanolamin was detected in four products at a level between 2 and 10 mg/kg (Pors & Fuhlendorff, 2002b).

4.3.1.5 Chemical substances in toilet paper (2008) – Öko-Test

The German test magazine Öko-Test tested 19 different brands of toilet paper for the content of problematic chemicals. The toilet paper was tested for content of formaldehyde, optical brighteners, halogenated organic compounds and the packaging material was tested for the content of PVC. Traces of formaldehyde were found in three of the toilet papers tested. In one of the tested toilet papers, high concentrations of halogenated organic compounds were found and in other 16 toilet papers traces of halogenated organic compounds were found. Optical brighteners were found in 16 of the toilet papers. In general, the test does not mention the specific concentrations measured for the different chemicals (Öko-Test 5, 2008).

4.3.1.6 Chemical substances in tissue paper (2008) – Öko-Test

The German test magazine Öko-Test tested 23 different brands of tissue paper for the content of problematic chemicals. The tissue paper was tested for the content of formaldehyde, optical brighteners, halogenated organic compounds and the packaging material was tested for the content of PVC. Traces of formaldehyde were found in seven of the tissue papers tested. In four of the tested tissue papers, high concentrations of halogenated organic compounds were found and in other 6 tissue papers traces of halogenated organic compounds were found. Optical brighteners were found in two of the tissue papers. In general, the test does not mention the specific concentrations measured for the different chemicals (Öko-Test 1, 2008).

4.3.1.7 Chemical substances in tissue paper (2014) – Öko-Test

The German test magazine Öko-Test tested 20 different brands of tissue paper for the content of problematic chemicals. The tissue paper was tested for the content of optical brighteners and halogenated organic compounds. In 11 of the tested tissue papers, high concentrations of halogenated organic compounds were found. Optical brighteners were found in five of the tissue papers. In general, the test does not mention the specific concentrations measured for the different chemicals (Öko-Test 1, 2014a).

4.3.1.8 Chemical substances in diapers (2014) – Öko-Test

The German test magazine Öko-Test tested 14 different brands of diapers for the content of problematic chemicals. The diapers were tested for the content of optical brighteners, UV absorbers, halogenated organic compounds and lotion. In two of the tested diapers, lotions were found based on paraffin oil or petroleum. Optical brighteners and UV absorbers were found in most of the diapers, but this content was not considered to be problematic. Problematic halogenated organic compounds were not detected. In general, the test does not mention the specific concentrations measured for the different chemicals (Öko-Test 1, 2008).

4.3.1.9 Chemical substances in toilet wipes (2014) – Öko-Test

The German test magazine Öko-Test tested 15 different brands of toilet wipes for the content of problematic chemicals. The toilet wipes were tested for content of formaldehyde or formaldehyde releasers, halogenated organic compounds and fragrances/perfume. Formaldehyde or formaldehyde releasers were found in five of the toilet wipes tested. All of the tested toilet wipes contained halogenated organic compounds. Two of the tested toilet wipes contained fragrances/perfume. In general, the test does not mention the specific concentrations measured for the different chemicals (Öko-Test 5, 2008).

4.3.2 Review of existing legislation relevant for hygiene products

Chemical requirements for hygiene products in existing legislation are limited to the restriction of organic tin compounds and the fungicide DMF. These chemical requirements are listed in more details below.

The following organostannic compounds are restricted:

- Tributyltin (TBT) compounds, triphenyltin (TPT) compounds, dibutyltin (DBT) compounds and dioctyltin (DOT) compounds must not be used in articles in levels over 0.1% by weight. Limited via REACH annex XVII entry no. 20. For DOT it is specifically stated that DOT is restricted in ***“female hygiene products and nappies”***.

The following biocides are restricted:

- Dimethyl fumarate (DMF) must not be used in any articles in concentrations greater than 0.1% by weight. Limited via REACH annex XVII entry no. 61. DMF is a fungicide that may be used in paper products¹⁵.

One of the examples given in Table 6 – toilet wipes (or wet wipes) - is actually regulated under the EU Regulation on cosmetics products (EU Regulation No. 1223/2009). For this type of hygiene product, the restriction of chemicals is much longer (according to the annexes of the Cosmetics Regulation). However, this aspect will not be elaborated here as this type of product is untypical for the product group of hygiene products.

Finally, it should be mentioned that a relevant restriction is being discussed as a future REACH Annex XVII restriction:

- The use of lead in articles (or accessible parts of articles) which can be placed in the mouth by children (i.e. one dimension is smaller than 5 cm or has detachable parts of that size). The limit value suggested is 0.05% by weight. RAC and SEAC have prepared and adopted an opinion¹⁶ regarding this restriction, but discussions are still ongoing and the final decision to adopt the restriction is missing¹⁷ (as of September 2014).

4.3.3 Review of existing eco-labelling requirements for hygiene products

A review has been made of the existing chemical requirements in the eco-labelling criteria for hygiene products. The review only comprises the EU Flower and the Nordic Swan. The following relevant eco-labelling criteria exist which are relevant for hygiene products:

- EU Flower: Tissue paper (Commission Decision 2009/4596/EC)
- Nordic Swan: Tissue paper (Nordic Swan: Tissue paper, 2014)
- Nordic Swan: Sanitary products (Nordic Swan: Sanitary products, 2013)

¹⁵ http://www.bureauveritas.com.bd/wps/wcm/connect/bv_com/group/home/about-us/our-business/our-business-consumer-products/our+services/cpsdservicesheets/eu+bans+dimethyl+fumarate

¹⁶ <http://echa.europa.eu/documents/10162/10a7006f-1342-40ad-8aa3-c28365d0faca>

¹⁷ <http://echa.europa.eu/previous-consultations-on-restriction-proposals/-/substance/1402/search/+/term>

These chemical requirements in the eco-labelling criteria are described in the table below.

Table 7: Chemical requirements in Eco-labelling criteria relevant for hygiene products

Hygiene products				
Chemical compound	Relevant material	EU Flower: Tissue paper	Nordic Swan: Tissue paper	Nordic Swan: Sanitary products
<i>CMRs and other hazardous chemicals</i>				
PCB		Shall not contain more than 0.15 mg/kg	Shall not contain more than 0.15 mg/kg	May not contain more than 2 mg/kg
Formaldehyde	Products with recycled fibres	Shall not contain more than 1 mg/dm ²	Shall not contain more than 1 mg/dm ²	May not contain more than 1 mg/dm ² Must not contain, except glue must not exceed 10 ppm
APEOs		Shall not be added to clearing chemicals	Shall not be added to clearing chemicals	
<i>Phthalates and other plasticizers</i>				
Phthalates	Adhesive			Must not contain
<i>Elements</i>				
Antimony	Polyester			Must not exceed 200 ppm (except recycled polyester)
<i>Sensitizing substances</i>				
Perfume/other fragrance substances	Fragrances		Not permitted	Must not contain
	Lotion or skin care Softeners, lotion and additives	Must not be CMR, environmental hazardous or sensitizing	Must meet the requirements of the Nordic Ecolabelling criteria document for cosmetics	Must not contain Must not be added
	Odour control			Only permitted in incontinent care products
<i>Flame retardants</i>				
Flame retardants				Must not be added
<i>Halogenated compounds</i>				
Chlorine		Shall not be used as a bleaching agent	Shall not be used as a bleaching agent	
Chloro-organic substances epichlorohydrin (ECH), 1,3-dichloro-2-propanol (DCP) and 3-monochloro-1,2-propanediol (MCPD) Epichlorohydrin (ECH), dichlorisopropanol (DCP) or chloropropanediol (CPD)	Wet strength agents	Must not contain more than 0.7 % calculated as the sum of the three components related to the dry content	Wet strength agents may contain a total of no more than 7000 ppm (0.7%) low-molecular chloro-organic compounds epichlorohydrin (ECH), dichloroisopropanol (DCP) and chloropropanediol (CPD) – calculated on the basis of the dry matter content. Other auxiliary chemicals used on Yankee cylinders in tissue paper production must not contain a total of epichlorohydrin (ECH), dichloroisopropanol (DCP) or chloropropanediol (CPD) in excess of 500 ppm (0.05%).	Similar to tissue paper: Must not contain more than 0.7 % calculated as the sum of the three components related to the dry content Similar to tissue paper: Must not contain more than 0.05 % calculated as the sum of the three components related to the dry content
Halogen-based polymers	Polymers			Must not contain

Hygiene products				
Chemical compound	Relevant material	EU Flower: Tissue paper	Nordic Swan: Tissue paper	Nordic Swan: Sanitary products
Halogenated organic compounds or phthalates				Must not contain, except pollutants (less than 100 ppm)
Preservatives and biocides				
PCP		Shall not contain more than 2 mg/kg	Shall not contain more than 2 mg/kg	
Nanomaterials				
Nano materials				Must not be actively added
Other chemicals				
Glyoxal		Shall not contain more than 1.5 mg/dm ²	Shall not contain more than 1.5 mg/dm ²	Must not exceed 1.5 mg/dm ²
Dyes, optical brighteners and ink		Must not contain	Must not contain	Must not contain
Optical brightener				Must not be added to the pulp
Residual monomers	Super-absorbents			Must not exceed 400 ppm
Octamethyl cyclotetrasiloxane (D4) Decamethyl cyclopentasiloxane (D5)	Silicon treatment			Must not be present
Colophony resin				Must not contain

All-in-all, the EU Flower and Nordic Swan criteria for hygiene products restrict the following groups of chemicals:

- Elements (antimony)
- Halogenated organic compounds
- Chlorine
- Epichlorohydrine and similar compounds (ECH, DCP, MDCP, CPD)
- Flame retardants
- Brighteners
- Phthalates
- Alkylphenol/alkylphenoethoxylates (APEOs)
- Formaldehyde
- Nano materials
- CMR substances
- Residual monomers
- Siloxanes (D4 and D5)
- Colophony resin
- Perfume/fragrances
- Glyoxal
- PCP
- PCB

This long list of different chemicals limited in eco-labelled hygiene products illustrates that many different hazardous chemicals may exist in this product group.

When comparing the list of eco-label requirements with the restricted chemical substances, it can be seen that it is only a small part of the listed substances in eco-labelling that is restricted by legislation.

On the other hand, it is not the intention that all eco-label requirements should be converted to restrictions in legislation, as the intention and purpose of eco-labelling are that only about the best 10-30% of the products should be able to live up to all the chemical requirements. However, the number of available hygiene products on the market with an eco-label illustrates that it is possible to avoid these dangerous chemicals in this type of products.

4.3.4 Review of possible chemical requirements in relevant standards for hygiene products

A search on the CEN (European Committee for Standardization) webpage on 'hygiene' reveals 148 standards from 19 different committees, where the only committee that seems to be relevant to some degree is the committee on "Sanitary appliances". However, this committee covers sanitary appliances such as WCs, shower trays, wall-hung urinals etc.

Some standards on tissue paper and tissue products can also be found in the committee CEN/TC 172 "Pulp, paper and board", but these standards (16 in all) all concern physical and performance aspects and do not address any aspects concerning the content of chemicals in the hygiene products.

A search on the CEN webpage on 'hygiene products' only reveals six standards where five of these concern standards from the committee on dentistry and oral hygiene products. However, these standards only concern professional dentistry tools and do not cover consumer hygiene products. This means that no relevant CEN standards covering the area of hygiene products exist.

4.3.5 Discussion

The examples of chemicals found in hygiene products (especially formaldehyde, fragrances, halogenated organic compounds and other organic compounds) illustrate that hazardous chemicals may be present in hygiene products. This is further supported by the long list of requirements for hazardous chemicals in eco-labelling criteria for hygiene products.

For hygiene products, the existing chemical requirements in regulation of today are limited to the content of organic tin compounds and DMF. This means that it is only few of the hazardous chemicals which can be present in hygiene products that actually are restricted today, thus there may be a need for further restriction of chemicals in this product area.

If further restrictions on chemicals should be set on this area, it is suggested to focus on the following type of chemicals:

- Formaldehyde
- Halogenated organic solvents
- Elements
- Fragrances and other sensitizing substances

It should be noted that these chemicals are only a suggestion that is based on this screening of the product group prepared in this project. These chemicals are chosen because they have been identified in the products in this product

group, are restricted in other areas, are considered to be hazardous and may contribute to the total burden/exposure through various types of consumer products. Of course, it will be necessary in future work on this area to go into much more details about the exposure and risk of these types of chemicals in this product group to determine if restrictions should be made for these groups of chemicals and if so which limit values to use.

4.4 Paper products

The product group paper products cover all types of printed paper products such as newspaper, magazines and printed cardboard products. Simple copying paper (white paper) is not included in this product group, as one of the most interesting aspects of paper products is the printing inks used.

Food contact materials (FCM) and packaging materials are not included in this product group as the chemical requirements for food contact materials and packaging materials have been presented and discussed in a former ASI Consumer Council study (Chemical requirements for consumer products – Part II), (Poulsen and Strandesen, 2011).

This product group is covered by the European Flower criteria document for Newsprint paper (Commission Decision 2012/448/EU) and Printed paper (Commission Decision 2012/481/EU) which covers any printed paper products (at least 90 % paper) except for books, catalogues, pads, booklets or forms (at least 80 % paper). The Nordic Swan criteria document covers printing companies, printed matter, envelopes and others converted paper products such as books etc. (Nordic Swan: Printing companies, 2014).

4.4.1 Examples of chemicals found in paper products

A literature search for chemicals found in paper products resulted in the following examples (see Table 8), which are described in more details in the text below.

Tests and reports addressing tattoo colours have been included in the examples as well because the colours used for tattooing may be similar to the printing inks used for printing of paper.

Table 8: Literature describing chemicals found in paper products

Paper products	Source	Year	Chemicals found
Receipts	Danish EPA	2011	Bisphenol A (BPA)
Paper and board coating for food packaging	Environmental science and pollution research	2011	More than 115 molecular structures including polyfluoroalkyl-mono- and di-ester phosphates (monoPAPS, diPAPS and S-diPAPS), -ethoxylates, -acrylates, -amino acids, -sulfonamide phosphates and -thio acids, Di- and trialkylated PAPS and S-diPAPS.
Receipts	US Environmental working group	2010	Bisphenol A (BPA)
Organic volatile compounds in printed matter	Danish EPA	2003	Toluene

Paper products	Source	Year	Chemicals found
Printing inks used for food packaging	BfR	2006	In all more than 1,000 different chemicals used for printing of food packaging
Tattoo colours	Reported by Kemi, Sweden (Swizz origin)	2009	Azodyes Nitrosamines Preservatives
Tattoo colours	Reported by Kemi, Sweden (Italian origin)	2010	Elements (aluminium, barium, copper, iron, strontium, cadmium, manganese, lead, antimony, vanadium, mercury, chromium, nickel, cobalt)
Dangerous substances in tattoo colours	Kemi, Sweden	2010	Elements (arsenic, barium, chromium, copper, nickel, tin, zinc, strontium) PAH Aromatic amines
Tattoo colours	Öko-test 1	2013	Aromatic amines Nitrosamines Formaldehyde Benzoisothiazolinone Elements (barium and nickel) Halogenated organic compounds PEG/PEG-derivative

4.4.1.1 Receipts (2011) - Danish EPA

In 2011, the Danish EPA investigated receipts from various stores and detected a large amount of BPA (which is suspected of being an endocrine disruptor) in the receipts. The BPA originates from thermal paper. The content of BPA in 7 out of 12 analysed cash register receipts varied from 8,700 to 17,000 mg/kg. In the report, the Danish EPA concluded that the BPA was not a risk for customers or staff working in the stores (Lassen et al., 2011).

4.4.1.2 Paper and board coating for food packaging (2011) – Environmental Science and Pollution Research

In this study, the identity of different polyflurinated surfactants (PFS) used for food contact materials, mainly paper and board was investigated. PFS are of interest as they can be precursors of poly – and perfluorinated alkyl substances (PFAS), of which several are persistent and found in human blood and the environment. More than 115 molecular structures were found in industrial blends from the EU, the US and China, belonging to the groups of polyfluoroalkyl-mono- and di-ester phosphates (monoPAPS, diPAPS and S-diPAPS), -ethoxylates, -acrylates, -amino acids, -sulfonamide phosphates and -thio acids, together with residuals and synthesis by-products. In addition, a number of starting materials such as perfluorooctane sulfonamide N-alkyl esters was analysed. Di- and trialkylated PAPS and S-diPAPS were found in migrates from European food contact materials (Environmental Science and pollution research, 2011).

4.4.1.3 Receipts (2010) – US Environmental Working Group (EWG)

In the American investigation, 36 receipts were analysed and close to one of two contained Bisphenol A (BPA) in concentrations between 0.8 – 2.8%. EWG also performed a specialized test to determine how much of the BPA that was released from the receipts. An average of 2.4% of the BPA content was released from the four investigated receipts (Lunder et al., 2010).

4.4.1.4 Volatile organic chemicals in printed matter (2003) – Danish EPA

In 2003, the Danish EPA investigated the emission of volatile organic chemicals in printed matter. Toluene was the substance that raised most attention. In the study, maximum emissions up to 272 mg/kg printed matter were measured during one hour. However, as the maximal estimated exposure concentration of 23 mg/m³ did not exceed NOAEC of 150 mg/m³ it was concluded that toluene was not expected to be a health problem to the average consumer (Christensen, O., Eggert, T., 2003).

4.4.1.5 Printing inks used for food packaging (2006) – German BfR

BfR, the German Federal Institute for Risk Assessment, has made a press release on printing inks in food contact materials in 2006. BfR states that fact that about 1,000 different chemical substances are used to print food packaging. Whether or not they migrate into food depends on the printing ink, the food, and the packaging material. BfR criticizes the fact that for most of these chemicals no toxicological data are available which makes it very difficult to perform a health assessment, especially as data do not seem to be provided by the industry before 2010-2015 and only on some of the relevant effects (BfR, 2006). This is problematic as the Food Contact Materials Regulation does not cover printing inks. No specific measures have been taken within this group of materials.

4.4.1.6 Tattoo colours (2009) – Switzerland

Kemi, the Swedish Chemicals Agency, reports on a Swiss analysis of 152 different tattoo colours. The tattoo colours were analysed for the content of breakdown products from the azodyes, including nitrosamines and non-permitted preservatives. 62 samples (or 41%) were found to have such serious deficiencies that a ban on sale was imposed (Kemi, 2010).

4.4.1.7 Dangerous substances in tattoo colours (2010) – Kemi, Sweden

Kemi, the Swedish Chemicals Agency, tested 31 different tattoo colours for the content of problematic chemicals. The tattoo colours were tested for the content of 20 different aromatic amines (which are considered to be carcinogenic, mutagenic and sensitizing), 14 different elements, 16 different polyaromatic hydrocarbons (PAH) and other seven substances classified as carcinogenic.

The result was that 10 of the 31 tattoo colours contained one or two different aromatic amines in a content of 24-68 ppm¹⁸. PAH was found in six different tattoo colours in concentrations of 0.2-270 ppm. In a black colour 12 different PAHs were found in the highest total concentration of 270 ppm.

None of the elements lead, cadmium, mercury, selenium or chromium VI was detected in any of the tattoo colours; however, the following elements were found (the concentration found is listed in brackets): Arsenic in one colour (18 ppm), barium in 23 colours (11-9,800 ppm), chromium in 11 colours (15-100 ppm), copper in 18 colours (15-45,000 ppm), nickel in one colour (71 ppm), tin in 7 colours (10-56 ppm), zinc in 9 colours (16-95 ppm), strontium in 10 products (12-120 ppm). Kemi noted that for many of the colours the recommended limit value for the elements in tattoo colours and permanent make up is exceeded (Kemi, 2010).

¹⁸ The limit value for these aromatic amines in textiles is 30 ppm (REACH annex XVII).

4.4.1.8 Tattoo colours (2010) – Italy

Kemi, the Swedish Chemicals Agency, reports on an Italian analysis of tattoo colours. The tattoo colours were analysed for the content of different elements. The elements found in high concentrations were: aluminium, barium, copper, iron and strontium. Toxic metals such as cadmium, manganese, lead, antimony and vanadium were detected in small amounts in a few products. Mercury was only found in trace amounts. Sensitizing elements such as chromium, nickel and cobalt were also detected in some of the colours¹⁹.

4.4.1.9 Tattoo colours (2013) – Öko-Test

The German test magazine Öko-Test tested 20 different tattoo colours for the content of problematic chemicals. The tattoo colours were tested for content of aromatic amines, nitrosamines, formaldehyde or formaldehyde releasers, preservatives, halogenated organic compounds and other problematic substances.

Barium (above 50 mg/kg) and nickel were found in four and three tattoo colours respectively (not the same three tattoo colours). Halogenated organic compounds were found in concentrations above 500 µg/kg in seven of the tattoo colours. Aromatic amines that can be carcinogenic were found in six of the tattoo colours, and nitrosamines in one of the tattoo colours (in concentrations above 20 mg/kg). Formaldehyde or formaldehyde releasers were found in five of the tattoo colours and in additional 10 of the colours smaller amounts of formaldehyde were identified. The sensitizing preservative benzoisothiazolinone was found in a concentration above 10 mg/kg in three of the tattoo colours. Finally, a PEG/PEG-derivative was found in seven of the tattoo colours. In general the test does not mention the specific concentrations measured for the different chemicals (Öko-Test 1, 2013).

4.4.2 Review of existing legislation relevant for paper products

Chemical requirements for paper products in existing legislation are limited to the restriction of organic tin compounds and the fungicide DMF. These chemical requirements are listed in more details below.

The following organostannic compounds are restricted:

- Tributyltin (TBT) compounds, triphenyltin (TPT) compounds, dibutyltin (DBT) compounds and dioctyltin (DOT) compounds must not be used in articles in levels over 0.1% by weight. Limited via REACH annex XVII entry no. 20. Organostannic compounds may be used in paper products.

The following biocides are restricted:

- Dimethyl fumarate (DMF) must not be used in any articles in concentrations greater than 0.1% by weight. Limited via REACH annex XVII entry no. 61. DMF is a fungicide that may be used in paper products²⁰.

¹⁹ <http://www.kemi.se/sv/Innehall/Nyheter/Forslag-om-regler-for-tatueringsfarger/>

²⁰ http://www.bureauveritas.com.bd/wps/wcm/connect/bv_com/group/home/about-us/our-business/our-business-consumer-products/our+services/cpsdservicesheets/eu+bans+dimethyl+fumarate

No other chemical requirements for paper products have been identified – nor for the use of printing inks. However, it should be mentioned that a relevant restriction is being discussed as a future REACH Annex XVII restriction:

- The use of lead in articles (or accessible parts of articles) which can be placed in the mouth by children (i.e. one dimension is smaller than 5 cm or has detachable parts of that size). The limit value suggested is 0.05% by weight. RAC and SEAC have prepared and adopted an opinion²¹ regarding this restriction, but discussions are still ongoing and the final decision to adopt the restriction is missing²² (as of September 2014).

Furthermore, some chemicals, like e.g. specific dyes (e.g. based on lead), are on the REACH Candidate list. This means that there is a duty of disclosure (REACH Article 33) in the supply chain if products contain more than 0.1% of these substances. On the other hand, if the products are sold to consumers, there is only a duty to disclose the content of these substances, if consumers demand this information.

4.4.3 Review of existing eco-labelling requirements for paper products

A review has been made of the existing chemical requirements in the eco-labelling criteria for paper products. The review only comprises the EU Flower and the Nordic Swan. The following relevant eco-labelling criteria exist which are relevant for paper products:

- EU Flower: Newsprint paper (Commission Decision 2012/448/EU)
- EU Flower: Printed paper (Commission Decision 2012/481/EU)
- Nordic Swan: Printing companies, printed matter, envelopes and other converted paper products (Nordic Swan: Printing companies, 2014)

These chemical requirements in the eco-labelling criteria are described in the table below.

Table 9: Chemical requirements in Eco-labelling criteria relevant for paper products

Paper products (printings inks)				
Chemical compound	Relevant material/ relevant for	EU Flower : Printed paper	EU Flower: Newsprint paper	Nordic swan: Printing companies...
CMRs and other hazardous chemicals				
Aromatic hydrocarbons	Washing agents	0.1 % (w/w)		
APEOs (alkylphenol ethoxylates or other derivatives)		Shall not be added to inks, dyes, toners	Shall not be added to clearing substances, de-inking substances, foam inhibitors or dispersants	
Azodyes (cleave to aromatic amines)			Shall not be used	The content of primary unsulphonated aromatic amines expressed as aniline must not exceed 500 mg/kg No more than 10 mg/kg benzidine, β-naphthylamine and 4-

²¹ <http://echa.europa.eu/documents/10162/10a7006f-1342-40ad-8aa3-c28365d0faca>

²² <http://echa.europa.eu/previous-consultations-on-restriction-proposals/-/substance/1402/search/+/term>

Paper products (printings inks)				
Chemical compound	Relevant material/ relevant for	EU Flower : Printed paper	EU Flower: Newsprint paper	Nordic swan: Printing companies...
				aminobiphenyl in printing inks, toners or inks
<i>Phthalates and other plasticizers</i>				
Phthalates		Shall not be added if they are classified with certain hazard phrases		
<i>Elements</i>				
Elements	Printing ink, toners, inks, varnishes, foils and laminates	Cadmium, copper, lead, nickel, chromium VI, mercury, arsenic, barium, selenium, antimony shall not be used	Metal complex dye stuff or pigments based on lead, copper, chromium, nickel or aluminium, shall not be used	The content of the heavy metals, lead, cadmium, mercury and chromium VI must in total not exceed 100 ppm
Cobalt		Can be used up to 0.1 % (w/w)		
<i>Halogenated compounds</i>				
Chlorine			Shall not be used as a bleaching agent	
Halogenated solvents		Shall not be added if they are classified as hazardous		
<i>Other chemicals</i>				
Residual monomers (excluding acrylamide) with risk phase			Shall not exceed 100 ppm (on basis of solid content)	
Acrylamide			Shall not be present in coatings, retention aids, strengtheners, water repellents or chemicals used in water treatment higher than 700 ppm (on basis of solid content)	

All-in-all, the EU Flower and Nordic Swan criteria for paper products restrict the following groups of chemicals:

- Elements (cadmium, copper, lead, nickel, chromium VI, mercury, arsenic, barium, selenium, antimony and cobalt)
- Halogenated solvents
- Aromatic hydrocarbons
- Chlorine
- Acrylamide
- Azodyes (which cleave to aromatic amines)
- Phthalates
- Alkylphenol/alkylphenolethoxylates (APEOs)

This long list of different chemicals limited in eco-labelled paper products illustrates that many different hazardous chemicals may exist in this product group.

When comparing the list of eco-label requirements with the restricted chemical substances, it can be seen that only a small part of the listed substances in eco-labelling is being restricted by legislation.

On the other hand, it is not the intention that all eco-label requirements should be converted to restrictions in legislation as the intention and purpose with eco-labelling is that only about the best 10-30% of the products should be able to live up to all the chemical requirements. However, the number of available paper products on the market with an eco-label illustrates that it is possible to avoid these dangerous chemicals in this type of products.

4.4.4 Review of possible chemical requirements in relevant standards for paper products

A search on the CEN (European Committee for Standardization) webpage on 'paper products' revealed zero standards concerning this product group, whereas a search on 'paper' revealed 262 standards from more than 40 different committees. The following committees seem (or to some degree seem) to be relevant for the product group of 'Paper products':

- The committee CEN/TC 99 on "Wall coverings"
- The committee CEN/TC 194 on "Utensils in contact with food"
- The committee CEN/TC 261 on "Packaging"
- The committee CEN/TC 172 on "Pulp, paper and board"

The committee CEN/TC 99 on "Wall coverings" covers different types of wall papers, including plastic wall coverings and wall vinyls, and is not a product type that is relevant under the definition on the product group 'Paper products'.

A search on 'paper' and the committee CEN/TC 194 on "Utensils in contact with food" reveals two standards where one concerns plastics and the other concerns polymeric coatings on paper and board. However, both standards are within the area of food contact materials (FCM), for which the chemical requirements have been described and discussed in a former ASI Consumer Council study (Part II). Therefore, this is not discussed further here.

A search on 'paper' and the committee CEN/TC 261 on "Packaging" reveals nine standards primarily on paper sacks for household waste. However, these standards are within the area of packaging, for which the chemical requirements have been described and discussed in a former ASI Consumer Council study (Part II). Therefore, this is not discussed further here.

The committee CEN/TC 172 on "Pulp, paper and board" mainly covers paper and board intended to come into contact with foodstuffs, but also printing and business paper, and tissue paper and tissue products. A search on 'paper' under this committee reveals 63 standards in all. A few of these standards concern extracts regarding specific chemicals. However, only measurement methods are listed and the standards are not establishing requirements. The measurement methods listed are:

- Formaldehyde in extract (EN 1541: 2001, "Paper and board intended to come into contact with foodstuffs - Determination of formaldehyde in an aqueous extract").

- Phthalates in extract (EN 16453: 2014, “Pulp, paper and paperboard - Determination of phthalates in extracts from paper and paperboard”).
- Mercury in aqueous extract (EN 12497:2005, “Paper and board - Paper and board intended to come into contact with foodstuffs - Determination of mercury in an aqueous extract”).
- Cadmium and lead in aqueous extract (EN 12498:2005, “Paper and board - Paper and board intended to come into contact with foodstuffs - Determination of cadmium and lead in an aqueous extract”).
- Diisopropylnaphthalene in extract (EN 14719:2005, “Pulp, paper and board - Determination of the Diisopropylnaphthalene (DIPN) content by solvent extraction”).
- Cytotoxicity of aqueous extract (EN 15845:2010, “Paper and board - Determination of the cytotoxicity of aqueous extracts”).
- Pentachlorophenol in aqueous extract (EN ISO 15320:2011, “Pulp, paper and board - Determination of pentachlorophenol in an aqueous extract”).

Therefore, in conclusion, it can be said that none of the standards under the CEN/TC 172 committee on “Pulp, paper and board” sets chemical requirements, but test methods for the following substances (concentration in extracts) are listed:

- Formaldehyde
- Phthalates
- Elements (mercury, cadmium and lead)
- Diisopropylnaphthalene
- Pentachlorophenol

4.4.5 Discussion

The examples of chemicals found in paper products (especially aromatic amines, formaldehyde and elements) illustrate that hazardous chemicals may be present in paper products. This is further supported by the list of requirements for hazardous chemicals in eco-labelling criteria for paper products.

For paper products, the existing chemical requirements in regulation today are limited to content of organic tin compounds and DMF. This means that it is only few of the hazardous chemicals, which can be present in paper products that actually are restricted today. On the other hand, some chemical requirements are set in standards related to pulp, paper and board.

As discussed in ASI Consumer Council study Part II, the use of printing inks is not regulated in the area of Food Contact Materials. Here a call for further regulation in this area was made. The same applies for printing inks used for paper products. Several examples (tattoo inks) illustrate that hazardous substances may be present, and a press release from the German Federal Institute for Risk Assessment – BfR (BfR, 2006) points to the fact that about 1,000 different chemical substances are used for print food packaging. Therefore, the area needs a more in depth investigation. A recent report from Kemi (the Swedish Chemicals Agency) also concludes that one of seven areas, that Kemi regards as being the most important areas to act on with regard to chemicals in products in the EU, is to raise the knowledge about printing inks

(and perfluorinated compounds and mineral oils) in paper for food contact, i.e. Kemi is also concerned about the missing knowledge about the many printing inks used and their chemical hazards (Kemi, 2012).

If further restrictions on chemicals should be set in this area, it is suggested to focus on the following type of chemicals:

- Printing inks/dyes (azodyes and other dangerous substances in printing inks and dyes)
- Elements
- Bisphenol A in specific types of paper

It should be noted that these chemicals are only a suggestion that is based on this screening of the product group prepared in this project. These chemicals are chosen because they have been identified in the products in this product group, are restricted in other areas, are considered to be hazardous and may contribute to the total burden/exposure through various types of consumer products. Of course, it will be necessary in future work in this area to go into much more details about the exposure and risk of these types of chemicals in this product group to determine if restrictions should be made for these groups of chemicals and if so which limit values to use.

4.5 Leather products

The product group “Leather products” contains all kinds of leather products such as shoes, clothing, bags, straps for watches etc. As described in Nordic Swan criteria document for Textiles, Skin and Leather (Nordic Swan, Textile, Skin and Leather), leather products can be defined as hide and leather products, such as jackets, trousers, belts or bags, and hides/skins and leather as raw materials.

4.5.1 Examples of chemicals found in leather products

A literature search for chemicals found in leather products resulted in the following examples (see Table 10), which are described in more details in the text below.

Table 10: Literature describing chemicals found in leather products

Leather products	Source	Year	Chemicals found
Leather products	Danish EPA	2002	Elements (chromium VI)
Children’s leather sandals	Öko-test	2009	Elements (chromium) Organic tin compounds PAHs Chloroparaphines o-phenylphenol
Leather shoes	Danish EPA	2011	Elements (chromium)
Leather shoes	Naturskyddsforeningen	2009	Elements (chromium, arsenic, lead and mercury) DMF Carcinogenic aromatic amines Formaldehyde
Children’s leather slippers	Healthystuff, The Ecology Center	2008	Elements (bromine and chromium).
Children’s leather shoes	Healthystuff, The Ecology Center	2008	Elements (chlorine and bromine)

Leather products	Source	Year	Chemicals found
Leather products	www.erdefarlig.no	2014	No direct tests, but it is stated that the following chemicals may be found in leather products: Elements (arsenic, lead, chromium, nickel) Phthalates (DEHP) Chloroparaphines Perfluorinated compounds (PFOS / PFOA / PFCA) Dimethylfumarat (DMF)
Leather gloves	Öko-test 11	2011	Anilin PAH Elements (chromium, lead, antimony) Halogenated organic compounds Chlorocresol o-phenylphenol Organic tin compounds (DBT) Formaldehyde
Leather gloves	Kemi, Sweden	2011	Elements (chromium VI)
Chemicals in leather	Kemi, Sweden	2014	Kemi in Sweden states on their website which chemicals that can be found in leather: Elements (chromium) Phthalates Formaldehyde Pigments/colours
Leather shoes	Swedish Society for Nature Conservation	2009	Elements (chromium, arsenic, lead, and mercury) Chlorinated paraffins Azodyes Ortho-phenylphenol Biocides (2,4,6-trichlorophenol, DMF) Formaldehyde

4.5.1.1 Investigation of leather products (2002) – Danish EPA

In 2011, the Danish EPA investigated the content of Cr (VI) and Cr (III) in leather products on the Danish market. 43 leather products were purchased in Denmark and the leather was analysed for its content of hexavalent chromium and total chromium. The products represented ten different product groups (watch-straps, shoes, gloves, baby-shoes, working gloves, leather jackets, trousers, leather-tops, skirts and leather-hats).

15 out of the 43 of the-leather products contained hexavalent chromium in levels above the detection limit of 3 mg/kg. 35% of the products contained hexavalent chromium. In the 15 products where hexavalent chromium was detected, the concentration range was from 3.6 to 14.7 mg/kg.

Additionally ten baby-shoes were analysed for its content of hexavalent chromium (chromium VI). The content of hexavalent chromium was below the detection limit in all samples. Two of the baby-shoes were also analysed for migration of chromium according to the European Standards on safety of Toys.

The high number of leather products containing hexavalent chromium was not expected, especially taking into consideration that it is relatively easy and

well known to produce leather, which does not contain any hexavalent chromium (Rydin, 2002).

4.5.1.2 Children's leather sandals (2009) – Test (Öko-test)

The German consumer council tested 15 sandals for children for problematic chemical substances. The test showed that all 15 sandals (3 of synthetic material and 12 of leather) contained problematic chemicals and chromium was detected in all of the leather sandals. The other problematic chemicals detected were organic tin compounds and PAHs. EU Flower eco-labelled sandals were among the tested sandals. One of these contained chloroparaphines and o-phenylphenol, which are suspected of being endocrine disrupting. In general, the EU eco-labelled sandals performed better in the test compared to non-eco-labelled sandals. (Öko-test, 2009).

4.5.1.3 Survey of chromium in leather shoes (2011) – Danish EPA

The Danish EPA investigated the content of chromium in leather shoes. The release of chromium from shoes can result in allergic reaction and potential food eczema. XRF screening of the 60 pairs of shoes revealed that the typical range of chromium content in leather shoes seemed to be between 1 and 3%. Low levels of Cr(VI) may cause allergic contact dermatitis and patients with Cr(VI) allergy may react to a single occluded exposure to 1 ppm – 3 ppm Cr(VI) (Johansen et al., 2011).

4.5.1.4 Leather shoes (2009) – Test (Naturskyddsföreningen)

The Swedish EPA tested together with multiple environmental organisations from around the world 21 pairs of leather shoes. The shoes were tested for a variety of metals and organic compounds, e.g. chromium, mercury, arsenic and azodyes. All of the shoes tested contained metals in various amounts. High levels of chromium was detected in all of the shoes, even a pair that was marked as natural tanned. In a couple of the shoes, arsenic, lead and mercury were detected. In a single pair of shoes, a small amount of DMF was detected (DMF is a mold and fungicide used in products from Asia and is a strong allergen and therefore restricted in the EU). In one pair, even carcinogenic aromatic amines and formaldehyde (carcinogenic and allergenic) were detected. (Naturskyddsföreningen, 2009)

4.5.1.5 Children's leather slippers (2008) – Test (Healthystuff.org, The Ecology Center)

The American page healthystuff.org (researching toxic chemicals in everyday products) tested a product referred to as Birthday Boy Leather Slippers. The chemicals tested for were lead, chlorine, cadmium, arsenic, mercury and bromine. Bromine was detected in concentrations of 24 – 53 ppm and an unspecified amount of chromium was also detected in the product. The overall exposure level was categorised as being “low”. (The Ecology Center, 2008)

4.5.1.6 Children's leather shoes (2008) – Test (Healthystuff.org, The Ecology Center)

The American page healthystuff.org (researching toxic chemicals in everyday products) tested a product referred to as Pink Patent Leather Shoes. The chemicals tested for were lead, chlorine, cadmium, arsenic, mercury and bromine. A chlorine level of 320 – 359 ppm and a bromine level of 327 ppm were detected in the product. The overall exposure level was categorised as being “medium”. (The Ecology Center, 2008)

4.5.1.7 Leather products - Erdetfarlig.no

The Norwegian website “www.erdetfarlig.no” (translated: “is it dangerous”) has listed which chemical substances that are present in different consumer products. The list is not based directly on tests, but on experiences with chemicals found in different consumer products. For leather products such as shoes, furniture, clothing, handbags etc. the following chemicals are listed: Elements (arsenic, lead, chromium, nickel), phthalates (DEHP), chlorinated paraffines, perfluorinated compounds (PFOS/PFOA/PFCA) and dimethylfumarate (DMF).

4.5.1.8 Leather gloves (2011) – Öko-Test

The German test magazine Öko-Test tested 17 different brands leather gloves for the content of problematic chemicals. The leather gloves were tested for the content of aniline, polycyclic aromatic hydrocarbons (PAH), elements, halogenated organic compounds and other problematic substances. Anilin was found in concentrations higher than 5 mg/kg in 12 of the tested leather gloves. Polycyclic aromatic hydrocarbons were detected in all leather gloves, but in high amounts (above 1,000 µg/kg) in six of the leather gloves. The element chromium was detected in all of the leather gloves; however, the concentrations found or whether or not chromium was found as chromium III or chromium VI are not stated. Furthermore, lead was detected in two of the leather gloves and antimony in one of the leather gloves. Halogenated organic compounds were found in all 17 leather gloves, and chlorocresote was found in concentrations higher than 50 mg/kg in 8 of the products. Chlorinated paraffins were detected in one of the leather gloves. The organic tin compound DBT was detected in amounts higher than 250 µg/kg in four of the products and in one of the products other organic tin compounds were detected as well. Furthermore, formaldehyde was detected in one of the leather products in concentrations higher than 20 mg/kg. Finally, o-phenylphenol was detected in six of the leather gloves. In general, the test does not mention the specific concentrations measured for the different chemicals (Öko-Test 11, 2011).

4.5.1.9 Leather gloves (2011) – Kemi, Sweden

Kemi, the Swedish Chemicals Agency, has tested 31 leather gloves for the content of hexavalent chromium (chromium VI). The content varied from 3 to 52 ppm²³.

4.5.1.10 Leather products (2014) – Kemi, Sweden

Kemi, the Swedish Chemicals Agency, describes on their website that leather products can contain the following problematic substances: chromium, phthalates, formaldehyde and pigments/colours²⁴.

4.5.1.11 Chemicals in leather shoes (2009) - SSNC

The Swedish Society for Nature Conservation (2009a) has tested 21 pair of leather shoes from all over the world for the content of different heavy metals and organic compounds. Most of the chemical compounds studied can be assumed to originate from the tanning, preservation, or dyeing of the leather. Metals in various concentrations were found in all the shoes that were analysed. The report concludes that although there may be no immediate risk to the wearer of the shoes, they may pose a long-term health risk to humans

²³ <http://www.kemi.se/sv/Innehall/Tillsyn/Inspektionsprojekt/Analys-av-sexvart-krom-i-laderhandskar/>

²⁴ <http://konsument.kemi.se/kemikalier-i-vardagen/varor-och-kemiska-produkter/ladervaror>

and the environment as shoes end up as waste and the metals and semi-metals they contain will eventually leach out and enter the natural environment. Extremely high levels of trivalent chromium were found in the shoes. Highly toxic metals, such as arsenic, lead, and mercury, were also found in some shoes at concentrations higher than the levels found in untanned raw hide. Organic compounds (such as chlorinated paraffins, azodyes, ortho-phenylphenol etc.) hazardous to health and the environment were detected in some of the shoes. Two shoes contained azodyes, capable of forming carcinogenic amines.

A high level of the bactericide/fungicide 2,4,6-trichlorophenol was found in one shoe bought in Sweden. This compound is not easily degradable in natural environmental systems. It is also bioaccumulative, highly toxic and presumed to disrupt the body's production of thyroid and sex hormones. The highly allergenic compound dimethylfumarate, a mould inhibitor, was found in a shoe in a concentration corresponding to the threshold limit value (REACH Annex XVII). Low concentrations of formaldehyde, a highly allergenic and possibly carcinogenic compound, were detected in some shoes (Swedish Society for Nature Conservation, 2009a).

4.5.2 Review of existing legislation relevant for leather products

Chemical requirements for leather products in existing legislation are limited primarily to the restriction of DMF, organostannic (organic tin) compounds, azodyes, and certain elements in specific situations. These chemical requirements are listed in more details below.

The following organostannic compounds are restricted:

- Tributyltin (TBT) compounds, triphenyltin (TPT) compounds, dibutyltin (DBT) compounds and dioctyltin (DOT) compounds must not be used in articles in levels over 0.1% by weight. Limited via REACH annex XVII entry no. 20.

The following elements are restricted (or on its way to be restricted):

- Nickel in articles intended to come into direct and prolonged contact with skin. The release of nickel is limited to 0.2 µg/cm²/week. Limited via REACH annex XVII entry no. 27.
- Chromium VI concentrations in leather articles must not exceed 0.0003% by weight. Limited via REACH annex XVII entry no. 47, but will not apply to leather articles on the market before 1 May 2015²⁵.

The following dyes are restricted:

- Azodyes that by reductive cleavage of one or more azogroups may release one or more of a list of 22 aromatic amines²⁶ must not be found in detectable concentrations (0,003% by weight) in textile and leather articles intended to come into direct and prolonged contact with the human skin.

²⁵ http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOL_2014_090_R_0001_01&from=EN

²⁶ Appendix 8 of REACH – contains 22 specific aromatic amines listed by CAS number.

The following biocides are restricted:

- Dimethyl fumarate (DMF) must not be used in any articles in concentrations greater than 0.1% by weight. Limited via REACH annex XVII entry no. 61.

Furthermore, some chemicals like e.g. several phthalates that may be used in artificial leather are on the REACH Candidate list. This means that there is a duty of disclosure (REACH Article 33) in the supply chain, if products contain more than 0.1% of these substances. On the other hand, if the products are sold to consumers, there is only a duty to disclose the content of these substances, if consumers demand this information.

It should be noted that some of the abovementioned restrictions only are valid for direct and prolonged contact with the human skin. Therefore the restriction will not apply for e.g. hand bags where it is debatable whether the contact is prolonged. However, the restrictions should apply for leather products such as shoes, leather furniture (also covered by the furniture product group described above) and leather clothing such as gloves and trousers etc. where direct and prolonged contact with the leather could occur.

Finally, it should be mentioned that a relevant restriction is being discussed as a future REACH Annex XVII restriction:

- The use of lead in articles (or accessible parts of articles) which can be placed in the mouth by children (i.e. one dimension is smaller than 5 cm or has detachable parts of that size). The limit value suggested is 0.05% by weight. RAC and SEAC have prepared and adopted an opinion²⁷ regarding this restriction, but discussions are still ongoing and the final decision to adopt the restriction is missing²⁸ (as of September 2014).

4.5.3 Review of existing eco-labelling requirements for leather products

A review has been made of the existing chemical requirements in the eco-labelling criteria for leather products. The review only comprises the EU Flower and the Nordic Swan. The following relevant eco-labelling criteria exist which are relevant for leather products as these products can be made of leather:

- EU Flower: Footwear (Commission Decision 2009/563/EC).
- Nordic Swan: Textiles, hides/skin and leather (Nordic Swan: Textile, hides/skins and leather, 2013).

These chemical requirements set for leather in the eco-labelling criteria are described in the table below. These eco-labelling criteria also cover other materials such as textiles, but only the relevant chemical requirements for leather are listed below.

²⁷ <http://echa.europa.eu/documents/10162/10a7006f-1342-40ad-8aa3-c28365d0faca>

²⁸ <http://echa.europa.eu/previous-consultations-on-restriction-proposals/-/substance/1402/search/+/term>

Table 11: Chemical requirements in Eco-labelling criteria relevant for leather products

Leather products			
Chemical compound	Relevant material/ relevant for	EU Flower: Footwear	Nordic swan: Textiles, hides/skin and leather
CMRs and other hazardous chemicals			
Dyes classified as carcinogenic, mutagenic, toxic to reproduction or hazardous/dangerous to the environment		Shall not be used	Shall not be used Furthermore, toxic and highly toxic dyes shall not be used
Substances on the REACH Candidate list			Must not be used in tanning processes
Alkyl phenols, alkyl phenol ethoxylates or other derivatives		Shall not be used (alkylphenol ethoxylate, APE)	Must not be added
Azodyes that may cleave to aromatic amines		Shall not be used, limits for aromatic amines: Leather: 30 ppm	Shall not be used
Free and hydrolysed formaldehyde	Components of the footwear	Leather: 150 ppm	
Phthalates and other plasticizers			
Phthalates (in artificial leather)		Must not contain phthalates that are toxic to reproduction or toxic to the environment. Furthermore, DNOP, DINP and DIDP are not permitted in the product	Must not contain
Elements			
Chromium (VI)		Shall not be present in the final product	Shall not be found (detection limit 3 ppm)
Arsenic, cadmium and lead		Shall not be present in the materials used for product assembly of the final product	Cadmium and lead shall not be found in the products (detection limit 10 ppm)
Elements in dyes			Limit values are set for impurity content of 16 specific elements in colourants and pigments
Salts from heavy metals (except iron)	Color extraction or depigmentation used in finishing		Must not be used
Sensitizing substances			
Dyes classified as sensitizing to skin		Shall not be used	Shall not be used
Halogenated compounds			
PVC	Coatings, laminates or membranes used in finishing		Not permitted
Halogenated polymers	Plastisol-based printing used in finishing		Must not contain
Halogenated organic compounds			Must not be used in treatment
Fluorinated organic compounds, such as PFOA and PFOS		PFOS shall not be used	Must not be used
Preservatives and biocides			
Biocides		Only biocidal products containing biocidal active substances included in Annex IA of the Directive 98/8/EC of the European Parliament and of the Council, and authorised for use in footwear, shall be	The biocides used must follow the Biocide Regulation 528/2012

Leather products			
Chemical compound	Relevant material/ relevant for	EU Flower: Footwear	Nordic swan: Textiles, hides/skin and leather
		allowed for use.	
Pentachlorophenol (PCP), Tetrachlorophenol (TCP) and its salts and esters	Substances used up until purchase	Shall not be used	
Nanomaterials			
Nano particles			Finishing treatment with nano particles is not permitted
Other chemicals			
Volatile organic compounds	Printing pastes used in finishing		Must not contain more than 5%
Octamethyl cyclotetrasiloxane (D4), decamethylcyclopentasiloxane (D5)	Silicone treatment, siloxane used in finishing		May not be included except for impurities (less than 100 ppm)
C10-C13 chloroalkanes		Shall not be used in leather components	

All-in-all, the EU Flower and Nordic Swan criteria for leather products restrict the following groups of chemicals:

- Elements (chromium VI, cadmium, lead, arsenic) and impurities of several elements in dyes
- Alkylphenol/alkylphenolethoxylates (APEOs)
- Halogenated organic compounds
- Nano particles
- PVC
- Halogenated polymers
- Phthalates (used in artificial leather products)
- Fluorinated organic compounds such as PFOS and PFOA
- Volatile organic compounds
- Siloxanes (D4 and D5)
- Penta- and tetrachlorophenols
- Azodyes (which cleave to aromatic amines)
- Chloroalkanes C₁₀-C₁₃
- Dyes that are classified as CMR or hazardous to the environment
- Sensitizing dyes
- Biocides

This long list of different chemicals limited in eco-labelled leather products illustrates that many different hazardous chemicals may exist in this product group.

When comparing the list of eco-label requirements with the restricted chemical substances it can be seen that it is only a small part of the listed substances in eco-labelling that is being restricted by legislation.

On the other hand, it is not the intention that all eco-label requirements should be converted to restrictions in legislation, as the intention and purpose of eco-labelling is that only about the best 10-30% of the products should be able to live up to all the chemical requirements.

4.5.4 Review of possible chemical requirements in relevant standards for leather products

A search on the CEN (European Committee for Standardization) webpage on 'leather products' revealed zero standards concerning this product group, whereas a search on 'leather' revealed 155 standards from more than 10 different committees. The following committees seem (or to some degree seem) to be relevant for the product group of 'Leather products':

- The committee CEN/TC 161 on "Foot and leg protectors".
- The committee CEN/TC 162 on "Protective clothing including hand and arm protection and lifejackets".
- The committee CEN/TC 207 on "Furniture".
- The committee CEN/TC 248 on "Textile and textile products".
- The committee CEN/TC 309 on "Footwear".
- The committee CEN/TC 289 on "Leather".

Under the committee CEN/TC 161 on "Foot and leg protectors" two standards exist, when using 'leather' as a search word. Both these standards concern footwear protecting *against* chemicals. One of these standards EN 20345:2011 "Personal protective equipment – Safety footwear" regulates Cr VI in leather for footwear (limit value 3 mg/kg), nickel release from metals and carcinogenic amines from azocolourants (Strandesen and Poulsen, 2012).

A search on 'leather' and the committee CEN/TC 162 on "Protective clothing including hand and arm protection and lifejackets" reveals one standard which concerns impact cut test for leather. Hence, this standard contains no chemical requirements. Another standard under this committee, EN 420: 2003 + A1:2009 "Protective gloves – General requirements and test methods" regulates Cr VI in leather for footwear (limit value 3 mg/kg), nickel release from metals and carcinogenic amines from azocolourants (Strandesen and Poulsen, 2012). Another standard under this committee is under enquiry. This upcoming standard prEN 16778 "Protective gloves - The determination of Dimethylformamide in gloves" concerns the determination of dimethylformamide in different glove materials like leather coated polyurethane (PU). However, this standard ensures the compliance of the existing DMF restriction in REACH Annex XVII.

A search on 'leather' and the committee CEN/TC 207 on "Furniture" reveals 10 standards that all concern surface resistance on furniture and therefore not the content of dangerous chemical substances.

A search on 'leather' and the committee CEN/TC 248 on "Textile and textile products" reveals one standard EN 14362-3:2012 which concerns the method for determination of certain aromatic amines derived from azocolourants. This is the standard for testing of the restriction on aromatic amines in textiles and leather listed in REACH Annex XVII entry no. 43.

A search on 'leather' and the committee CEN/TC 309 on "Footwear" reveals only one standard that concerns a test method for heels (heel pin holding strength). Therefore, this standard does not contain any chemical requirements.

A search on 'leather' and the committee CEN/TC 289 on "Leather" reveals 111 different standards. Many of these standards concern standards for selection of leather for special purposes, colour fastness, physical and

mechanical tests like heat resistance and water vapour absorption. Several standards concern the determination of the content and extraction of certain chemicals. It is, however, measurement methods that are listed and the standards do not establish requirements. The measurement methods listed are:

- Preservative content (EN ISO 13365:2011, “Determination of the preservative (TCMTB, PCMC, OPP, OIT) content in leather by liquid chromatography”).
- Pentachlorophenol content (EN ISO 17070:2006, “Leather - Chemical tests - Determination of pentachlorophenol content”).
- Extractable metals (EN ISO 17072-1:2011, “Leather - Chemical determination of metal content - Part 1: Extractable metals”).
- Total metal content (EN ISO 17072-2:2011, “Leather - Chemical determination of metal content - Part 2: Total metal content”).
- Chromium VI content (EN ISO 17075:2007, “Leather - Chemical tests - Determination of chromium(VI) content”). This standard is relevant for the upcoming restriction on chromium VI.
- Formaldehyde content (EN ISO 17226-1:2008, “Leather - Chemical determination of formaldehyde content - Part 1: Method using high performance liquid chromatography”).
- Formaldehyde content (EN ISO 17226-2:2008, “Leather - Chemical determination of formaldehyde content - Part 2: Method using colorimetric analysis”).
- Formaldehyde release (EN ISO 17226-3:2011, “Leather - Chemical determination of formaldehyde content - Part 3: Determination of formaldehyde emissions from leather”).
- Aromatic amines derived from azocolourants (EN ISO 17234-1:2010, “Leather - Chemical tests for the determination of certain azocolourants in dyed leathers - Part 1: Determination of certain aromatic amines derived from azocolourants”).
- Aromatic amines derived from azocolourants (EN ISO 17234-2:2010, “Leather - Chemical tests for the determination of certain azocolourants in dyed leathers - Part 2: Determination of 4-aminoazobenzene”).
- Tan content (EN ISO 17489:2013, “Leather - Chemical tests - Determination of tan content in synthetic tanning agents”).
- Chromic oxide content (EN ISO 5398 Part 1-4:2007-9, “Leather - Chemical determination of chromic oxide content”).
- Chlorophenol content – standard under approval (FprEN ISO 17070, “Leather - Chemical tests - Determination of tetrachlorophenol-, trichlorophenol-, dichlorophenol-, monochlorophenol-isomers and pentchlorophenol content”).
- N-methyl-2-pyrrolidone content – standard under enquiry (prEN ISO 19070, “Leather - Chemical determination of N-methyl-2-pyrrolidone (NMP) in leather”).
- ‘Critical chemicals’ – standard under drafting (prEN ISO 20137, “Leather - Chemical tests - Guidelines for testing critical chemicals in leather”).

Therefore, in conclusion, it can be said that several standards under the CEN/TC 289 committee on “Leather” describe measurement methods for several chemicals, but in general the number of standards establishing requirements are limited. Measurement methods are listed for the following substances:

- Preservatives (TCMTB, PCMC, OPP, OIT)
- Pentachlorophenol and a standard for other chlorophenols are under approval
- Extractable metals and total metal content
- Chromium VI content (upcoming restriction)
- Chromic oxide content
- Formaldehyde content and release
- Aromatic amines derived from azocolourants (existing restriction)
- Tan content
- N-methyl-2-pyrrolidone content (a standard under enquiry)
- 'Critical chemicals' (a standard under drafting)

Only a few standards on personal protective equipment (under the committee CEN/TC 161 and CEN/TC 162) set chemical requirements and regulate Cr VI in leather for footwear (limit value 3 mg/kg), nickel release from metals and carcinogenic amines from azocolourants. Furthermore, a standard under the committee CEN/TC 162 sets a chemical requirement concerning the dimethylformamide content in protective gloves made of e.g. leather coated polyurethane.

4.5.5 Discussion

The examples of chemicals found in leather products (especially chromium VI, aromatic amines, phthalates, formaldehyde and other elements) illustrate that hazardous chemicals may be present in leather products. Furthermore, the list of requirements for hazardous chemicals in eco-labelling criteria for leather products illustrates this.

For leather products, the existing chemical requirements in regulation today are limited to content of organic tin compounds, DMF, aromatic amines from azodyes, nickel and a restriction on chromium VI from 2015. This means that a few of the hazardous chemicals that can be present in leather products are actually restricted today.

If further restrictions on chemicals should be set in this area, it is suggested to focus on the following type of chemicals:

- Elements
- Phthalates (in artificial leather products)
- Halogenated organic solvents
- Formaldehyde

It should be noted that these chemicals are only a suggestion that is based on this screening of the product group prepared in this project. These chemicals are chosen because they have been identified in the products in this product group, are restricted in other areas, are considered to be hazardous and may contribute to the total burden/exposure through various types of consumer products. Of course, it will be necessary in future work in this area to go into much more details about the exposure and risk of these types of chemicals in this product group to determine if restrictions should be made for these groups of chemicals and if so which limit values to use.

4.6 Softened plastic products

This product group of softened plastic products has been chosen as one of the five areas, as this product group has been discussed due to the presence of plasticizers and other chemicals in softened plastic products.

This product group of softened plastic products does not cover toys as toys are regulated with respect to phthalates and other dangerous chemicals (see the previous ASI Consumer Council study on “Chemical requirements for toys” (Poulsen, 2013)).

4.6.1 Examples of chemicals found in softened plastic products

A literature search for chemicals found in softened plastic products resulted in the following examples (see Table 12), which are described in more details in the text below.

Table 12: Literature describing chemicals found in softened plastic products

Plastic products	Source	Year	Chemicals found
Phthalates in products for 2-year-olds	Danish EPA	2009	Phthalates (DEHP, DBP, DINP, DIBP)
Plastic clogs	Öko-test 7	2008	Phthalates PAH Organic tin compounds Elements (cadmium, lead, chromium)
Plastic shoes	Swedish Society for Nature Conservation	2009	Elements (mercury, lead, cadmium) Phthalates (DEHP and others) PAH
Air mattresses (swimming)	Öko-test 6	2010	Phthalates PAH Organic tin compounds (DBT) Phenol Isophenrone
Plastic shoes	Kemi, Sweden	2009	Cadmium Phthalates (DIBP, DBP, BBP, DEHP)
Different soft plastic products	Kemi, Sweden	2010-12	Phthalates (DEHP, DBP, DIBP) SCCP
Plastic sandals	Danish EPA	2010	Phthalates (DEHP, BBP, DBP, DIBP)
Balance balls	Danish EPA	2010	Phthalates (DEHP, DBP, DIBP)
Shower curtains	Danish EPA	2010	Phthalates (DEHP, DBP, DIBP)
Airbeds	Danish EPA	2010	Phthalates (DEHP, DIBP)
Oil cloths and dinner mats	Danish EPA	2010	Phthalates (DEHP, DIBP)
Phthalates in products for children	Danish EPA	2010	Phthalates (DEHP, DBP, DIBP, DINP)

4.6.1.1 Phthalates in products for 2-year-olds (2009) – Danish EPA

Most of the previous reports on consumer products published by the Danish EPA conclude that the release of chemicals from one single product does not give rise to concern but the collective burden of chemicals from all products that children are exposed to may possess a problem. Therefore, in 2008 the Danish EPA initiated a project with the purpose to investigate the sum of

endocrine disrupting chemicals that two-year-old children are exposed to via consumer products.

A dose-addition approach was used in the project to assess the risk of exposure to phthalates and other antiandrogene substances. The project listed different exposures that former have been measured for different types of consumer products that two-year-old children are exposed to. Exposure to endocrine disrupting chemicals like DEHP, DBP, DINP, DIBP, BBP, PCBs, parabens, and bisphenol A through the food and the indoor climate was also added.

The conclusion of the project was that a health risk is definitely involved when looking at the worst case exposure to endocrine disrupting chemicals for two-year-old children. Some single exposures are critical in this respect: For example exposure to phthalates in plastic clogs, exposure to PCB's through the indoor climate and food, exposure to DEHP through indoor climate and food, and exposure to parabens through cosmetic products (Tønning et al., 2009).

4.6.1.2 Plastic shoes (2008) – Öko-Test

The German test magazine Öko-Test tested 22 different plastic shoes (plastic clogs) for the content of phthalates, organic tin compounds, polycyclic aromatic hydrocarbons (PAH), PVC and certain elements. Traces of phthalates were found in two of the plastic shoes as only two of them were based on PVC. Organic tin compounds were found in trace amounts in four of the tested plastic shoes. A high content of PAHs (> 1000 µg/kg) was found in five plastic shoes and content of PAHs in other 16 of the tested shoes. Chromium, lead and cadmium were detected in one, one and two of the tested samples respectively (Öko-Test 7, 2008).

4.6.1.3 Air mattresses (2010) – Öko-Test

The German test magazine Öko-Test tested 13 different plastic air mattresses used for swimming for the content of phthalates, organic tin compounds, polycyclic aromatic hydrocarbons (PAH) and other organic compounds. All but one of the air mattresses were made of PVC and therefore phthalates were found in five of the air mattresses. PAHs were found in all of the tested products, in five of the products, however, only trace amounts were detected. Dibutyltin (DBT) was found in five of the air mattresses, and in one of the products other organic tin compounds were found as well. Finally, the substances phenol and isophorone were found in 7 and 6 products respectively (Öko-Test 6, 2010).

4.6.1.4 Plastic shoes (2009) – Kemi, Sweden

In 2009 Kemi, the Swedish Chemicals Agency, tested 30 pairs of plastic shoes for the content of cadmium, lead, organic tin compounds and phthalates (DIBP, DBP, BBP, DEHP). In one of the shoes cadmium was found in high amounts. In nine of the shoes phthalates were found in concentrations higher than 0.1% (Kemi, 2014b).

4.6.1.5 Different soft plastic products (2010-12) – Kemi, Sweden

In 2010 and 2011-12 Kemi, the Swedish Chemicals Agency, tested in all 64 different articles that contained soft PVC plastic or other softened plastic. The product types tested were grips for tools, bicycle accessories, plastic shoes, plastic covered dumb bells and accessories for cars. In 33 of these samples phthalates were detected in concentrations above 0.1% . The phthalates

DEHP, DBP and DIBP were found most often. Short chained chlorinated paraffins (SCCP) were also detected in some of the samples (Kemi, 2014b).

4.6.1.6 Plastic shoes (2009) - SSNC

The Swedish Society for Nature Conservation tested 27 different pairs of plastic shoes from all over the world for different hazardous chemicals, such as phthalates, tin organic compounds, PAHs and heavy metals. 18 of the shoes were tested for content of different phthalates. The analyses showed that 17 of the 18 shoes that were tested contained one or more of the tested phthalates. The phthalate DEHP was present in various amounts in all 17 of these products. The highest content, 23.2%, was found in a pair of flip-flops from South Africa. The analyses that were conducted also showed that several shoes contained PAH, tin organic compounds and heavy metals. Two pairs of shoes contained mercury (highest level 0.1 ppm), and several contained lead (highest level 2220 ppm) and cadmium (highest level 117 ppm). 5 of the 27 pair of shoes had a content of lead over 100 ppm, which is the limit value of lead in products according to Danish legislation. The report concludes that the results in the report indicate the need for tighter legislation at international level, at EU level and at domestic level, leading to the phasing out of hazardous chemicals in products (Swedish Society for Nature Conservation, 2009b).

4.6.1.7 Plastic sandals (2010) – Danish EPA

The Danish EPA has investigated the content of four specific phthalates (DEHP, BBP, DBP and DIBP) in 60 different plastic sandals and foam clogs/foam shoes – 20 of these were shoes for the age group 2-year-old. A content of the phthalates DIBP, DBP and DEHP was detected in several of the analysed plastic sandals and foam clogs/foam shoes and for all age groups. Several plastic sandals for children contained phthalates in the sole or strap in the order of magnitude of 10-46% (weight percent). BBP was only detected in a few sandals and in low concentrations.

Migration of the phthalates was measured as well and showed a maximum migration value of 53 ppm for DBP. Supplementary tests were performed to evaluate the influence of dynamic conditions (corresponding to movement of the foot) and use of sun lotion. These results show that dynamic conditions together with sun lotion can increase the migration of the phthalates by a factor 3 to 149 depending on the water solubility of the different phthalates. These results indicate that use of plastic sandals for a long time each day in combination with sun lotion contributes significantly to the total phthalate exposure for consumers, especially for 2-year-olds and children (Tønning et al., 2010b).

4.6.1.8 Phthalates in products with large surfaces, balance balls (2010) – Danish EPA

In 2009, the Danish EPA investigated various products with large surfaces for the content of phthalates. Ten balance balls were analysed for the content of the four phthalates DIBP, DBP, DEHP and DEHP. A high content of DEHP was detected in two balance balls in concentrations of 44%. A high content of DIBP was detected in two balance balls in concentrations of 11% and 35% respectively. In a number of balance balls DIBP, DBP and DEHP were detected in smaller concentrations less than 1%. BBP was not detected in any of the balls above the detection limit of 0.001% (Tønning et al., 2010a).

4.6.1.9 Phthalates in products with large surfaces, shower curtains (2010) – Danish EPA

In 2009, the Danish EPA investigated various products with large surfaces for the content of phthalates. Ten shower curtains were analysed for the content of the four phthalates DIBP, DBP, DBB and DEHP. 8 of the shower curtains contained one or more of the four phthalates, and four of the shower curtains had a content of the phthalates over 1%. DEHP was found in concentrations between 8.2-30.4%. DIBP and DBP were found in three and one shower curtains respectively, but only in very small concentrations (well below 0.1%). BBP was not detected in any of the products (Tønning et al., 2010a).

4.6.1.10 Phthalates in products with large surfaces, airbeds (2010) – Danish EPA

In 2009, the Danish EPA investigated various products with large surfaces for the content of phthalates. 13 airbeds were analysed for the content of the four phthalates DIBP, DBP, DBB and DEHP. 11 of the airbeds contained one or more of the four phthalates, and four of the airbeds had a content of the phthalates over 1%. DEHP was found in four products in concentrations between 8.2-30.4%, and in six other products in concentrations well below or around 0.1%. DIBP was detected in one product in a concentration well below 0.1%. DBP and BBP were not detected in any of the products (Tønning et al., 2010a).

4.6.1.11 Phthalates in products with large surfaces, oilcloths and dinner mats (2010) – Danish EPA

In 2009, the Danish EPA investigated various products with large surfaces for the content of phthalates. 12 oil cloths and dinner mats balls were analysed for the content of the four phthalates DIBP, DBP, DBB and DEHP. 10 of the products contained one or more of the four phthalates, and four of the products had a content of the phthalates in concentrations over 1%. DEHP was found in concentrations between 13-25.3% and in four other products in concentrations well below 0.1%. DIBP was detected in three products in concentrations well below 0.1%. DBP and BBP were not detected in any of the products (Tønning et al., 2010a).

4.6.1.12 Phthalates in products for children (2010) – Danish EPA

The Danish EPA has investigated the content of the four phthalates (DEHP, BBP, DBP and DIBP) in products that children are in direct contact with, i.e. plastic bags (sponge bags, rucksacks), swimming equipment, swimming pools, textiles with prints, tablecloths and dinner mats, shower curtains that appeal to children and balance balls. A total of 72 products for 2-year-olds and 6/7-year-olds were analysed for the content of the four phthalates. High concentrations of DEHP and DIBP were detected in a number of products. DIBP was primarily detected in balance balls in concentrations between 11-35%, whereas DEHP was measured in all types of the investigated products in concentrations between 2-44%. BBP was not detected in the analysed products and DBP was only detected in concentrations less than 0.1%. Ten T-shirts were analysed and all detected phthalates were in concentrations less than 0.05%. A high content of DINP and isophthalate was detected in a wide range of products that were not quantified in this project. In the light of the quantitative analysis results, 10 products were selected for 18 migration analyses with artificial sweat and saliva to simulate the exposure of skin and mouth contact of a child with the products. The migration analyses detected the migration of DEHP in concentrations less than 0.0005% in the products, while the migration of DIBP was detected in a concentration of 0.02% in one product (Danish EPA No. 109, 2010).

4.6.2 Review of existing legislation relevant for softened plastic products

When it comes to softened plastic products (which are not toys) the existing regulation is very limited and concerns the following legal aspects in the REACH Regulation:

- Restriction of cadmium in articles made of different plastic materials (such as PVC, PUR etc.). The content of cadmium is restricted to 0.01% by weight of the plastic material. Limited by REACH annex XVII entry no. 23.
- Duty of disclosure (REACH article 33) in the supply chain, if products contain more than 0.1% of substances on the REACH Candidate list. On the other hand, if the products are sold to consumers, there is only a duty to disclose the content of these substances, if consumers demand this information. Several phthalates are today on the REACH Candidate list.
- The use of 8 specific PAHs (as listed in REACH Annex XVII entry no. 50) in rubber and plastic components that are in direct as well as prolonged or short-term repetitive contact with the human skin or oral cavity under normal or reasonably foreseeable conditions of use. The limit value is 1 mg/kg (0.0001%) by weight of the component of any of the listed PAHs. This restriction will not apply to articles placed on the market before 27 December 2015²⁹.

Several phthalates (which are used as plasticizers to soften plastic products) are on the REACH Candidate list. Four phthalates (DEHP, BBP, DIBP and DBP) are on the REACH Authorisation list (REACH Annex XIV) meaning that these substances may not be used inside the EU for production of products from February 21 2015 unless an application for an authorisation of using these substances has been granted. The authorisation will only be granted for specific uses.

However, article 56 of REACH concerning the legislation on authorisation only applies for use of the substances within the EU market. This means that articles produced outside of the EU containing these four phthalates and being imported into the EU and sold on the EU market do not fall under the rules of authorisation. This has been called a 'loophole' of the REACH Regulation by several organisations, e.g. by the German Federal Environment Agency (Kalberlah et al., 2011).

The Danish EPA tried to close this 'loophole' for imported articles by preparing a restriction proposal³⁰ regarding these four phthalates for indoor use. The proposal should restrict the sum of the four phthalates in products for indoor use that would come into direct contact with human skin or mucous membranes. The limit value for the sum of the four phthalates was set to be 0.1%. However, the restriction proposal was dismissed in the REACH Restriction process system³¹ mainly based on a claim of a declining trend of the volume of these phthalates in articles on the EU market. At the same time, Denmark went on with a national legislation concerning these four phthalates, but was forced to withdraw this national legislation before it

²⁹ [http://eur-](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:328:0069:0071:EN:PDF)

[lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:328:0069:0071:EN:PDF](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:328:0069:0071:EN:PDF)

³⁰ <http://echa.europa.eu/documents/10162/c6781e1e-1128-45c2-bf48-8890876fa719>

³¹ [http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0809\(01\)&from=EN](http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0809(01)&from=EN)

entered into force because of the EU Commission decision³². However, the phthalates are still used and found in plastic articles within the EU as illustrated by several surveys carried out by the Danish EPA.

Finally, it should be mentioned that a relevant restriction is being discussed as a future REACH Annex XVII restriction:

- The use of lead in articles (or accessible parts of articles) which can be placed in the mouth by children (i.e. one dimension is smaller than 5 cm or has detachable parts of that size). The limit value suggested is 0.05% by weight. RAC and SEAC have prepared and adopted an opinion³³ regarding this restriction, but discussions are still ongoing and the final decision to adopt the restriction is missing³⁴ (as of September 2014).

4.6.3 Review of existing eco-labelling requirements for softened plastic products

A review has been made of the existing chemical requirements in the eco-labelling criteria for plastic products. The review only comprises the EU Flower and the Nordic Swan. The following relevant eco-labelling criteria exist which are relevant for plastic products:

- Nordic Swan: Toys (Nordic Swan: Toys, 2013)

These chemical requirements in the eco-labelling criteria are described in the table below.

Table 13: Chemical requirements in Eco-labelling criteria relevant for softened plastic products

Softened plastic products		
Chemical compound	Relevant material/ relevant for	Nordic swan: Toys
<i>CMRs and other hazardous chemicals</i>		
CMR substances	All additives in the plastic material and for surface treatment	Shall not be used if classified as CMR 1A, 1B or 2.
Substances which meet the criteria of PBT and vPvB in accordance with REACH	All additives in the plastic material and for surface treatment	Shall not be used
Substances considered particular problematic, i.e. substances according to REACH article 57, annex XIV (subject to authorisation), and substances which meet the criteria for PBT, vPvB according to Annex XIII of REACH	All additives in the plastic material and for surface treatment	Shall not be used
Substances considered as endocrine disruptors category I and II according to EU reports on endocrine disruptors ³⁵	All additives in the plastic material and for surface treatment	Shall not be used
Akylphenols, alkylphenoethoxylates or other alkylphenol derivatives	All additives in the plastic material and for surface treatment	Shall not be used
Aziridine and polyaziridines	All additives in the plastic material and for surface treatment	Shall not be used

³² [http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0809\(01\)&from=EN](http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0809(01)&from=EN)

³³ <http://echa.europa.eu/documents/10162/10a7006f-1342-40ad-8aa3-c28365d0faca>

³⁴ <http://echa.europa.eu/previous-consultations-on-restriction-proposals/-/substance/1402/search/+/term>

³⁵ http://ec.europa.eu/environment/chemicals/endocrine/strategy/substances_en.htm

Softened plastic products		
Chemical compound	Relevant material/ relevant for	Nordic swan: Toys
<i>Phthalates and other plasticizers</i>		
PVC		Shall not be used except for in cables
Phthalates	All additives in the plastic material and for surface treatment	Shall not be used
<i>Elements</i>		
Elements (lead, pewter, cadmium, chromium VI and mercury)	Pigments used in the plastic material or for surface treatment	Shall not be used in pigments
<i>Halogenated compounds</i>		
Halogenated organic compounds	All additives in the plastic material and for surface treatment	Shall not be used
PFOA and PFOS	All additives in the plastic material and for surface treatment	Shall not be used
<i>Preservatives and biocides</i>		
Biocides (chlorophenols and dimethylfumerat (DMF))	All additives in the plastic material and for surface treatment	Shall not be used
Biocides	For surface treatment	No biocides shall be used for surface treatment
Isothiazolinones	All additives in the plastic material and for surface treatment	Must not exceed 0.05% by weight
Kathon ³⁶	All additives in the plastic material and for surface treatment	Must not exceed 0.0015% by weight
<i>Other chemicals</i>		
Volatile aromatic compounds	All additives in the plastic material and for surface treatment	Must not exceed 1% by weight
Volatile organic compounds (VOC)	Used for surface treatment	Must not exceed 130 g/l chemicals used for surface treatment
Polycarbonate plastic	In products in games with food	Shall not be used

All-in-all, the Nordic Swan criteria for plastic products restrict the following groups of chemicals:

- Elements (lead, chromium VI, cadmium, mercury, pewter)
- Alkylphenol/alkylphenoethoxylates (APEOs)
- Halogenated organic compounds
- Volatile organic compounds
- Volatile aromatic compounds
- PVC and polycarbonate plastic
- Phthalates
- PFOS and PFOA
- Biocides (chlorophenols and DMF)
- Aziridine and polyaziridines
- Isothiazolinones and Kathon
- CMR substances
- Endocrine disrupting substances
- SVHCs
- PBT and vPvB substances

This long list of different chemicals limited in eco-labelled plastic products illustrates that many different hazardous chemicals may exist in this product group.

³⁶ The mixture (3:1) of CMIT/MIT (5 chloro-2-methyl-4-isothiazolin-3-one CAS. No. 247-500-7; 2-methyl-4-isothiazolin-3-one CAS. No. 220-239-6

When comparing the list of eco-label requirements with the restricted chemical substances it can be seen that only a small part of the listed substances in eco-labelling is being restricted by legislation.

On the other hand, it is not the intention that all eco-label requirements should be converted to restrictions in legislation, as the intention and purpose of eco-labelling is that only about the best 10-30% of the products should be able to live up to all the chemical requirements.

4.6.4 Review of possible chemical requirements in relevant standards for softened plastic products

A search the CEN webpage on 'paper products' only reveals four standards where two of these concern standards from the committee CEN/TC 249 on 'Plastics'. However, these standards only concerns declaration and reporting of the bio-based carbon content and are therefore not considered relevant concerning chemical requirements for softened plastic products.

A search on all standards under the committee CEN/TC 249 on 'Plastics' reveals that 527 standards exist on the plastics area. When using the search words 'chemical', 'extraction' etc. this only reveals the following standard that seems to set chemical requirements for plastics:

- Determination of free phenols (EN ISO 119:1998, "Plastics - Phenol-formaldehyde mouldings - Determination of free phenols - Iodometric method".

This means that the chemical requirements set in standards for plastics are limited.

4.6.5 Discussion

The examples of chemicals found in softened plastic products (especially phthalates, elements and PAH) illustrate that hazardous chemicals may be present in softened plastic products. Furthermore, the list of requirements for hazardous chemicals in eco-labelling criteria for plastic products illustrates this.

For softened plastic products, the existing chemical requirements in regulation today are limited to content of cadmium and the upcoming restriction on eight PAHs (from 2015). This means that a few of the hazardous chemicals that can be present in softened plastic products are actually restricted today. Therefore, the chemical requirements for softened plastic products should be investigated further in future work.

If further restrictions on chemicals should be set on this area, it is suggested to focus on the following type of chemicals:

- Phthalates
- Elements

It should be noted that these chemicals are only a suggestion that is based on this screening of the product group prepared in this project. These chemicals are chosen because they have been identified in the products in this product group, are restricted in other areas, are considered to be hazardous and may contribute to the total burden/exposure through various types of consumer products. Of course, it will be necessary in future work in this area to go into

much more details about the exposure and risk of these types of chemicals in this product group to determine if restrictions should be made for these groups of chemicals and if so which limit values to use.

5 Conclusions & recommendations

In this project, five groups of consumer products have been selected for a review regarding:

- the content of hazardous chemical substances identified in these types of products,
- the existing legislation regarding chemical substances for these types of products,
- the chemical requirements set in eco-labelling for these product groups, and
- the possible chemical requirements set in standards related to these product groups.

Overall, the review shows that for all of the product groups investigated in this project, hazardous chemicals have been found in several cases. Generally, the review on the existing chemical requirements in legislation for these product groups illustrates that the chemicals restricted by legislation today are limited. Furniture represents the product group where most chemicals are restricted today, but most of the restrictions are only valid for textile and leather furniture, which can be considered to be in direct and prolonged contact with the human skin. This means that many pieces of furniture are outside the scope of these existing chemical restrictions.

Therefore, an overall conclusion for all five selected product groups is that these product groups seem to lack restrictions regarding the content of the hazardous chemicals that can be present in these products. Especially for the product group hygiene products there is a large 'gap' between chemicals identified in the products and the chemicals actually restricted in the product group. However, this 'gap' is also found in the other product groups. For leather products, a recent restriction has been adopted regarding chromium VI in leather, which has been widely investigated and discussed because of the sensitizing abilities of chromium VI. This new restriction on chromium VI in leather will enter into force in 2015. However, this does not close the 'gap' for leather products, as other non-restricted hazardous substances may be present in leather.

For each of the five selected product groups, it has been discussed shortly, which chemicals/group of chemicals that could (or should) be restricted within this specific product group. These are summarised below:

- Furniture
 - Elements
 - Phthalates (in artificial leather products)
 - Formaldehyde
 - VOC
 - Nonylphenol and nonylphenol ethoxylates (restriction may be on its way)
- Hygiene products
 - Formaldehyde
 - Halogenated organic solvents
 - Elements
 - Fragrances and other sensitizing substances

- Paper products
 - Printing inks/dyes (azodyes and other dangerous substances in printing inks and dyes)
 - Elements
 - Bisphenol A in specific types of paper
- Leather products
 - Elements
 - Phthalates (in artificial leather products)
 - Halogenated organic solvents
 - Formaldehyde
- Softened plastic products
 - Phthalates
 - Elements

The listed chemical requirements for eco-labelling of the five selected products together with the fact that eco-labelled products do exist within these product groups illustrate that it is possible to produce products without the listed hazardous substances. On the other hand, it is not the intention that all eco-label requirements should be converted to restrictions in legislation, as the intention and purpose with eco-labelling is that only about the best 10-30% of the products should be able to live up to all the chemical requirements. However, the eco-label requirements could be used for inspiration for setting new chemical restrictions within the five product groups.

This initial review of the five selected product groups, hence, shows that there is a 'gap' between the chemicals restricted for the product groups and the chemicals found in product examples from the products groups. However, a common aspect for all these tests carried out is that it may be stated in which concentrations the different hazardous chemicals are detected, but an actual risk assessment whether or not the detected level constitutes a risk to human health has not always been carried out. Some of the hazardous chemicals are detected in very small concentrations and may therefore not – when looking at the one single product – constitute a risk to human health. Nevertheless, it is necessary to consider the fact that some of the identified hazardous substances may be present in more than just one of the product groups, but may be present in several product groups and numerous different products that consumers and children are exposed to every day. A precautionary principle may therefore be needed in order to avoid human exposure to the most dangerous chemicals, i.e. there may be a need for further restrictions of chemicals in these areas.

Therefore, it is therefore necessary to go into much more depth of these five selected areas in order to determine, if and which of the chemical substances that should be restricted in order to protect the consumers from health risks for the identified substances. In such a more in depth investigation aspect such as the following could be considered and will be dependant on the specific products and product groups:

- In which exposure situations do the specific chemical substances constitute a human risk?
- Should restrictions be limited to these exposure situations only? (E.g. for products with direct skin contact or direct and prolonged skin contact?).
- What is the total exposure of the substances from all other consumer products sources? Does this require a general restriction across all product groups as carried out for the recently adopted lead restriction?

- Should limitations be set for indoor products as these products may contribute the total burden of chemicals in our indoor environment?
- Should limitations be set only for selected materials (e.g. for furniture limitations regarding textile, leather and wood seem to be more urgent compared to e.g. metal furniture)?
- Should limitations be based on the content present in the products or on migration/emission values?

5.1 Recommendations

For future work, it is recommended that one or more of these product groups are investigated further with respect to specific chemical requirements that could be set for the product groups. It is suggested in such further work that the following is investigated in more detail:

- Direct suggestions (including suggestions for specific limit values) for which chemical requirements that could be suggested/set for these product groups.
- Especially, the area of hygiene products, leather products and perhaps the area of printing inks used in paper products should be in focus.

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