TEXTILES:
Stop the chemical overdose!

October 2013
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A report by WECF

EEHI
European Environement and Health Initiative

Fondation LÉA NATURE JARDIN BIO
SOUS L'ÉGIDE DE LA FONDATION DE FRANCE

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Textiles: Stop the chemical overdose! Towards more coherent and transparent rules in the EU and beyond for a better protection of workers, consumers and the global environment

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Introduction: Why is WECF concerned about hazardous chemicals in textiles?

In this report WECF explores whether textile products containing potential or known chemicals of concern, manufactured within or outside the EU and then placed on the EU market, are adequately regulated to ensure proper consumer information and protection from exposure to hazardous compounds. Indeed, textiles manufacturing is associated with huge consumption of chemicals, some of which are hazardous or potentially hazardous. Some estimate that 4 kg of chemicals are needed to produce 1 kg of t-shirts1. One of the challenges is: how to provide an adequate and easily understandable legislative framework for products that are inherently complex while at the same time ensuring a high level of protection of the European consumer? The first Chapter of this report will examine how textile products go through a wide range of processes, which result in a multitude of potential sources of contamination with hazardous chemicals through the whole textiles supply chain, which can also remain in the final consumer product. Chapter II will examine the question of whether current EU regulations are sufficient to protect consumers and the environment from the hazardous chemicals in textile products.

In April 2013, the Swedish Chemical Agency (KEMI) released a report entitled "*Hazardous chemicals in textiles*"[2]. The authors examine the need to further adapt existing EU regulation to provide for a better consumer protection from hazardous chemicals present in textiles. Therefore, this chapter will not repeat the contents of KEMI report – neither those of the numerous reports on chemicals in textiles drafted in the recent years - but will focus on complementary aspects and stress, when necessary, the arguments put forward by KEMI, which WECF considers to be in line with better protection of human health and the environment, and especially of the health of children, the members most at risk in our societies.

Scope of this report

The main focus of this report is the following:

- The use of chemicals in textiles manufacturing and in particular their presence in clothing products used by consumers; all chemicals are considered but with priority given to those known to be "hazardous chemicals" (for example persistent, bioaccumulative and toxic chemicals (PBT)) and in particular endocrine disrupting chemicals (EDCs).
- Clothing items *made from textiles* for pregnant women and young children, with a particular focus on newborns and infants (0-2 years)

The report does not cover: leather shoes and non-textile components of garments eg. metallic parts, zippers, etc. toys made from any material; textiles used for other children's products, ie. mattresses, car seats, pushchairs, nursery furnishings, bags and toys; non re-usable nappies; garment production (cutting, sewing) and the impacts on workers (crowded dangerous factories, low wages, worker rights).

[1] Need for coherent Union legislation on hazardous substances in textiles,
Information from the Swedish delegation to the Council of the European Union, October 2012
http://register.consilium.europa.eu/pdf/en/12/st14/st14905.en12.pdf

[2] Hazardous chemicals in textiles – report of a government assignment, Swedish Chemicals Agency, Report No 3/13,

CHAPTER I

The use and presence of hazardous chemicals in clothes for infants, children and pregnant women and their use in the textile supply chain

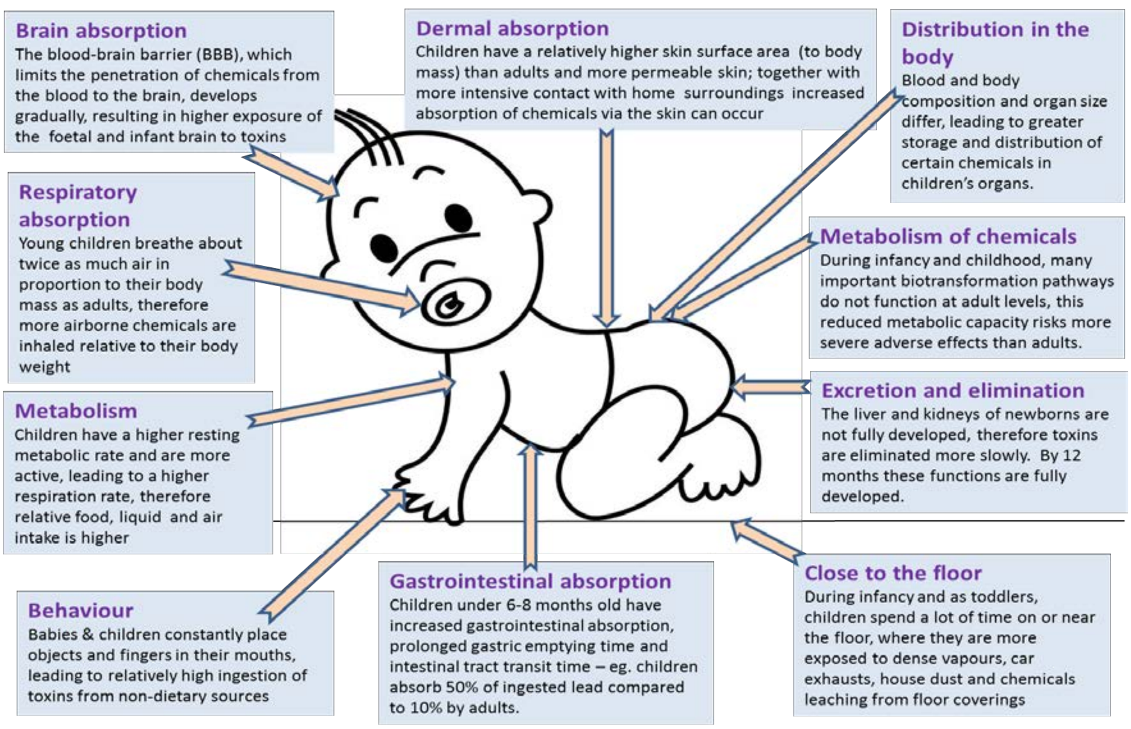
1. The impacts of hazardous chemicals on children's health

1.1 Vulnerability of the unborn child, infants and children to hazardous chemicals

The developing foetus, infants and children are particularly sensitive to chemicals and their toxic effects, and their impacts can cause life-long health effects. There is a wide range of health problems that affect children, or have their origins in childhood, that have been increasing in the last 50 years. These include birth defects, cancer, asthma, immune system disorders, developmental and reproductive disorders and nervous system disorders. Many hazardous chemicals that have been found to accumulate in our bodies have been linked to these diseases. Endocrine disrupting chemicals in particular may be playing a role in the rise of reproductive and developmental disorders, among other factors. (Dorey, 2003)

The foetus developing in the womb can be exposed to chemical substances that might be present in the mother's blood, either from daily exposure to chemicals or to chemicals that have been stored in her tissues and released during pregnancy (eg. during the third trimester when fat stores are mobilised). The placenta does not provide a barrier so that certain types of chemicals (ie. fat soluble, small, neutrally charged molecules) pass through to the umbilical cord. Levels of some chemicals, (eg. methylmercury) in the umbilical cord will eventually exceed levels in the mother's blood. For bisphenol A, levels in foetal plasma are higher than for maternal blood, in many cases, and the rate of clearance of bisphenol A from the blood in slower in foetuses because the enzymes required to clear it are not expressed until after birth (Dorey, 2003).
Infants are also especially vulnerable to the effects of hazardous chemicals after birth, when they continue to be exposed to relatively higher quantities of hazardous chemicals, particularly in their food and from the indoor environment (see Figure 1).

Figure 1. Increased exposure and vulnerability of the developing child to chemicals, Dorey 2003



For the general population, a major source of exposure to many hazardous chemicals is food, which can be contaminated due to environmental pollution (affecting the agricultural production of food) and as a result of leaching of contaminants from components and packaging used during manufacturing, processing and storage. Depending on the chemical, air is also a major source of chemical contamination; there are studies showing that indoor concentrations of alkylphenols and phthalates are greater indoors than out (Rudel et.al. 2010).

House dust is also an important exposure pathway in young children (Butte and Heinzow, 2002). Contamination of house dust makes continuous exposure to harmful chemicals possible, via inhalation, ingestion or direct skin contact. A number of studies have found a wide range of chemicals in indoor dust in many European countries, including alkylphenols, bisphenol A, organotins, flame retardants, phthalates and chlorinated paraffins, for example Greenpeace Environmental Trust (2003), Greenpeace Research Laboratories (2003), Greenpeace Belgium (2004), and more recently the Swedish Society for Nature Conservation (2011).

There is also the potential for infants and children to directly ingest chemicals present in clothing, toys and other items, by chewing or sucking them. For example, the potential exposure of children to phthalates in soft PVC baby toys led to an EU-wide ban on the use of three phthalates in children's toys and childcare articles, with a further three banned in items designed to be put in the mouth, which was first agreed as an emergency measure in 1999 and finally made permanent in 2005. However, children will not limit their behaviour to chewing on toys and childcare articles; other everyday items not included in the ban, in particular garments, may also contain hazardous chemicals and are often chewed. The particular behaviour of children in relation to clothing is described and assessed in a study by the Danish Ministry of the Environment (Danish MoE 2013), in relation to the presence of nonylphenol ethoxylates in samples of childrenswear (see Section 4).

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1.2 Hazardous chemicals – setting the scene

In Europe and around the world, synthetic chemicals are present in everyday consumer items from personal care and cleaning products to clothes, toys, furniture and kitchen utensils; we are directly exposed to them in our everyday lives. Hazardous chemicals have been detected in a range of different consumer products that incorporate textiles; however, the scope of this report is focussed on clothing for infants, children and expectant mothers. A large number of complex chemical ingredients are used to produce textiles for clothing, some of which are potentially hazardous; these chemicals have many different functions at different points of the textiles process or the finishing of garments and may be present in the finished articles, whether intentionally or not. Inevitably, our clothing is in close and continuous contact with our skin and people have justifiable concerns about what might be found within these most intimate of products, especially where infants, young children and pregnant mothers are concerned.

However, exposure to hazardous substances from products can also be indirect, via the environment. Many of these chemicals are released into the environment, at many points in the life cycle of these products – from raw materials and manufacture though to their use and disposal. Some of these chemicals are persistent organic pollutants (POPs) and are globally dispersed, accumulating in wildlife such as seals and polar bears – and in our bodies. Research into levels of industrial chemicals in the human body, from new-born babies to adults, has shown that we are continuously exposed to a multitude of chemical pollutants that accumulate in our bodies and the environment; for example, studies on chemicals in the blood of umbilical cords have found more than 200 individual chemicals from 15 groups of well-known hazardous chemicals in each new born baby (Scientific American, 2009) (Environmental Working Group 2009).

The exact number of chemicals on the global market is unknown, but 143,835 chemical substances have been pre-registered under the EU's chemicals regulation REACH (UNEP 2012). However, concern is focussed on chemicals that exhibit properties which make them intrinsically hazardous – such as toxicity, persistence, or carcinogenicity, for example (see Box 1). The hazardous properties of many chemicals on the market have not been fully assessed and this lack of data makes it hard to judge which substances might also be intrinsically hazardous.

Box 1. What properties make a chemical intrinsically hazardous?

Chemicals that cause particular concern when released into the environment display one or more of the following properties:

- **persistence** (they do not readily break down in the environment);
- **bioaccumulation** (they can accumulate in organisms, and even increase in concentration as they work their way up a food chain); and
- toxicity

Chemicals with these properties are described as PBTs (persistent, bioaccumulative and toxic substances). Organic chemicals with these properties are sometimes referred to as persistent organic pollutants (POPs), for example under the global Stockholm Convention.[3]. Despite initial dilution in large volumes of water or air, such pollutants can persist long enough in the receiving environment to be transported over long distances, to concentrate in sediments and organisms, and some can cause significant harm even at what may appear to be very low concentrations.

Heavy metals are inherently persistent and some of them (for example cadmium, lead and mercury) are also able to bioaccumulate and/or are toxic. Although they occur naturally in rocks, their use by industry can release them into the environment in quantities that can

[3] The Stockholm Convention is a global treaty to protect human health and the environment from the effects of POPs. For full text of the convention see: http://chm.pops.int/Convention/tabid/54/language/en-US/Default.aspx

damage ecosystems. Heavy metal compounds do not break down into harmless constituents but can react to form new compounds.

- Some types of toxicity make it difficult to define ‘safe’ levels for substances, even at low doses, for example, substances may be:
- **carcinogenic** (causing cancer), **mutagenic** (able to alter genes) and/or **reprotoxic** (harmful to reproduction) (**CMR**); or
- **endocrine disruptors** (interfering with hormone systems)
- **neurotoxic** (toxic to the neurological system) and **neurodevelopmental toxicity**
- **immunotoxic** (toxic to the immune system)
- **sensitizers**

1.3 Endocrine disrupting chemicals (EDCs)

WHO defines an endocrine disruptor as:
“an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub) populations” (IPCS 2002).

The World Health Organisation (WHO) recently published an assessment of the state of the science of endocrine disruptors for UNEP (WHO 2013b). “The UN study, which is the most comprehensive report on EDCs to date, highlights some associations between exposure to EDCs and health problems including the potential for such chemicals to contribute to the development of non-descended testes in young males, breast cancer in women, prostate cancer in men, developmental effects on the nervous system in children, attention deficit /hyperactivity in children and thyroid cancer.” (WHO 2013a)

“Research has made great strides in the last ten years showing endocrine disruption to be far more extensive and complicated than realized a decade ago,” said Professor Åke Bergman of Stockholm University and Chief Editor of the report

The report notes that recent increases in the incidence of endocrine-related diseases in people and wildlife cannot be explained by genetics alone and that EDCs are a “global threat that needs to be resolved.” A recent editorial referring to the report (Environmental Health Perspectives 2013) identifies that; *“Three strands of evidence fuel concerns over endocrine disruptors:*

- *The high incidence and the increasing trends of many endocrine-related disorders in humans;*
- *Observations of endocrine-related effects in wildlife populations;*
- *The identification of chemicals with endocrine disrupting properties linked to disease outcomes in laboratory studies.”*

The report (WHO 2013b) also highlights that *“of special concern are effects on early development of both humans and wildlife, as these effects are often irreversible and may not become evident until later in life.”*

Scientists have urged the UN to take action on chemicals in consumer products and pesticides (Endocrine Society, 2013); two of the points in their letter to the UN are:

- *“EDCs effects occur at low doses. Many EDC effects occur at low doses even when high dose effects are not apparent.*

- *EDCs can affect future generations and timing of exposure is key. The most sensitive period is during periods of development, from the fetal and post-natal periods, which can extend into infancy and childhood for some tissues."*

A recent statement by the Collegium Ramazzini, recommends that *"the scope of* REACH art 60(3) should be extended by default to all EDCs as substances of very high concern" using stringent, hazard-based evaluation criteria; and that "exposure to EDCs must be controlled, particularly considering the evidence that early life stages - including fetal, neonatal, and childhood development - are particularly vulnerable to EDCs" (Collegium Ramazzini 2013).

2. Sources of chemicals in textiles – raw materials

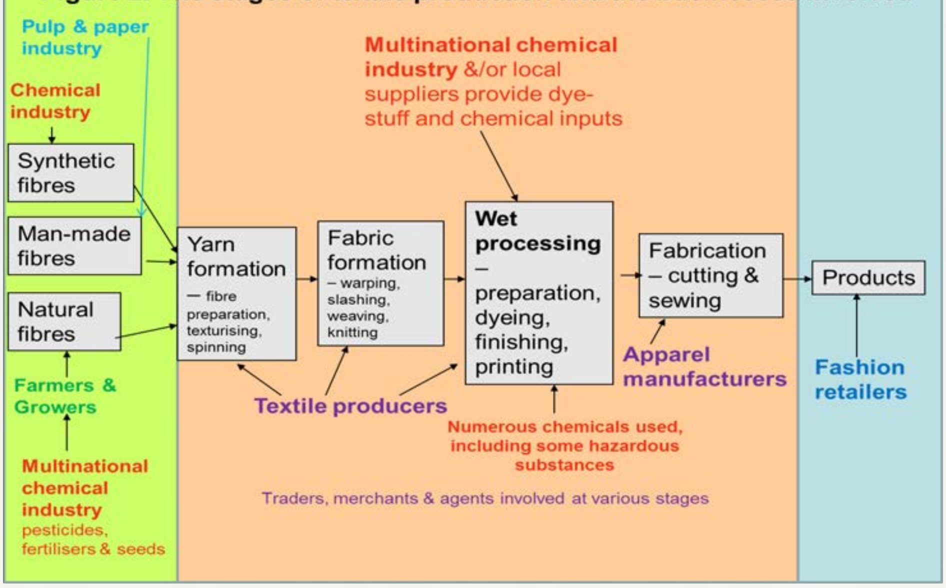
BOX 2: The textiles production chain – sources of chemicals in babies, children's and pregnant women's clothing

Textile and clothing product chains can be long and complex, with the various steps of textile processing and garment manufacture taking place in many different countries around the globe. The following description by the Swedish Chemicals Agency in 1997 (p.23) is still relevant today:

> Scarcely any production or trade is as old and as international as that of textiles. Fibre growing may take place in one country, spinning in another and weaving or knitting in a third. The woven fabrics may be sent to yet another country for dyeing and finishing, and then further to be made into clothing and other made-up articles and exported for sale in some other part of the world.

Figure 2 (based on Greenpeace 2011a) shows the different stages of textile and garment production. Different chemicals are used at various points in the production of natural raw materials, but particularly in the agricultural production of natural fibres such as cotton, the manufacture of synthetic fibres such as polyester, and in the various stages of textiles manufacture, especially the wet processing stage. Some of these chemicals are hazardous[4] and can be released to the environment at any point in the process and during the final product's life-cycle.

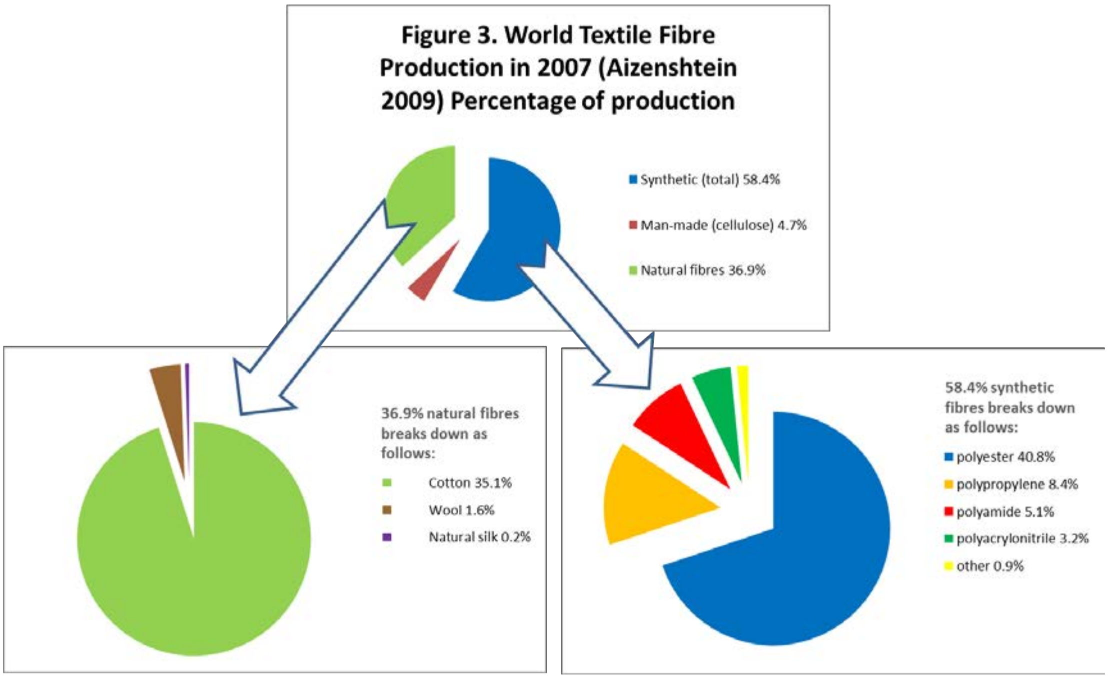
Figure 2. The stages of textile production and the businesses involved



[4] The basic intrinsic properties of hazardousness are any of the following: persistence, bioaccumulation, toxicity (PBT), very persistent and very bioaccumulative (vPvB), carcinogenicity, mutagenicity and toxicity to reproduction (CMR); endocrine disruption; and equivalent concern.

2.1 Textile raw materials

As reported in UNEP 2011, natural fibres include animal wools and plants such as cotton and flax. Man-made fibres include viscose (also known as 'rayon', which is based on cellulose products) and acrylic. Synthetic fibres (based on oil) include acrylic, polyester, polyurethane, polyamide and others. Among the synthetic fibres polyester dominates, and is often blended with cotton or wool to improve its properties (Swedish Chemical Agency 1997). Leather articles are also included in the sector but are outside the scope of this report.



The major issues of environmental concern for raw material production include pesticide and defoliant usage on cotton, ectoparisiticides on sheep, and industrial practice and emissions in the case of natural and synthetic fibres (Bunke *et al* 2003 in Walters et al 2005).

2.1.1 Natural fibres

Cotton

The intensive cultivation of cotton growing requires considerable quantities of chemical fertilisers and pesticides and has been identified by UNEP as a major cause of ecotoxicological effects (Finnish Environment Institute 2011, p.30-31). Cotton also has a high water footprint and exerts other pressures on natural resources, although it is of course a renewable resource in itself. The cultivation of cotton with organic methods avoids many of these problems, however, it still represents less than 1% of cotton produced (FAO 2009).

A 2007 report by the Environmental Justice Fund/Pesticides Action Network UK "Deadly Chemicals in Cotton" (EJF 2007) compiles information about the use of pesticides in cotton production and shows the severe impacts on human health, the environment and the food chain that result.

Cotton accounts for 16% of global insecticide releases – more than any other single crop, with almost 1.0 kilogram of hazardous pesticides applied for every hectare of cotton produced (ERF 2007 p.2). A total of US$ 2 billion is spent on agricultural pesticides for cotton farming every year, with at least US$ 819 million of these classified as hazardous by the World Health Organisation. Aldicarb is the world's second biggest selling cotton pesticide (US$ 112 million), and one of the most toxic chemicals in global agriculture. Two of the most widely used hazardous insecticides on cotton are deltamethrin and the organochlorine endosulfan, (ERF 2007 p.9 & 10) which is the dominant cotton pesticide in 19 countries (EJF 2007 p.27). Other hazardous pesticides used in large volumes include parathion, methamidophos and alphacypermethrin (ERF 2007 p.9 & 10). The organochlorine lindane is for example still in use in countries like India and Togo[5] (EJF 2007).

Cotton by-products can also be a source of hazardous pesticide residues in the food chain. Data collected by the FAO/ WHO Joint Meetings on Pesticides Residues in Food, show that hazardous pesticides applied to cotton – (including aldicarb, parathion, methyl parathion, methamidophos, deltamethrin, imidacloprid, and chlorpyrifos) – can potentially contaminate both refined cottonseed oil, and cottonseed derivatives commonly fed to animals. These cottonseed products are consumed locally, where facilities for monitoring contamination are lacking. (ERF 2007 p.16). Cottonseed oil is also used in the manufacture of processed food by the the food industry, eg. as 'vegetable oil' in cereals.

Some reviews show that residues from hazardous pesticides can also be found in cotton clothing; detectable traces of parathion and endosulfan, as well as numerous persistent organic pollutants such as aldrin, endrin and DDT have been detected in garments manufactured from cotton originating from Uzbekistan, Kazakhstan, Turkmenistan, Tajikistan, and USA, although these did not exceed permissible levels (Rybicki 2004). However, other studies report that no residues can be found, and it is considered that any pesticide residues that remain after textiles processing are mostly bound into the fabric and won't be released.

Use of GMOs in cotton crops for textiles

Genetically-engineered cotton is grown widely in India, China, South Africa and the US. These genetically-engineered cotton varieties are known as 'Bt cotton'. Bt cotton plants contain a gene from the soil bacterium Bacillus thuringiensis, which produces a toxin designed to kill a group of insect pests, mostly larvae of moths, which are generally called 'bollworm'. Bt cotton, and in general any genetically-engineered crop, continues to be hailed as the silver bullet for fighting poverty and hunger in the world, in spite of the acknowledged low established consensus, scientific research or serious evaluation about the impact of this technology so far.

A study which examined the economic case for GE cotton in India compared to organic agriculture (Greenpeace 2010) found that contrary to expectations, Bt cotton farmers continued to use a large amount and variety of chemical pesticides, especially insecticides. In total 26 different chemical pesticides were recorded being used by Bt farmers. Results indicated that for many reasons, Bt cotton poses a serious financial risk to poor, rain-fed smallholding farmers in India. Other studies have found the emergence of Bt-resistant bollworms in Indian cotton fields (Sci Dev Net 2006). On the other hand, organic cotton is a clear pro-poor option for improving economic livelihood in rural communities (Greenpeace 2010).

Wool

The environmental impacts of sheep farming depend on the intensity of the system and on the climate (Australian Wool Innovation 2011). The most common pesticides used on sheep are organophosphorous (OP), synthetic pyrethroids (SP) and insect growth regulators (IGR). Organochlorine (OC) pesticides are still found on wool from certain grower countries (IPPC 2003).

[5] http://www.pic.int/TheConvention/Chemicals/AnnexIIIChemicals/tabid/1132/language/en-US/Default.aspx

The greatest hazard is the risk to farmers using sheep dips and to workers handling the pre-treated wool (The Ecologist 2012).

As described in Walters et al 2005, the preparation of wool is the most intensive of all the natural fibres; an energy intensive process which uses large amounts of hot water and surfactants (eg. alcohol ethoxylates or alkylphenol ethoxylates) is used to remove wool grease (lanolin) dyed perspiration (stuint) and pesticides. The lanolin removed contains high levels of pesticides; up to half the lanolin is recovered for use as a feedstock for cosmetics, although the pesticides are removed. An alternative technique which uses less water and energy is an organic-solvent-based wool scouring technique, however, the solvent used, trichloroethylene, is a persistent chemical with concerns about its carcinogenicity and mutagenicity. However, there is concern about the limitations of life cycle assessments that make negative claims about the environmental credentials of wool (Australian Wool Innovation 2011).

Other natural fibres

Bast fibres – which include flax (linen), hemp, jute, ramie, kenaf and abaca – have been cultivated for more than 8,000 years and are considered to have the potential to be cultivated with little or no detrimental effect on the ecosystem. By-products from these fibres can be used for food, fodder, pharmaceuticals, cosmetics and body care items (The Textile Institute 2005). Chemical pesticides and fertilisers are used to a lesser extent of these alternative fibres than on cotton; for example hemp requires little to no pesticides or herbicides, it grows rapidly on very poor soils in a range of climates and requires little water (Ecotextile News 2012).

The SSNC (2008a) has also reviewed a number of different alternative textile fibres, such as abaca, bamboo, fibre nettle, and hemp, among others.

2.1.2 Synthetic fibres

Chemicals used in synthetic textile manufacture and likely residues.

The dominant synthetic fibre is polyester) (see Figure 3), which is a plastic produced by the petrochemical industry from fossil resources such as oil and natural gas. The term polyester refers not to one plastic but to a chemical class (group) of polymers. Of these poly(ethylene terephthalate), or PET, is of the greatest significance, accounting for the bulk of production. PET is also widely used as a plastic (ie. in packaging). To make textile fibres from a thermoplastic such as PET, melt spinning is used, which results in fine filaments which are then processed into the type of fibres typically used in textiles manufacturing.

The polymerisation process used to produce PET is normally catalysed by antimony trioxide (Jaffe and East 2007), which is classified as possibly carcinogenic to humans.[6] Waste residues from the polymerization process must be handled as hazardous waste due to their antimony content (Pang *et al* 2006).

Commercial polyester fibres typically contain concentrations of 200-300 ppm (parts per million) antimony trioxide. The EU ecolabel for textile products (2009/567/EC) currently requires that the antimony content is less than 260 ppm. Polyester textile fibres have a massive surface area and are subjected to harsh conditions during processing (wet treatments, high temperatures, and chemical attack) during which the catalyst may be expected to leach out into processing water (Lacasse and Baumann 2004).

[6] Group 2B by IARC (International Agency for Research on Cancer), based on evidence of a significant increase in incidence of lung tumours in female rats resulting from inhalation of the compound (IARC 1989). It is also recorded as a poison by intravenous and subcutaneous routes (Lewis 2004).

Antimony trioxide is the preferred catalyst for PET production due to a balance of cost, catalytic ability and colour of the produced polymer; antimony is cheap, a sufficiently active catalyst and produces white PET. Alternatives, mainly based on titanium, exist and are in limited use. These exhibit a higher catalytic activity but are more expensive and tend to produce yellow tinted polymer (Pang *et al* 2006).

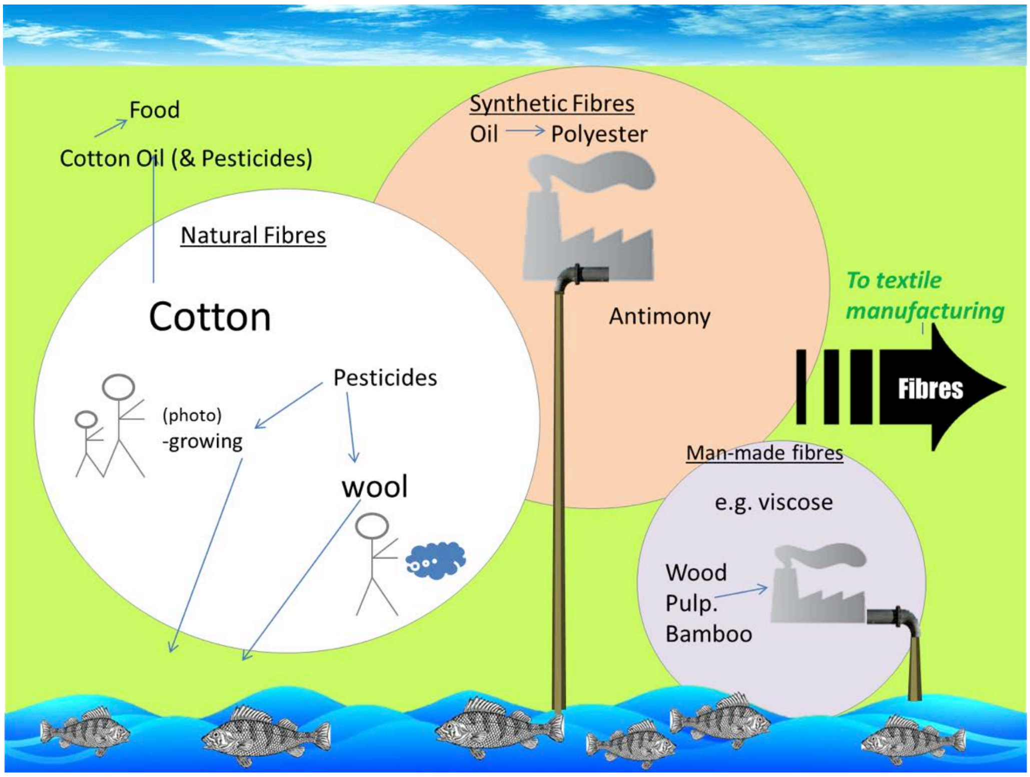
2.1.3 Cellulose – man-made/artificial fibres (viscose)

Viscose

Viscose (also known as rayon) is based on cellulose fibres which are usually derived from bleached wood pulp (although any though any plant material with long molecular chains can be used, such as bamboo). It is mainly produced using the 'viscose process' where the cellulose is treated with caustic soda (sodium hydroxide) and carbon disulphide, converting it into a highly viscous liquid. Chronic exposure to carbon disulphide can cause nervous system damage, whereas sodium hydroxide and sulphuric acid (which is also used in the process to harden the viscose), are harmful to the environment if released untreated. The weaving of these viscose fibres into fabric also uses chemicals and water. Alternative methods of producing viscose, based on closed loop systems, use solvent spinning rather than the traditional viscose process and are reported to have less environmental impacts (Lyocell is the generic name for these fibres (Tencel ® and Modal ®) (O Ecotextiles 2012).

A bachelor thesis for the Swedish Society for Nature Conservation (2011) made an assessment of regenerated bamboo viscose to consider whether it fulfilled the criteria for its 'Good Environmental Choice' ecolabel. A review of the literature showed a significant environmental impact from a number of factors associated with the production of pulp which the viscose and lyocell processes depend on, for example: chemicals used in the process, energy and energy source, the need to purify emissions to air and water and to recycle energy and chemicals. Its conclusion was that "if the regenerated bamboo is produced as it is today, it is not a sustainable fibre. If the production is done through an integrated process in which chemicals and energy recovery and purification of air and water occurs, bamboo viscose can be a sustainable fibre for the future." However, even if the viscose production is not fully integrated, it can still obtain the ecolabel if the requirements for emissions are fulfilled. It should be noted that regenerated fibres derived from any raw material source (e.g. bamboo, wood, cotton lints, soybean, milk) are not accepted as 'organic' by the Global Organic Textile standard, even if grown organically (GOTs 2013).

Figure 4a. Raw materials used for textiles



3. Sources of chemicals in textiles – textiles manufacturing

3.1 Summary of the main chemicals of concern used in some textile industry processes (spinning, pre-treatment, wet processing)

Textiles manufacturing involves many different processes and chemicals, most of which are non-hazardous chemicals such as sodium chloride, used in large quantities. A full description of textile processing can be found in IPPC 2003 or Walters et al 2005. The textile processes that involve more intensive consumption of chemicals, (including some hazardous chemicals) are highlighted below.

In the ***yarn and fabric formation***, and ***pretreatment*** stages, the chemicals used are less likely to remain in the finished produce due to subsequent processing stages. Although the later ***wet processing*** stages involve more significant use of hazardous chemicals, there are some issues that should be highlighted.

- In ***spinning and weaving*** surfactants such as alkylphenol ethoxylates (APEOs) can be used (see BOX 6); bactericides and fungicides are also used as preservatives.
- ***Pretreatment –***
  - In ***scouring*** APEOs can be used as surfactants.
  - ***Bleaching –*** chlorine based bleaches such as sodium hypochlorite and sodium chlorite lead to the production of a range of **absorbable organic halogens (AOX),** including **trichloromethane**, in varying degrees. However, the alternative hydrogen peroxide also requires the use of potentially hazardous complexing agents, for example **EDTA,** which is persistent in the environment under acid conditions, where there is also concern about the fate of metals that are mobilised and made bioavailable at higher concentrations.

However, biodegradable alternatives are available. There is also concern that optical brighteners could be persistent

Wet processing

The majority of chemical use in textile finishing processes occurs during 'wet processing', such as dyeing, washing, printing and fabric finishing (Lacasse et. al. 2004). According to surveys measuring natural resource use in all industries, textile dyeing and finishing mills use considerable quantities of water– as much as 200 tons of water for every ton of textiles produced (Greer et.al. 2010).

The Swedish Chemical Agency (KEMI 2013 p.23 & 24) has identified a non-exhaustive list of 1,900 chemicals that are known to be used in textile production today; this does not include many chemicals that are considered as confidential. Of the 1,900 chemicals, 165 (8.7%) have been identified by KEMI as hazardous,[7] however, it's possible that some of the remaining 1,750 chemicals may also have hazardous properties and should be considered for restriction on a case by case basis. The ZDHC Group[8] has recently compiled a non-exhaustive inventory of chemicals which has 4357 entries (although it includes some duplicates) (ZDHC 2013).

The availability of such a large number of chemicals for use by industry poses obvious difficulties when it comes to sharing and maintaining information about them, as well as drawing up and enforcing regulations for their use.

With some exceptions, chemicals used in the early stages of textiles processing are more likely to be consumed and washed away; chemicals used in the dyeing/printing and finishing processes are more likely to remain in the finished product (KEMI 2013). Releases of chemicals from textiles are mostly released in waste water effluents, where they enter the environment directly; they can also be released via the air and to soil from solid wastes. The chemicals and their breakdown products can remain in ecosystems over prolonged periods and concentrate in biota.

UNEP, DTIE/Chemicals Branch (2011) provides a list of some of the chemicals of concern, according to their functions, some of which are designed to remain in the article (such as coatings and fire retardants) and others that are present in finished articles as an indirect result of the manufacturing process. Table 1 includes some of these well-known examples, with some additions, combined with a more comprehensive list of chemicals used in the various stages of textiles manufacturing, as follows.

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[7] *According to Regulation (EC) No 1272/2008 (CLP) and endocrine disrupting substances:* Carcinogenic category 1A/1B, Mutagenic category 1A/1B, Toxic to reproduction category 1A/1B, Respiratory sensitisation 1A/1B, Skin sensitisation 1A/1B, Endocrine disrupting substances /(EDCs), at present not covered by any harmonised classification, Environmentally hazardous, long-term effects Aquatic Chronic 1.

[8] Zero Discharge of Hazardous Chemicals Group,

Table 1. Important chemicals or chemical classes used in different stages of textile and clothing manufacturing and their function[9]
Chemicals with particular toxicity are shown in bold.

Process step	Chemicals or chemical groups used	Function/product specifics
Fibre production	**Pesticides**, soda, detergents	Remove wool impurities
	Pesticides, fertilizers (and irrigation water)	Cotton
	Heavy metals, sulphides	Viscose
	Heavy metals, acetaldehyde, 1,4-dioxane	Polyester
	nitrile, acrylate, acetate, amide, sulphate, chloride, pyridine	Acrylic
Yarn manufacturing	**mineral**/vegetable oil; emulsifiers, **anti-mould agents**	Spinning oil
Spinning and weaving	starches	sizing agents
Sizing	starch based agents, alcohol, acrylate	
Knitting	**mineral oils (including poly-aromatic hydrocarbons -PAHs)**, waxes	lubricating/emulsifying
washing	synthetic tensides; **organic solvents, nonylphenols/nonylphenol ethoxylates (NPE/NPEOs)**	detergents in washing
scouring	caustic liquor, acidic liquor	remove wax, grease, base
desizeing	Enzymes, alcohol, carboxy methyl cellulose, **DDT, Pentachlorophenol (PCP)**	remove starch sizes
bleaching	hydrogen peroxide, chlorite, perborite, hydroxide	
mercerizing	Sodium hydroxide (NaOH)	
dyeing or printing	**azo dyes (which can cleave into carcinogenic aromatic amines)** and other organic compounds	
	acids, bases, salts (irone, copper, aluminium, tin), **heavy metals (e.g. mercury, cadmium, chromium VI,**	e.g., attach dyes to fibre

[9] Based on: a) Finnish Environment Institute 2011, Table 1 p.16, b) UNEP, DTIE/Chemicals Branch (2011), Table 1, p.7.) and c) SSNC 2012 – p.20-21

	lead & arsenic), carriers (also organic) – eg. **organochlorines (chlorinated solvents, chlorinated benzenes)**	
	solvents, formaldehyde, NPEOs	auxiliary substances
patterning acid	base	
stiffening starch,	PVA, resins, esters, starch, **chlorides, CMC products**	
softening oil	paraffin, wax, alkane, fatty acids, silicones, PE, enzymes	
stonewashing,	antipill. enzymes	
stabilizing	**formaldehyde, triazones, carbamates**, N-alkylol compounds	stabilizing of cellulose fibre
anti-shrink acids	salts, N-alkanol compounds	
fire-proofing	**heavy metals, halogens, salts, formaldehyde**	
	Brominated Fire Retardants (BFRs) eg. Poly-brominated diphenyl ethers (PBDEs), hexabromocyclododecone (HBCD) Other fire retardants - TCEP	
	Short chain chlorinated paraffins (SCCPs)	
	Asbestos	
water repulsion salts,	paraffins, **chlorinated, fluorinated** and silicone compounds, pyridines, **isocyanates**	water repellents
oil repulsion acids,	polymers and other oil repellents	
dirt repulsion oxides	,clay minerals, PVC, phosphates, resins, F compounds	
antistatic treatment	polymers, synthetic tensides	
biocide treatment	**phenols (also halogen), metals – eg. silver (nano-silver), ammonia (NH4) & ammonia compounds, SCCP, Dimethylfumarate (DMF)** [10]**, Triclosan, Organotins,**	anti-mould or – microbial
moth proofing acids	urea	
microencapsulation	**fragrances**, softeners, **preservatives/biocides**, potential drugs	for durable effect
additional parts	metals including **chromium and nickel** in zippers, buttons etc	

[10] DMF evaporates at room temperature: http://www.kemi.se/en/Content/In-focus/Dimethylfumarate/

anti-pilling, water proof	**PVC (Phthalates (e.g. DEHP) heavy metals (e.g. lead, cadmium, organotins),** PU, pigments, inks, lacquers, Si, **perfluorinated compounds (PFCs - including PFOS, PFOA, PFNA, FTOH)**, waxes	cotton/PE, polyamide
protective printing inks	**PVC (Phthalates (e.g. DEHP) heavy metals (e.g. lead, cadmium, organotins),**, PU, lacquer,	depend on fabric and use
coating	PU	for polyamide and PE
Water-, oil-, stain- and wrinkle resistant coatings	**PFCs (Perfluorinated compounds, including PFOS, PFOA, PFNA, FTOH)**,	
	Formaldehyde	
wet washing	soap, synthetic tensides	active substances
	phosphates, zeolites	improve effect of tensides
	enzymes, silicates, brighteners, **perfumes, metals, anti-mould**	cleaning, brightening etc
	silicate, phosphonate	fibre protection agents
	carboxymethyl cellulose, carboxylate glycol	prevention of greying
dry cleaning	**tetrachloroethylene, trichloroethane, CFCs**, hydrocarbons	
bleaching	perborate, percarbonate	bleach stains
dyeing	e.g. azo dyes, pyridine derivatives (disperse) etc	pigments industrial and domestic
maintenance	various	water, stain proof coating
Transport and storage	**Chlorinated phenols eg. pentachlorophenol (PCP), methyl bromide, chloropicrin, 1,2-dichloroethane**	added as biocides
Other (see SSNC 2012 – p.20-21 for a list of prohibited substances; the following are not already included in list above	• -MES, -methy-ester sulphonate • Aromatic solvents • Benzene, toluene and xylene • DHTDMAC, DSDMAC, DTDMAC (Quaternary ammonium compounds) • DPTA, Diethylene triamine penta acetic acid • EDTA, Ethylene diamine tetra acetic acid • Short-chain aldehydes, with up to 6 carbon atoms, such as acetaldehyde, formaldehyde and glyoxal • LAS, Linear alkyl benzene sulphonates • NTA, Nitrilo-tri-acetic acid	

Fabric specific uses of hazardous chemicals

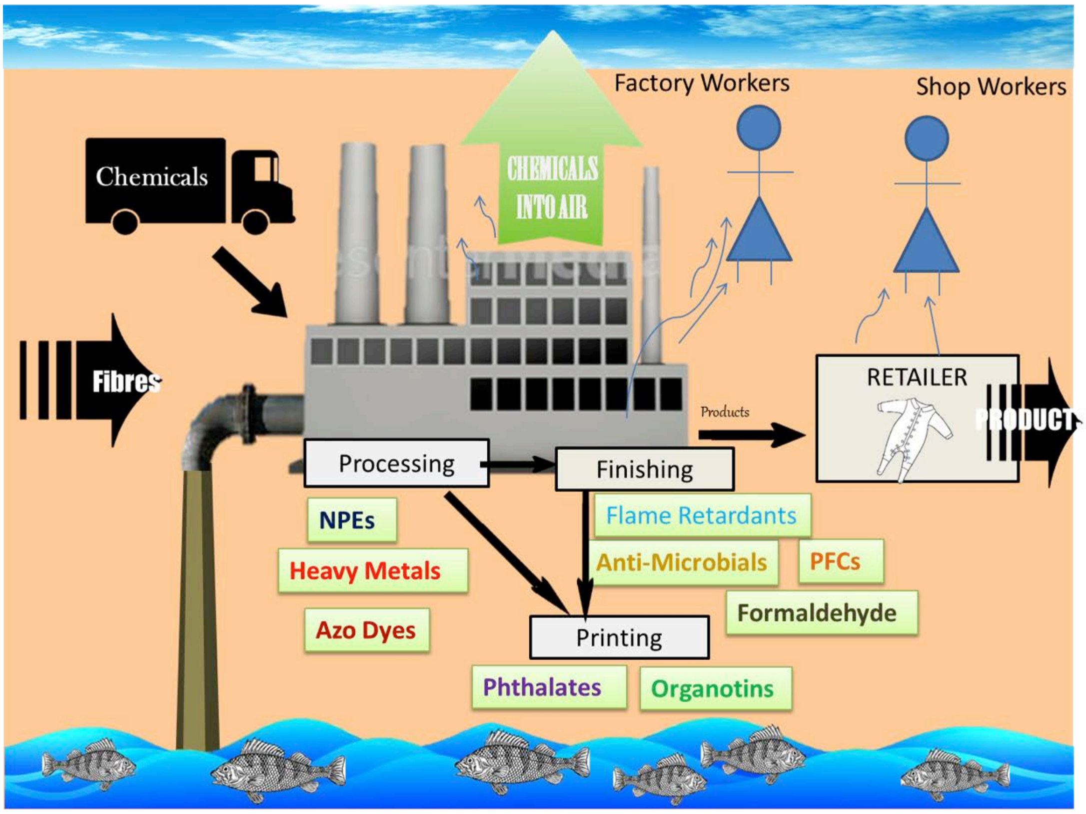
There are some differences to the chemicals used according to the type of fibre, as follows:

Cotton: Wrinkle resistant agents can be added to cotton, which can release formaldehyde, although there are formaldehyde free agents available. Direct dyes used for cotton in particular belong to the azo group of dyes. There is sometimes the need for flame retardants, as although cotton is difficult to ignite, it burns for longer and more completely than synthetic fibres.

Synthetic fibres: Organochlorine carriers are sometimes used for blends of synthetic fibres (polyester) and wool, which are difficult to dye. Carriers have sometimes been detected in textiles and can cause skin irritation. Organochlorines are also persistent and bioaccumulative. Disperse dyes for polyester and polyamide in particular previously caused skin allergies, although allergenic dyes are generally not used today. Polyester is dyed exclusively with disperse dyes of which more than 50% are azo compounds and another 25% anthraquinones (IPPC 2003). Antistatics and sufactants, which sometimes have irritating or allergenic properties, are used to counteract static electricity problems with nylon and acrylic. Synthetic fibres are hydrophobic therefore it can be difficult to ensure that finishes stay on the fabric.

Wool: Woollen textiles need to be protected against moths. Currently more than 65% of wool is dyed with chrome or metal-complex dyes (Walters 2005). Residues may remain causing allergies and irritation.

Figure 4b Routes of exposure from the use of some hazardous substances in the manufacture of textiles and clothing, and their retail



3.2 Environmental and health impacts in supply chain countries

Box 3: Pollution of waterways and the contribution from industry

The severity of impacts from economic and population growth on water resources is summarised by the UN as follows:

"In some areas depletion and pollution of economically important River basins and associated aquifers have gone beyond the point of no-return, and coping with a future without reliable water resources systems is now a real prospect in parts of the world." World Water Assessment Programme (2009)

Nitrate and other nutrient pollution from agricultural runoff and sewage from public wastewater systems have the most obvious and visible effect on waterways, as they lead to the growth of algal blooms, which in turn deplete the oxygen supplies in the water. Industrial effluent is also part of the problem. According to the United Nations Environment Programme, "*worldwide, it is estimated that industry is responsible for dumping 300–500 million tons of heavy metals, solvents, toxic sludge, and other waste into waters each year*"(UNIDO (2003). In high-income countries, industrial pollution is said to be stabilising or decreasing. The Organisation for Economic Co-operation and Development reports that since the 1970s, high-income countries have reduced industrial discharges of heavy metals and other persistent chemicals by 70 to 90 per cent or more in most instances (OECD 2006). However, this is not the case for economies in the Global South, where pollution is expected to increase along with economic and industrial development (World Water Assessment Programme 2009, p.143).

Much of the waste discharged by industry is relatively non-hazardous, although it can still have serious acute impacts on rivers and waterways. However, hazardous chemicals such as heavy metals and hazardous organic substances are of particular concern. Many such chemicals pose a long-term threat to human health and eco-systems once released into the environment. In addition, some chemicals bioaccumulate or biomagnify (becoming more concentrated higher up the food chain) – and can have serious, long-term effects on the organisms that ingest them (Greenpeace International 2006). Furthermore, the effects of such persistent and bioaccumulative substances can be global, as they may be transported far beyond their source via ocean currents, atmospheric deposition and food chains. Some have even been found to accumulate in the polar regions.

3.2.1 The role of the textiles industry and its contribution to water pollution

The largest impacts, on both health and the environment, usually occur in the countries where textiles are manufactured (KEMI 2013). The manufacturing of textiles is an important industrial sector in many countries in the Global South and a driver of economic growth.The leading countries for the export of both textiles and clothing are shown in Figures 5a and 5b.

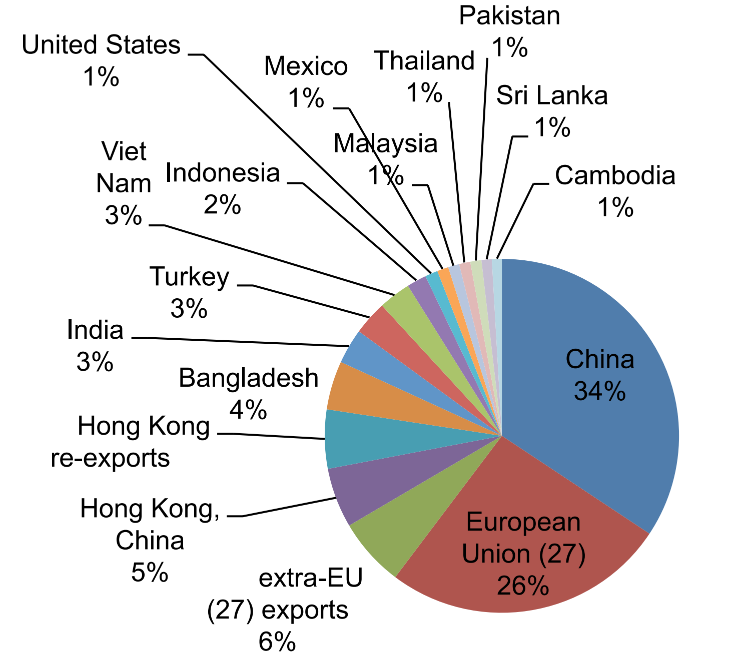


Figure 5a. Leading exporters of clothing 2011 (WTO 2012)

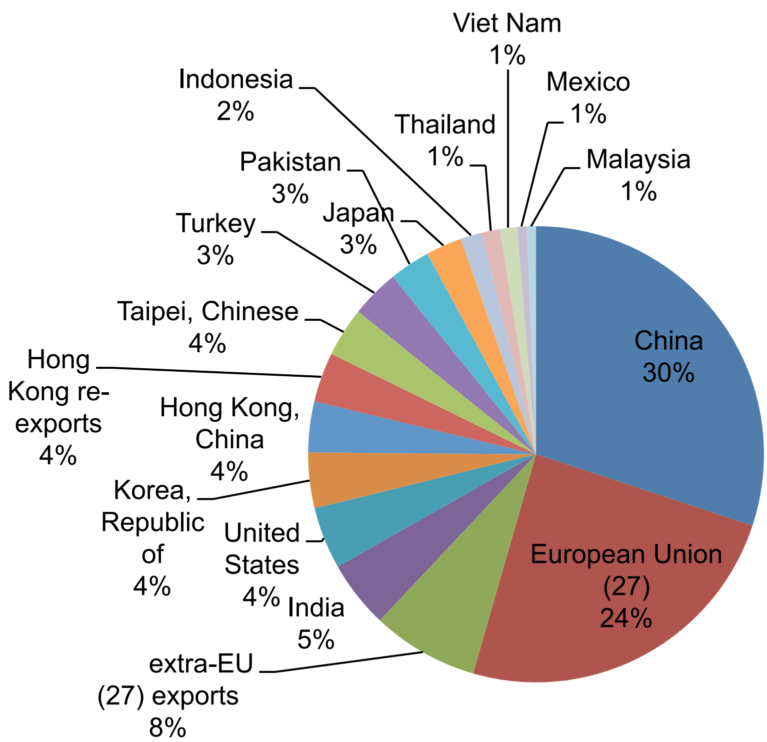


Figure 5b. Leading exporters of textiles 2011, (WTO 2012)

China dominates both for the export of textiles and clothing. Textiles account for 7.6% of total trade volume, according to the General Administration of Customs.[11] The textiles industry is

[11] China`s textiles exports growth regains momentum in 2010 http://www.yarnsandfibers.com/news/print_article.php3?id=24553 (08 Mar, 2011 – China)

reported to be one of the most polluting industrial sectors in the country, behind the chemical industry.[12]

Excluding the EU, India is second to China for the textiles industry and like China is also an important exporter of clothing. The Indian textile industry is second only to agriculture in employment, providing jobs for over 35 million people. Textiles also represent more than 10% of the country's exports.[13]

Bangladesh is not a major exporter of textiles but it is the largest exporter of clothing outside of China and Hong Kong. Recent events graphically illustrate the extreme dangers and poor working conditions faced by garment workers in Bangladesh, most of them women, following the collapse of a factory that left hundreds dead and wounded. *"The international brands sourcing from Bangladesh have a responsibility to conduct human rights due diligence to identify and address their own impacts on human rights,"* said Pavel Sulyandziga, who currently heads the five-strong UN Working Group on business and human rights (Fibre2Fashion 2013).

In Mexico, the textile and apparel industry constitutes the fourth largest manufacturing activity in Mexico and as the number one creator of jobs it is vital to its economy. Mexico is the fourth largest supplier of textiles and apparel to the US market.[14] The Tehuacan region, formerly known as one of "Mexico's jeans capitals", became infamous at the beginning of the 2000s for environmental pollution caused by the industry, as well as human rights issues, such as low wages, which were widely denounced in the press. As a result of these scandals, many international fashion brands, for example Levi's and GAP, stopped sourcing their products in the region by the mid-2000s.[15]

Indonesia is currently among the top ten largest exporters of clothing in the world, while it was the 11th largest exporter for textiles in 2011. Indonesia is the largest economy in South East Asia and textiles and clothing accounted for 8.9 % of the country's total exports in 2010.[16] Wastewater from the textile industry is also a major source of pollution; the industry is concentrated in West Java, especially in the Upper Citarum river catchment, where 68% of industrial facilities produce textiles.[17]

3.2.2 Where and how chemicals are released from textiles manufacturing

The main environmental concern in the textile industry centres on the amount of water discharged and the chemical load it carries. Other important issues are energy consumption, air emissions, solid wastes and odours, which can be a significant problem in certain treatments, in particular volatile chemicals such as chlorinated carriers which can be released during drying and curing (IPPC 2003)

Effluent from textiles processing can be complex due to the wide variety of raw materials and processes used (see Table 1). For example, as described in IPPC 2003, much of the total emissions from textile processing result from substances that are already on the raw material

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[12] Business for Social Responsibility (2008) *Water management in China's apparel and textile factories,* www.bsr.org/en/our-insights/report-view/water-management-in-chinas-apparel-and-textile-factories

[13] http://blog.airdye.com/goodforbusiness/2011/12/05/india-struggles-with-textile-water-pollution/

[14] Mexico Today (2011). Mexican Textile Industry: A Fit for Your Business http://mexicotoday.org/article/mexican-textile-industry-fit-your-business

[15] Maquila Solidarity Network and The Human and Labour Rights Commission of the Tehuacan Valley Tehuacan (2003) op cit, and update: Maquila Solidarity Network and Rodrigo Santiago Hernandez (2010) op cit.

[16] Business Vibes; Industry Insight (2013) Textile Industry in Indonesia, http://www.businessvibes.com/blog/industry-insight-textile-industry-indonesia, exports in terms of monetary value.

[17] PUSDATIN Ministry of Industry (2012) Company Directory (Table C2, Toxic out of control)

before it enters the finishing mill, some of which are non-biodegradable or hazardous.[18] Dyeing processes lead to the discharge of metals and pigments, or other chemicals used in the dye formulation such as carriers, dispersing and anti-foaming agents, and residual contaminants present on the fibre, such as residues of pesticides on wool and spin finishes on synthetic fibres. Effluents can also be highly alkaline or acidic and contain large volumes of biodegradable materials, as a result of basic chemicals and auxiliaries used in dyeing processes, such as alkalis, salts, reducing and oxidising agents. Chemicals used for finishing can also be non-biodegradable and sometimes also toxic (e.g. biocides or PFCs) and can also be released into effluent (IPPC 2003).

There are examples of poor management of wastewater from the textile industry, where basic treatment to neutralise the highly alkaline wastewater or deal with biodegradable waste is lacking, or where a wastewater treatment plant (WWTP) is present but not being used. Improved wastewater treatment is extremely important in such cases; however, it will not resolve the concerns regarding hazardous chemical use. Wastewaters containing NPEs and NP and certain other hazardous substances including heavy metals such as antimony, cannot be treated effectively in conventional wastewater treatment processes. Many of the hazardous substances listed in Table 1 (above) have been found in effluent from textile manufacturing, despite the presence of modern WWTPs (see Box 4).

BOX 4: Discharges to waterways – specific examples

Greenpeace investigations into textile manufacturers

Greenpeace has reported on a total of six investigations into textile manufacturers in Thailand, China, Mexico and Indonesia, between 2009 and 2013. The investigations focussed on effluent from individual textile manufacturing facilities or communal WWTP[19] that primarily treat wastewaters from textile manufacturing & related facilities, which can provide an indication of the broader picture. Samples were analysed for the presence of hazardous chemicals in wastewater discharged directly from the facility into local waterways and in two cases from communal industrial wastewater treatment plants. For some textiles manufacturers in China, Mexico and Indonesia, the business relationships between these facilities and major fashion or sportswear brands was also investigated.

The hazardous chemicals most commonly identified in effluent from these textiles manufacturers included **APs/APEs (mainly NPs/NPEs), PFCs (PFOA), amines, chlorinated anilines, organochlorines, phthalates** and **heavy metals,** along with many other chemicals identified at individual locations**.**

Other discharge monitoring studies

C&A, H&M and GStar RAW (2013) released a Data Discharge Report on selected suppliers, made up of 11 major suppliers from three major production countries, (i) China (3 units), (ii) Bangladesh (5 units) and (iii) India (3 units). Samples were analysed for the 9 +2 groups of chemicals known as the "priority 11"[20], which are prioritised for elimination as part of the brands' commitments to zero discharges of all hazardous substances by 2020 (see Section 5). Chemicals from 5 groups of substances were found **- aromatic amines from azo dyes, chlorobenzenes, phthalates, short chain chlorinated paraffins (SCCPs**) and **heavy**

[18] such as impurities in natural fibres, preparation agents, spinning lubricants, sizing agents; their removal results in the discharge of hard-to-biodegrade organic substances such as mineral oils, but also of hazardous compounds such as PAHs, APEOs and biocides.

[19] Waste Water Treatment Plants

[20] The 11 hazardous chemicals prioritised by the ZDHC Group are: APs/APEOs, PFCs, phthalates, brominated flame retardants, etc. (get from website)

metals, except chromium VI (Cr VI).[21] **Chlorinated paraffins** were found in effluent from 10 out of the 11 factories tested. However, although the study lists the possible sources of these substances (Table 4, p.11), it focuses on comparing the levels found with 'acceptable' limits.

ZDHC Group Benchmarking Study

As reported in the ZDHC 2012 Annual Report (ZDHC 2012), benchmarking was conducted at a sample of suppliers that ensured a mix of processes, raw materials, and geographic locations, covering 19 sites in Bangladesh, China, India, Taiwan, and Vietnam. Key processes targeted were dyeing and finishing, washing, printing, and durable water repellent application for a range of specific textile types including cotton, polyester, denim, and leather. The sportswear brands conducted benchmarking at eight sites—four in China, three in India, and one in Vietnam—while fashion brands investigated 11 sites—five in Bangladesh, three in India, and three in China. Out of the priority 11 substances that were investigated, [22] the key chemical groups detected were **APEOs, aromatic amines from azo dyes, chlorobenzenes, heavy metals, phthalates,** and **short-chained paraffins**. The completed benchmarking report was published in July 2013 (ZDHC 2013a).

Tiripur, India – Zero Liquid Discharge (ZLD) Norm

A report by the *Danish Federation for Small and Medium-sized Enterprises* (Valeur 2013) describes how in Tirupur, India, which is known as the knitted garment capital of India, the discharge of wet processing effluent from the textile industry to rivers and river beds for many years had led to the destruction of agricultural crops. A strong agricultural lobby campaigned to change this situation which resulted in a new regulation known as the Zero Liquid Discharge (ZLD) norms. In 2010 the Madras High Court ordered the closing down of all of the approximately 754 dyeing plants because of non-compliance with the ZLD norms. These norms require the use of effluent treatment processes that ensure 100% reuse of water resources (Valeur 2013 Appendix B).

The extreme situation and the urgent measures taken to resolve the problem arose because of water scarcity; as a dry region where rivers only flow during the monsoon, the textile industry relied on the extraction of groundwater. Polluted effluent was discharged direct to dry river beds which in turn led to contamination of agricultural land and of groundwater, which was "polluted to such a level that it was (is) unfit for domestic, industrial and agricultural activities". The bleaching and dyeing process was reported to be the main source of pollutants which include caustic soda, hydrochloric acid, sodium hydro sulphate, hypochlorite and peroxides. The presence of hazardous chemicals in effluent is not mentioned although this must also have contributed to the problem.

The court ruling led to innovation within the industry in terms of the specific adaptation of ZLD technology from various different parts of the world, which resulted in the setting up of water recycling technology so that all water is re-used and no effluent is discharged. Further innovation is now taking place with investment in alternative energy sources such as wind energy and other green initiatives. The role of the Nordic buyers and institutions involved in the project will be to promote Ecolabelled textiles from Tirupur on the Nordic market and therefore support the development of a Green Textile Cluster in Tirupur.

[21] *Not detected were: Alkylphenols (APs) & Alkylphenol Ethoxylates (APEOs), Brominated and Chlorinated Flame Retardants, Chlorinated solvents, Chlorophenols, Organotin compounds, Perfluorinated Chemicals (PFCs)*

[22] Op.cit.

BOX 5: Impacts on female workers' health

Workers at various stages of the in textile chain, from manufacturing to packing and retailing of the final products are significantly exposed to the variety of chemicals present in clothing products, because of the volumes of material involved. The majority of these workers will be women.
Zhang (2009, p.27) summarises the impacts on workers in dyeing/printing and finishing processes: inevitably workers will be in daily and routine contact with a large number of chemical substances, many of which are known to be hazardous to human health. For example, advice from the UK Health and Safety Executive (HSE) (2007) indicates that some reactive dyes are respiratory sensitizers which can cause occupational asthma by inhalation; some of the dyestuffs can cause skin allergies; furthermore, a small number of dyes, based on their chemical characteristics, are potentially carcinogenic. HSE also points out that health problems are most commonly caused by the use of textile chemicals which act as irritants, for example formaldehyde-based resins, ammonia, acetic acid and soda ash, which can cause health effects such as skin irritation, stuffy noses, sneezing and sore eyes.

In addition, the concentration of chemicals in clothing can reduce after being washed; for example, levels of formaldehyde were shown to fall markedly after one launder at a low temperature.[23] This indicates that the greatest exposure to this carcinogen is likely to be to industry employees including retail staff. (Danish EPA 2003) In general, although levels of formaldehyde in textile processing facilities have reduced significantly since the 1980s (p. 53, Danish EPA 2003), high levels can still be found in some garments (see Section 4, RAPEX) and formaldehyde is the most commonly found substance in laboratories among tested substances.
Specific studies that show ill health effects linked to textiles processing include:

- A study by the US National Institute for Occupational Safety and Health found a link in textile workers between length of exposure to formaldehyde and leukaemia deaths (Pinkerton et.al. 2004)
- Women who work in textile factories and are exposed to synthetic fibres and petroleum products at work before their mid-30s seem to be most at risk of developing breast cancer later in life. For example, women working with acrylic and nylon fibres increased the risk of developing breast cancer compared to the normal population (Labreche 2010).
- A study of textile workers in Shanghai, China found an elevated risk of a spontaneously aborted first pregnancy associated with exposure to synthetic fibres and mixed synthetic and natural fibres. (Wong et.al. 2009)

3.2.3. Occupational exposure from fumigation and treatments for storage and shipment

The treatment of containers by fumigation takes place before shipment of goods. Biocidal products such as methyl bromide, 1,2-dichloroéthane, phosphine, dichloromethane and sulfuryl fluoride are generally used. Given the intrinsic hazard of these products, customs employees have to use gas masks to inspect containers. These substances, which are normally colourless and odourless, are associated with various health conditions including headaches, drowsiness, concentration and memory disorders, skin irritations, dizziness, nausea, nasal and eyes irritations, respiratory disorders and muscular troubles.

Occupational exposure can occur during treatment or during transport if fumigation takes place during maritime transport. Dockers and customs employees may be exposed in ports while

[23] Formaldehyde is therefore partly washed out in wastewater where it will be either discharged directly to waterways of via and public sewage treatment works, with the consequent pollution.

unloading and inspecting products. At a later stage, employees of textiles retailers may be exposed when the products are delivered, put in storage and finally put on the shelves, where the customer will buy them. In a recent French TV documentary,[24] a customs employee explained the necessary precautions when inspecting a container: not standing in front of the door of the container when opening it; wait at least 30 minutes before entering and proceeding to the inspection, despite the fact that odourless gasses with hazardous health effects could still be off-gassing.

3.3 Further details on selected hazardous chemicals

The following hazardous chemicals used in textiles are highlighted because they have been identified as chemicals of concern and are the subject of legislative restrictions or bans to a greater or lesser extent at an international or national level, due to their intrinsic hazardous properties. Many of them are highlighted in bold in Table 1. They are listed in the following order:

Process chemicals	BOX 6: Surfactants: nonylphenol (NP) and nonylphenol ethoxylates (NPEs) BOX 7: Dyes i) Carcinogenic amines released by certain azo dyes ii) Heavy metals: cadmium, lead, mercury and chromium (VI) BOX 8: Chlorinated carriers: chlorobenzenes, chlorinated solvents BOX 9: Phthalates
Functional finishes – designed to stay in the clothes	BOX 10: Flame retardants i) Brominated and chlorinated flame retardants ii) Short chain chlorinated paraffins BOX 11: Water and stain resistant finishes - Perfluorinated Chemicals (PFCs) BOX 12: Easy care finishes – formaldehyde BOX 13: Anti-microbials, nanosilver, triclosan, triclocarban BOX 14: Coatings – MEK, UV/sunscreen filters
Post-production treatments	BOX 15: Biocides – organotins, chlorophenols, DMF

[24] Ibid 5

Process chemicals

BOX 6: Surfactants: Nonylphenol (NP) and nonylphenol ethoxylates (NPEs)

Nonylphenolethoxylates (NPEs): NPEs are a group of manmade chemicals that do not occur in nature other than as a result of human activity. They are most widely used as detergents and surfactants, including in formulations used by textile manufacturers. Once released to wastewater treatment plants, or directly into the environment, NPEs degrade to nonylphenol (Brigden 2011, see Box C).

Nonylphenol (NP): NP is used to manufacture NPEs, among other things. Following use, NPEs can break back down into the NP from which they were produced. NP is known to be persistent, bioaccumulative and toxic, and is able to act as a hormone disruptor. NP is known to accumulate in the tissues of fish, among other organisms. NP has also recently been detected in human tissue.[25]

NPs & NPEs belong to a wider group of chemicals known as alkylphenols and alkyllphenol ethoxylates, which also include octylphenols and their ethoxylates.

In some regions NPs and NPEs have been regulated for many years. NP and NPEs were included on the first list of chemicals for priority action towards achieving the OSPAR Convention target of ending discharges, emissions and losses of all hazardous substances to the marine environment of the northeast Atlantic by 2020. NP has also been included as a "priority hazardous substance" under the EU Water Framework Directive. Furthermore, within the EU, since January 2005 products (formulations used by industry) containing greater than 0.1% of NP or NPEs may no longer be placed on the market, with some minor exceptions. In contrast, many countries in the Global South do not have legal restrictions on the use of NP/NPEs.

Restrictions on the sale of textile products containing residues of NPEs within the EU do not currently exist, though such a regulation is currently proposed by one EU member state, Sweden. In addition, Germany has recently announced its intention to propose both NP and a related substance - t-OP - as substances of very high concern (SVHC) under the EU REACH Regulation

[25] Lopez-Espinosa MJ, Freire C, Arrebola JP, Navea N, Taoufiki J, Fernandez MF, Ballesteros O, Prada R & Olea N (2009). "Nonylphenol and octylphenol in adipose tissue of women in Southern Spain", Chemosphere, vol 76, no 6, pp847-852

BOX 7: Dyes

Carcinogenic amines released by certain azo dyes

Certain azo dyes can break down under reductive conditions to release aromatic amines. This release can take place under a number of conditions, including within the body and in contact with sweat; reduction can occur in many different types of cells, including within intestinal and skin bacteria. Some, though not all aromatic amines that can be released from azo dyes have been shown to be carcinogenic.

Azo dyes are manufactured using the same amines that can be later released through reduction: it is therefore possible for commercial azo dye formulations to contain residues of amines used in their manufacture. Furthermore, certain carcinogenic amines have been detected as residues in other amines that are used for azo dye manufacture, providing an additional route for contamination of commercial azo dye formulations with carcinogenic amines. These sources could contribute to the presence of carcinogenic amines at trace levels within textile products.

Legislation exists in certain countries, including EU member states and China, which prohibits the sale of products containing dyes that can degrade under specific test conditions to form carcinogenic amines at concentration above set limits, for textile articles which may come into direct contact with human skin. The EU regulation lists 22 compounds (including *o*-dianisidine), with a limit of 30 mg/kg.[26] The regulation in China sets a limit of 20 mg/kg and lists the same compounds as the EU regulation, as well as two additional compounds.[27]

Heavy metals: cadmium, lead, mercury and chromium (VI)

Heavy metals such as cadmium, lead and mercury have been used in certain dyes and pigments used for textiles. These metals can accumulate in the body over time and are highly toxic, with irreversible effects including damage to the nervous system (lead and mercury) or the kidneys (cadmium). Cadmium is also known to cause cancer.

Uses of chromium (VI) include certain textile processes and leather tanning: it is highly toxic even at low concentrations; chromium (VI) is nonessential and toxic.[28] Compounds are corrosive, and allergic skin reactions readily occur following exposure, independent of dose. Chromium (VI) is also toxic to many aquatic organisms.

Within the EU cadmium, mercury and lead have been classified as “priority hazardous substances” under regulations which require that measures be taken to eliminate their pollution of surface waters in Europe.[29] Uses of cadmium, mercury and lead have been severely restricted in Europe for some time, including certain specific uses of mercury and cadmium in textiles.[30]

[26] EU (2002) Directive 2002/61/EC of the European Parliament and of the Council of 19 July 2002 amending for the 19th time Council Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations (azocolourants): [http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:243:0015:0018:EN:PDF]

[27] SAPRC (2012) op.cit.

[28] ATSDR 2012, Toxicological Profile for Chromium September 2012 CAS#: 7440-47-3 http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=62&tid=17

[29] EU (2000) Directive 2000/60/EC op.cit.

[30] Commission Regulation (EC) No 552/2009 of 22 June 2009, op. cit. (REACH)

Disperse Dyes
Polyester is dyed exclusively with disperse dyes; of which more than 50% are azo compounds and another 25% anthraquinones (IPPC 2003). As the fibre is hydrophobic watersoluble dyes do not attach. Instead a variety of electrostatic interactions increase affinity for the fibre, resulting in fixation. The lack of a strong chemical bond permits a degree of migration out of the fibre,this accounts for the high incidence of contact dermatitis associated with disperse dye stuffs. (Walters 2005).

BOX 8: Chlorinated carriers: chlorobenzenes, chlorinated solvents

Chlorobenzenes
Chlorobenzenes are persistent and bioaccumulative chemicals which have been used as solvents and biocides, in the manufacture of dyes and as chemical intermediaries. The effects of exposure depend on the type of chlorobenzene; however, they commonly affect the liver, thyroid and central nervous system. Hexachlorobenzene (HCB), the most toxic and persistent chemical of this group, is also a hormone disruptor.

Within the EU pentachlorobenzene and HCB are classified as "priority hazardous substances" under regulations which require measures to be taken to eliminate their pollution of surface waters in Europe.[31] They are also listed as "persistent organic pollutants" for global restriction under the Stockholm Convention, and in line with this they are prohibited or scheduled for reduction and eventual elimination in Europe.[32]

Chlorinated solvents
Chlorinated solvents, such as trichloroethane (TCE), are used by textile manufacturers to dissolve other substances during manufacturing and to clean fabrics.
TCE is an ozone-depleting substance that can persist in the environment. It is also known to affect the central nervous system, liver and kidneys.[33] Since 2008 the EU has severely restricted the use of TCE in both products and fabric cleaning.[34]

BOX 9: Phthalates

Phthalates are mainly used as plasticisers (or softeners) in plastics, especially PVC, and as ingredients in inks, adhesives, sealants and surface coatings. Specifically related to textiles, phthalates were recently reported within plastisol prints on textile products manufactured and sold around the world, with very high levels of certain phthalates in some products, including DEHP.[35] They are widely found in the environment, primarily due to their presence in many consumer products. They are also commonly found in human tissues, with reports of

[31] EU (2000) Directive 2000/60/EC, the EU Water Framework Directive, http://ec.europa.eu/environment/water/water-framework/

[32] Commission Regulation (EU) No 757/2010 of 24 August 2010 amending Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annexes I and III, *Official Journal* L223 25.8.2010, pp.29-36

[33] Agency for Toxic Substances and Disease Registry (2006, 1989) *Toxicological profiles for 1,1,1-trichloroethane & 1,1,2-trichloroethane*, United States Public Health Service, Agency for Toxic Substances and Disease Registry

[34] Use of TCE is regulated via Entry 34 of Annex 17 of the EU chemical law (REGULATION (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)) to concentrations to or greater than 0.1 per cent by weight of product for sale to the general public and in diffusive applications such as surface cleaning and cleaning of fabrics. COMMISSION REGULATION (EC) No 552/2009 of 22 June 2009 (REACH) op.cit.

[35] Greenpeace 2012b, see bibliography

significantly higher levels of intake in children.[36] (Koch *et al.* 2006) There are substantial concerns about the toxicity of phthalates to wildlife and humans. For example, DEHP, one of the most widely used to date, is known to be toxic to reproductive development in mammals.[37],[38]

At present, there are relatively few controls on the marketing and use of phthalates, despite their toxicity, the volumes used and their propensity to leach out of products throughout their lifetime. Of the controls which do exist, however, probably the best known is the EU-wide ban on the use of six phthalates in children's toys and childcare articles, first agreed as an emergency measure in 1999 and finally made permanent in 2005.[39] While this addresses one important exposure route, exposures through other consumer products have so far largely escaped regulation. Within the EU, four phthalates (DBP, BBP and DEHP and DiBP), have been included on the candidate list of 'substances of very high concern' that will require justification and authorisation for their continued use under the REACH Regulation.[40]

Within the EU DEHP is listed as a priority substance under the Water Framework directive, a regulation designed to improve the quality of water within the EU.[41] DEHP and DnBP have also been identified as substances for priority action under the OSPAR convention, under which signatory countries have agreed a target of cessation of discharges, emissions and losses of all hazardous substances to the marine environment of the North-East Atlantic by 2020, the "one generation" cessation target.[42] In August 2012, despite a European Commission ruling from June 2012,[43] the Danish Ministry of Environment announced plan to introduce a wider ban on marketing and use for four hormone-disrupting phthalates; DEHP, DBP, BBP and DiBP (DMOE 2012)[44] and is submitting a strategy for consultation.[45]

Functional finishes – designed to stay in the clothes

These are chemicals which are designed to remain in the article (such as coatings and fire retardants); they can be bound to the fabric to a greater or lesser extent and can also be released during use, laundering and disposal.

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[36] Koch, H. M., Preuss, R. & Angerer, J. (2006) Di(2-ethylhexyl)phthalate (DEHP): human metabolism and internal exposure—an update and latest results. Int. J. Androl. 29: 155–165

[37] Howdeshell, K. L., Wilson, V. S., Furr, J., Lambright, C. R., Rider, C. V., Blystone, C. R., Hotchkiss, A. K. & Gray Jr, L. E. (2008) A mixture of five phthalate esters inhibits fetal testicular testosterone production in the Sprague Dawley rat in a cumulative dose additive manner. Toxicol. Sci. 105: 153–165

[38] Lin, H., Ge, R.-S., Chen, G.-R., Hu, G.-X., Dong, L., Lian, Q.-Q., Hardy, D.O., Sottas, C.M., Li, X.-K. & Hardy, M.P. (2008) Involvement of testicular growth factors in fetal Leydig cell aggregation after exposure to phthalate in utero. Proc. Natl Acad. Sci. USA 105(20): 7218–7222

[39] EC (2005) Directive 2005/84/EC of the European Parliament and of the Council of 14 December 2005 amending for the 22nd time Council Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (phthalates in toys and childcare articles). Official Journal of the European Communities L344, 27.12.2005: 40-43 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:344:0040:0043:EN

[40] ECHA (2010) Candidate List of Substances of Very High Concern for Authorisation, publ. European Chemicals Agency (ECHA), 13.01.2010 http://www.precidip.com/data/files/pdf/Candidate_List_of_Substances_of_Very_High_Concern_for_authorisation.pdf (accessed 23.08.2012)

[41] EU (2000) Directive 2000/60/EC, the EU Water Framework Directive, http://ec.europa.eu/environment/water/water-framework/

[42] OSPAR (1998) OSPAR Strategy with Regard to Hazardous Substances, OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, OSPAR 98/14/1 Annex 34

[43] ENDS (2012) Danish Phthalate ban unnecessary – experts. http://www.endseurope.com/29054/danish-phthalate-ban-unnecessary-experts accessed 23.08.2012

[44] DMOE (2012) 'Danish Ministry of the Environment protects consumers from dangerous phthalates' announcement by the Danish Ministry of the Environment (DMOE), 23rd August 2012. http://www.mim.dk/Nyheder/20120823_ftalater.htm (in Danish)

[45] Denmark at the leading edge regarding phthalates, 9/04/2013, http://www.mst.dk/English/About+the+Danish+EPA/News/Denmark_and_phthalates.htm

BOX 10: Flame retardants

Brominated and chlorinated flame retardants

Many brominated flame retardants (BFRs) are persistent and bioaccumulative chemicals that are now present throughout the environment. Polybrominated diphenyl ethers (PBDEs) are one of the most common groups of BFRs and have been used to fireproof a wide variety of materials, including textiles.

Some PBDEs are capable of interfering with the hormone systems involved in growth and sexual development. Under EU law the use of some types of PBDE is tightly restricted[46] and one PBDE has been listed as a "priority hazardous substance" under European water law, which requires that measures be taken to eliminate its pollution of surface waters.[47,48]

Short-chain chlorinated paraffins

Short-chain chlorinated paraffins (SCCPs) are used in the textile industry as flame retardants and finishing agents for leather and textiles (water-proofing, industrial protection). They are highly toxic to aquatic organisms, do not readily break down in the environment and have a high potential to accumulate in living organisms.[49] Their use has been restricted in some applications in the EU since 2004.[50]

BOX 11: Easy-care finishes

Formaldehyde

According to the Danish EPA 2003, "formaldehyde releasing formulations are used in the textile industry during manufacturing, especially in crease impregnation, e.g. production of crease-resistant and easy-care textiles but also as flame-retardant and other functional after-treatments (including anti-pilling, stiffening, for better colour fastness, for better wash fastness of different functional finishings such as flame retardency).[51]

Formaldehyde releasing cross-binding substances may be used in textile printing. From such textiles formaldehyde may be released to air." Formaldehyde can also be used as preservative and fungicide during transportation. About "60-85 per cent of all apparel fabric is finished with formaldehyde-containing resins"; workers are exposed to airborne formaldehyde when it off-gasses from products manufactured with these resins.[52]

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[46] Commission Regulation (EC) No 552/2009 of 22 June 2009, op. cit. (REACH). Existing restrictions set out in the Marketing and Use Directive (76/769/EEC) were carried over to REACH. Directive 76/769/EEC was repealed on 1 June 2009. (EU (2003) Directive 2003/11/EC of the European Parliament and of the Council of 6 February 2003 amending for the 24th time Council Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations (pentabromodiphenyl ether, octabromodiphenyl ether), Official Journal L 42, 15.02.2003: 45-46)

[47] EU (2000) Directive 2000/60/EC establishing a framework for Community action in the field of water policy, *Official Journal* L327 22.12.2000, pp.1-72

[48] EU (2000) Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, *Official Journal* L348 24.12.2008 pp.84-97

[49] OSPAR (2001) *Short chain chlorinated paraffins*, London: OSPAR Commission, London

[50] Commission Regulation (EC) No 552/2009 of 22 June 2009, op.cit. (REACH)

[51] Glyoxal resins contain formaldehyde: http://www.fibre2fashion.com/industry-article/15/1464/easy-care-and-durable-press-finishes-of-cellulosics-glyoxal-resins3.asp

[52] Occupational Safety and Health Administration, III. Properties, Manufacture, and Uses of Formaldehyde, https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=PREAMBLES&p_id=923

The Danish EPA study of chemicals in clothes found free-formaldehyde in three out of ten garments tested. Levels were shown to fall markedly after one launder at a low temperature. This indicates that the greatest exposure to this carcinogen is likely to be to industry employees including retail staff. Severe allergic skin reactions have been reported as a result of formaldehyde in garments.

Formaldehyde is toxic to humans and is classed as an evident carcinogen by IARC (2004), via respiratory exposure; it is also a skin and eye irritant, toxic by inhalation and known for its ability to cause sensitisation.[53]

In a 2012 report by the German Federal Institute for Risk Assessment (BfR), glyoxal, a formaldehyde substitute, is classified as genotoxic, harmful by inhalation, irritating to skin and very irritating to eyes. In addition, it can trigger allergic skin reactions. As far as is known, the use of glyoxal is limited compared to formaldehyde and there have been no reports of allergic reactions caused by glyoxal treated textiles articles. Apart from glyoxal resins, other resins can also contain formaldehyde.

BOX 12: Water and stain resistant finishes*

Perfluorinated Chemicals (PFCs):

Perfluorinated chemicals (PFCs) are man-made chemicals widely used by industry for their non-stick and water-repellent properties. In the textile industry they are used to make textile and leather products both water- and stain-proof.

They are generally highly resistant to chemical, biological and thermal degradation, The stable properties of PFCs are also a major environmental down-side, namely their long persistence in the environment once they are released. Some PFCs (PFOS and PFOA) have been reported as contaminants throughout the environment, including freshwater, groundwater and seawater sediments and soils; numerous studies have also reported the presence of PFCs in tissues of aquatic invertebrates, amphibians, fish, birds and mammals including humans. Laboratory studies have shown that some PFCs can cause adverse impacts during development and during adulthood in animals; some have also been shown to act as hormone (endocrine) disruptors.

Evidence shows that many PFCs persist in the environment and can accumulate in body tissue and biomagnify (increasing levels) through the food chain. Once in the body some have been shown to affect the liver as well as acting as hormone disruptors, altering levels of growth and reproductive hormones. The best known of the PFCs is perfluorooctane sulphonate (PFOS), a compound highly resistant to degradation; it is expected to persist for very long periods in the environment. A recent study has found that levels of PFOA and PFOS in the environment have decreased since 2002, but that increasing levels of short chained sulfonates have been observed; there are also considerable information and knowledge gaps regarding PFCs other than PFOA and PFOS.[54]

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[53] IARC, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 88 Formaldehyde, 2-Butoxyethanol and
1-*tert*-Butoxypropan-2-ol http://monographs.iarc.fr/ENG/Monographs/vol88/volume88.pdf

[54] Nordic Council (2013), in bibliography

PFOS is one of the "persistent organic pollutants" restricted under the Stockholm Convention, a global treaty to protect human health and the environment, and PFOS is also prohibited within Europe[55] and in Canada[56] for certain uses.

BOX 13: Anti-microbials

KEMI (2011) notes that a large number of different biocides are reported to be used to protect textiles from odour. The most commonly known are various silver compounds, triclosan and triclocarban, highlighted in the KEMI 2011 study. Other substances reported to be used as biocides include, for example, zinc pyrithione, polyhexamethyl biguanide, tributyl tin, isothiazolines, cyclodextrin, permethrin, chitosan and quaternary ammonium compounds. Antibacterial substances are most commonly used to treat synthetic material. In contrast, other materials, such as wool, are sometimes marketed as naturally antimicrobial as the water-repellent structure of the wool fibre does not form the same breeding ground for microorganisms.

Silver can be added to textiles in various chemical forms (metallic, salts etc.) that can release silver ions. Silver is also reported to be used in nanoform. The definition of nanoparticles is a subject for discussion, but generally refers to structures that are one to a few hundred nanometres (i.e. less than a millionth of a metre) and are consequently capable of giving the material special properties. Knowledge of how nanoparticles are taken up in humans and animals is incomplete and consequently so too is knowledge of what risks these small particles pose. It should be noted, however, that nanoparticles are so small that they can cross barriers in the body's tissues, for example the blood-brain barrier.

There is also concern about bacteria developing resistance to anti-bacterials such as silver with reports of silver-resistant bacteria.[57]Silver ions are very toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment. Fish and small crustaceans (for example water fleas) are particularly sensitive. Growth and reproduction are adversely affected at silver ion concentrations as low as less than 1 g/l. Silver is persistent, which means that once silver has been released into the environment it will remain there. Silver from wastewater gradually sinks down into sediment or ends up on arable land through WWTP sludge, where it can accumulate and have adverse effects on sediment and soil organisms.

Triclocarban is classified as "very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment". It is persistent and appears to be capable of bioaccumulation; it has also been found to be toxic to mammals, with effects on reproductive capacity. Triclocarban is broken down among other things to 3,4-dichloroaniline, which is persistent in the environment and has been found to be toxic to reproduction in fish; 3,4-dichloroaniline has also been found to be sensitising (allergenic) in a standard test for skin allergy. Like silver, triclocarban in wastewater is deposited in WWTP sludges. Triclocarban has already been evaluated and has not been permitted in biocidal products in the EU since 2006. However, it is permitted as a preservative in cosmetics and hygiene products in the EU with a maximum permitted concentration of 0.2 per cent.

Triclosan is an organochlorine compound which is officially classified as "irritating to eyes and skin" and "very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment". Triclosan has been shown to have endocrine disrupting properties in

[55] Commission Regulation (EC) No 552/2009 of 22 June 2009, op. cit. (REACH)
[56] Government of Canada (2007) "Chemicals Management Plan – Implementation timetable" www.chemicalsubstanceschimiques.gc.ca/plan/table-tableau_e.html
[57] Acta Dermato Venereologica (2011), Effects of Silver-Based Wound Dressings on the Bacterial Flora in Chronic Leg Ulcers and Its Susceptibility In Vitro to Silver, http://www.medicaljournals.se/acta/content/?doi=10.2340/00015555-1170&html=1

experiments on frogs and on rats. Triclosan is not readily degradable and can consequently

accumulate in the environment. One study showed that triclosan was present in human breastmilk. It is suspected that triclosan can contribute to increased resistance in bacteria, which has been demonstrated in the laboratory environment.
*see KEMI 2011 for references

BOX 14: Coatings

Methyl ethyl ketone (MEK)
Methyl ethyl ketone is an industrial solvent, used in plastics, surface coatings and the manufacture of textiles. It is toxic to the nervous system, and can irritate the skin, eyes, nose and throat. Prolonged exposure to workers can cause neurological symptoms such as fatigue and headache, according to occupational studies. MEK also is considered a reproductive toxicant based on lab animal evidence that included decreased foetal weight and malformations. It has been reported by companies in the plastics, surface coatings and textiles of 469 children's products, including boots, hats, trousers and arts and crafts, among dozens of others.[58][59]

Sunscreen filter substances:
It's generally thought that sunscreen filter substances are only used in sun-cream or beauty or baby creams? In fact, photochemical reactions due to UV rays can impair the colour fastness or tear resistance of polyurethane and polyester fibres. To prevent this occurring, UV absorbers are used to protect both dyes and fibres. As noted by the German Federal Institute for Risk Assessment in a 2012 report:[60] "*Furthermore, garment textiles are explicitly finished with UV-absorbing substances in order to reduce consumer exposure to UV rays. The UV permeability of textiles depends on fibre material, porosity, thickness of the textile surface, the dye used and colour intensity. Generally speaking, synthetic fibres like polyester absorb more UV radiation than natural fibres like cotton.* ***The main area of use of a finishing treatment with UV-absorbing substances is, therefore, cotton textiles***."

[58] Environmental Health News (2013), Methyl ethyl ketone in 469 products, May 6 2013, http://www.environmentalhealthnews.org/ehs/news/2013/methyl-ethyl-ketone
[59] Thompsons Solicitors, MEK Poisoning Compensation Claims, http://www.thompsons.law.co.uk/workplace-illnesses-and-diseases/mek-poisoning-compensation-claim.htm
[60] *BfR und UBA empfehlen, den Einsatz von Organozinnverbindungen in Verbraucherprodukten weiter zu begrenzen,* 2008, http://www.bfr.bund.de/cm/343/bfr_und_uba_empfehlen_den_einsatz_von_organozinnverbindungen_in_verbraucherprodukten_weiter_zu_begrenzen.pdf

Post-production treatments

BOX 15: Biocides

Organotin compounds

Organotin compounds are used in biocides and as antifungal agents in a range of consumer products. Within the textile industry they have been used in products such as socks, shoes and sport clothes to prevent odour caused by the breakdown of sweat. Organotins are also used as stabilisers in PVC (particularly MBT, DBT and DOT) (Greenpeace 2004).

One of the best known organotin compounds is tributyltin (TBT). One of its main uses was in antifouling paints for ships, until evidence emerged that it persists in the environment, builds up in the body and can affect immune and reproductive systems; its use as an antifouling paint is now largely banned. TBT has also been used in textiles.

TBT is listed as a “priority hazardous substance” under EU regulations which require that measures be taken to eliminate its pollution of surface waters in Europe.61 From July 2010 and January 2012 products, including consumer products, containing more than 0.1 per cent of certain types of organotin compounds will be banned across the EU. [62]

Chlorophenols

Chlorophenols are a group of chemicals used as biocides in a wide range of applications, from pesticides to wood preservatives and textiles.

Pentachlorophenol (PCP) and its derivatives are used as biocides in the textile industry. PCP is highly toxic to humans and can affect many organs in the body. It is also highly toxic to aquatic organisms. The EU banned production of PCP-containing products in 1991 and now also heavily restricts the sale and use of all goods that contain the chemical.[63] Reports of contamination of children’s clothes as a result of PCP treated wood transportation boxes being shipped from Asia in the late 1990’s/early 2000’s are well known in France.

Dimethylfumarate (DMF)

Dimethylfumarate (DMF) is a biocide used to prevent mould growth that can cause deterioration of textiles, leather furniture or footwear during storage or transport, especially in a humid climate. DMF is often contained in pouches fixed inside furniture or added to footwear boxes, where it sublimates protecting product from mould. Often, the pouches look similar to those used to contain silica gel, a non-harmful desiccant frequently used in leather products.In France, Poland, Finland, Sweden and the UK, consumers have experienced skin irritation, redness and burns and, in some severe cases, acute respiratory difficulty, which is said to have been caused by DMF contact with skin. European Directive (2009/251/EC) was published on the 17th March 2009 and requires that products containing DMF are not placed on the market.[64] See Section 4 for more information.

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[61] EU (2000) Directive 2000/60/EC, op. cit.

[62] Commission Regulation (EU) No 276/2010 of 31 March 2010 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards Annex XVII (dichloromethane, lamp oils and grill lighter fluids and organostannic compounds), *Official Journal* L86 1.4.2010, pp.7-12

[63] Since 1991, all PCP-containing products sold and used in the EU have been imported (EU production was banned under Directive 76/769/EEC). Now entry number 22 of Annex 17 of the EU chemical law (REACH) prohibits the marketing and use in the EU of PCP and its salts and esters in products in a concentration equal to or greater than 0.1 per cent. COMMISSION REGULATION (EC) No 552/2009 of 22 June 2009, op. cit. (REACH)

[64]Fibre2Fashion (2009) Dimethyl Fumarate (DMF) to be banned within EU, 9/4/2009, http://www.fibre2fashion.com/news/textile-news/newsdetails.aspx?news_id=71123

4. Chemical residues in garments on the market

Of the many chemicals used in the textile manufacturing process, not all will be found in the finished textile, mostly depending on the specific physical and chemical properties of the chemical and when they are used in the process. Most chemicals in the finished textile derive from the dyeing/printing and finishing during the manufacturing process (KEMI 2013 p.24).

Most studies looking at chemical residues in clothing products focus on chemicals that are likely to present and specifically look for those; for example, PFCs, NPEs, phthalates, azo dyes, heavy metals, or a combination of these substances.[65]In addition, the European rapid alert system for non-food dangerous products (RAPEX) reports products that are hazardous to consumer health on its system for a number of hazardous chemicals (but not all), when levels of these chemicals exceed the regulatory limits, as well as the regulatory or voluntary action taken.

It is less common for studies to take a broader approach of screening to see which chemicals have been identified without pre-selection; both the Danish EPA 2003 (p.107) and Greenpeace 2012b undertook screening and identified a broad range of other chemicals, some of which were identified as hazardous or potentially hazardous[66] no single chemical stands out among these findings.

KEMI 2013 (p.98) provides a summary of chemicals found in surveys of textile products between 2005 and 2012, referring to a total of 13 different studies; it is a useful overview but not comprehensive as some key recent studies are not included. The relevant findings for clothing products are extracted in Table 2, together with results from some 5 additional studies not referred to by KEMI (making a total of 18 studies).

Many children's products were included in these studies, for example in Greenpeace 2012b, 31 of the products were children's garments. Of these, 21 had levels of NPE above the detection limit of 1mg/kg, ranging from 1.7 – 2600 mg/kg. The ratio (2/3) of articles in which NPEs were identified reflects that found in the sample of all articles in this study, showing little apparent difference between clothing products for adults and children. One study, the Danish MoE 2013, specifically looked at the presence of NPEs in children's products.

[65] Examples of studies investigating chemicals such as these include: those by NGOs, such as several Greenpeace reports dating from 2011 (Dirty Laundry II, III, Toxic Threads I, Chemistry for any Weather) and the Swedish Society for Nature Conservation (SSNC) (T-shirts with a murky past); reports from Government bodies such as the Danish Ministry of the Environment (into PFCs, nanosilver and NPEs) and the Swedish Chemical Agency (KEMI) (antibacterial substances and chemicals in general); and reports from consumer organisations and magazines such as BEUC and Ökotest, which both address a range of chemicals.

[66] see Table 2, Other Organic Substances;

TABLE 2: Overview of chemicals found in clothing products, based on KEMI 2013 (p.98) (survey of textile analysis studies from 2005-2012) Some additional studies not in the KEMI report are in blue.

Chemical Group or Function	Chemical substance	Sources	Concentration range	Uses	References
PFCs	PFOA Other perfluorinated compounds	Carpets, furniture textile, weather proof jackets	0,4-3,74 **g/m^2** 0,38-368 **g/m^2**	Soil and water repellance	Herzke et al., 2012. Greenpeace, 2012.
Alkylphenols & alkylphenol ethoxylates	Nonylphenol Ethoxylate (NPE)	T-shirts, towels, weather proof jackets, jeans, pyjamas, snowsuits, underwear, shorts, shirts, jackets, trainers, trousers, dresses	2 – 10608 1 – 45,000 mg/kg	Surfactant	Kemikalieinspektionen, 2013. Naturskyddföreningen, 2008. Naturskyddföreningen, 2007. Greenpeace e.V., 2012. Rasmussen et al. 2012 Greenpeace 2011b Greenpeace 2012b Danish MoE, 2013
	Nonylphenol	Child's coat	Not quantified	Degrades from NPE surfactant	Greenpeace 2012b
Phthalates	Phthalates DEHP, DBP, DIDP, DINP, DNOP, BBP)	T-shirt prints, oilcloths, shower curtains, toilet bags, backpacks, mittens, weather proof jackets, jeans, trousers, dresses, underwear	12 - 300 000 **mg/kg DEHP** 9 – 290 mg/kg DBP 630 – 16000 mg/kg DIDP 1800-86000 mg/kg DINP 60 mg/kg DNOP 300 – 5700 mg/kg BBP All phthalates - 3 mg/kg – 37%	Plasticisers , Softeners DBP – also solvents	Kemikalieinspektionen, 2013. Göteborgs stad miljöförvaltning, 2009.Tønning et al., 2010. Klif, 2010. Greenpeace, 2012. Greenpeace 2012b
Amines from azo dyes	o-diansidine	Child's jeans 2 out of 134 articles	7 – 9 mg/kg	From cleavable azo dyestuffs	Greenpeace 2012b
	Various amines from azo dyes	Clothing, textiles and fashion items	52 articles exceeded regulatory limits since 2010 up to 3/6/13)	"	RAPEX
Elements	Antimony (Sb)	Jacket, mittens, towels, weather proof jackets	0,2 - 200	Catalyst, Flame reatardant (Antimony oxide)	Tønning et al., 2009. Naturskyddföreningen, 2007. Greenpeace, 2012.
	Barium (Ba)	Strollers,	12,5		Kemikalieinspektionen,

		clothing and foam			2013.
	Bromine (Br)	Mitten, Towels	1,5 - 660		Tønning et al., 2009. Naturskyddföreningen, 2007.
	Fluorine (F)	Jackets, mittens, towels	230 - 140000		Tønning et al., 2009. Naturskyddföreningen, 2007.
	Silver (Ag)	Sportswear, Pyjamas, Body	0,4-38,8	Biocides, antibacterial	Kemikalieinspektionen, 2011.
Flame retardants	Decabromodiphenyl Ether (DecaDBE)	Car seats foam and clothing	19	Flame retardants	Kemikalieinspektionen, 2013.
Isocyanates	Methylene diphenyl diisocyanate (MDI)	Jackets, Mittens	130-2900	Precursor in manufacturing of polyurethane	Tønning et al., 2009.
	Toluene diisocyanate (TDI)	Matresses foam, weather proof jackets	5.-23	"	Kemikalieinspektionen, 2013. Greenpeace, 2012.
	Various Isocyanates	Jackets, mittens	75 - 2900	"	Tønning et al., 2009.
Antibacterial substances	Triclocarban	Sportswear	4,4	Biocides, antibacterial	Kemikalieinspektionen, 2011.
	Triclosan	Sportswear	48,9	"	Kemikalieinspektionen, 2011.
	Organotins (DOT, MOT, TeET, MBT, DBT)	Weather proof jackets	2.3 – 18 mg/kg	" & accelerator in PU	Greenpeace 2012 Greenpeace 2004
Other organic substances	Formaldehyde	Strollers clothing and foam, mattresses, car seats (fabric and foam), jackets, mittens, towels, sheets	11 - 58	Biocides, solvents	Kemikalieinspektionen, 2013. Tønning et al., 2009. Naturskyddföreningen, 2007.
	Aliphatic hydrocarbons	Jackets, Mittens	6100		Tønning et al., 2009.
	Alkanes in 59 of the 63 items tested; Benzyl benzoate in 12 items;	Jeans, trousers, t-shirts, dresses, and underwear	Not quantified		Greenpeace 2012b

	benzophenone, 1,1'-biphenyl, butylated hydroxytoluene (B hT), benzyl naphthyl ether, in smaller numbers of the samples. 2,2´-oxybis ethanol, 2-(2-butoxyethoxy) ethanol, Propylene glycol, Benzylbenzoate, 5-hydroxy-Methylfurfural, Bis(2-ethylhexyl)maleate, Squalene, Hydrocarboner C 8-20, Hydrocarboner C 20-40, fatty acids, Aliphatic alcohols, Aliphatic amides	Fabric and apparel	Not quantified		Danish EPA 2003

4.1 Some examples of hazardous substances found in children's garments

Some of the most relevant findings from these various studies are summarised and discussed below.

4.1.1 Perfluorinated chemicals - PFCs (also see BOX 11)

In 2006, Friends of the Earth Norway (Schultz & Norin 2006) conducted tests on all-weather jackets for children, to confirm their suspicion that they were impregnated with fluorinated compounds despite the availability of more environmentally friendly impregnation products. Six jackets from five different brands were bought in the Nordic countries and investigated for fluorinated substances: a number of unbound fluorinated compounds were found, with levels for PFOS-related compounds at between <5 and 100$\mu g/m^2$, well above the EU legislative limit of 1$\mu g/m^2$ in some cases. Based on the findings of this report, further investigations were also reported by the Danish Ministry of the Environment 2008 on the market for PFCs.

Another study by Greenpeace e.V. 2012, tested 14 weatherproof jackets and trousers, and found PFCs in all of them; among them was the well-known hazardous compound perfluorooctanoic acid (PFOA). In five samples, PFOA was found in significant concentrations. In addition, six samples had fluorotelomer alcohols (FTOHs) in high concentrations, which can break down into the corresponding perfluorinated acid (such as PFOA.

4.1.2 Heavy metals in EURO 2012 football shirts

The European Consumer Organisation BEUC (BEUC 2012) tested nine national football shirts for EURO 2012 bought in Italy (the teams were France, Germany, Italy, Poland, Portugal, Russia, Spain, The Netherlands and Ukraine). Lead was found in a majority of the samples, with the highest levels – above the Oekotex 100 standard for babies - in shirts for Germany and Spain. Not all shirts contained lead, showing that it's possible to avoid this substance with good manufacturing practice.

Several shirts contained nickel and one shirt contained chromium, which are both known to be sensitizers. Once people are sensitised, allergies can be triggered which will remain a life-long health concern. Therefore, prevention is the only option and exposure to nickel and chromium from textiles must be avoided, particularly for children.

One shirt contained antimony which in combination with sweat can lead to skin dermatitis. Like antimony, lead, nickel and chromium are also prompted by sweat, thus there could be a risk for people wearing these shirts.

Other chemicals found by BEUC: One shirt contained the **organotin DBT**, at levels above the legal standards, which is of serious concern. Nonylphenol ethoxylates (**NPEs**) were detected in two shirts. Other substances (flame retardants, phthalates, arsenic, polycyclic aromatic hydrocarbons (PAHs), formaldehyde, azocolorants and azodyes) were either below the level of detection or were present only in traces.

4.1.3 Children's jeans

In 2013, the German Ökotest Magazine performed tests on 20 children jeans[67]. Not a single one was classified as "Good" or "Very good", only 4 were considered "satisfactory", and more than half were found to be "insufficient". Aniline, a suspected carcinogen was found in several jeans, whereas 3 brands contained a carcinogenic amine. Generally jeans can be dyed with Indigo, a colorant which is not known for hazardous properties. Bio-jeans were found to be better than others, through GOTS certification and sometimes social audits. 1 pair of jeans was found to contain formaldehyde. 12 contained organohalogen compounds which may trigger allergies. NPEs were found in 3 pairs of jeans.

4.1.4 The European rapid alert system for non-food dangerous products (RAPEX)[68]

A search on 3rd June 2013 produced 318 results (out of a total of 12,216 entries) with the key word 'chemical' in the category 'clothing, textiles and fashion items' since the end of 2010 – via the website at: http://ec.europa.eu/consumers/safety/rapex/alerts/main/index.cfm?event=main.search. These are all products that have been reported on the RAPEX system, some of which have also been the subject of measures taken by Member States and some examples that, while not illegal, resulted in withdrawal from market. The 318 results were mainly represented by the following chemicals:

- Dimethylfumarate (DMF) – 86 entries, the majority were shoes. There were 3 garments (jeans).
- Chromium VI — 84 entries, including 36 items of clothing (the remainder were shoes and leather products)
- Phthalates – 36 entries, the majority were false nails; there were also many children's shoes. 3 were clothing products.
- Formaldehyde – 6 entries, four of which were clothing including 2 garments for infants.
- Azo dyes – 52 entries, 33 of which were clothing.

Many of the above substances (such as formaldehyde, DMF and chromium VI) can cause irritation or other acute reactions upon exposure. However, other hazardous chemicals, which are also commonly found in textile products (such as the ones listed in Table X) do not appear to be included on the RAPEX system. For example, there are no entries for nonylphenol ethoxylates, the perfluorinated chemicals PFOS and PFOA, organotins or flame retardants.

Surveillance in Finland: According to the Finnish Environment Institute 2011 (p.44); "clothing, textiles and fashion items represented 23 % of all 395 RAPEX notifications in 2009, whereas in 2008 the proportion was 9 %. While this may partly reflect fluctuation in the share of different product categories, it does suggest an increasing importance of textiles."

National customs laboratories also conduct surveillance tests on imported clothing;

"In 2009, the Finnish customs laboratory tested a total of 692 textile samples, including e.g. clothing for children less than two years of age, clothing in contact with the skin, bed linen and

[67] *Hosen runter!* Öko-Test Kinder 5, 2013

[68] RAPEX is the European rapid alert system for non-food dangerous products, which reports products that are hazardous to consumer health on its on-line database system.

outdoor clothing for children. Of the samples analysed, 12% did not conform to regulations. Significant concentrations of formaldehyde were found in children's outdoor clothing. Prohibited azo dyes were found on 33 imported batches of scarves, most of them from India." 4.1.5 Anti-mould agents in clothing – Dimethylfumarate

In 2009 there were media reports that clothing may contain the allergenic substance dimethylfumarate, which counteracts mould attack in transport. The problem was previously not known to the general public. In the UK at least 3,500 consumers had reported complaints of skin rashes due to DMF use in Chinese leather furniture, prompting the EU to emergency action in 2009 (Finnish Environment Institute, 2011). This substance was banned in articles imported into the EU in the spring of 2009. Following this, the Swedish Chemical Agency (KEMI) tested samples from fourteen pairs of jeans, four boots, four pairs of briefs and children's mattresses but no traces of dimethylfumarate were present in the samples tested. Likewise, the Finnish customs laboratory also tested 109 samples for DMF, including textiles, footwear and bags of drying substances in furniture, finding no DMF (Finnish Environment Institute 2011, p.45).

4.1.6 Garments worn close to the skin

The Swedish Chemicals Agency (KEMI) commissioned an analysis of garments worn close to the skin (KEMI 2013a). 110 garments from 29 stores in Sweden were analysed. The garments were scarves, swimwear (mostly for children), underwear and T-shirts, sweaters and tops. The substances analysed were azo dyes, certain phthalates, nonylphenol and nonylphenol ethoxylate.

NPE was found in 48 garments (32%). Many of the garments that contained NPE were underwear. Five children's swimsuits contained NPEs and one contained low levels of phthalates. Two children contained phthalates that are not allowed in toys and childcare products, although they are not prohibited in clothes. One of the prints contained levels of a phthalate that is prohibited in soft parts of toys and childcare articles, and one print contained a phthalate that is regulated in toys and childcare articles that children can put in their mouths.

BOX 16: CASE STUDY: Hazardous substances in plastisol prints on textiles

Phthalates:
Printed motifs on clothing most commonly use PVC plastisol printing, although there are alternatives available (as demonstrated by retailers such as H&M and M&S, which no longer use PVC plastisol printing). The hazardous chemicals **phthalates** are the main substances used to plasticise PVC and can make up a substantial proportion of the plastisol – up to 40%.

A 2004 study which looked specifically at hazardous substances in plastisol prints in infants and children's products ("Toxic Childrenswear by Disney (Greenpeace 2004) found **phthalates** in all 19 samples (at concentrations from 1.4 to 200,000 mg/kg in printed fabric and 320,000mg/kg in a PVC raincoat);

Despite a number of regulatory and voluntary restrictions in the intervening years, PVC plastisol printing on garments continues to be used. For example, Greenpeace 2012a found four products imported to Europe and the USA with high quantities of phthalates (between 20% and 38%); in fact, phthalates were detected in all of the 31 garments with a printed image tested, above the detection limit of 3ppm, but most were not in quantities associated with their use as a plasticiser.

The current EU guideline prescribes a permissible limit of 1,000 mg/kg phthalates for components of toys or objects that children can put into their mouths; children's products with components containing concentrations of phthalates above this limit are considered not acceptable; however, children's clothing is not included within the scope of the legislation. Of the products bought in Europe, 2 out of 12 (or 17%) contained high concentrations of phthalates, above 1,000mg/kg (the levels were 27.6% and 23.3%). If reflected across all products this would still mean a potentially large number of clothing products on the European market containing high concentrations of phthalates.

Other examples of recent imports (since 2010) of infants and children's products containing phthalates can be found on the RAPEX database (the European rapid alert system for non-food dangerous products). The type of plastic used isn't specified for either of these products but the high concentrations of various phthalates indicate their use as a plasticiser:

- Baby pink and black 'overalls' imported to Finland in 2012, contained 39% of the **phthalate DEHP** in a printed skull on the arms. The RAPEX database notes "The figure is situated on the arm so it could easily reach the baby's mouth". The import was rejected by customs authorities.
- In 2010 children's 'Star Wars' and 'Hello Kitty' tops with printed images on were withdrawn in Sweden due of levels of various **phthalates (DINP, DEHP, DBP and DIDP)** of between 0.12% and 3.9%.

Other uses of phthalates
The majority of phthalates are used as plasticisers in PVC, however, they have other uses such as inks, adhesives and sealants (see BOX 9). Concentrations of phthalates up to 5,700mg/kg (0.5%) were also found in outdoor clothing, (by Greenpeace Germany 2012); the highest quantity of 5,700 mg/kg was found in a child's rain poncho made of polyester. The RAPEX database also reports that a children's raincoat reported to be made of PU (but possibly had printed plastisol spots) containing 3.6% of the phthalate DEHP (packed in a 'poly bag') was voluntarily withdrawn in Finland in 2012; a level of 3.6% would suggest deliberate use as a plasticiser.

Other hazardous substances in PVC plastisol
Other additives, such as the heavy metals **lead** and **cadmium**[69], are also sometimes used as stabilisers; EU regulations and voluntary restrictions on these substances do not prevent their presence in imported consumer products.

The Greenpeace 2004 study also found **lead** in all samples (from 0.14 to 2,600 mg/kg); **APEOs** in 17/17 samples (from 49 to 1,700 mg/kg); **organotins** in 10/17 samples

(from 4 to 1,129 mg/kg); c**admium** in 14/19 samples and f**ormaldehyde** in 8/16 samples (23 – 1100 mg/kg).
More recently, high levels APEOs were also detected in the plastisol print of garments (Greenpeace 2012a), with one garment containing as much as 45,000 mg/kg.

For lead and cadmium, the RAPEX database reports:

- A child's T shirt with a motif in yellow, red and black ink, imported to Poland in 2011 was found to contain "5844 mg/kg of **lead** in the yellow print" in breach of national legislation.

[69] The use of cadmium stabilisers in PVC has been severely restricted in the Community since 1991 through Directive 91/338, which effectively banned their use in PVC except for profiles. European producers of PVC have abandoned the use of cadmium. However, this does not cover the import of PVC containing cadmium from countries outside the EU. Lead stabilisers have also been phased out in Sweden and Denmark.

In addition, the product contained "554 mg/kg of **lead** in the black print, 2598 mg/kg of **lead** in the red print, and **cadmium** (above 1.4 mg/kg)". As a result withdrawal from the market was ordered by the authorities. It is not stated whether PVC plastisol print was used in this product.

Tests on pyjamas

The German magazine Ökotest examined pyjamas (Ökotest 2011) and found 10 out of 20 garments to "unsatisfactory" with only 7 receiving a "good" rating. Some of the pyjamas had plastisol prints on them, although not all of these prints used PVC.

In the items with PVC prints, phthalates, PAH and organotin compounds were found, with one article containing 12% DEHP (in comparison, the maximum allowed concentration of phthalates in children's articles and toys is 0,1%, although this does not apply to clothing).

However, one product which used a plastisol print free from phthalates and PVC still contained traces of PAH and organotin compounds, but below the limit set by Okotex of 0.1%. According to the report, these low levels indicate that the print may not be stable.

In total, 11 out of 20 pyjamas contained organotin compounds, with trace amounts in 4 items and higher or very high concentrations in 7 items, as much as 2,690 mg/kg dibutyltin, and 9,960 mg/kg dioctyltin. Dioctyltin is considered immunotoxic. Since January 1st 2012, the EU has banned both dioctyltin and dibutyltin in textiles above a limit 0.1% by weight of tin.

The study also tested Ökotex-labelled products which must contain less than 0,1% of the phthalates DINP, DNOP, DIDP, BBP and DBP, DIBP. However, one girl pyjama with the Ökotex label was found to contain more DINP and DIDP than authorized by the label.
Alternatives to PVC: The study shows that it's possible to use plastisol without PVC or phthalates. There are also other printing methods (known as "Siebdruck") which contain dispersion colors. However, printing without plastisol is not automatically better; the dyes used by the manufacturer can also be problematic: one pyjama product contained 28.6 mg/kg of 2,4-toluendiamine (which is a banned carcinogenic amine) and another 25 mg/kg aniline.

BOX 17: Chemical residues in children's Fancy Dress

A Spanish consumer magazine investigated hazards in fancy dresses; they tested for many different hazards, including flammability, danger of injury & chemical content. The findings included:

- a dressing up suit (the belt of Disney Woody suit) contained unacceptable levels of lead which were close to permitted limits. The levels found are not given and there are no details on the type of material where the lead was found in the belt, although it could be PVC
- a dressing up mask (Alien) contained 24.72% DINP, again the material isn't mentioned but it could be PVC,
- face paint make up also contained phthalates, although the levels aren't given. (OCU-Compra Maestra (2011),

Given the findings above and the fact that plastisol printing is very common in children's fancy dress, it's likely that PVC plastisol prints containing phthalates and other hazardous substances are likely to be common in fancy dress outfits for children.

TABLE 3: Selected examples of products containing hazardous chemicals	
Chemical found, the level, reference & further details	**Product**
Examples of products from analytical studies	
Plastisol printing/biocides? Organotins: dioctyltin, 9,960 mg/kg Ökotest 2011 Cotton pyjamas with PVC plastisol print Very high levels of DBT, high levels of TBT and other organotins, high levels of PAH, optical brighteners, organohalogen compounds, plasticiser DEHA.  DBT stark erhöht, TBT erhöht, andere zinnorganische Verbindungen erhöht, PAK erhöht, optische Aufheller, halogenorganische Verbindungen, Ersatzweichmacher DEHA	
Process chemicals: nonylphenol ethoxylates 2,600 mg/kg Greenpeace 2012b Made & bought in mainland China	 Zara, child's jacket

<table>
<tr>
<td>Weather-proofing - Perfluorinated chemicals:
perfluorinated carboxylic acids (PFCAs)(6.3 g/m2). Significant levels of PFOA 2.3 g/m2 (> 1 g/m2)
Greenpeace e.V. 2012
Made in China
Bought in Germany, Globetrotter
UPF / UV40:
96% Nylon, 4% Elastane</td>
<td>

Marmot Boy's Torrey Pant #64310</td>
</tr>
<tr>
<td colspan="2">Examples of products from the RAPEX database, with levels of hazardous chemicals in excess of regulatory limits</td>
</tr>
<tr>
<td>Plastisol printing: phthalates: 38-39 % by weight of DEHP in print. The figure is situated on the arm so it could easily reach the baby's mouth.
RAPEX, January 2012
Made in China
Imported to Finland, Import rejected by the customs authorities.</td>
<td> 
Babies overalls by Leather Heaven</td>
</tr>
<tr>
<td>Easy-care finishes:
158-168 mg/kg of formaldehyde.
RAPEX, February 2012
Made in Thailand
Imported to Poland, withdrawal from the market ordered by the authorities.</td>
<td>
Padi Club, baby's outfit</td>
</tr>
</table>

Process chemicals: carcinogenic amines from azo dyes, 51 mg/kg of the aromatic amine 4-methyl-m-phenylenediamine RAPEX , September 2011 Made in Bangladesh Imported to Germany Voluntary withdrawal from the market and recall from consumers by the distributor. Monitoring of withdrawal and recall by the authorities.	 Kik: boys Underwear Set "Spider-Sense; Spider-Man"
Process chemicals: heavy metals hexavalent chromium, in concentrations varying from 0.6 to 5 mg/kg RAPEX, December 2010 Made in China Imported to Italy Seizure of the products ordered by the authorities.	 Yong Da White fabric child's T-shirt and five other items
Examples of products marketed as 'anti-bacterial' and 'flame retardant'	
Nano Silver Antibacterial Children Socks The inner lining uses SEECOME antibacterial fiber which has silver powder on the surface. [70]– Flame retardant finishes	

[70] http://seecome123.en.ec21.com/Nano_Silver_Antibacterial_Children_Socks--4956726_4987335.html

Flame Retardants
Pyjamas and nightwear for children are required to be flame retardant, especially if loose fitting[71]

4.2 Releases of chemicals from garments during use and washing – NPEs and anti-bacterials

4.2.1 Nonylphenol ethoxylates (See BOX 6)

Several reports, including SSNC 2008, Greenpeace 2011b, Greenpeace 2012b and the Danish Ministry of the Environment 2013 have demonstrated the widespread presence of NPEs in clothing products, which were found to be present above detection limits in approximately two thirds of samples tested. This shows that despite restrictions within the EU on their use in textiles manufacturing, these chemicals are used routinely during the manufacture of textiles elsewhere, in particular countries in the Global South such as China (see Section 3).

Exposure of children to NPEs

Although the primary concern is about environmental contamination with NPEs/NPs, infants, children and pregnant mothers are more susceptible to harmful health effects from hazardous chemicals and children are also more likely to be exposed to larger quantities relative to their body weight (see Section 1).

The Danish Ministry of the Environment (2013), (p.8 &9) has also analysed clothing products for NPEs and looked at the quantities washed out during laundering. Children's wear samples (bed linen, mittens, underwear, jeans and T-shirts) were chosen on the basis of preliminary exposure assessments, showing i.a. that children are exposed to NP and NPE in textiles to a higher extent than adults. In general, the concentrations of NPE were lower than those found in the literature, however, the study notes that a very limited number of textile samples were analysed. Tests on the amount of NPE washed out were also conducted on samples with a higher NPE content; the

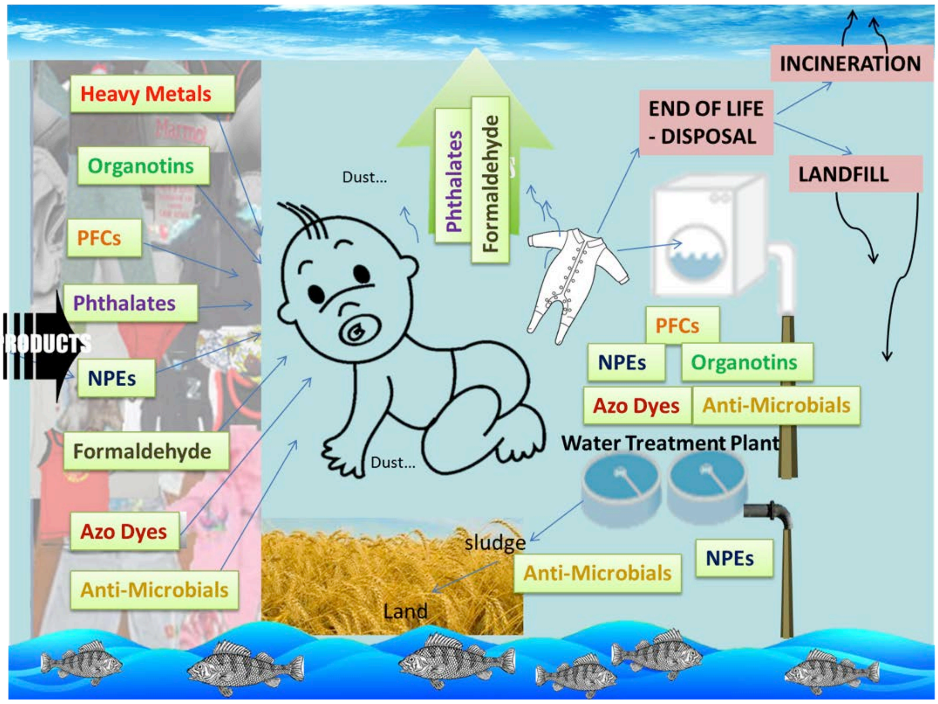
[71] Page from Sears catalogue

removal of NPE by one single wash varied from between 25% and 99.9%,[72] similar to Greenpeace 2011b.

Children's exposure to NPE from several pieces of clothing worn at the same time was calculated, based on the sample results. The migration of NPEs into sweat, for clothing worn next to the skin, and to saliva from chewing on mittens, was assessed. The results showed that in a worst-case scenario, where a child wears new unwashed clothes 1 time every 2 weeks, and wears jeans, underwear and T-shirts that gives the highest absorption through the skin at the same time, a child's absorption of NP indicates an increased health risk (although other studies show that it is unlikely that there would be any dermal adsorption of NPEs[73]). As noted by the study, higher concentrations of NPEs have been found in other reports and the authors express their concern;

"Textiles containing these substances are therefore assessed to be a significant source of exposure to NP/NPE in daily life. It therefore makes good sense to try and reduce the levels of NP and NPE in textiles as much as possible, partly to achieve better protection against nephrotoxicity effects, but also, because these substances are suspected of endocrine disrupting effects, to overcome any possible combination effects of NP/NPE, respectively, and other endocrine disruptors which humans may come into contact with in daily life."

Figure 4c, Exposure of the child to hazardous chemicals in garments during use, emissions from laundering and from disposal



[72] The analyses also showed that the content of NPE metabolites, e.g. short-chained ethoxylates and NP, increased by washing in some cases. This indicates that part of the observed removal of NPE by washing is the result of decomposition and not an actual removal.

[73] Nancy A. Monteiro-Riviere, John P. Van Miller, Glenn Simon, Ronald L. Joiner, James D. Brooks and Jim E. Riviere, Comparative in vitro percutaneous absorption of NP and NPE through human, porcine and rat skin, DOI: 10.1177/074823370001600201, *Toxicol Ind Health* 2000; 16; 49

BOX 18: Pollution of waterways with nonylphenols from washing clothes

In some cases, the presence of hazardous chemicals in products – though undesirable from the point of view of the consumer – ultimately poses more of a threat due to the environmental impacts associated with its manufacture, but also its use or disposal. Nonylphenol ethoxylates (NPEs) and nonylphenols (NPs) are a case in point; despite the fact that the use of NPEs and NPs by the textile industry is restricted in the EU (see BOX 6), NPs are still being found in the sludge of EU wastewater treatment plants and in discharged treated wastewater, as reported by the SSNC 2008. Because legislation does not control the import of textiles and clothes containing NPEs, these substances can be released into wastewater during washing. Two studies of products in Sweden, one on hand towels and one on T-shirts, confirmed that they contained NPEs; in T-shirts, the levels were generally highest in garments produced outside the EU, particularly in Turkey and China. If the towels and T-shirts are representative, it is estimated that in 2006 about 46 tonnes of NPs were imported into Sweden in textile products, the majority of which ended up in the wastewater system.

The study on T-shirts emphasised that the quantity of NPEs found in the product does not reflect the quantity of chemicals used in the manufacturing process, but rather how well the fabric was rinsed before it was made into an item of clothing. We should not have to choose between NP pollution in EU wastewater treatment systems on the one hand, and even greater discharges of NPs from manufacturing facilities into rivers in China and other developing countries on the other.

In a follow up to its tests for NPEs in textile products in 2011 (Greenpeace 2011b), Greenpeace found that the majority (80%) of NPE residues in half of the plain fabric samples were washed out during a single wash. Given the number of times that a textile product is likely to be washed during its lifetime, this study suggests that all residues of NPEs within textile products will be released over their lifetime and that in many cases this may have occurred after just the first few washes. Once in the environment, NPEs subsequently break down to form the toxic chemical nonylphenol which then enters the food chain with the implication that consumers could be exposed to nonylphenol residues in food.

4.2.2 Antibacterial chemicals – triclosan, triclocarban and nanosilver

The Swedish Chemicals Agency (KEMI 2011) analysed 30 textile articles with respect to their levels of three antibacterial agents (biocides): silver, triclosan and triclocarban. Chemical analyses were performed on all samples before washing and after three and ten washes. The focus was on sports and leisurewear for both adults and children, in particular where claims such as “anti-odour”, “hygienic”, “counteracts odour” etc. were made.

Silver was found in sixteen of the thirty product samples before washing. A combination of triclosan and triclocarban was found in two samples. Concentrations of biocides fell for all samples where these biocides were found. In the case of triclosan and triclocarban, about half or more of the original level was washed out after ten washes. In the case of silver, the original concentration and washed-out level varied greatly. The original concentration of silver ranged between 0.4 mg/kg textile and 1,360 mg/kg textile. After ten washes 10-98 per cent of the silver had been washed out of the textiles. But half of the silver had already been washed out after three washes in several textiles. [74]

There are several problems that result from antibacterial chemicals being washed out of clothing products. An American study has found that antibacterial substances in the wastewater can interfere with wastewater treatment processes by harming necessary bacteria. In addition, studies show that biocides (**triclosan**) are found in fish downstream of sewage treatment plants, suggesting that the wastewater treatment plants are not able to deal with hazardous chemicals. In addition, biocides such as **silver, triclosan** and **triclocarban** have been reported in sludge from sewage treatment plants, making it unsuitable for use as a fertiliser or in landscaping.

The use of **silver** as an antibacterial is contributing to increased levels in sludge; as a result of the digitalisation of the photographic industry the level of silver in sewage and sludge has fallen in the 21st century. This trend has been interrupted in the last few years. The fact that levels of silver are no longer declining in the sludge is assumed to be due to increased use of silver as a biocide in various articles.

KEMI questions the effectiveness of the biocidal treatment, considering the high proportion of the original concentration of the biocides that was found to be washed out in many of the analysed garments.There is also potential exposure to consumers; another survey by the Danish MoE (2012) assessed the migration of silver into sweat and saliva, but the exposure scenarios indicated the risk was low.

Are consumers demanding clothing treated with anti-bacterials?

Manufacturers of clothing treated with anti-bacterials claim that there is demand from customers for this function; however, a survey by the Swedish School of Textiles (in KEMI 2011) found that there was no consumer demand for antibacterial treatment. It is also argued that treated clothing does not have to be washed as often and consequently saves water and energy. The same survey found no change in behaviour and that consumers washed treated clothing just as often as untreated garments.

KEMI notes that *"According to the Biocidal Products Directive, use of biocidal products must be limited to a minimum. Therefore, there is reason to question whether the function of antibacterial treatment of clothing and other textiles is necessary, and weigh this against the risks that may arise."* The new EU Biocidal Products Directive comes into force in September, and will require the active ingredients of biocidal products to be approved. According to KEMI this will *"result in considerable changes and improved opportunities for authorities to restrict the use of biocides involving risks".*

The Danish MoE 2012 also tested clothing products for nanosilver and conducted a survey of the market to determine selection of products, and found that staff and customers are mostly unaware that textiles had antibacterial substances; customers do not specifically ask for these products. The consumer organisations ANEC/BEUC compile a list of products claiming to have nano-silver particles on the EU market (ANEC/BEUC 2013).

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[74] The results suggest that the method used to add the biocides to the textile or fibre influences the way these substances leak out. Fabrics such as cotton and mixtures of synthetics, wool and silk were also found to be treated with biocides, not only synthetic materials.

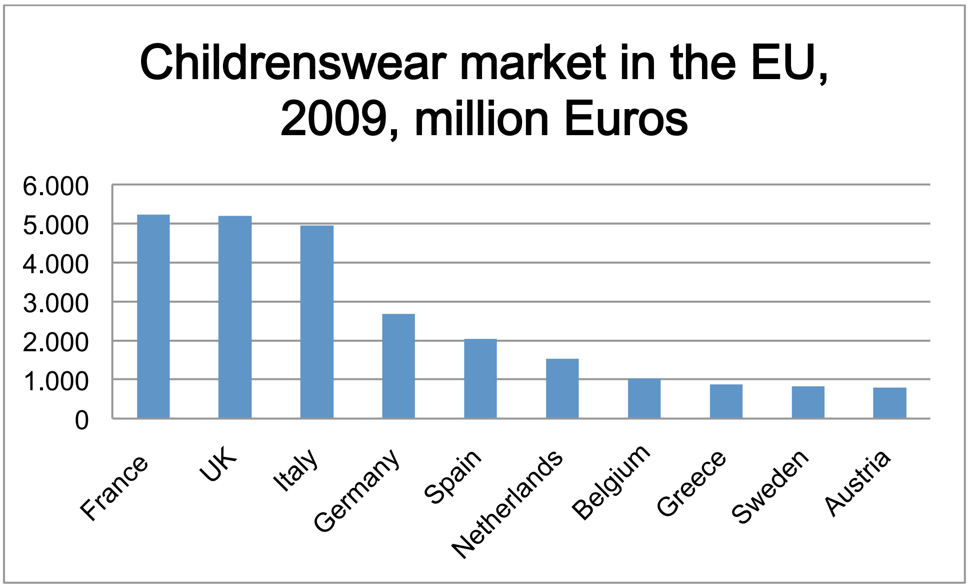
5. Children's and maternity wear brands and their chemicals policies

The global textile and garment market is currently worth more than $400 billion a year; it is predicted to grow by 25 per cent by 2020 with much the biggest contribution to this growth coming from Asia.[75] China ranks second in the world for annual textile exports with 28 per cent of the market (just behind the EU with 30 per cent); it is first in the world for clothing exports, with 34 per cent of the market;[76] taking the two sectors together, China has been the world's leading exporter of textiles and clothing since 1995.[77] The EU, the US, India, Turkey, Pakistan, Indonesia, Thailand, and Vietnam all rank among the top 15 exporters of textiles and clothing, according to WTO trade statistics.[78] (See Section X, p. Y)

5.1 Childrenswear

Verdict 2010 reports that the childrenswear market in the EU is worth 28 billion Euros, with five countries making up 67% of the market - France, UK, Italy, Germany & Spain. Childrenswear is outperforming the overall clothing market despite consumers trading down. Furthermore, the sub sector is increasing its share of total EU clothing expenditure to 10.5 per cent. Growth has been boosted by rising birth rates and increased expenditure per child.

Figure 5



[75] World Trade Organization (2011) Regional integration and the African textile industry, part 5: Analysis of EAC textiles sector – The African textiles industry under siege, WTO Updates for Business **www.intracen.org/BB-2011-03-07-Regional-Integration-and-the-African-Textile-Industry/**

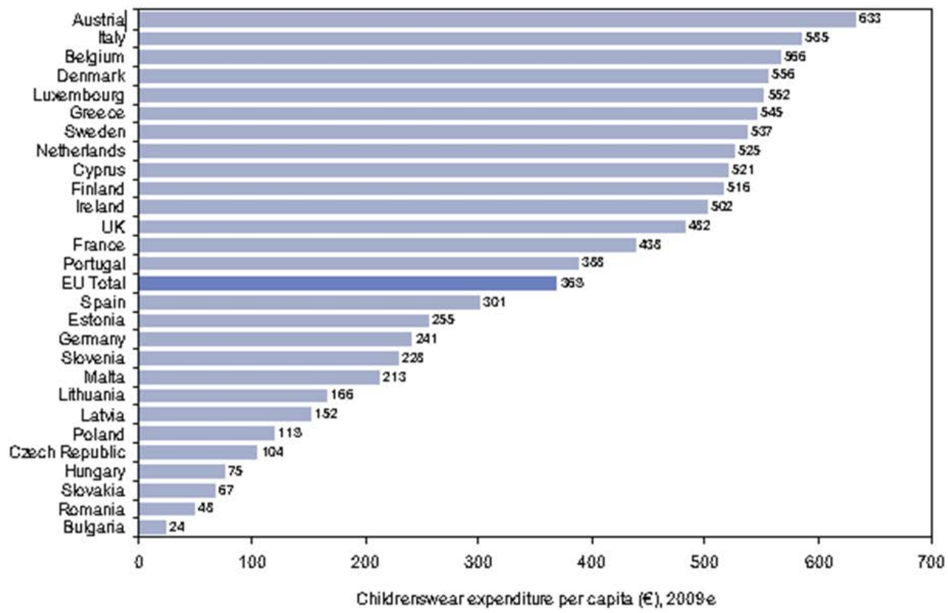
[76] World Trade Organization (2010) *International Trade Statistics 2010*, Merchandise trade by product, www.wto.org/english/res_e/statis_e/its2010_e/its10_toc_e.htm, www.wto.org/english/res_e/statis_e/its2010_e/its10_merch_trade_product_e.pdf

[77] OECD, Case Study 10, "Releases from the use phase of textile and leather products", in OECD Resource Compendium on PRTR RETS Part IV Products http://search.oecd.org/officialdocuments/displaydocumentpdf/?cote=env/jm/mono(2011)7/part2&doclanguage=en

[78] World Trade Organization (2010), op.cit.

In contrast, when expenditure per child is taken into account, both Spain and Germany are below the EU average:

Figure 4: EU27 childrenswear expenditure per child under 15, 2009e



Source: Verdict Research VERDICT

Characteristics of the four largest markets, according to market research reports, are as follows

France: Dominated by numerous specialist childrenswear chains that offer a broad spectrum of children's clothing such as Atelier de Courcelles' high-end offer and Orchestra's more mid-market offering, while hypermarkets are prominent players at the value end of the scale."

COUNTRY	Childrenswear specialists, position + no of stores	Fashion multiples, position + no of stores	Grocers	Department Stores
France Note: Euromonitor 2012 has Petit Bateau 3rd DuPareil au Meme 4th	1.**Okaidi/Obaibi** 200 +	1. Kaibi 200 +	Carrefour, Auchan, E Leclrec	Printemps, Galeries Lafayette
	2. Orchestra 200 + (merged with Premaman 2012)	2. Zara 100+		
	3. Sergent Major 100+	3. C&A 100+		
	4. Catimini 100 +	4. H&M 100+		
	5. Du pareil au meme	5. La Halle		

	100	50+		
	Petit Bateau 100	Styleco, Ikks		
	ID Group, Tape a l'œil, online retailer Abikid – continue to be successful & grow, Others, eg. Zannier Group (15 childrenswear brands) had sharp fall in profit Kiabi			

Germany: There is an established value and discount clothing sector which means that its childrenswear market size is comparatively smaller than France, UK & Italy. The popularity of value childrenswear from specialist chains such as Takko as well as discount stores such as Lidl and Aldi means that average spend per capita on childrenswear is significantly lower than in the other top five European retail markets, at 241.

Germany	1. Walz 50 +	1. Kik (1st 200+)	Aldi, Lidl, Real	Galeria Kaufhof
	2. Sons & Daughters -50	2. Takko (2nd 200+),		
	Jako-o, Baby Baby Butt, Calimini,	3. Ernsting's Family (3rd 200+)		
		4. C&A (4th 100+),		
		5. H&M (5th 100+),		
		6. Zara (6th -50),		
		Peek & Cloppenburg, Mexx, Esprit,		

Italy: Despite its comparatively smaller child population size, childrenswear expenditure in the country is not far behind France and the UK, due to the overall large size of the clothing market and the number of specialist high-end independent boutiques that occupy the fragmented market.

ITALY	1. Brummel Group (Brums, Bimbus 200+	1. OVS Industry (OVS kids) 200 +	Carrefour, Auchan, Ipercoop	Rinascente, Upim (acquired by Gruppo Coin), Coin
	2. Chicco 200+	2. Benetton 200+		
	3. Mirtillo 50+	3. Zara Kids 50+		

	4. Simonetta 50	4. H&M 50+		
	5. Il Gufo - 50)	5. Diesel (Diesel kids) – 50		
	Preca Petit Bateau, Luxury designers – Armani junior line, Dolce & Gabbana (D&G Kids), Roberto Cavalli Devils & Angels line wholesale (at Simonetta stores)	Original Marines		

Spain

SPAIN	1. Charanga 100+	1. Zara 200+	Carrefour, Alcampo	El Corte Ingles (Sfera Kids)
	2. Neck & Neck 100+	2. H&M 100+		
	3. Mayoral 50 +	3. C&A (& Kids Store) 100+		
	4. Du Pareil au Meme 50+	4. Sfera 100+		
	5. Boboli -50	5. Kiabi 50+		
	Tuc Tuc, Gocco, 7 Colores,	6. Primark -50		

***UK**:* Only a few childrenswear specialists, such as Mothercare, which compete with multiple fashion and value chains such as Next, Primark and M&S, as well as grocers such as Tesco, Asda and Sainsbury, for childrenswear spend.

UK	1. Mothercare 200+	1. M&S 200+	Tesco, Sainsbury's, Asda (George)	Debenhams, John Lewis, House of Fraser
	2. Mamas & Papas 50+	2. Next 200+		
	=3. Petit Bateau -50 =3. Bon Point -50	3. BHS 200+		
	Little White Company	4. Gap 200+		
		5. Primark 100+ (value multiple)		
		6. H&M 100+,		
		7. Zara – 50		
		Monsoon, Value multiples, Matalan, Peacocks		

Table 4. Major fashion multiples selling childrenswear and childrenswear specialists in the Netherlands, Sweden and Denmark

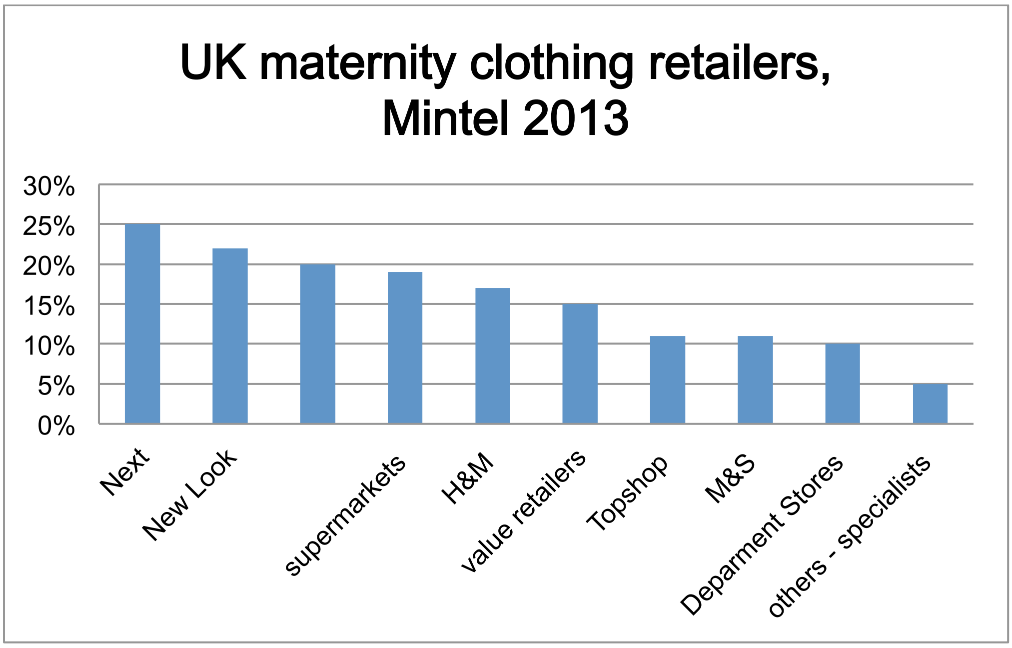
NETHER-LANDS[79]	C&A Nederland BV 7.8% Hema BV 6.1% Shoeby Franchise BV 5.4 Cool Cat Fashion BV 4.6% Hennes & Mauritz (H&M) 4.3% Nederlands BV Zeeman textielSupers BV 4.1% Cars Jeans & Casuals BV 3.4 Vingino Jeans BV 2.8% Mexx International 2.3% Group BV The Hilt BV 1.8% The BoDean Co, 1.4% Inditex (Zara) 1.1% Diseño Textil SA BPC Amersfoort BV 0.6% Obermeyer GmbH & Co KG 0.5%
SWEDEN[80]	Lindex Sverige AB 17.2% H&M Hennes & Mauritz 17.2% KappAhl 10.4% Polarn O Pyret AB 4.8% adidas Sverige AB 2.1% Åhléns AB 2.0% Cubus AB 1.7% Nike Sweden AB 1.6% Under 1%
DENMARK[81]	H&M leader Bestseller AS Dansk Supermarked AS HTM Group AS Claire Group AS Kabooki AS Katvig AoS Smafolk IS Need Aps Queenz ApS Bennetton Denmark ApS Noa Noa ApS Hummel International Sport & Leisure etc.

[79] Euromonitor, Childrenswear in the Netherlands 2012
[80] Euromonitor, Childrenswear in Sweden, 2013
[81] Euromonitor, CHILDRENSWEAR IN DENMARK, 25 APR 2013,

5.2 Maternitywear

Information about the maternitywear market in Europe as a whole is not available. The only specific information found concerns the UK market (Maternitywear - Mintel, 2013). The UK market is worth £142 million in 2012 – less than 1% of women's clothing sector and is relatively flat with a modest growth forecast. The main retailers for maternitywear are follows:

Figure 6



This shows, in the UK at least, that women are mostly buying their maternitywear from the same fashion retailers that they would use for their usual clothing, and that childrenswear and maternitywear specialists make up relatively small proportion of sales.

5.3 Brand policies – or lack of

Compilation of existing corporate information on hazardous chemicals in clothing products

The major actors in the textile and clothing supply chain are multinational brand owners, raw materials suppliers, textile and clothing producers, financiers, retailers and customers. Companies are sometimes responsible for more than one link in the supply chain task: for example, the brand owner and retailer may be the same company, or the brand owner may have its own in-house production chain. Brand owners may contract suppliers directly or indirectly, through agents or importers. Normally, it is the brand owner that triggers the product development process, including research and design.[82] Brand owners are therefore the best placed actors to bring about change in the industry.[83]

[82] Cao, N., Zhang, Z., Kin, M. T. and Keng, P. N. (2008) "How Are Supply Chains Coordinated? An empirical observation in textile-apparel businesses", *Journal of Fashion Marketing and Management*, vol. 12, pp.384-397
[83] Business for Social Responsibility (2008) op. cit.

Referring to sections 1 & 2 above, summarise current chemicals policy and specific restrictions on chemicals use and presence in finished items. Focus on dedicated children's & maternity brands and the most important general brands.

Following the Greenpeace Detox campaign 17 brands have made individual commitments and action plans aimed at achieving zero discharges of hazardous chemicals by 2020. The strength of these commitments and action plans varies considerable, however all state the precautionary principle as the basis for their chemicals policy and most also commit to implementing the 'Right to Know' which requires transparency on the reporting of chemicals discharged by suppliers on a facility level. Several of these brands – notably the first six to make commitments (Puma, Nike, Adidas, H&M, LiNing and C&A) collaborated to form the ZDHC Group (Zero Discharges of Hazardous Chemicals Group), which has elaborated two roadmaps (JRM & JRM v.s) to achieve some of the zero discharge aims. It is, however, being compromised by the introduction of risk assessment methodologies to determine further action to be taken. See http://www.roadmaptozero.com/ for a list of all the brands that are currently signatories and for access to the roadmaps and other documents.

From the list of the main fashion multiples selling childrenswear from each country (see below – the top 2 from each), **Zara**, **H&M**, **Benetton**, **M&S** and **C&A** have all made commitments to Detox their clothing, in response to Greenpeace's campaign. All of these brands have relatively sophisticated chemicals management policies based on the Precautionary Principle, with Restricted Substances Lists (at least), have committed to eliminate many hazardous chemicals, are working with their suppliers to disclose releases of these chemicals in China & elsewhere and have action plans to achieve their stated goals (to varying degrees). However, all are still in the process of implementing these commitments; while some have been achieved, for example H&M was the first brand to complete the elimination of PFCs in their products by January 2013, many hazardous substances are still in the process of being eliminated, for example NPEs. Some brands, M&S for example, restricted the use of PVC plastisol (containing phthalates) in childrenswear many years ago, yet do not restrict its use in garments for adults. Two of these brands – H&M and C&A are also ZDHC Group signatories, but also have their own individual action plans which go further than the JRM.

Fashion multiples

FRANCE

1. **Kaibi**: http://www.kiabi.com/ No obvious environmental or chemical information on their website
2. **Zara**: committed to Detox – see above

GERMANY

1. **Kik** http://www.kik-textilien.com/unternehmen/de/verantwortung/?quelle=shop Has a section about responsibility on its website, mentions suppliers but not environment or chemicals (in German)
2. **Takko** http://www.takko-fashion.com/de_de/unternehmen/nachhaltigkeit/oekologisch-handeln.html Has a section about sustainability on its website, including 'act ecologically' does not refer to specifically to chemicals

ITALY

1. **OVS Industry (OVS kids)** http://en.ovs.it/pages/social-responsiblity OVS has a section on social responsibility but it is only concerned with charitable giving
2. **Benetton** - committed to Detox – see above

SPAIN

1. **Zara** (& significant in several other markets) - committed to Detox – see above
2. **H&M** (& significant in several other markets) - committed to Detox – see above

UK

1. **M&S** - committed to Detox – see above
2. **Next** - http://www.nextplc.co.uk/corporate-responsibility/environment.aspx Has CSR report and a section on the environment, it looks reasonably comprehensive, lists suppliers, however, there is no obvious mention of chemicals. Would need to be properly assessed

NETHERLANDS

1. **C&A** Nederland BV (& C&A significant in several other markets) committed to Detox – see above
2. **Hema BV** http://www.hema.nl/hema/verantwoord-ondernemen/verantwoord-ondernemen.aspx Hema has a CSR report, no position on chemicals is evident but it would need to be investigated further.

OTHER – SWEDEN, DK

Lindex - http://www.lindex.com/csr/en/environmental-responsibility/ Lindex has a corporate responsibility section on its website, which mentions chemicals and cleaner production, although no RSL could be found – would need to be properly assessed.

Bestseller - http://www.bestseller.com/About/Responsible- Bestseller has a CSR section on its website where it has high visibility; its approach is also relatively free from greenwash. Responsibility for hazardous chemicals forms a major part of this; its policy is informed by the precautionary principle and its Restricted Substances List compares well with many of the other 'progressive' brands. It also already has a focus on the wastewater discharges of its suppliers' subcontractors (wet processors). However, the approach that it takes with these discharges is not explained – there is no evidence that zero discharges of hazardous substances is required. There is also a lack of transparency in the detail of its reporting on auditing its suppliers (no information on discharges) and its list of suppliers is not published. Bestseller responded to the Toxic Threads product testing report, by emphasising that it has "chosen to ban the use of it (NPE) in our internal chemical restrictions because we agree this chemical is harmful for the water environment."

Childrenswear retailers

FRANCE

1.Okaidi/Obaibi - http://www.idgroup.com/en/commitments.html owned by ID Group which has a 'commitments' section on its website, mostly social and charitable work to do with children, the environment is mentioned.
2. Orchestra - http://www.orchestra-kazibao.com/qui-sommes-nous/ no mention of corporate, social or environmental responsibility

GERMANY

1. Walz - http://www.versandhaus-walz.de/unternehmen/nachhaltigkeit.html There is a statement about sustainability on the Walz Group website, which states that it is extending its range of organic textiles, & refers to environmentally friendly processes, but chemicals are not mentioned.
2. Sons & Daughters - http://www.sons-and-daughters.com/en/son_s-and-daughter_s/concept - retailer offering many different brands, no details of company policy on CSR, the environment or chemicals.

ITALY

1. Brummel Group (Brums, Bimbus) - http://www.precabrummel.com/en/group/about-us - no details of company policy on CSR, the environment or chemicals.
2. Chicco - http://www.artsana.it/ILGRUPPO/Solidariet%c3%a0/tabid/115/language/en-US/Default.aspx provides information about the parent company (Artsana's) social & health care work, but no reference to the environment or chemicals (although it is known that Chicco were one of the first companies to stop using PVC in their childrens toys in the late 1990s).

SPAIN -
1. Charanga - http://www.charanga.es/en/grupo.html Charanga is a franchise network, - no details of company policy on CSR, the environment or chemicals.
2. Neck & Neck - http://www.neckandneck.com/Who_we_are - no details of company policy on CSR, the environment or chemicals.
UK
1. Mothercare http://www.mothercareplc.com/responsible-sourcing Mothercare has a CSR section on its website with headings for responsible sourcing and the environment. No specific mention of chemicals but would need further investigation.
2. Mamas & Papas http://www.mamasandpapas.com/about_us/environmental_policy.php Mamas & Papas has an environmental policy which refers to manufacturing and suppliers, but does not mention chemicals.

6. Useful labels to limit hazardous chemicals in textile products

A useful review of the various different types of ecolabels for textiles is provided by KEMI 2013 (p.33). Most ecolabels are controlled by an independent third party that verifies the information, as well as being time limited. Companies also choose self-declaration of their products, according to their own criteria and without external verification, which is obviously open to manipulation. There is a huge number and great variety of ecolabels for textiles; as KEMI reports, "according to the eco-textile labelling guide from 2012 there are about 100 international standards and labels, but only 10 different kinds of textile labelling that put demands on the entire textile processing." KEMI also summarises the best known ecolobels. The following is a selective list of some of the most comprehensive and stringent ecolabels currently available.

Name/picture of the label	Main characteristics
EU Ecolabel	The EU Flower ecolabel is one of the best known by the consumers. This label has a range of 40 criteria which covers the whole life cycle of textile articles made of natural, artificial or synthetic fibres. The Ecolabel aims at identifying products with a reduced environmental impact during their whole life cycle. It includes restrictions/bans on the use of ingredients such as pesticides, antimony, lead, formaldehyde, allergens, etc. If the cotton used is 100 percent certified organic, the reference to "organic cotton" can be included on the ecolabel. Social or economic criteria are not covered. www.ecolabel.eu
Confidence in Textiles - Oeko-Tex Standard 100	Oeko-Tex is the international association for research and control in the field of textile ecology. The "Confidence in Textiles" label guarantees the absence of hazardous chemicals in the textile above specified limits. Limits or bans are set for a wide range of hazardous chemicals, including formaldehyde, chlorinated phenols, phthalates, organotins, allergens, flame retardants, etc. Oeko-Tex has **separate product categories for infants and children as well as for products that have "direct skin contact" which provide specific guarantees to the consumer**. Oeko-Tex also covers product categories like

	mattresses, bed linen, leather articles, etc. www.oeko-tex.com
Confidence in Textiles -Eco-friendly factory/ Oeko-Tex Standard 1000	To be granted Oeko-Tex standard 1000 certification, companies have to fulfill specific criteria and show evidence of conformity, and at least 30% of their production has to be certified Oko-Tex standard 100. Criteria encompass the main aspects of pollution generated by the textile industry as well as social criteria, and requirements include meeting certain standards for the treatment of waste water, the absence of dyes harmful to the environment, the absence of child labour. www.oeko-tex.com
Confidence in textiles – Oko-Tex Standard 100 Plus	Products with the label 100 Plus fulfill both the criteria of the Oeko-Tex 100 and Oeko-Tex 1000 certification. This encompasses both environmental and social requirements. But the label does not guarantee the absence of use of nanoparticles and biocides for anti-dirt or anti-dust mite treatments.
Global Organic Textile Standard –**Organic**	A product labelled with GOTS and the indication “organic” must contain a minimum of 95% of organic certified fibres. GOTS criteria are very demanding and encompass the manufacture of fibres, the process, toxicity for human health and minimum social criteria. GOTS replaces former Ecocert organic and ecological textiles as well as the Dutch EKO label, and covers natural textiles only. www.global-standard.org
GOTS – Global Organic Textile Standard – **Made with Organic**	A product labelled with GOTS and described as “made with organic” must contain a minimum of 70% of organic certified fibres. GOTS replaces former Ecocert organic and ecological textiles as well as the Dutch EKO label, and covers natural textiles only. www.global-standard.org

bioRe	bioRe cotton is organically grown. BioRe also encourages farmers to diversify their production in order to step out of monoculture. The dyeing of textiles takes place without the use of synthetic chemicals and chlorine is avoided for bleaching. The label guarantees decent working conditions for workers, and the traceability of all products through the use of a code makes it possible to follow each step, from the culture of the cotton to its final transformation into the product. www.remei.ch
Blauer Engel	The German label Blauer Angel gives guarantees on both environmental and health concerns. The use of GMO crops is banned, and all natural fibres used have to be organic. For example, the material for cellulose must come from forests which are subject to sustainable management. Fire retardants are banned, and dyes must be resistant to cleaning, sweating, light, etc. www.blauer-engel.de
Naturtextil	This label is well known in German-speaking countries. A Naturtextil Best product bans the use of ammonia, chlorine, heavy metals, formaldehyde, nickel and chromium among others and also requires that basic conventions set by the International Labour Organization are respected. The label also requires manufacturing processes which rely on less polluting methods, a specific requirement compared to other labels.
	The Swedish eco-label Bra miljöval (Good Environmental Choice) is administered by the Swedish Society for Nature Conservation (SSNC). This eco-label is reported to be the most stringent of all environmental labels, with restrictions that apply to the whole textiles life cycle, from raw materials and processing to the finished article. “Good Environmental Choice” aims to use less harmful chemicals in the textile production and targets the toxicity and persistence of chemicals used, which should not be harmful to factory workers or to consumers using the finished article. The standards apply to textiles made of natural fibres and to specific types of man-made fibres such as viscose and recycled fibres from polyester and polyamide. Reused textile products can apply for Bra miljöval Second hand or Re-design label to reduce the use of new resources and environmental impacts.
Demeter	Demeter label means that the fibres of the product come from farms with a “biodynamic agriculture” certification, according to criteria which are more stringent than the

	"AB" label. The rules from the International Natural Textiles Association (Naturtextil) apply to the fibres manufacturing process. http://demeter.net
Fairtrade/Max Havelaar	This label guarantees that fibres supplied are "fair trade" guaranteeing decent revenues for farmers and producers, as well as for development perspectives. Criteria mostly cover trade aspects but the environment is also taken into account, since GMOs are banned, only cotton which does not require irrigation is used and cultivation takes place in polycultures. The quantities of pesticides used are reduced by half compared to conventional farming.
Better Cotton Initiative	The Better Cotton initiative was launched in 2005. Integrated Pest Management is among its requirements, and **the label requires that pregnant women or children do not handle pesticides**. Only pesticides which have been granted an homologation and are labelled in the language of the country of use are authorized and those listed under the Stockholm Convention are prohibited. Some pesticides, such as endosulfan, which is listed in the Annexes of the Rotterdam Convention, are no longer used. Employees and staff have access to drinking water and are trained in health/safety measures relevant to their specific job. The employment of children under 15 years is forbidden.

CHAPTER II:

Regulating textiles in the EU: towards improved consumer safety, resulting in better conditions for workers and reduced environmental impacts throughout the textile chain

Chapter II of this report focuses on the current EU regulation of textile products, in particular clothing. Despite the existence of a huge amount of literature on textile products, the chemicals associated with them, and their impacts on the environment, it is not easy to summarize the exact rules applicable to textiles. This is due to several reasons, in particular the variety of information sources on this product category and the absence of a EU legislative tool specifically dedicated to textiles, which would summarize the applicable rules, as is the case for example with toys, food contact materials or cosmetics.

Textiles consumption in the EU at a glance

According to figures from the French *Union des Industries textiles*, textiles imports to the EU accounted for 14.1 billion Euros in 2012, while textiles exports are estimated at 7.7 billion Euros. In France alone, some 4,771 million Euros worth of children's clothes were sold in 2012. It is estimated that the overall number of clothing items bought in France between 1990 and 2008 increased by 35%.[84]

Of the 56,187 million Euros of clothes imported and sold in the EU, some 27,234 originate from China, 8,249 from Bangladesh and 8,211 from Turkey[85]. Based on WTO figures (WTO 2012), China is the leading exporter of clothes in the world, with exports worth some $154 billion in 2011 (see Section 3, Figure 5a); the EU ranks 1st among the importers with a value of $189 billion for the same year. Imports of textiles and clothing to the EU have increased by 22% between 2000 and 2009, with significant increases from India, Bangladesh and Turkey and a three-fold increase from China.[86] In addition, in the 20 years between 1991 and 2011, the proportion of synthetic fibres relative to natural fibres such as cotton, has increased from 45% to 66% of the total volume of fibres produced globally (also see figure 3). These figures demonstrate the need to ensure imported textiles articles are properly regulated at EU level.

As stated by KEMI*, "[It is not] currently feasible to regulate or control industrial activities that occur outside the Union and any regulation on chemicals in textiles should therefore be aimed at the final product that is placed on the market in the EU".* This argument also shows the need for better harmonization of textiles regulations worldwide, not only based on the promotion of free trade of textile goods, but rather dedicated to improving working conditions and environmental protection all along the textiles supply chain.

[84] Dossier *Déshabillons*-nous !, Terra Eco, Septembre 2013
[85] *Activity Report 2009-2010*, Union des Industries Textiles (France), 2010
[86] European Commission (2011),The Textile and Clothing Sector and EU Trade Policy, February 2011, p.13 http://trade.ec.europa.eu/doclib/docs/2011/october/tradoc_148259.pdf

1. Overview and evolution of European legislation on chemicals of concern in textiles

1.1 A new Regulation for naming textile fibres, labelling and marking of fibre composition

Textile products are one of the basic consumer products in the world, second only to food. The worldwide textiles market is very dynamic, as it is in the EU, where the market has been rapidly growing in the last 10 to 15 years. Within the EU, chemicals classified according to their hazardous properties may be restricted accordingly in certain consumer articles, including textiles. The new Textile Fibre Regulation 1007/2011 has long been awaited: replacing 3 Directives, it aims to clarify and improve the readability of EU textiles legislation. This Regulation entered in force on May 8th 2012 with a transition period up to November 9th 2014. However, it does not contain information on existing restrictions and bans on the use of certain hazardous chemicals in textiles. This information cannot be found in any single Regulation or Directive, as is the case for the Toys Safety Directive, for example. It is therefore very difficult to have an overview of which substances/mixtures are or are not regulated in textiles.

1.2 A variety of legislative instruments for regulating a range of chemicals and mixtures in a range of products and uses

Inherent complexity of chemicals regulations

EU legislation on chemicals is inherently complex. One could even say that for each case of each substance or mixture different rules could apply:

- Is the substance or mixture classified under a hazard category?
- Is the substance banned or only limited from use, and at what concentration?
- Is the substance simply banned from being placed on the EU market (Authorization of REACH[87])
- Is the substance/mixture subject to restrictions on use in general, including in textiles? In certain products only? Under certain conditions of use? (REACH restriction)
- Which property of the substance/mixture triggers the restriction?
- Is the substance/mixture granted derogations for use in certain applications?

How can it be determined which regulations or questions apply to which chemical/mixture of chemicals or which product? The huge number of chemical substances used in textiles(around 1,900 according to the 2013 KEMI investigation, described as “non-exhaustive”) and the alleged number of corresponding mixtures (around 15,000 according to a 2012 study by DG Enterprise) makes it difficult to get a clear picture of the situation. According to KEMI, only 165 of the 1,900 above-mentioned chemicals have currently been identified as requiring harmonized classification as hazardous[88] (PBT, CMR respiratory or skin sensitizers, environmentally hazardous, or known to

[87] Stands for Registration, Evaluation, Authorisation and restriction of Chemicals Regulation (EC) No 1907/2006 (and Directive 2006/121/EC)

[88] See Box 1 for a description of hazardous properties such as PBT, CMR. REACH sets up a system for better control of “substances of very high concern” such as those that accumulate in the environment and our bodies, cause cancer, are toxic to reproduction or alter genes, and substances that interfere with the hormone system. REACH will

have long-term effect on aquatic organisms; see Box 1), or are included in the REACH candidate list as Substances of Very High Concern (SVHC).

Hazardous chemicals in textiles can be regulated through a wide range of instruments (non-exhaustive list):

- Regulation EC n°1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) in its chapters on authorization and restriction,
- Regulation EU n° n°528/2012 concerning the marketing and use of biocidal products, regarding biocides that could be present in the composition of textiles,
- EU and national government legislation on specific substances eg: flame retardants (penta-BDE, octa-BDE), azodyes, dimethylfumarate, PFOS, etc,
- Directive 2001/95/EC on general product safety,
- EU Eco-labelling schemes,
- Other specific regulations may apply indirectly to the global textile production chain, including production within the EU:
- Directive n°2008/01 EC concerning Integrated Pollution Prevention and Control (specifically relevant for industrial activities within the EU),
- The Global Stockholm Convention on Persistent Organic Pollutants,
- EU Water Framework Directive n°2000/60/EC (specifically relevant for industrial activities within the EU and all wastewater discharges).

"Positive" lists; the necessary complement to negative lists of chemicals in textiles

Positive lists of chemicals used in textiles are absent

Labelling of certain products, such as cosmetics or food products means that in fact a positive list of ingredients is used, which can be valuable in helping consumers to make more informed choices, once they have understood the meaning of the lists. This is not the case for textiles, where labelling is only required for the types of fibre used and its percentage in the final product. The lack of transparency about chemicals used in the textile sector is a major obstacle to the phase out of chemicals of concern and protection of workers, consumers and the environment.

UNEP notes that "*the absence of "positive lists" of chemicals used in textiles is problematic in developing countries and countries with economies in transition"* (UNEP, DTIE/Chemicals Branch (2011). Indeed, this is where most of textiles production is currently located. Promoting limited transparency in Western countries, while pursuing efforts to avoid more stringent rules in developing countries where most of the production is located, gives certain companies a chance to maintain their good reputation while turning a blind eye to conditions in production countries. UNEP further states that "*Most of these activities point to efforts aimed at identifying and controlling hazardous substances which might be contained in products. These efforts can be characterized as risk monitoring and control activities. No efforts were discovered in DC/CET that were oriented towards positive list approaches to chemicals content management in textile products.*" These activities in themselves are based on a risk approach, and do not favour the elimination or phase out of chemicals of concern, but rather their "controlled" use. Given the huge

require some of these substances to be substituted with safer alternatives, whenever these alternatives become available variety of chemicals and chemical mixtures used, their fate once released into the environment and their impact on living organisms, it is all the more difficult to monitor.

Voluntary initiatives, their value and limits

Besides official regulations, companies, including textile companies and clothing brands, have developed "Restricted Substances Lists" (RSLs), which are lists of chemicals that a company voluntarily restricts in its products. One of the positive aspect of RSLs is that a culture of information has been developed within the long [textile] supply chain, and that downstream suppliers are accustomed to reporting on their chemicals use. However, RSLs are only indicative and negative and do not provide information about which chemicals are actually used in the textile products. In addition, chemicals are restricted in RSLs according to "safe limits" for hazardous chemicals, which are usually based on a risk assessment methodology and not exclusively on the intrinsic hazard of a chemical. Self-declarations which cannot be checked by independent and competent stakeholders to be validated cannot be given the credit of being absolutely trustworthy. Some companies have also decided to promote their own garments as "green" or "Eco", as noted by KEMI in its 2013 report. However, without third party verification of what's in the product or not, it is hard to trust such claims. Ecolabels such as the EU Ecolabel, GOTS, Good Environmental Choice or the label for human ecology Oeko-Tex 100 (among others) do trigger independent third party testing (see Chapter 1, Section 6) for an in depth comparison of the main requirements of some of the Ecolabels).

2. How complex EU legislation applicable to hazardous chemicals in textiles triggers confusion

Among other objectives, the EU textiles regulation n° 1007/2011 aims to achieve a high level of consumer protection (recital 26) and mentions the link between allergic reactions and chemical substances or mixtures used in textile products as a point of interest (article 27).

Within REACH, hazardous chemicals may appear under both the Authorization and Restriction chapters. In order to know if a substance is restricted in a textile article, one has to check the Restriction chapter, which covers imported articles, rather than the Authorization chapter, which focusses on substances or mixtures of very high concern on their own, and not in articles. Indirectly, if a substance/mixture is subject to authorization, it will not be permitted for use within the EU, and therefore should not be found in an article manufactured within the EU.

2.1 REACH Candidate list substances: consumer right to know about Substances of Very High Concern (SVHC) contained in articles

Being informed about the presence of hazardous chemicals in an article is the first step towards better consumer understanding and protection. Substances/mixtures placed on the REACH candidate list of Substances of Very High Concern (SVHC) are classified according to their hazardous properties (CMR, vPvB, PBT, equivalent level of concern including endocrine disruption – see Box 1). There are 144 Substances currently on the candidate list. However, a substance listed on the REACH candidate list is not necessarily restricted from use in articles. In fact, the situation is more complex:

- Being a candidate means a substance has been identified at EU level as a substance which in future may be submitted to an authorization process (possibly after several years); i.e. it will in principle be forbidden unless companies are granted **authorization** for its use. The candidate list gives long term guidance to the industry on which substances need to be phased-out and substituted. Currently there are 22 chemicals on the REACH Authorization list, which will have to be phased-out progressively over the next few years.

Among the 165 substances with a harmonized classification at EU level which KEMI identified as hazardous chemicals which may be found in final textile products, only 58 are on the current REACH candidate list.

- All substances listed on the candidate list trigger a right to information for the consumer called the “right to know”. According to this right (article 33 of REACH), consumers can request information from retailers about the presence of SVHC in consumer products; retailers are required to respond within 45 days to report on the presence of SVHCs in any article and if so how to use it safely. This is also applicable to textile products.

2.2 Restriction in REACH: dealing with hazardous chemicals in consumer products but no right to know for the consumer

The REACH restriction table is currently the most appropriate legislative tool to find out about existing restrictions on chemicals in textiles in the EU. The REACH “Restriction” chapter concerns restrictions on the presence of certain hazardous chemicals in articles, including textiles, and also encompasses imported articles. It also includes restrictions on the use of hazardous chemicals in manufacturing, which do not necessarily lead to a corresponding restriction on their presence in articles, imported or otherwise. The critical point, once restrictions do exist, is that they are implemented and that sufficient enforcement by the authorities ensures compliance with any restrictions.

- A recent search[89] for the word “textile” under Annex XVII of REACH, resulted in the following list of substances/mixtures:
- **“Tris (2,3 dibromopropyl) phosphate, Tris(aziridinyl)phosphinoxide, Polybromobiphenyls, Polybrominatedbiphenyls (PBB)** are banned from use in textile articles, such as garments, undergarments and linen, intended to come into contact with the skin,
- **Mercury compounds** banned from use in the impregnation of heavy-duty industrial textiles and yarn intended for their manufacture (occupational use),
- **Dioctyltin compounds**, banned from use in textile articles intended to come into contact with the skin, gloves, footwear or part of footwear intended to come into contact with the skin […],
- **Cadmium and its compounds**, banned from use in certain industrial applications,
- **Certain azocolourants and azodyes**, banned from use in textile and leather articles which may come into direct and prolonged contact with the human skin or oral cavity, such as clothing, bedding, towels, hairpieces, wigs, hats […], footwear, gloves, textile or leather toys and toys which include textile or leather garments, yarn and fabrics intended for use by the final consumer,
- Azodyes, which are contained in Appendix 9, ‘List of azodyes’ shall not be placed on the market, or used, as substances, or in mixtures in concentrations greater than 0,1 % by weight, where the substance or the mixture is intended for colouring textile and leather articles.

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[89] At the date of October 3rd 2013.

- **Nonylphenol and nonylphenol ethoxylates**, banned from use as substances or in mixtures in concentrations equal to or greater than 0,1 % by weight for the following purposes: in textiles and leather processing (occupational use), except processing with no release into waste water, systems with special treatment where the process water is pre-treated to remove the organic fraction completely prior to biological waste water treatment (degreasing of sheepskin)."

Obviously, restrictions may cover the occupational/industrial use of a substance and/or the presence of the substance in a final consumer product. However, the above list does not make it sufficiently clear which chemicals are restricted in the final consumer product and which are only restricted for use in manufacturing. For example, the restriction on NP/NPE refers to its use as a formula in textiles manufacturing, but not its presence in clothing products, whereas the restriction on azo dyes also includes a legal limit for the presence of certain azo dyes in consumer products. Consequently, a search of the RAPEX database will only reveal information on a limited number of these hazardous chemicals. This brings even more confusion to the understanding of EU legislation. Surprisingly enough, the consumer has no right to know about the presence of many of these restricted substances in articles, contrary to the supposed entitlement to know if a SVHC is used in a product, particularly as some of the above-mentioned substances are classified as CMR or/and sensitizers or irritants. This does not provide a logical framework for the consumer and contributes to the confusion and complexity of the textiles world.

Even more confusing, certain chemicals that are known to be hazardous (such as PFOS, which is a Persistent Organic Pollutant under the Stockholm Convention) and are commonly used in textiles and clothing, do not even appear on this list, despite the fact that they are restricted under REACH.[90] In fact, one of the most striking things about the outcome of this search of the REACH database is the limited number of chemicals on the resulting list.

2.3 From A to Z: illustrations of hazardous chemicals regulated in textiles to a greater or lesser extent

Anti-mould agents, the case of Dimethylfumarate: Despite a restriction at EU level[91], passed following a huge number of serious health problems and skin reactions in consumers to textiles treated with dimethylfumarate, in 2013 consumers still have to be careful, since the flow of imported textiles can still be contaminated by DMF. The RAPEX website in 2013 continued to identify the presence of DMF in imported textiles (see Box 15 & Section 4).

ChromiumVI: Chromium VI is a contaminant that can be found in both leather and textile articles, for example dyed wool and silk (see Box 7). Referred to as hexavalent chromium, it is known to be carcinogenic and has other undesirable health effects such as severe allergic contact dermatitis. It can be formed through the use of Chromium III which contains metal complex dyes and inorganic pigments, and is used to colour textiles, due to its colour- fastness properties. Other substances such as potassium chromate and potassium dichromate, both of which contain Cr (VI) may be added as part of the dye manufacture processes. Chromium VI regulation may differ from one Member Sate to another. Germany limits the Cr (VI) content of leather or textile products to 3mg/kg,[92] in line with the EU Ecolabel for footwear. Contamination of articles with Chromium VI

[90] http://www.cirs-reach.com/Testing/REACH_Restricted_Substances_List.html
[91] To be placed on the EU market, articles shall not contain more than 1 mg/kg of DMF, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2006R1907:20121009:EN:PDF#page=247 , page 246
[92] http://www.cbi.eu/system/files/marketintel/2012_Germany_legislation_Chromium_in_leather_and_textile_products_additional_requirements.pdf

continues to occur; in 2010, Italian authorities seized seventeen different textile products such as skirts, shirts, track suits and trousers containing chromium (VI) in amounts ranging from 2.4 to 19.2 ppm despite the fact that the products do not contain any natural or synthetic leather[93]. At EU level, Denmark proposed a restriction of Cr (VI) in articles, on which a final decision should be taken in the near future: two EC committees[94] have already given their opinion; the European Commission now has to take a final decision[95].

Dyes and colorants: (See Box 7) Azo dyes are the most commonly used dyes in the textile industry. Some can break into toxic aromatic amines, considered carcinogenic, allergenic and toxic by inhalation or for aquatic organisms. The azo dyes which can release these 22 classified aromatic amines are banned from use in textiles, i.e. they cannot be present in textiles and leather goods above concentrations of 30 mg/kg. This is one of the restrictions currently applicable to textiles articles under the REACH regulation.

Flame retardants: (See Box 10) In contrast to many other textile auxiliaries and finishing agents, where only small quantities remain on the garment, a flame-retardant coating may account for up to 20 % of product weight, according to the German Risk Assessment Institute[96].

- **Brominated flame retardants:** Certain brominated flame retardants are restricted under REACH; Tri-(2,3-dibromo-propyl)-phosphate (TRIS), tris-(aziridinyl)-phosphine oxide (TEPA) and polybrominated biphenyls (PBB), however, there are no restrictions on other brominated flame retardants.

- **Antimony**: Antimony is used as a flame retardant in the form of "antimony trioxide" which is present in polyester (PET). It is used for the manufacture of polyester based on PET (polyethylene phthalate) as a catalyst (see Chapter 1, Section 2). Despite existing alternatives to achieve flame resistance, including the choice of other categories of fibres, antimony is still used in combination with brominated flame retardants. At EU level, according to the CLP regulation, antimony is classified as a substance suspected of causing cancer (H351). In May 2013, two European consumer organizations BEUC and EEB, asked for the derogation allowing the use of antimony trioxide in bed mattresses to be withdrawn from the proposed EU Ecolabel criteria.

Formaldehyde: (See Box 12) Formaldehyde has been identified as a priority indoor air pollutant at international level and within the EU and is classified as skin sensitizer, acutely toxic if swallowed, inhaled and in contact with the skin. It has been classified as a skin corrosive under CLP, and as a human carcinogen (group 1) since 2006 by the International Agency for Research on Cancer (IARC), on the basis of induction of nasopharyngeal cancers. Surprisingly enough, despite this international classification, the EU still does not classify formaldehyde as a carcinogenic compound but only as a substance which is presumed to have carcinogenic potential for humans (Carc. 1B). In 2011, France proposed to classify formaldehyde as carcinogenic for

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[93] http://product-industries-research.hktdc.com/business-news/article/Garments-Textiles/Italy-Seizes-Textile-Products-Containing-Chromium-VI/psls/en/1/1X000000/1X078FVW.htm#5

[94] ECHA committees (RAC and SEAC) – spell out in full

[95] http://echa.europa.eu/previous-consultations-on-restriction-proposals/-/substance/413/search/+/term

[96] *Introduction to the problems surrounding garment textiles*, Updated BfR Opinion No. 041/2012, 6 July 2012, page 5.

humans 1A and mutagenic 2[97]. On December 2012, ECHA Risk Assessment Committee agreed to the proposal on mutagenicity classification but rejected the proposed carcinogenicity classification.

Formaldehyde specific labelling requirements by certain EU Member State and labels

Sensory irritation via inhalation exposure to formaldehyde vapour may also take place. It has been so far impossible to set a threshold for the sensitizing and allergenic properties of formaldehyde. The Ecolabel Oekotex 100 for class 1 products (baby products) requires formaldehyde to be "not detectable" (<16 ppm) in class 1 products (baby products), with a maximum limit of 75 ppm for class 2 (direct skin contact) products.

The following figure shows that regulations in China on the presence of formaldehyde in products are more stringent than those in France.[98]

Figure 7. Formaldehyde regulations worldwide, Study on the links between allergic reactions and chemicals in textile products, final report, RPS for DG Enterprise, 7 January 2013

Table 20 The existing regulations on formaldehyde for textiles in different countries

Country	Regulations on formaldehyde for textiles	
	Conditions	**Requirements**
Netherlands	direct contact with skin	- Any containing more than 120 ppm formaldehyde must be labelled "Wash before first use" - After washing, these products must not contain more than 120 ppm
Germany	direct contact with skin	Release more than 1500 ppm formaldehyde must bear a label that states: "Contains formaldehyde. Washing this garment is recommended prior to first time use in order to avoid irritation of the skin."
France	For baby products & direct contact with skin	20 ppm
	direct contact with skin	100 ppm
	Not direct contact with skin	400 ppm
US		If a product contains 0.1% or more formaldehyde or can release formaldehyde into the air above 0.1 ppm, then the product label must include the following information, as required by OSHA's Formaldehyde standard, 29 CFR 1910.1048(m)(3): - a statement that the product has formaldehyde in it - the name and address of the manufacturer, importer, or other company responsible for the product - a statement that the employer and MSDSs can readily give health hazard information. Additionally, if the product can release formaldehyde into the air above 0.5 ppm, the label must also have the following information: - a list of all product health and safety hazards - the phrase "Potential Cancer Hazard".
China	For infants and babies	Less than 20 ppm
	direct contact with skin	Less than 75 ppm
	Not direct contact with skin	Less than 300 ppm

[97] CLH report, Proposal for Harmonized Classification and Labelling, based on Regulation (EC) No 1272/2008 (CLP Regulation), Annex VI, Part 2 Substance Name: FORMALDEHYDE, 28th September 2011

[98] DG Enterprise (2013), Study on the links between allergic reactions and chemicals in textile products, final report, RPS for DG Enterprise, 7 January 2013, page 44, http://ec.europa.eu/enterprise/sectors/textiles/files/studies/study-allergic-reactions-textile_en.pdf

BOX 19: IN FOCUS – Searching for coherence: the case of nonylphenol and nonylphenol ethoxylates (NP, NPE)

NPE is a category of surfactants (emulsifying or cleaning agents) used in textiles, which breaks down into the more toxic NP in the environment, which is known to be toxic to aquatic organisms (see Box 6). The use of NPs and NPEs in concentrations equal or higher than 0.1% has been restricted within the EU since 2005 for the processing of leather and textiles amongst others. NP and NPE are no longer used in EU countries, but are used to a great extent for textile production outside the EU; textile products containing NPE are then imported to EU member states.

In August 2012, Sweden submitted to ECHA its intention to propose a restriction on NP and NPE in textile articles placed on the EU market[99]. ECHA committees rejected this proposal. One year later, Sweden again proposed a restriction of NP and NPE in textiles, with a slight nuance, proposing to restrict NP and NPE in textile clothing, fabric accessories and interior textile articles (including their prints) that can be washed in water, if these articles contain either NP or NPE, or both in concentrations above 100 mg/kg textile"[100] The reason for the proposed restriction is therefore the contamination of water rather than human health concerns.

Restricting the use of NP and NPE in textile articles is expected to *"decrease the mean concentrations of NP/NPE in textile articles to roughly 29 mg/kg, i.e. about 73% lower by the year 2020 compared to the estimated 107 mg NPs/NPEs per kg textile in the baseline scenario. The annual environmental release from textiles of NPs and NPEs and their derivatives is estimated at 257 tonnes expressed in terms of weight equivalents to (NPeq) (roughly half of the overall EU environmental release)".* It is estimated that following waste water treatment, 2.5% of this volume is released to surface water.[101] ECHA has opened a consultation on Sweden's restriction proposal just recently.[102]

Germany also proposed 4-nonylphenol (part of the nonylphenol family of compounds) as a SVHC based on its EDC properties; consequently, this substance was placed on the REACH candidate list in June 2013. Its presence on this list means that consumers have the right to be informed of its presence in consumer products in concentrations above 0.1%. However, this is not the case for other nonylphenol compounds.[103]

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[99] Document available at : http://echa.europa.eu/registry-of-submitted-restriction-proposal-intentions/-/substance/792/search/+/term
[100] Document available at : http://echa.europa.eu/registry-of-submitted-restriction-proposal-intentions/-/substance/3603/search/+/term
[101] Information note on NPs and NPEs restriction report: http://echa.europa.eu/documents/10162/0f74c80f-0dac-450a-b881-51d2051f9f40
[102] Consultation available at: http://www.echa.europa.eu/web/guest/restrictions-under-consideration/-/substance/4507/search/+/term
[103] http://echa.europa.eu/candidate-list-table/-/substance/3201/search/+/term

BOX 20: IN FOCUS Playing with words… and gambling with the health of children?

Phthalates: Plasticizers such as certain phthalates (DEHP, DBP, BBP, DINP, DNOP, DIBP, etc.) can be found in the PVC print of various textiles, including children's clothing. Due to their impacts on the reproductive system, DEHP, DBP and BBD are banned from use in all toys and childcare articles[104], and DINP, DIBP and DNOP from toys and certain articles which can be placed in the mouth.

In a guidance document[105], the European Commission provides stakeholders with its interpretation on the meaning of the expression "**which can be placed in the mouth**": "*Placing in the mouth" means that the article or parts of an article can actually be brought to the mouth and kept in the mouth by children so that it can be sucked and chewed**. If the object can just be licked, it cannot be regarded as "placed in the mouth***". For example, children's soft play-mats are considered to be covered. The document also states that "*[…] Directive 2005/84/EC covers the accessible parts of articles such as push chairs, car seats and bike seats which are intended to facilitate sleep and relaxation during transport. The main purpose of pyjamas is to dress children when sleeping and not to facilitate sleep.* ***Pyjamas should therefore be regarded as textiles and, like other textiles, do not fall under the scope of the Directive. Sleeping bags are designed to facilitate sleep, and should therefore fall under the Directive***".

Does this mean that a sleeping bag needs to be safer than pyjamas? Is a child more or less likely to suck on a pair of pyjamas compared to a sleeping bag? Ironically, a pair of pyjamas is considered to be an item in close and prolonged contact with the skin, and is therefore subject to certain other restrictions according to European law, but not to restrictions on phthalates. As shown in Chapter 1 (Section 4, Box 16), phthalates continue to be found in prints on imported textile articles in quantities as high as 39%. However, this is not only a problem for products manufactured outside the EU; there is no specific restriction on the use of phthalates in PVC prints for textiles within the EU itself either.

TBT and organotin compounds: (Also see Box 15) Organotin compounds include MBT, DBT, TBT, MOT, DOT and TPT. In a 2008 report, the German Federal Institute for Risk Assessment (BfR) estimated that T-shirts with PVC print (19%) together with PVC shoes contributed to 52% of children's Tolerable Daily intake of DBT and DOT. Since children can also inhale or ingest these compounds in house dust, BfR recommends that DOT and DBT should not be used in soft plastic PVC goods.[106] Bans on the use and marketing of di- and tri-organo tin compounds have been

[104] According to the official EU definition, a childcare article means « any product intended to facilitate sleep, relaxation, hygiene, the feeding of children, or sucking on the part of children ».

[105] *Guidance document on the interpretation of the concept "which can be placed in the mouth" as laid down in the Annex to the 22nd amendment of Council Directive 76/769/EEC*, European Commission, http://ec.europa.eu/enterprise/sectors/chemicals/files/markrestr/guidance_document_final_en.pdf and on REACH regulation, http://ec.europa.eu/enterprise/sectors/toys/files/gd008_en.pdf

[106] « *Die Aufnahme von Hausstaub kann bei Kleinkindern zu einer hohen Auslastung des TDI führen. BfR und UBA empfehlen vor diesem Hintergrund auf die Verwendung von DOT- und DBT-Verbindungen in Weich-PVC-Produkten zu verzichten.* », Bundes Institut für Risiko Bewertung, Aktualisierte gemeinsame Stellungnahme* Nr. 032/2008 des UBA und des BfR vom 05. Februar 2008.

incorporated in Annex XVII of the REACH Regulation. Since 2010, no tri-organotin compounds such as TBT must be used in products if the concentration of tin in the product or in parts thereof exceeds 0.1% by weight. Products with a higher content cannot be placed on the market. Similar bans have been in place since 1 January 2012 for DBT compounds in products which are intended for supply to, or use by, the general public. Since the new biocidal products regulation entered into force in September 2013, only biocides approved at EU level can be used in articles, whether manufactured within or imported to the EU. These provisions apply to substances which are still in the review program of the new regulation.

Water, Dirt and Oil repellents: (Also see Box 11) Perfluorinated chemicals (PFCs) are used in textiles for their effective oil and water repellence, as well as stain and oil resistant properties. In particular PFOS and PFOA are extremely persistent, bioaccumulative, toxic to reproduction and toxic to aquatic organisms. A restriction on the use of PFOS in textiles was implemented after its classification as PBT by OECD in 2002; it is now incorporated in REACH Restriction Annex[107] and PFOA is a candidate for restriction under REACH. A 2013 report by the Nordic Council explores the presence of perfluorinated substances in textiles. There has recently been a shift to "short-chain" fluorinated products use, such as fluorotelomer alcohols, although there are also considerable information and knowledge gaps regarding PFCs other than PFOA and PFOS. In addition, EU restrictions on PFOS in manufacturing will not impact the treatment of textiles outside the EU and the import of clothing products containing PFOS is not restricted. Some brands have limited or banned the use of PFCs, showing that the substitution of all PFCs (not only PFOS and PFOA), with safer alternatives that do not use fluorine-based chemistry is possible.

3. The human, social and environmental factor

Textiles: the human and environmental cost of globalized production

Textile goods manufacturing, production and sale has gone global. This means a long chain between the raw materials suppliers, the textiles manufacturers, the garment producers, the retailers, and finally the consumer; transparency about any part of this chain is the exception not the rule. Moreover, as with other products, the search for low-cost production and the avoidance of the more stringent environmental, safety and social rules in force in Western countries, for example, is a driver for international textile companies to locate the major part of their production in developing countries. Indeed, since 2005, when export quotas disappeared, the trade in textiles has been governed by the general rules of the multilateral trading system, making it even easier to develop giant factories in countries where production costs are minimized.Textile goods manufacturing, production and sale has gone global. This means a long chain between the raw materials suppliers, the textiles manufacturers, the garment producers, the retailers, and finally the consumer; transparency about any part of this chain is the exception not the rule. Moreover, as with other products, the search for low-cost production and the avoidance of the more stringent environmental, safety and social rules in force in Western countries, for example, is a driver for international textile companies to locate the major part of their production in developing countries. Indeed, since 2005, when export quotas disappeared, the trade in textiles has been governed by the general rules of the multilateral trading system, making it even easier to develop giant factories in countries where production costs are minimized.

3.1 Working conditions in the textile industry, one part of the picture

[107] http://www.cirs-reach.com/Testing/PFOS_PFOA_Testing.html

Box 21: In Focus: Bangladesh, Collapse of a Textiles Mirage

In April 2013, the collapse of the Rana Plaza in Bangladesh killed 1,132 people and injured many more. This was the largest of many similar tragic accidents, in other textile factories within the country and beyond, that had already occurred. The ready-made garment sector has become a pillar of the national economy in Bangladesh, accounting for 75% of exports and 10% of the Gross Domestic Product, supporting 3 million jobs. The former WTO Director, in a speech at Dhaka University in 2012[108] praised *"Bangladesh's ability to translate WTO flexibilities for the world's poorest nations into trade and development outcomes"* as a positive example to other low income countries. In fact, encouraged by international financial institutions such as the World Bank and the International Monetary Fund to privatize companies and cut public spending, the country opened the door for the development of unregulated industries, such as textiles. These measures went hand in hand with the liberalization of textiles trade. But who considered the fate of workers? Child labour, for example in the dyeing industry[109], low salaries, long working hours (10 hours a day, six days a week), the absence of safety and security within buildings and exposure to hazardous chemicals without appropriate protection, were and are still common in textile factories in Bangladesh.
Once again on April 2013, ILO[110] expressed its "deep sadness" for the tragedy of Rana Plaza. It seemed suddenly to realize the situation, but too late: is it a surprise when workers' safety and social rights are denied to ensure ever growing production? In recent months, several "high level" measures aimed at improving workers' safety have been announced, such as the assessment of garment factories and a national action plan of fire safety. However, it is striking to see the contradictory approach of the whole UN system: what if the development of workers safety had been implemented at the same pace as the development of textiles production? What if the concerns of the ILO and other organisations representing social and human rights took precedence over the interests of the trade and financial institutions? Instead a system has been promoted where export figures and the reduction of costs come before human, social and environmental factors and the power of workers and civil society has been eroded in the process.

Reactions following the catastrophe

In May 2013, international brands signed the Accord on Fire and Building Safety in Bangladesh to guarantee proper safety and fire-protection measures in Bangladesh textiles factories. To date, around 70 global brands have signed the agreement[111], among them H&M, Inditex (Zara),

C&A, PVH (Calvin Klein and Tommy Hilfiger), Tchibo, Tesco, Marks & Spencer, Primark, El Corte Inglés, Hess Natur, jbc, Mango, Carrefour, KiK, Helly Hansen, G-Star, Aldi, New Look, Next, Mothercare, Loblaws, Sainsbury's, Benetton, N Brown Group, Stockmann, WE Group, Esprit, Rewe, Lidl, Switcher et Abercrombie & Fitch. At EU level, the European Commissioner

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108 Speech of WTO Director Pascal Lamy, 31 March 2012, Dhaka, http://www.wto.org/english/news_e/sppl_e/sppl223_e.htm
109 *Textiles : la mode toxique ?*, Envoyé Spécial, France 2, 19th September 2013, http://www.france2.fr/emissions/envoye-special
110 *International Trade Organization*, 7 september 2013, http://www.ilo.org/dhaka/Informationresources/Publicinformation/Pressreleases/WCMS_220950/lang--en/index.htm
111 *Bangladesh : 31 marques signent l'Accord pour la sécurité des usines*, Collectif Ethique sur l'Etiquette, communiqué du 16 mai 2013, http://ethique-sur-etiquette.org/Bangladesh-31-marques-signent-l,283

for Trade, in a September 2013 speech[112], pointed out the responsibility of companies which buy from suppliers, as having the "most influence over [these suppliers]". A compact, initiated by the EU and adopted by the ILO, the EU and the Bangladesh government,[113] aimed at improving health, safety, labour rights and responsible business in the Bangladesh textiles industry, was adopted in July 2013. Among the actions identified as priorities targets are: reform of the Bangladesh Labour Law to strengthen workers' rights; improving building and fire safety by June 2014; and recruiting 200 additional inspectors by the end of 2013. Other institutions, such as the European Parliament, in a May 2013 resolution[114], also urged the European Commission to promote corporate responsibility in the garment sector.

3.2 Occupational exposures through the textile supply chain

Many occupational exposures to hazardous chemicals can occur during textile processing. For example, apparel manufacturing workers may be exposed to formaldehyde by-products, when urea-formaldehyde resins and concentrates are used: decay may occur, off-gassing formaldehyde from products manufactured with these resins (see Box 12).[115]

Box 22: In Focus: Methyl Bromide – Double Standards For Different Uses

To take only one example, the use of methyl bromide (MB) (also see Section 3.2.4) has been in principle banned by the Montreal Protocol,[116] due to its effects on the ozone layer: MB is an ozone depleting substance and therefore its use is limited. But several exemptions for so-called "critical uses" do exist, which allow its use in significant amounts. MB is classified by the US EPA as a Category I acute toxin, the most potent class of toxic chemicals. It is a colourless, odourless, and deadly gas, and because it is applied as a gas, it naturally drifts off site.
The acute effects of MB exposure include headaches, drowsiness, lethargy, nausea, vomiting, dizziness, blurred vision, twitching and convulsions, seizures, psychosis and death. More disturbing, these effects may persist long after a single poisoning incident.[117] A 2009 report by a Montreal Protocol expert panel dedicated to MB use[118] gives some interesting figures:

- Between 1999 and 2007 the annual production of MB for Quarantine and Pre-shipment (QPS) remained approximately constant. Between 2002 and 2007, the cumulative total reported production and consumption was 69,265 and 69,882 tonnes respectively. Reported global consumption for QPS has averaged nearly 11,000 metric tonnes a year since 1995.

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[112] Speech of EU Commissioner for Trade, *Trade and Human Dignity in the Workplace*, 9 July 2013 http://europa.eu/rapid/press-release_SPEECH-13-623_en.htm
[113] http://www.ilo.org/global/about-the-ilo/activities/all/WCMS_217271/lang--en/index.htm
[114] Resolution of the European Parliament, http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2013-0230+0+DOC+XML+V0//EN&language=EN
[115] OSHA, https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=PREAMBLES&p_id=923
[116] Montreal Protocol Homepage, http://ozone.unep.org/new_site/en/montreal_protocol.php
[117] http://www.ewg.org/research/heavy-methyl-bromide-use-near-california-schools/health-effects-methyl-bromide
[118] *Report of the Technology and Economic Assessment Panel Quarantine and Preshipment Taskforce* – Final Report October 2009, http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/teap-qpstf-october2009.pdf

- Over all categories of QPS fumigation it is estimated that around 79% of applied methyl bromide is emitted, in the absence of recapture and destruction processes and with standard industrial practice.

  In the report of the 23rd Meeting of Parties of the Montreal Protocol (November 2011),[119] some complementary information is provided:

- Countries using QPS treatment with MB note that “they [are] often required to use methyl bromide by countries to whom they exported goods.”

- Ms Marta Pizano, co-chair MBTOC, mentions that in 2008, MB use was higher for QPS than for controlled uses for the first time, whereas, in 2010, QPS consumption was 51% higher. She notes that **the increased use of methyl bromide for QPS is offsetting the gains made by reductions in controlled uses**. She noted that while there is no obligation or incentive under the Protocol to limit QPS uses or emissions, some Parties had nonetheless phased out MB for QPS and others are committed to a phase-out in the near future. She stressed that 20-35% of present global QPS use can be replaced with alternatives available today.

- According to the Occupational Health Centre of Hamburg, both epidemiologic and toxicological data suggest an association between exposure to MB and certain health conditions including prostate cancer.[120]

3.3 Exposure of final consumers

To what extent are consumers exposed to hazardous chemicals in textiles? It is hard to assess since exposure scenarios have only been calculated for 10 chemicals, according to KEMI (out of the estimated 1,900 chemicals noted above that are used in textile production of which only 165 currently have a harmonized classification at EU level). This gives some idea of the existing knowledge gap about the hazards of chemicals used in textiles, their presence the product and their possible effects.

Children, more at risk than adults from exposure to chemicals in textiles
As discussed in Section 1, in children, patterns of behaviour and differences in metabolism increase their general exposure to contaminants. Putting things in the mouth and inhaling or ingesting contaminated dust are two important routes of exposure which deserve attention. For example, indoor dust is believed to be the largest single route of exposure to brominated flame retardants and PFC[121] (See Section 1, Figure 1)

Residues of hazardous chemicals in children’s clothing
As detailed in Chapter 1 (Section 4), there are numerous studies that show the presence of hazardous chemicals in clothing, including clothes for infants and children, many of which are summarised in Table 2. Hazardous chemicals that are commonly found include nonylphenol ethoxylates, Perfluorinated chemicals, phthalates, heavy metals such as lead and chromium VI,

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[119] Report available on the site of the Convention : http://conf.montreal-protocol.org/meeting/mop23-cop9/draft-reports/Draft%20Reports/MOP-23-11-COP-9-7E.pdf

[120] *Vertige, nausée, cancer, les effets dus à la fumigation des conteneurs*, Paul Benkimoun, Le Monde, janvier 2013, disponible en ligne : http://www.espace-chsct.fr/toutes-les-actualites/886-vertige-nausee-cancer--les-effets-dus-a-la-fumigation-des-conteneurs.html

[121] Bjöklund, 2011, quoted in Hazardous chemicals in textiles – report of a government assignment, KEMI, April 2013

organotins and formaldehyde. The presence of some – but not all – of these hazardous chemicals in items of clothing on the European market, at levels that exceed regulatory limits, is also picked up by the European rapid alert system for non-food dangerous products (RAPEX), with a total of 318 results between 2010 and June 2013.[122]

The fate of contaminants that are washed out

According to a 2011 report (Danish MoE 2011), *"Especially phthalates, some heavy metals, and antibacterial agents are not washed out of the textiles during wash"*. These are the compounds which should be primarily targeted when exploring the possibility of skin sensitization through dermal exposure to textiles, as they will be in direct contact with the skin. If these compounds are not bound to the fibre they can be released. This release of such substances from textiles depends on the type of fibre and the chemicals used to bond them to the surface. For instance, phthalates are not chemically bound to the PVC: they are therefore emitted from the material. When compounds are applied to cellulosic fibres (cotton, viscose or lyocell) covalent bonds can ensure that chemicals are bound to the fibre, which is not the case for synthetic fibres.

Preventing textiles waste: illustration of Nordic countries approach

A large proportion of these clothes are thrown-away at the end of their lives, either dumped in landfills or incinerated; in both Germany and the UK 1 million tonnes of clothing is thrown away every year, respectively.[123][124] In Sweden, approximately 132,000 tonnes of textiles from clothes and home textiles was used in 2008. Based on the total population of Sweden in 2008, this means an average of 14.2 kg per inhabitant. Of the 26,000 tonnes of used textiles collected by charitable organisations, a small percentage were sold within Sweden while 73% - about 19,000 tonnes or 2.1 kg per person – is either sold or donated to receivers abroad (Norden 2011).

Next step: towards a circular and sustainable economy of textiles

Despite the above-mentioned challenges, it is possible for textile products to originate from organic or low-impact fibres and to be manufactured in a sustainable way, which benefits workers producing raw materials and in manufacturing, the environment and the final consumers. Whether in Nordic countries or countries of the South, some initiatives are becoming a reality:

- In India, a company[125] is exclusively using dyes from natural pigments, treating the water resulting from the process and even reusing the resulting sludge in agriculture. This is an illustration of successful circular economy model, at a time when more and more countries in the world, most recently France and the European Commission in 2012, have identified the circular economy as a key element for effective sustainable policies;
- In the USA, the small enterprise *Stitch and Hammer*[126] is proving that it is possible to manufacture high quality hand-made leather products at a small scale, and to develop into a successful economic model.
- In response to Greenpeace's Detox campaign, a growing number of clothing brands, including fashion multiples such as H&M, M&S & C&A, luxury brands such as Valentino and Benetton and sportswear brands such as Puma, are implementing changes throughout their supply chains with the aim of eliminating hazardous chemicals by 2020. Firstly, the

[122] RAPEX is the European rapid alert system for non-food dangerous products, which reports products that are hazardous to consumer health on its on-line database system.

[123] http://www.fairwertung.org/ 5th September 2011

[124] DEFRA (2011), Sustainable Clothing Roadmap, Progress Report, page 2: http://www.defra.gov.uk/publications/files/pb13461-clothing-actionplan-110518.pdf

[125] The company, called Aura, is located in Southern India, close to Ahmedabad. Information based on an interview of a French textile designer by WECF, October 2013.

[126] Article by Amy Temper on her small enterprise « Stitch and Hammer », Pure Green magazine, N°5, Automne 2013.

suppliers of several of these brands have already demonstrated transparency by publishing data on the release of hazardous chemicals from their individual facilities, via a public online platform set up by the Chinese Institute of Environmental Affairs. This provides local communities and interested consumers with the "Right to Know" which chemicals are being used and released during the manufacture of products. Secondly, the elimination of some priority hazardous chemicals is already taking place, where the achievement of zero discharges, or zero use of hazardous substances will be verified by the best current methods of testing to ensure the lowest levels technically possible, not some "acceptable limit" as was previously accepted, which allows the continued use of hazardous chemicals.[127]

4. 9 Recommendations to address 9 facts about textiles in the EU

Fact 1: Current EU legislation on chemicals in textiles is not clear and transparent enough to ensure a proper understanding.

Recommendation 1: Ensure clarity, transparency and comprehensive understanding of EU textiles legislation

WECF recommends that all information and rules applicable to restrictions on hazardous chemicals in final textiles articles should be included in a single document, so as to make it comprehensible. Option As proposed by KEMI in its 2013 report, entitled "*Expanding the Fibre Labelling Regulation to restrict the chemical content in articles*" should be favoured.

Justification: It is feasible, as shown by the coexistence of legislation such as the Toys Safety Directive, the Cosmetics Directive and RoHS in electronics, alongside more general legislation such as REACH, the General Products Safety Directive and the Biocidal products regulation, to create specific legislation for a product category. This makes it much easier for consumers and other stakeholders to ascertain which chemicals are banned, restricted or authorized in the products concerned. As textiles is such a major product category as well as being a complex issue, it deserves a single regulatory instrument encompassing both labelling and information requirements as well as the regulatory limits on the presence of chemicals in the product. Currently, textiles regulations do not encompass restrictions on substances of concern, which are covered by REACH. The issues of allergic reactions and additional information on textile labels for consumers are currently being considered by the European Commission; the amendment of Regulation No. 1007/2011 by adding a chapter called "Restrictions on hazardous chemicals in textiles", similar to the existing Regulations for cosmetics or toys, seems to be a simple option that will enable progress towards transparency in a short period of time.

[127] Detox Catwalk http://www.greenpeace.org/international/en/campaigns/toxics/water/detox/

Fact 2: In the EU and globally, textiles for infants and children are regulated in the same way as textiles for adults

Recommendation 2:
Implement specific rules for children's textiles that are adapted to children's vulnerability

Justification: Currently, apart from textile toys, which are regulated as toys and therefore subject to the Toys Directive, no specific requirements for children's textiles and clothing exist: the consequence is that there is no difference between the levels of chemical residues found in both children's and adults' textile goods. Existing regulations concentrate on knowing if there is direct and prolonged contact with the skin to determine the restriction of hazardous substances in textile products. Despite restrictions on certain azo dyes, formaldehyde and heavy metals in textiles, there is no global approach on children's textiles as a whole.

Parents want the best for their child: this is also the case with textiles. According to some sources, in Norway for example, that "*The market share of ecolabelled clothes […] is […] less than 1% and mainly driven by children's wear*". This is a cause for concern, when we consider the variety and quantity of chemicals compounds which may be found in textiles and clothing. Children put textiles and their hands in their mouths, are in prolonged skin or respiratory contact with them and with house dust that can contain chemicals that have migrated from clothing; they are therefore potentially more contaminated than adults, particularly due to their size, the delicacy of their skin and their metabolism. They are also more vulnerable to the adverse effects of chemicals, due for example to their developing immune, respiratory, neurological and reproductive systems. A list of compounds to be banned from children's textiles, to the lowest possible detection limit (together with regular reviews to ensure continuous reductions in levels of chemicals) must be urgently established at EU level, with particular attention paid to some of the chemicals listed in this report.

Fact 3 Imported products are not controlled to ensure the lowest possible exposure of consumers and the environment to (potentially) hazardous chemicals

Recommendation 3:
Ensure the adequate and sufficient control of both imported and EU-made textiles

Justification: Whereas imported textile goods make up the major part of textiles products sold in the EU, they are out of the scope of certain major chemicals regulations such as REACH. They are only covered by restrictions for a limited number of chemicals, but not by the authorization regime of SVHC, since REACH is **not** primarily designed to regulate chemicals in products, including textiles, as noted by KEMI in its 2013 report. Searches on RAPEX, the European system of rapid exchange between member states on dangerous consumer goods illustrate the extent of the problem: in 2012, clothing, textiles and fashion items account for 668 notifications of RAPEX, i.e. 34 % of all notifications by the 27 EU Member States.[128] However, there is a very limited list of chemicals which are controlled and enforced by the RAPEX system and well-known hazardous chemicals, some of which are highlighted in this report (see Chapter 1, Section 4), are not included in this enforcement system. The situation is illustrated by following statement by the Finnish Environment Institute[129] that: *"(D)due to lack of resources the national customs laboratory has not been able to extend(t) the surveillance to cover all articles and chemicals of the Annex XVII of REACH, only those based on previous legislation"* . The EU should not wait for a wave of acute allergies/severe skin irritations as was the case for dimethylfumarate, or for some other health issue to arise as a result of exposure to chemicals with more chronic health effects, to tackle this specific issue. Legislative requirements need to be enforced hand in hand with adequate controls to significantly reduce the risk of consumer exposure.

Since most textiles sold in the EU today originate from countries outside the EU, it is important to dedicate appropriate human, logistical and financial resources to ensure the control of these goods, which every single European citizen consumes at a very rapid pace.

Fact 4: Many potentially harmful chemicals used in textiles are absent from textiles regulations

Recommendation 4:
Fill the knowledge gap to ensure transparency and regulate all relevant known and potentially harmful chemicals used in the textiles sector

Justification: Currently, a preliminary list of some 1,900 chemicals are known to be used in the textile production, whereas only 165 of these chemicals have been identified as hazardous and have a harmonized classification in the EU. For chemicals in textiles, as for chemicals in general, we observe the same "science ad nauseam", which focuses on a small group of contaminants, ignoring other potential hazards. Among the numerous reports on textiles, a report by the Finnish Environment Agency[130] states that: *"The chemicals focused on in textiles have varied, and attention has shifted. For instance, risks from fire retardant chemicals is increasingly emphasized, based in part on POPs regulations. Also REACH and biocides regulations shape the foci of governance. However, other chemicals may get insufficient attention or interest in their management may fade, such as with formaldehyde. Management is also often conceived and framed narrowly, for instance focusing on restrictions instead of incentives, or technical instead of institutional measures. The object of governance is regularly restricted to chemicals or textiles only without account of the broader areas of product policy, environment and natural resources, safety and health. This is often coupled with a narrow framing of the risks and lacking coupling with associated benefits (such as when considering risks of losing benefits when substituting alternative products or processes)"* (emphasis added). […]

[128] Q&A RAPEX, 2012, http://europa.eu/rapid/press-release_MEMO-13-438_en.htm?locale=FR

[129] *Risk management and governance of chemicals in articles Case study textiles*, Timo Assmuth, Piia Häkkinen, Jaana Heiskanen, Petrus Kautto, Päivi Lindh, Tuomas Mattila, Jukka Mehtonen and Kristina Saarinen, Finnish Environment Institute, 2011, Page 60.

[130] Page 55, Op. cit.

WECF considers that that only information and transparency can trigger adequate action. In the absence of knowledge, it is unrealistic to suggest that unknown hazardous chemicals will be considered for restriction or ban. Considering one category of chemicals, such as endocrine disrupters for example, should not prevent regulators from considering all kind of hazardous chemicals which may impact on health and the environment.

All tools should be used to fill the existing knowledge gap, including:

- Mandatory reporting by companies of restricted hazardous chemicals in products, which trigger sanctions in the case of non-compliance,
- Positive lists of chemicals to be used to complement existing Restricted Lists of Substances,
- An inventory of chemicals used by textile supply chains,

One crucial element is the access to information for enforcement agencies to allow adequate testing and verification to take place. When public health is at stake, it must take priority over commercial confidentiality. A 2011 UNEP report states that: *"Environment ministries and enforcement agencies themselves typically have no access to CiP information:* ***it was noted that government personnel interviewed had neither access to negative list data (e.g. from suppliers) nor to data on actual chemical content of products".***

It has been noted that RAPEX system is useful and widely used in Europe, but it is only there to correct the situation after products have already been placed on the market and can only address a small proportion of textile products potentially containing hazardous chemicals, which is not enough. More focus on preventing the contamination of clothes with hazardous chemicals is needed.

Fact 5: Dermal exposure is the number one route of exposure for textiles consumers but limited knowledge exists on allergic/sensitizing reactions to textile ingredients; consequently these hazards are under-regulated

Recommendation 5: Enhance knowledge about the health impacts of dermal exposure to chemicals in textiles to adequately protect the consumer from exposure to sensitizing and irritating substances

Justification: Several reports note that the dermal route is the number one route of exposure to chemicals contained in textiles. This raises the issue of the role that chemicals in textile products play in the sensitization of people who develop allergies as a result. An allergic reaction is a hypersensitivity disorder of the immune system, occurring when a person's immune system reacts to normally harmless substances in the environment. Allergic conditions are one of the most common chronic diseases in Europe[131]. *Skin allergy or contact dermatitis is one of the most common skin diseases, and has a significant socio-economic impact*. A 2006 review estimated that

[131] *Study on the links between allergic reactions and textile products*, RSP for DG Enterprise, January 2013, page 10

among 3,000 individuals using a textile dye mix consisting of 8 disperse dyes the frequency of contact allergy was 1.5 per cent. In Denmark, some 20% of the population is allergic to chemical substances and known allergies have increased over the past 10 years. For dyes alone, a 2013 study[132] estimated that for 3 dyes (Disperse Blue 106, Disperse blue 124 and Disperse Orange 3), at least one in one hundred people are allergic. However, data on the prevalence of contact allergy in humans is not available for most existing dyes.

Based on an assumption of 1,500 chemicals used in textiles, DG Enterprise estimates the number of chemical mixtures used in textiles to be 15,000. However, the concentrations of sensitizing and irritating chemical substances used in these mixtures which potentially remain in the finished textile product are completely unknown. This knowledge gap is stressed as a major obstacle by a 2013 study on allergies and chemical compounds in textiles commissioned by DG Enterprise,[133] to the need to draw conclusions on *"whether there is a link between these substances (at the levels remaining on finished textiles) and contact dermatitis (allergy)".* When the lack of a standard testing method on allergies related to textiles is also taken into account, a clear idea of the extent of the knowledge gap emerges. Interestingly, the same report notes that most of the maximum limit values – maximum limits authorized in a product of said sensitizers – are not based on Quantitative Risk Assessment, but are arbitrary. This should urgently be changed, since Quantitative Risk Assessment, which takes into account aggregate exposures, is currently the most adequate available tool to set "safe limits" of chemicals in textiles.[134]

WECF is especially concerned about the arbitrary setting of maximum limit values for the strongest chemical sensitizers in textiles, and therefore supports measures to harmonize current limit values on quantitative risk assessments (QRA) as an immediate and urgent step, as well as to reinforce consumer information on which (potential) allergens may be found in textile products. However, to ensure sufficient consumer protection, regulation needs to go beyond the determination of 'safe limits' for hazardous chemicals such as sensitizers. WECF recommends stronger action to enforce a strict ban on strong chemical sensitizers in textile products, based on their intrinsic hazard, to the strictest possible detection limit using the most up to date testing technology (which would need to be periodically updated in the future), in particular for children's textiles, in order to reduce potential risk arising from cumulative sources of exposures.

Fact 6: Consumers are lost in a jungle of textile labels and confused by unclear information

Recommendation 6: Restore the confidence of consumers and citizens through the availability of clear and comprehensible information on textiles

Justification: Consumers want information on the presence or absence of certain chemicals in textile products, but they cannot find it! Are fashion/textile companies required to provide information about the manufacturer and/or the circumstances (e.g. factory working conditions) under which these products have been made, whether this is in the EU or elsewhere in the world?

[132] Quoted by KEMI, *Malinauskiene et al*, 2013.
[133] Study on the links between allergic reactions and textile products, RSP for DG Enterprise, January 2013, http://ec.europa.eu/enterprise/newsroom/cf/itemdetail.cfm?item_id=6955&lang=en&tpa_id=170&title=New%2DEC%2Dreport%2Dinvestigates%3A%2Dis%2Dthere%2Da%2Dneed%2Dfor%2Dadditional%2Dlabelling%2Dof%2Dtextile%2Dand%2Dleather%2Dproducts%3F
[134] Winjhove, S.W.P., Dutch RIVM Report 320025001/2008, *Allergens in Consumer Products*, 2008, http://www.rivm.nl/bibliotheek/rapporten/320025001.pdf

According to Textile Regulation n° 1007/2011, businesses may state the country of origin and provide social and environmental information in their labelling or packaging provided it is not misleading to consumers. In fact, there is no reliable and information system for the consumer to provide consumers with adequate information on the country of origin and ensure traceability of textile products.

UNEP notes the existence of a variety of some 70 textiles labels, as of 2011[135]. How are consumers to navigate their way through this jungle? Some companies judge it "too risky" to communicate about chemicals in products to the general public! But is it not too risky to be exposed to so many chemicals in textile products?

WECF recommends:

- **Coherence:** Simple rules that are based on the application of the most protective rules for health and environment should be the rule for all textile products: pyjamas would then be considered in the same category as sleeping bags!

- **REACH right to know:** Like to other articles, textile items are subject to the consumers "right to know" granted by REACH regulation, which means European consumers upon request to the supplier or retailer, must be informed of the presence of any substance classified as a "Substance of Very High Concern", if present in more than 0,1% (w/w). But how many consumers know about this right and use it? However, many chemicals of concern that could be present in textiles are not yet included in the REACH SVHC list. Consumers have a right to know which hazardous chemicals are used in the manufacture of textile products and are likely to be present in the final product.

Fact 7: Cheap textiles at any cost? The sacrifice of textile workers to the devastating economic, social and environmental production of textiles

Recommendation 7: The EU should champion social and environmental rights over trade and the "optimization of costs"

Justification: The workforce: As demonstrated by what can only be called the collapse of the textile mirage in Bangladesh, textiles production is governed by the need to "optimise" costs, by minimising workers' salaries as well as environmental and social protection costs. Indeed, the globalized textiles world of today is the result of a process which has been monitored and firmly encouraged by the World Bank, the WTO, IMF, and other interested stakeholders, such as corporations looking for a cheap workforce to be found in countries where environmental and social protection laws are not in force. In 2013, the result is obvious. Far from improving conditions in low-income countries, the pace of development in the textiles sector has created real inhuman conditions for workers, who pay the true cost of this industrial model in their everyday lives. Local communities, living with the effects of pollution from textiles manufacturing, also pay through lost livelihoods and health problems. It is unacceptable that countries have been encouraged to rely on one specific economic activity, as is the case for Bangladesh, and thus

[135] *The Chemicals in Products Project: Case Study of the Textiles Sector prepared by United Nations Environment Program*, January 2011, page 11.
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become dependent on this very sector, meaning that workers who are already in a very vulnerable situation due to the low revenues of the country, are forced to accept inhuman working conditions that can be likened to slavery in disguise, in order to make a living. Women are especially vulnerable to this kind of situation.

It is clear that legally binding instruments should be urgently implemented to prevent such tragic events in future. WECF urges institutions such as the International Labour Organization, UNEP and the World Health Organization to intervene to prevent activities by transnational companies that can cause long-term, irreversible damage to human health, the environment and the social conditions of workers. This is unacceptable in the 2013 globalized economy.

Missing corporate liability: At present, the textiles production chain lacks transparency, as for many imported goods which involve a long chain of successive stakeholders. Legal instruments to ensure corporate liability are not in place. A company acting at an international level can easily evade responsibilities that it does not feel liable for, due to the lack of coherent rules. In textiles, as in other sectors, companies too often do not bear the costs of their negative impacts on people and the environment (which can include poor working conditions, pollution of the air and water, damage to local agricultural production, violation of communities' rights and diseases caused to local populations as a result of contamination from industrial activities).

This report primarily addresses challenges for EU legislators and stakeholders, but in a globalized world, the global situation must also be considered. WECF stresses the need for the EU to engage in this issue by ensuring that sufficient resources (human and financial) are dedicated by in particular the big textile players to implement actions on the ground by monitoring, controlling and raising standards to ensure that the best available standards applicable within the EU are also in place outside the EU, where most of the textiles sold in the EU are today manufactured. This could be co-ordinated via a fund, to which large textile companies would contribute, which would serve to ensure that corporate responsibility becomes a reality. In addition, at national level, legal provisions to address damages caused by corporations outside the country where they occur should be enacted, with the support of technical and legal assistance mechanisms and sufficient dedicated resources to allow their implementation.

WECF supports international and national initiatives such as:

- The petition led by the Ecuadorian government at the United Nations Human Rights Council on Friday, September 13th, which marks a departure from reliance on voluntary mechanisms that have characterised the corporate social responsibility debate,
- The Stop Corporate Impunity campaign, http://www.stopcorporateimpunity.org/
- The national French Proposal to enhance social corporate responsibility, http://www.forumcitoyenpourlarse.org/data/File/mesures-phare-colloque-final.pdf
- The Clean Clothes campaign, http://www.cleanclothes.org/resources/publications/Breathless

Fact 8: Textiles production and the washing of textiles products releases contaminants into the environment, increasing the environmental burden of hazardous chemicals

Recommendation 8: Regulate chemicals released in the environment today to ensure a cleaner environment tomorrow

Justification: Tools such as the EU Water Framework Directive and Air Quality guidelines do not keep up with the development and consequent release of newly developed chemical compounds into the environment. While considering legislative measures to restrict the use and release of historic pollutants, which are more or less no longer used at an EU level, we miss the opportunity to restrict the use of their potentially toxic substitutes. This is a never ending story.

It is known that a certain number of chemicals found in garments may be water soluble and therefore released during washing: exposure to the consumer will be limited, as the substance will be washed off, contaminating the water cycle. Air and water contamination originating from textiles may be unnoticed but it is still real. In Finland for example, according to Månsson (2009), the stocks of DEHP, PBDE and AP/APEO are accumulating in the technosphere. This means that future emissions are likely to be higher than current emissions, even if no new additions are made. For DEHP, past usage might contribute to most of the current emissions.

Legislative action needs to implement the Precautionary Principle,[136] through enforcing the 'principle of producer responsibility' which places the responsibility to prevent ecological harm in the hands of those who can make the most effective changes. The REACH[137] approach of 'no data, no market' provides a good example, but its implementation needs to be accelerated and the scope of hazardous chemicals for regulation enlarged.

WECF recommends that **legislation should be adaptable to quick changes, while there is still time, to limit the dissemination of hazardous compounds in water, air and soil**: once released, some of these chemicals may persist in the environment. They become measurable but not avoidable, therefore action should not be delayed. The Water Framework Directive is a tool which should be used for this purpose and should include endocrine disrupters as well as antibacterial compounds for example, which are substances of very high concern.

Existing legal instruments, such as the Stockholm Convention and the SAICM process, also need to be implemented and enforced more rigorously so that that concrete improvements in the protection of both human health and the environment are achieved.

[136] This means taking preventive action before waiting for conclusive scientific proof regarding cause and effect between the substance (or activity) and the damage. It is based on the assumption that some hazardous substances cannot be rendered harmless by the receiving environment (i.e. there are no 'environmentally acceptable'/ 'safe' use or discharge levels) and that prevention of potentially serious or irreversible damage is required, even in the absence of full scientific certainty. The process of applying the Precautionary Principle must involve an examination of the full range of alternatives, including, where necessary, substitution through the development of sustainable alternatives where they do not already exist.

[137] REACH is the European Community Regulation on chemicals and their safe use (EC 1907/2006). It deals with the Registration, Evaluation, Authorisation and Restriction of Chemical substances. The law entered into force on 1 June 2007. The aim of REACH is to improve the protection of human health and the environment through the better and earlier identification of the intrinsic properties of chemical substances, and to make the `burden of proof´ (of a chemical´s safety) the responsibility of the chemical producer and not the authorities. At the same time, REACH aims to enhance innovation and competitiveness of the EU chemicals industry. See http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm [accessed 18 February 2011]

Fact 9: The standardization of manufacturing and consumption prevents the emergence of a sustainable textiles model

Recommendation 9: From global to local - engage in a transitional model for textiles, valuing the wealth of local, high-quality and small-scale textile stakeholders

Eco-design may prove to be the sustainable way forward for textiles, as well as for other categories of goods, such as toys and furniture. Indeed, all over the world, consumers ask for cleaner and greener products, while at the same time existing resource constraints makes it necessary to change the patterns of the current textile model.

Towards a more local model: As is the case for other activities, it is clear that there is a need to change to a more local model. All countries in the world would benefit. Reducing the distance between the places where textiles are manufactured and sold could be one option, and would help to restore local markets, with less interim actors involved. This would also make it easier for stakeholders to communicate, and improve the flow of information through the whole supply chain, enhancing transparency.

Towards extended, trustworthy labelling: Extending labelling such as Oeko-Tex 1000, GOTS, or the EU ecolabel to a wide range of products would significantly help consumers in their choices. Labels should not be the exclusive preserve of a few select products, which are often sold at a higher price and used as marketing tools. Another option would be to extend the criteria of these best-practice labels to all textile products, a process that could be done step by step, starting as a priority with products for infants, children and pregnant women.

Towards renewed consumer confidence in the product: A better knowledge of the product will trigger greater consumer confidence. Moreover, helping local production and local consumption to develop would also reduce the need for long-range transportation, the consumption of fuel and consequently the use of biocidal products during transport, reducing the overall impact of the textiles sector on the global environment.

These are all elements which can guide interested legislators and stakeholders towards a more coherent textiles model, at a time when the transition towards a more sustainable model has to become a reality.

Conclusion:
Beyond textiles: a global agenda for reducing the environmental, social and human impacts of textiles related activities

In the process of compiling this information on the textiles world, the most striking aspect is the quantity and diversity of existing information on chemicals in textiles, and the fact that this is still not enough to provide an exhaustive picture of the situation, as the unknown information on chemicals use in textiles seems to be even more important than what we do know.

At the same time, enough elements are in place to justify the need to act now to further regulate - and devote sufficient resources – to work towards the elimination of hazardous chemicals in final textile products. **As for similar issues of hazardous chemicals in products, the best way to avoid costly processes in terms of economic, social and environmental costs is to prevent the use of hazardous/potentially hazardous chemicals in products at the first place.**

The textiles world of today is based on an unsustainable model where it is possible that children's clothes sold here in the EU have been manufactured by children in a low income country, in another part of the world. Human, social and environmental factors must be considered hand in hand when addressing the problems of this unsustainable model.

Indeed, the *status quo* of textiles manufacturing today deserves a global effort from multiple stakeholders in order to change. All the facts and obstacles identified above, which have already been recognised in an impressive number of existing reports, deserve global action by States, companies and competent authorities at all levels. Individuals should also be encouraged to contribute to this big change, to stop the destructive and unsustainable textiles model of today and turn it into a constructive and positive model.

There are many challenges for the sector and for all the stakeholders involved:

- corporate liability needs to be enhanced; technical assistance to countries to implement decent working conditions and workers protection needs to be provided;
- human, financial and technical resources to stop the use and discharge of hazardous chemicals and their presence in the final product, need to be deployed;
- remediation of past pollution and the prevention of further damage from textiles production needs to be ensured; and
- human and environmental conditions need to take priority over trade rules.

Finally, the confidence of consumers in the safety of textile products, especially those that will be worn by our infants, children and by pregnant women, needs to be restored. To WECF, it is clear that a sustainable textile model can be reached, step by step, which may also be beneficial to employment in the EU, by encouraging the textiles manufacturing industry to base its model on the use of sustainable materials, local know-how and traditions. With greater transparency and accountability in the textiles industry, we will know that the clothes that are produced will be safer for our children.

Glossary of terms

BfR: German Federal Institute for Risk Assessment

CLP: Classification, Labelling, Packaging

CMR: Carcinogenic, Mutagenic, Reprotoxic

DBT: Dibutyl tin compound (an organotin)

DOT: Di-octyl tin compound (an organotin)

ECHA: European Chemicals Agency EDC: Endocrine Disrupting Compound

EC: European Commission

EU: European Union

EPA: Environment Protection Agency (USA)

ILO: International Labour Organization

KEMI: Swedish Chemicals Agency

MB: Methyl Bromide

NP: Nonylphenol

NPE: Nonylphenol ethoxylate

PFOA: Perfluoro- octanic acid

PFOS: Perfluoro-octanic-salt

PVC: Poly Vinyl Chloride

QPS: Quarantine Pre-Shipment

REACH: European Chemicals Regulation

RSL: Restricted Substances List

SVHC: Substances of Very High Concern

TBT: tributyl tin compound (an organotin)

UNEP: United Nations Environment Program

WECF: Women in Europe for a Common Future

WTO: World Trade Organization

Bibliography

Aizenshtein, E.M. (2009) Polyester fibres continue to dominate on the world textile raw materials balance sheet. Fibre Chemistry 40 (1): 1-8

ANEC/BEUC (2013), ANEC/BEUC inventory of products claiming to contain nano-silver particles available on the EU market 2012, 28th February 2013 http://www.beuc.org/Content/default.asp?pageId=1120&searchString=nanosilver

Australian Wool Innovation & International Wool Textile Association (2011), Understanding the environmental impacts of wool: A review of Life Cycle Assessment studies, http://www.iwto.org/uploaded/publications/Understanding_Wool_LCA2_20120513.pdf

BEUC (2012), Q&A – Chemicals in EURO 2012 shirts, http://www.beuc.org/custom/2012-00422-01-E.pdf

Brigden, K., Labunska, L., and Santillo, D (2010) Investigation of hazardous chemical discharges from

two textile manufacturing facilities, and chemical contamination of nearby canals connecting to the lower Chao Phraya River, Thailand, 2010 Greenpeace Research Laboratories Technical Note 06/2010

http://www.greenpeace.to/greenpeace/wp-content/uploads/2011/05/ChaoPhraya_canals_textilefacilities.pdf

Brigden, K., Labunska, L., Pearson, M., Santillo, D. and Johnston P., (2011) Investigation into hazardous chemicals discharged from two textile manufacturing facilities, China, 2011, Technical Note 01/2011, Exeter: Greenpeace Research Laboratories Will need to add URL for tech note.

Butte W, Heinzow B. Pollutants in house dust as indicators of indoor contamination. Rev Environ Contam Toxicol 2002; 175:1-46.

C&A, H&M, GStar RAW (2013), Data Discharge Report, February 2013, http://about.hm.com/content/dam/hm/about/documents/en/CSR/Others/Full%20Discharge%20Report_en.pdf

Collegium Ramazzini 2013, THE COLLEGIUM RAMAZZINI RELEASES AN OFFICIAL POSITION ON

ENDOCRINE DISRUPTING CHEMICALS (EDCS) AND CHEMICALS SAFETY POLICY IN THE EUROPEAN UNION,

Bologna, 13 June 2013, http://www.collegiumramazzini.org/download/2013_06_13_Collegium_Ramazzini_PR_EDCs.pdf

Danish Environmental Protection Agency (2003): Laursen SE, Hansen J, Drøjdahl A, Hansen OC, Pommer K, Pedersen E & Bernth N (2003). Survey of chemical compounds in textile fabrics. Survey no. 23, on behalf of the Danish Environmental Protection Agency. http://www.mst.dk/NR/rdonlyres/B9CDE217-9E41-4F27-A8A3-921D5B50A737/0/23.pdf

Danish Ministry of the Environment (2009), Survey of Chemical Substances in Consumer Products, 102, 2009

Survey and Health Assessment of the exposure of 2 year-olds to chemical substances in Consumer Products, http://www.mst.dk/Publikationer/Publications/2009/10/978-87-92548-81-8.htm

Danish Ministry of the Environment (2012), Survey of chemical substances in consumer products no. 117, 2012

Exposure of pregnant consumers to suspected endocrine disruptors

http://www.mst.dk/Publikationer/Publications/2012/April/978-87-92903-02-0.htm

Danish Ministry of the Environment (2008), Astrup Jensen A, Brunn Poulsen P & Bossi R (2008). Survey and environmental/health assessment of fluorinated substances in impregnated consumer products and impregnating agents, Survey of Chemical Substances in Consumer Products No 99, Copenhagen: Danish Environmental Protection Agency. http://www2.mst.dk/udgiv/publications/2008/978-87-7052-845-0/pdf/978-87-7052-846-7.pdf

Danish Ministry of the Environment (2012), Assessment of nanosilver in textiles on the Danish market, Environmental Project No. 1432, 2012, http://www2.mst.dk/Udgiv/publications/2012/06/978-87-92903-31-0.pdf

Danish Ministry of the Environment (2013), Survey and environmental and health assessment of nonylphenol and nonylphenol ethoxylates in textiles, Survey on chemical substances in consumer products no. 120, 2013,

ISBN no. 978-87-92903-94-5, http://www2.mst.dk/Udgiv/publications/2013/02/978-87-92903-94-5.pdf

Dorey, C.N. (2003), Chemical Legacy: Contamination of the Child, Greenpeace UK, October 2003, ISBN 1-903907-06-3, http://www.greenpeace.org/international/Global/international/planet-2/report/2003/10/chemical-legacy-contaminatio.pdf

The Ecologist (2012), Pesticide used by UK farmers is linked to long-term brain damage, http://www.theecologist.org/News/news_analysis/1727905/pesticide_used_by_uk_farmers_is_linked_to_longterm_brain_damage.html

Ecotextile News (2012), Roisin Woolnough, August/September 2012 www.ecotextile.com

EJF (2007), The Deadly Chemicals in Cotton, Environmental Justice Foundation in collaboration with Pesticide Action Network UK, London, UK. ISBN No. 1-904523-10-2. http://ejfoundation.org/sites/default/files/public/the_deadly_chemicals_in_cotton.pdf

Endocrine Society (2013), Scientists Urge UN to Take Action on Chemicals in Consumer Products and Pesticides, 23 April 2013, http://www.endo-society.org/media/press/2013/Scientists-Urge-UN-to-Take-Action-on-Chemicals-in-Consumer-Products-and-Pesticides.cfm

Environmental Health Perspectives (2013), The Impact of Endocrine Disruption: A Consensus Statement on the State of the Science, Editorial, Ake Bergman et. al., 1/4/2013, http://ehp.niehs.nih.gov/1205448/

Environmental Working Group (2009), Pollution in Minority Newborns: BPA and other Cord Blood Pollutants

November 23, 2009, http://www.ewg.org/research/minority-cord-blood-report/bpa-and-other-cord-blood-pollutants

FAO (2009), THE MARKET FOR ORGANIC AND FAIR-TRADE COTTON FIBRE AND COTTON FIBRE PRODUCTS, Study prepared in the framework of FAO project GCP/RAF/404/GER “Increasing incomes and food security of small farmers in West and Central Africa through exports of organic and fair-trade tropical products" By Ellen Pay Trade and Markets Division FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS Rome, 2009

Fibre2Fashion (2013), UN exhorts apparel brands to avert more Bangla disasters
http://www.fibre2fashion.com/news/textile-news/bangladesh/newsdetails.aspx?news_id=146012

Finnish Environment Institute (2011), Risk management and governance of chemicals in articles, Case study textiles; The Finnish Environment 16, 2011, Helsinki 2011

FoE Norway/SSNC (2006) - Schultz P.-E & Norin H (2006). Fluorinated pollutants in all-weather clothing, Friends of the Earth Norway, Report 2/2006.
http://naturvern.imaker.no/data/f/0/75/41/1_2401_0/2_Fluorinated_pollutants_in_all-weather_clothing.pdf

GOTs 2013, Is it possible to use bamboo in GOTs certified textiles? http://www.global-standard.org/information-centre/faqs.html#is-it-possible-to-use-bamboo-in-gots-certified-textiles

Greenpeace Environmental Trust (2003), Consuming Chemicals, Hazardous chemicals in house dust as an indicator of chemical exposure in the home, May 2003,
http://www.greenpeace.org/international/en/publications/reports/consuming-chemicals-hazardou/

Greenpeace Research Laboratories (2003), Consuming Chemicals #2, Hazardous chemicals in house dust as an indicator of chemical exposure in the home, December 2003

http://www.greenpeace.org/eu-unit/en/Publications/2009-and-earlier/house-dust-2/

Greenpeace Belgium (2004), Hazardous Chemicals in Belgian House Dust, March 24 2004,
http://www.greenpeace.org/eu-unit/en/Publications/2009-and-earlier/Rapport-Hazardous-Chemicals-in-Belgian-House-Dust/

Greenpeace 2004, Toxic Childrenswear by Disney, Brussels, April 2004,
http://www.greenpeace.org/international/Global/international/planet-2/report/2004/4/finding-chemo-toxic-children.pdf

Greenpeace International (2006) "What are Persistent Organic Pollutants?", 10 April
www.greenpeace.org/international/campaigns/toxics/toxic-hotspots/what-are-persistent-organic-po/

Greenpeace 2009, "Poisoning the Pearl: An investigation into industrial water pollution in the Pearl River Delta", second edition 2010-01-19, http://www.greenpeace.org/eastasia/publications/reports/toxics/2010/pearl-river-report-2009-2nd/

Greenpeace 2010, Picking Cotton, The choice between organic and genetically-engineered cotton for farmers in South India, Reyes Tirado, Greenpeace Research Laboratories,

Greenpeace 2011a, Dirty Laundry, Unravelling the corporate connections to toxic water pollution in China, July 2011
http://www.greenpeace.org/international/en/campaigns/toxics/water/Dirty-Laundry-report/

Greenpeace International (2011b). Dirty Laundry 2: Hung Out to Dry: Unravelling the toxic trail from pipes to products. August 2011.
http://www.greenpeace.org/international/en/publications/reports/Dirty-Laundry-2/

Greenpeace e.V. 2012, Chemistry for any weather, Greenpeace tests outdoor clothes for perfluorinated toxins, October 2012, Greenpeace e.V.
http://www.greenpeace.de/fileadmin/gpd/user_upload/themen/chemie/gp_outdoor_report_2012_engl_fol_fin_neu_02_es.pdf

Greenpeace International (2012a). Dirty Laundry: Reloaded. How big brands are making consumers unwitting accomplices in the toxic water cycle. 20 March 2012.
http://www.greenpeace.org/international/en/publications/Campaign-reports/Toxics-reports/Dirty-Laundry-Reloaded/

Greenpeace International (2012b). Toxic Threads: The Big Fashion Stitch-Up. November 2012.
http://www.greenpeace.org/international/big-fashion-stitch-up

Greenpeace International (2012c). Toxic Threads: Putting Pollution on Parade. December 2012.
http://www.greenpeace.org/international/en/publications/Campaign-reports/Toxics-reports/Putting-Pollution-on-Parade/

Greenpeace International (2012d). Toxic Threads: Under Wraps. December 2012.
http://www.greenpeace.org/international/en/publications/Campaign-reports/Toxics-reports/Toxic-Threads-Under-Wraps/

Greenpeace (2013), Toxic Threads: Polluting Paradise. A story of big brands and water pollution in Indonesia, Publication - April 17, 2013 http://www.greenpeace.org/international/en/publications/Campaign-reports/Toxics-reports/Polluting-Paradise/

Greer, L., Keane, S.E. and Lin, X. (2010) NRDC's ten best practices for textile mills to save money and reduce pollution: A practical guide for responsible sourcing, New York: Natural Resources Defense Council, p.3

www.nrdc.org/international/cleanbydesign/files/rsifullguide.pdf

IPCS (2002), Global Assessment of the State of the Science of Endocrine Disruptors, International Programme on Chemical Safety, An assessment prepared by an expert group on behalf of the World Health Organization,

the International Labour Organisation, and the United Nations Environment Programme, WHO 2002,

http://www.who.int/ipcs/publications/new_issues/endocrine_disruptors/en/

IPPC (2003) Reference document on best available techniques for the textiles industry (adopted July 2003) http://www.bvt.umweltbundesamt.de/archiv-e/bvt_textilindustrie_zf.pdf

KEMI (1997), Chemicals in Textiles. Solna, Swedish Chemical Agency, p.19. http://www.kemi.se/upload/Trycksaker/Pdf/Rapporter/Report_5_97_Chemicals_in_textiles.pdf

KEMI (2011), Antibacterial substances leaking out with the washing water –analyses of silver, triclosan and triclocarban in textiles before and after washing, Swedish Chemicals Agency Order No. 511 032 Sundbyberg, February 2012, www.kemi.se

KEMI (2013), Hazardous chemicals in textiles – report of a government assignment, The Swedish Chemical Agency, Report no. 3/13

KEMI (2013a), Analysis of garments worn close to the skin, 18 June 2013 http://www.kemi.se/en/Content/News/Analysis-of-garments-worn-close-to-the-skin/

Labrèche F, Goldberg M S, Valois M-F, Nadon L, (2010), Postmenopausal breast cancer and occupational exposures, Occup Environ Med 2010;67:263-269 doi:10.1136/oem.2009.049817 http://oem.bmj.com/content/67/4/263.abstract

Lacasse, K. and Baumann, W. (2004) Textile chemicals: Environmental data and facts, Berlin, London: Springer, p.81, http://books.google.ch/books?id=bEGHgosxxPwC&printsec=frontcover&hl=de&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

Nordic Council (2013), Per and polyfluorinated substances in the Nordic Countries - Use, occurence and toxicology, ISBN 978-92-893-2562-2, http://dx.doi.org/10.6027/TN2013-542,

TemaNord 2013:542 © Nordic Council of Ministers 2013

OECD (2006) Water: The experience in OECD countries, p.39 www.oecd.org/dataoecd/18/47/36225960.pdf

OEkotextiles (2012), Eucalyptus fiber by any other name, 2/03/2012

http://oecotextiles.wordpress.com/tag/oeko-tex/

OCU-Compra Maestra (2011), Estudio; Disfraces – no juego con fuego, Marzo 2011 nº 357 I 29 (article in Spanish consumer magazine concerning fancy dress)

Ökotest (2011), Kinder & Familie, Test: Kinderschlafanzuge, Druckfehler, November 2011

Pinkerton, L E., Hein M J, Stayner L T, (2004), Mortality among a cohort of garment workers exposed to formaldehyde: an update, http://oem.bmj.com/content/61/3/193.abstract

Rudel R A., Dodson, R. E., Perovich L. J., Morello-Frosch R, Camann D. E., Zuniga M.M., Yau,Allan A. Y. Just C, and Green Brody J. (2013) Semivolatile Endocrine-Disrupting Compounds in Paired Indoor and Outdoor Air in Two Northern California Communities, Environ. Sci. Technol. 2010, 44, 6583–6590 http://pubs.acs.org/doi/pdf/10.1021/es100159c

Rybicki E et al., (2004), 'Changes in hazardous substances in cotton after mechanical and

chemical treatment of textiles,' Fibre and Textiles in Eastern Europe, April/ June, Vol. 12,

No. 2, 24, (2004). http://www.fibtex.lodz.pl/46_18_67.pdf

Sci Dev Net (2006), GM in India: the battle over Bt cotton, http://www.scidev.net/global/biotechnology/feature/gm-in-india-the-battle-over-bt-cotton.html

Scientific American (2009), Tests Find More Than 200 Chemicals in Newborn Umbilical Cord Blood, December 2 2009. http://www.scientificamerican.com/article.cfm?id=newborn-babies-chemicals-exposure-bpa

Schultz, P.-E. and Norin, H. (2006) Fluorinated pollutants in all-weather clothing, Friends of the Earth Norway, Report 2/2006, http://naturvern.imaker.no/data/f/0/75/41/1_2401_0/2_Fluorinated_pollutants_in_all-weather_clothing.pdf

Swedish Society for Nature Conservation (2011), Home Sweet Home? --- dusty surprises under the bed; A study on the chemical cocktail in household dust from all corners of the world, 14 September 2011, 978-91-558-0069-7, Tryckeri Åtta 45, Stockholm 2011,

http://www.naturskyddsforeningen.se/sites/default/files/dokument-media/dammrapport_eng_121217.pdf
http://www.chemsec.org/images/stories/2011/chemsec/home_sweet_home_lowres.pdf

Swedish Society for Nature Conservation (2011a), BAMBUVISKOS– En hållbar fiber för framtiden? (assessment of regenerated bamboo viscose), Göteborg, 24:e Maj 2011Elin Magnusson och Karin Svensson

Swedish Society for Nature Conservation (2012), Good Environmental Choice, Textiles Criteria, 2012: 1

Swedish Society for Nature Conservation (2008). T-shirts with a murky past, Report 8 9629,

http://www.naturskyddsforeningen.se/upload/report-t-shirts-with-amurky-past.pdf

Swedish Society for Nature Conservation (2008a), Faktaunderlag Hållbar odling av växtertill textile (review of alternative textile fibres, details in English).

The Telegraph (2010), Cancer risk 'at least doubles' for women in textile industry Young women working in the textile industry are at an increased risk of developing breast cancer after the menopause due to their exposure to man-made fibres, scientists have said. 1/4/2010 http://www.telegraph.co.uk/health/women_shealth/7542047/Cancer-risk-at-least-doubles-for-women-in-textile-industry.html

Test-Achats (2012), SUBSTANCES CHIMIQUES DANS LE TEXTILE (underwear), Test-sante 109, juin/juillet 2012

The Textile Institute (2005), Biodegradable and Sustainable Fibres, edited by R.S. Blackburn, CRC Press/Woodhead Publishing Limited

UNEP (2013), Global Chemicals Outlook, towards sound management of chemicals, synthesis report for decision makers, United Nations Environment Programme 2012, ISBN: 978-92-807-3275-7, http://www.unep.org/pdf/GCO_Synthesis%20Report_CBDTIE_UNEP_September5_2012.pdf

UNIDO (2003) The United Nations World Water Development Report: Water for people water for life http://portal.unesco.org/en/ev.php-URL_ID=10064&URL_DO=DO_TOPIC&URL_SECTION=201.htm

Valeur, Cecilie Camilla (2013), The Potential for Green Textile sourcing from Tirupur - On the path to more sustainable global textile chains, Danish Federation of Small & Medium Sized Enterprises. ISBN 978-92-893-2559-2 http://dx.doi.org/10.6027/TN2013-540 TemaNord 2013:540 © Nordic Council of Ministers 2013

Walters. A, Santillo, D, Johnston, P.: An overview of Textiles processing and related environmental concerns. Greenpeace Research Labaratories. University of Exeter. 2005.

http://www.greenpeace.to/publications/textiles_2005.pdf

Walters A & Santillo D (2006). Uses of Perfluorinated Substances, Technical Note 06/2006, Exeter: Greenpeace Research Laboratories.

http://www.greenpeace.to/publications/uses-of-perfluorinated-chemicals.pdf

Windler L, Height M, Nowack B, (2013), Comparative evaluation of antimicrobials for textile applications. Environ Int. 2013 Mar;53:62-73. doi: 10.1016/j.envint.2012.12.010. Epub 2013 Jan 21. http://www.ncbi.nlm.nih.gov/pubmed/23347947 (note, need to pay for access to full report, unless someone already subscribes…)

WHO 2013a, News Release, Effects of human exposure to hormone-disrupting chemicals examined in landmark UN report, 19th February 2013, http://www.who.int/mediacentre/news/releases/2013/hormone_disrupting_20130219/en/index.html

WHO 2013b, State of the science of endocrine disrupting chemicals - 2012

An assessment of the state of the science of endocrine disruptors prepared by a group of experts for the United Nations Environment Programme (UNEP) and WHO, 2013, http://www.who.int/ceh/publications/endocrine/en/index.html

WTO (2012), Table 11.69, Leading exporters and importers of clothing, 2011, International Trade Statistics 2012, Merchandise Trade, and Table 11.64, Leading exporters and importers of textiles, 2011. http://www.wto.org/english/res_e/statis_e/its2012_e/its12_merch_trade_product_e.htm

Wong E Y, Ray RM, Gao D L, Wernli K J, Li W, Fitzgibbons E D, Camp J E, Astrakianakis G, Heagerty P J, Thomas, and Checkoway H, (2009), Dust and Chemical Exposures, and Miscarriage Risk Among

Women Textile Workers in Shanghai, China, Occup Environ Med. 2009 March ; 66(3): 161–168. doi:10.1136/oem.2008.039065.

World Water Assessment Programme (2009) The United Nations World Water Development Report 3: Water in a changing world, Paris: UNESCO Publishing and London: Earthscan

www.unesco.org/water/wwap/wwdr/wwdr3/

World Water Assessment Programme (2009), www.unesco.org/water/wwap/wwdr/wwdr3/pdf/WWDR3_Water_in_a_Changing_World.pdf

ZDHC (2012), 2012 Annual Report, p.10 - 12, http://www.roadmaptozero.com/programme-documents.php

ZDHC (2013), Chemical Inventory Database and Chemical Inventory Summary List http://www.roadmaptozero.com/programme-documents.php

ZDHC (2013a), Benchmarking Report, July 2013 http://www.roadmaptozero.com/programme-documents.php

Zhang, Yuntao (2009), Chemical Information in Two Textile Supply Chains, A case study of producers in China, Chalmers University of Technology, Goteborg, Sweden, Report No. 2009:10 http://publications.lib.chalmers.se/records/fulltext/103455.pdf

Complementary bibliography for Chapter II

Analysis of garments worn close to the skin, Swedish Chemicals Agency, June 2013, http://www.kemi.se/en/Content/News/Analysis-of-garments-worn-close-to-the-skin/

Au Bangladesh, les meurtriers du prêt-à-porter, Olivier Cyran, Le Monde Diplomatique, Juin 2013

BfR und UBA empfehlen, den Einsatz von Organozinnverbindungen in Verbraucherprodukten weiter zu begrenzen, 2008, http://www.bfr.bund.de/cm/343/bfr_und_uba_empfehlen_den_einsatz_von_organozinnverbindungen_in_verbraucherprodukten_weiter_zu_begrenzen.pdf

Chemicals in textiles, practical advice for companies in the sector, Swedish Chemicals Agency, 2009

UNEP, DTIE/Chemicals Branch (2011), The Chemicals in Products Project: Case Study of the Textiles Sector, United Nations Environment Program DTIE / Chemicals Branch, January 2011,

http://www.unep.org/hazardoussubstances/Portals/9/CiP/CiPWorkshop2011/CiP%20textile%20case%20study%20report_21Feb2011.pdf

Des créateurs qui ont la banane, Néoplanète 33, février/mars 2013

The Commodity Guide, Swedish Chemicals Agency, http://www.kemi.se/en/Content/Statistics/The-Commodity-Guide/

EU Regulation 1007/2011 of the European Parliament and the Council of 27 September 011 on textile fibre names and related labelling and marking of the fibre composition of textile products, Frequently Asked Questions on regulation 1007/2011, http://ec.europa.eu/enterprise/sectors/textiles/files/regulation-1007-2011-faq_en.pdf

Guidance document on the interpretation of the concept “which can be placed in the mouth” as laid down in the Annex to the 22nd amendment of Council Directive 76/769/EEC, European Commission, http://ec.europa.eu/enterprise/sectors/chemicals/files/markrestr/guidance_document_final_en.pdf

Need for coherent Union legislation on hazardous substances in textiles, Information from the Swedish delegation to the Council of the European Union, October 2012

http://register.consilium.europa.eu/pdf/en/12/st14/st14905.en12.pdf

Plant Dyes for the textile industry, Astrid Konrad, Research Institute for Managing Sustainability - on behalf of the Austrian Ministry of Agriculture, Forestry, Environment and Water Management,

Norden (2012), Prevention of Textile waste, Material flows of textiles in three Nordic countries and suggestions on policy instruments, October 2012, Nordic Council of Ministers, http://www.norden.org/en/publications/publikationer/2012-545

Rapport annuel, Union des Industries Textiles France, 2012-2013, http://www.textile.fr/sites/default/files/ra_uit_2012-13.pdf

Report on the collaborative trial organised by the JRC on the determination of PVC and phthalates in textile products, P. Piccinini, C. Senaldi, Joint Research Center, 2012, http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/27312/1/lb_na_25674_en_n.pdf

Report on the proposal for a regulation of the European Parliament and of the Council on textile names and related labelling of textile products, IMCO committee, Toine Manders, 30 April 2010, http://www.europarl.europa.eu/sides/getDoc.do?language=EN&reference=A7-0122/2010

Risk management and governance of chemicals in textiles, Case study articles, Finnish Environment Institute, 2011, http://www.syke.fi/download/noname/%7BAC050A5F-30E3-48D0-A8A4-28C8763459E5%7D/28586

Study on the Link Between Allergic Reactions and Chemicals in Textile Products, Final Report for DG Enterprise, European Commission, RPS, 7 January 2013, http://ec.europa.eu/enterprise/sectors/textiles/files/studies/study-allergic-reactions-textile_en.pdf

Danish MoE (2011), Survey of chemicals substances in textiles, Danish Ministry of the Environment , 2011, http://www2.mst.dk/udgiv/publikationer/2011/09/978-87-92779-37-3.pdf

Survey and environmental and health assessment of nonylphenol and nonylphenlethoxylates in textiles, Survey on chemical substances in consumer products no. 120, 2013, Danish Environment Agency, http://www2.mst.dk/Udgiv/publications/2013/02/978-87-92903-94-5.pdf

Toxic Threads: the big Fashion Stitch-up, Greenpeace, October 2012

Tests on textiles products:

Hosen runter!; Öko-Test Kinder 5, 2013

Kinderschlafanzuge, Ökotest November 2011, http://www.oekotest.de/cgi/index.cgi?artnr=98859&bernr=07&seite=02

Websites:

Chemical Inspection and Regulation Service, http://www.cirs-reach.com/Testing/AZO_Dyes.html

European Environment Agency, http://www.eea.europa.eu/

European Chemicals Agency, http://echa.europa.eu/web/guest/home

European Topic Centre on Sustainable Consumption and Production http://scp.eionet.europa.eu/themes/waste_prevention/wplibrary/waste_textiles

EU Joint Research Center

KEMI, Swedish Chemicals Agency, http://www.kemi.se/en/

United Nations Environment Program, http://www.unep.org/

EU Rapid Alert Platform Information Exchange (RAPEX)

REACH Restriction table, ECHA website