

Chemicals in textiles

PRACTICAL ADVICE FOR COMPANIES IN THE SECTOR

KEMI
Swedish Chemicals Agency

Contents

- 3 Foreword
- 4 The textile industry – a chemical-intensive sector
- 4 Chemicals are used in manufacturing
- 7 Functions are fulfilled and needs are met using chemicals
- 8 The textile industry has an impact on the environment in many countries
- 9 More people need to know more about chemicals in articles
- 10 Statutory requirements and objectives in Sweden and the EU
- 15 Certain substances are persistent
- 18 Some substances have an impact on the aquatic environment
- 19 Certain substances are hazardous to health
- 20 The objective is a non-toxic environment
- 24 The Swedish Chemicals Agency's risk reduction tool Prio – a source of knowledge
- 25 Checklist to reduce risks associated with chemicals in textiles



Foreword

It is difficult to believe that anyone would deliberately manufacture articles that are harmful to humans and the environment. It nevertheless happens that substances of very high concern are present in such products as textiles.

It is the companies that place articles on the market that are responsible for ensuring that they are not harmful to human health or the environment. Many Swedish companies that handle textiles have been working to reduce chemical risks for many years, while others have not yet had time to start. New avenues need to be explored and new solutions have to be found. This represents a challenge.

Companies need to actively gather knowledge, exercise caution, phase out substances of very high concern and steadily reduce the risks. Active control of chemicals at the company makes it easier to respond to alerts, new rules on chemicals and worried consumers.

This brochure, *Chemicals in Textiles*, has been produced to assist both companies that already have good chemical control and those that feel that the time has come to face up to chemical issues. The brochure contains facts about chemicals in textiles and practical advice for companies in this sector.

The textile industry – a chemical intensive sector

More textiles than ever are now manufactured and used, and chemicals are added for an ever increasing number of purposes. And these chemicals do indeed offer certain benefits. They can, for example, make the manufacturing processes easier and endow the final products with a specific function or a particular desirable appearance. These textiles may, for example, be greenhouse fabrics that reflect the sun, flameproof furniture fabrics, durable airbags for vehicles, colour-coordinated bath towels, hard-wearing sweaters or workwear that effectively withstands moisture and dirt. Without chemicals it would almost be impossible to produce modern textiles.

But the increased use of chemicals has a downside. These substances may pose risks to the environment and human health which may have unsuspected consequences for the future. Chemicals therefore need to be used in a more sustainable way. Hazardous substances should not be used unnecessarily, and newly produced articles should not contain substances that have properties of very high concern from the points of view of human health or the environment.

Chemicals are used in manufacturing

In comparison with other countries, the volume of textiles manufactured in Sweden is small. The production that does take place is concentrated on the region around Borås. Textiles in Swedish shops principally come from countries outside Europe such as Bangladesh, India and China.

Chemicals for cultivation and manufacturing

The manufacturing of textiles from fibre to finished product takes place in several stages, and chemicals are involved in many processes. Traditional cultivation of cotton requires large quantities of pesticides, several of which are hazardous to human health or the environment.

No chemical pesticides, commercial fertilisers or genetically modified organisms are used in organic cotton cultivation. A number of chemicals are used in manufacturing in textile factories, such as lubricant oils in spinning and knitting and adhesives that strengthen and protect the threads in weaving.

Chemicals for colour and shape

Different materials have different properties, and the origin of the fibre has a significant bearing on what chemicals are used. Substances to increase absorption capacity and reduce shrinkage, for example, are used in the manufacturing of cotton fabrics. To make the textile white, bleaches and optical brighteners are used.

A number of different dyes and dyeing methods are used to obtain the desired colour and colour-fastness, and chemicals are added so that the dyeing process will work. Coatings of plastic and rubber are sometimes used to bring about patterns, make the fabric watertight or achieve other effects. These materials may contain plasticisers such as phthalates, which are hazardous to health.

Many of the chemicals used in the manufacturing process are rinsed out using detergents and water. Some substances are broken down or are dealt with in wastewater treatment, while others reach watercourses. Residual levels of manufacturing chemicals may sometimes remain in the finished products.





Find out what chemicals are used in cultivation and in the manufacturing of the textiles you use. Choose less chemical-intensive methods and materials. Choose organically grown cotton, for example, instead of traditionally cultivated cotton.

Functions are fulfilled and needs are met using chemicals


Textile materials take many different forms and have many different functions. Chemicals are used, for instance, to make the fabric stiff, soft or shiny. They may also be used to obtain a fabric that does not shrink, crease, become matted or cause static. In some cases the purpose for which they are used is flame-proofing, in others to repel oil, water or dirt. Chemicals may also be added so that the colours are not faded by sunlight, to provide a particular fragrance or to highlight luminous properties in the fabric.

They are sometimes used to prevent microbial attack. The substances are added so that the textiles can cope with transportation in damp conditions without becoming mouldy. Anti-mould agents may be present in the textile or be supplied with the packaging in separate bags. Chemicals are also used as preservatives, for example in dye pastes for textile printing, to counteract bacteria, for example in sportswear, or to counteract mould on outdoor fabrics.

Needs and effects vary

As different fibres have different properties, the need for and effect of a treatment varies from one material to another. Synthetic fibres, for example, require antistatic treatment to a greater extent than other materials, and wool has a lower capacity to ignite than other materials and therefore does not need flame-


retardant treatment. Functional chemicals are not always tightly bound to the material, and over the course of time may wear or be washed out of the textile, so that they are dispersed in the environment.

 *Find out which chemicals are used to attain certain functions in the textiles handled by your company. Are these particular functions needed? Can certain treatments that require the use of hazardous chemicals be omitted – for example with regard to dirt-repellent, flame-retardant and antibacterial treatment and certain shades of colour? Are there any alternative solutions?*

The textile industry has an impact on the environment in many countries

Both people and the environment are exposed to chemicals in and around cotton plantations and textile factories. Contaminated water and water shortages caused by an intensive textile industry may have extensive local consequences in the manufacturing countries.

Some countries have inadequate legislation to protect the environment and human health. It is therefore important that companies that trade in these countries are aware of their responsibility and stipulate requirements – wherever in the world they operate.

 *Bear in mind that the greatest chemical risks may be in manufacturing countries outside the EU. How can Swedish companies jointly contribute to reducing the risks in these countries? What can your company do?*

More people need to know more about chemicals in articles

A problem with chemicals in textiles is that there is insufficient knowledge. It may be difficult to obtain information on what substances have been used. Knowledge is sometimes also lacking on the properties of substances, how they interact, where they eventually end up and how they affect the environment and human health. To know the combined risk people and the environment are exposed to when hazardous chemicals are used, the entire lifecycle has to be considered, from the production of raw materials to manufacturing, use and final disposal. Caution should always be exercised where knowledge is lacking and there is uncertainty.

In products such as furniture and shoes, textile materials are combined with other types of material, such as plastic, foam rubber, wood and metal. This makes the picture even more complex with regard to chemical content, risk assessment, risk management and management of end-of-life products.

Acquire knowledge and make demands

Companies that place products on the Swedish market are responsible for ensuring that the products do not harm human health or the environment. They are obliged to replace chemicals that pose risks with less hazardous alternatives. This responsibility is laid down for instance in the Product Safety Act and the Environmental Code.

It is important to lay down requirements suppliers must meet with regard to chemical content. Hazardous substances that are no longer used in the EU may be permitted in other countries and enter Sweden in imported textiles. You can find advice on how to go about stipulating requirements in the checklist later in the brochure.



There is a need for increased knowledge on the content of chemical substances in textiles, the properties of the substances and how they affect the environment and human health. Try to keep the company updated at all times on what is required. Ask questions and make demands on suppliers. Ask for assistance from sector organisations, the Swedish Chemicals Agency etc.

Statutory requirements and objectives in Sweden and the EU

A description is given below of a selection of important regulations on chemicals and objectives primarily aimed at companies that import and sell textiles in Sweden. For the precise wording, please refer to the regulations concerned. Companies that manufacture and prepare textiles have more far-reaching responsibility and are affected to a greater extent by the Environmental Code, rules on the working environment and other rules concerned with chemicals. Further information is available on the website of the Swedish Chemicals Agency, www.kemi.se.

The environmental objective of A Non-Toxic Environment

The Swedish Parliament has adopted a number of short-term and long-term environmental objectives. The environmental objective for a non-toxic environment, in brief, means as follows:

- There must be better knowledge of the properties of substances with respect to the environment and health.
- Articles must be provided with information on the hazardous substances they contain.
- Newly produced articles must, as far as possible, be free of what are known as phase-out substances, that is to say the metals mercury, lead or cadmium, and substances that are: persistent and bioaccumulative, carcinogenic, mutagenic,



toxic to reproduction, endocrine disrupters and highly allergenic.

- Existing articles that contain the types of substances mentioned above must be handled in such a way that the substances do not leak into the environment. The substances must not be used in production processes unless companies can show that they cannot cause harm to health and the environment.
- The risks to health and the environment in the production and use of chemical substances must decrease. The presence and use of substances that make it more difficult to recycle materials must decrease.

General rules

- Anyone who operates a business, for example importing and selling textiles, is obliged to take the precautions required to protect human health and the environment (Chapter 2 of the Environmental Code).
- Chemicals that pose risks to human health or the environment must be replaced by less hazardous alternatives (Chapter 2 of the Environmental Code).
- Only consumer products that are safe from the point of view of health may be placed on the market (Product Safety Act [2004:451] and Product Safety Ordinance [2004:469]).
- Garments and materials for use in such garments must not be placed on the market if they have been treated with a chemical product and may consequently be harmful to humans (Chemical Products (Handling, Import and Export Prohibitions) Ordinance [1998:944], Section 16).

Detailed rules

- Any supplier of an article containing a substance of very high concern included in the candidate list for the authorisation procedure in the REACH Regulation is obliged to provide the recipient of the article with sufficient information to allow safe use of the article (Regulation (EC) No 1907/2006, Article 33). This information must, as a minimum, include the name of the substance. The relevant information must also be provided to consumers, at the request of consumers, within 45 days. Successive additions will be made to the candidate list. The substances included in the first candidate list (published in October 2008) and used in textile production are 4,4-diaminodiphenyl methane, dibutyl phthalate (DBP), di(2-ethylhexyl) phthalate (DEHP), hexabromocyclodecane (HBCDD), bis(tributyltin)oxide (TBTO) and benzyl butyl phthalate (BBP). Further information is available on the website of the Swedish Chemicals Agency, www.kemi.se.
- Substances intended to be released from an article (for example fragrances in textiles) must be registered. Authorisation is required to be allowed to sell and use substances of very high concern which are listed in Annex XIV to the REACH Regulation. The European Commission will decide which substances from the candidate list are to be included in Annex XIV. This work begins in 2009.
- Pesticides such as plant protection products, insecticides and anti-mould agents must be approved for sale and use in the EU under Directive 91/414/EEC on plant protection products and Directive 98/8/EC on biocidal products. The Swedish Chemicals Agency's Pesticides Register contains details of pesticides that are approved in Sweden.
- Toys must not contain hazardous substances that may pose risks to health (Toy Safety Act [1992:1327] and Toy Safety

Ordinance [1993:971]). The Toys Safety Directive (2009/48/EG) bans substances that are carcinogenic, mutagenic or toxic for reproduction. It also bans several allergenic fragrances and regulates the migration of metals. The rules will entry into force 2013.

- Cadmium must not be used as surface treatment or as a stabiliser or pigment. Articles that contain such a cadmium substance must not be sold or imported (Chemical Products (Handling, Import and Export Prohibitions) Ordinance [1998:944], Section 3. There are some exceptions to this rule in Swedish Chemicals Agency Regulations (KIFS 2008:2), Chapter 5.
- There are special rules on restriction in the EU for azo dyes, the flame retardants tris(2,3-dibromopropyl) phosphate, tris(1-aziridinyl) phosphin oxide, polybrominated biphenyls, pentabromophenylether and octabromodiphenylether, nickel, nonylphenol, nonylphenoxyethoxyethyl and perfluorooctane sulphonate (PFOS). These rules are contained in the Swedish Chemicals Agency's Restricted Substances Database.
- The allergenic anti-mould agent dimethylfumarate (DMF) is prohibited in Swedish articles from 1 May 2009. The decision was made pursuant to the General Product Safety Directive (2001/95/EC) and implemented in Swedish legislation by Sections 15 a-c in Ordinance (1998:944).
- A total of 33 prioritised substances have been included in the EU's Water Framework Directive (2006/60/EC). The goal for these substances is that emissions to the environment will cease by 2020.

- A company is responsible for products placed on the market not harming human health or the environment. It is easier to fulfil the more detailed rules on chemicals that limit certain substances by actively gathering knowledge, exercising caution, phasing out substances of very high concern and continuously reducing risks. Active control of chemicals also means that your company is better prepared when new detailed rules come into force.*

Certain substances are persistent

Environmentally hazardous substances in the textile industry pose risks, depending on how they are used and dispersed. Substances that are difficult to break down (persistent), accumulate in living organisms (bioaccumulative) or toxic – known as PBT substances – are particularly problematic. As it takes a long time for these substances to be broken down, they continue to be dispersed and may cause harm far away from the places where they were emitted. They are transported through water and air and are taken up by plants and animals. In some cases they end up in our food and gradually enter our blood. It is very difficult to gain an overview and understand the consequences of the diffuse dispersal of chemical substances from articles.

An example of persistent substances in the textile industry is what are known as highly fluorinated substances. These are used as impregnating agents to prevent water, dirt and oil from penetrating the fabric.



From jackets to polar bears

One of the highly fluorinated substances – perfluorooctane sulfonate (PFOS) – has been found in polar bears in the Arctic, in fish and in the blood and breast milk of Swedish women. Today PFOS is regulated in the EU, and this substance has been largely replaced by other highly fluorinated substances in manufacturing, but the alternatives may also pose risks as some of them are persistent and bioaccumulative. In other parts of the world, such as China, PFOS is still used, for instance to impregnate textiles.

Other persistent substances dispersed from the textile industry are brominated flame retardants and dioxins. Dioxins are unintentionally formed for instance as a residue in chlorine bleaching.

Metals are elements that are not broken down. The more they are used in society, the higher their concentrations in the environment rise. Mercury, cadmium and lead have particularly hazardous properties. The risks have long been known, and the substances today are to some extent prohibited, but they nevertheless occasionally crop up in consumer products. They may occur in textile products for example as dyes or metal parts on clothing.



Make sure that substances that are particularly hazardous to the environment are not present in production or in textile products. This applies to substances that are persistent in the environment, are toxic and accumulate in living organisms.

Some substances have an impact on the aquatic environment

Textiles consume large quantities of water – both in manufacturing and in washing throughout the life cycle of the product. The aquatic environment may be polluted when textiles are washed. The greatest problems affect the manufacturing countries, where treatment of wastewater is often less satisfactory.

Several of the substances used in the textile industry may harm the aquatic environment. Some are directly toxic to aquatic organisms, while others alter the pH value of the water. Emissions of fibre residues may additionally lead to oxygen deficiency in the water when the fibres are broken down.

From country of manufacture to Swedish watercourses

Nonylphenol is a substance that poses risks to the aquatic environment. Nonylphenol ethoxylates are common in certain manufacturing countries, where they are used in the washing, dyeing and printing of fabrics. When nonylphenol ethoxylates are broken down, they are converted to nonylphenol, which is highly toxic to aquatic organisms. It has endocrine-disrupting properties, can affect reproduction and can cause effects in the aquatic environment over a long period.

Residual concentrations of nonylphenol ethoxylates may remain in imported textiles and also be encountered in Swedish wastewater treatment plants. However, the residues cannot be removed by treatment and end up in sewage sludge and in aquatic environment.



Make sure that substances that pose risks to the aquatic environment are not present in production or in textile products.

Certain substances are hazardous to health

The people who are most exposed to chemicals in the textile sector are obviously those who work in the textile industry and handle large quantities of newly produced textile daily. Chemical substances can be absorbed through the skin in the direct handling of chemicals, process water and fabrics in the textile industry. They may also be inhaled when they are dispersed via textile dust or via volatile substances in the air.


Others also come into contact with these substances through clothing and furnishing textiles. Substances that are particularly serious from the point of view of health are carcinogenic substances and substances that are mutagenic or toxic to reproduction, collectively known as CMR substances. Examples of such substances in the textile industry are aryl amines which are formed from azo dyes, chromium compounds and phthalates.


There are also problems with substances that affect the nervous system, have endocrine-disrupting properties or are allergenic. Certain aryl amines from azo dyes and certain 'dispersion substances', for example, have allergenic properties. Other allergenic substances may also be present in textiles, for example residues of anti-mould agents (dimethylfumarate), preservatives, detergents or formaldehyde. There may also be an admixture of other materials that are allergenic, such as rubber chemicals and nickel.

Sportswear, shoes, sponges and dishcloths are sometimes given an antibacterial treatment. The increasing use of various antibacterial agents may, in the longer term, lead to adverse effects as useful bacteria disappear and more resistant bacterial strains arise. In the worst case this may lead to diseases that are difficult to treat. In addition, antibacterially treated textiles are rarely needed.

Children are particularly exposed

Children come into contact with textiles in a different way than adults. They spend time on the floor, close to dust and carpets, they suck and chew on gloves and cuddly toys. They sleep more than adults and consequently come into closer contact with bed, furniture and buggy textiles. As children's immune systems and nervous systems are not yet fully developed, contact with chemicals may have greater consequences in children than in adults. It is therefore crucial that textiles intended for children are as free of harmful substances as possible.

 *Make sure that substances that are of particularly high concern for human health are not present in production or in textile products. This applies to mercury, lead and cadmium, as well as substances that are carcinogenic, mutagenic, toxic to reproduction, endocrine disrupters and highly allergenic.*

 *Check that textiles that people come into contact with do not contain allergenic substances. Take particular care with products that children come into close contact with, check that they do not contain any substances with properties that are harmful to health.*

The objective is a non-toxic environment

Some companies have been working towards phasing out hazardous substances for many years. Swedish textile manufacturers no longer, for example, use brominated flame retardants, and several chlorinated compounds have also been replaced. Nonylphenol ethoxylates, phthalates, mineral oils and highly fluorinated substances, among others, are being phased out.



More and more consumers are demanding sustainably produced articles that are safe from the points of view of the environment and health. The development of completely new textile products and uses has gathered pace. Importing textile firms are setting stricter requirements for their suppliers today than they did in the past. The supply of organic cotton and ecolabelled products has increased. All this represents good progress on the road to a non-toxic environment. But more remains to be done.

A sustainable business concept

The chemical aspects need to be considered from the outset, at the time when the products are developed and purchases are made. These issues need to be integrated to a greater extent into the environmental efforts of companies and brought to the attention of consumers. There are several good examples today of designers, manufacturers, suppliers and purchasers seeing the extent of the problems and appreciating the opportunities offered by ecologically smart textiles. Environmental awareness often ultimately pays off.



Think carefully about what chemical risks the operations of your company lead to, all the way from raw material to manufacturing, use and final disposal. Make sure that hazardous substances are replaced by less hazardous alternatives.



The Swedish Chemicals Agency's risk reduction tool Prio – a source of knowledge

Use the Swedish Chemicals Agency's risk reduction tool Prio to learn more about chemicals and how you can reduce the risks associated with chemicals. Prio can be found at www.kemi.se. Prio contains a guide to prioritising risks associated with chemical substances and a database containing more than 4 400 substances. The guide examines systematically what companies can do, step by step, to phase out hazardous substances and reduce risks. Prio is based on the Swedish Parliament's environmental objective

of a non-toxic environment, and divides hazardous substances into those which should be phased out and prioritised risk-reduction substances. It contains information on criteria underlying the assessment. These criteria largely coincide with the criteria for substances of very high concern according to the EU's chemicals regulation REACH. Armed with this knowledge, companies can assess substances for themselves on the basis of the classification they have. Prio also shows which substances of very high concern appear in the candidate list in the REACH Regulation and which substances are prioritised under the EU's Framework Water Directive. Prio also contains links to other sources of knowledge, such as the Swedish Chemicals Agency's restricted substances database and classification database.

The restricted substances database contains rules on prohibitions and other restrictions applicable to individual substances. The classification database contains around 3 300 substances classified with regard to explosive and oxidising properties and fire, health and environmental hazards.

Checklist to reduce risks associated with chemicals in textiles

Work systematically. Integrate chemical aspects into an environmental or quality management system.

Upgrade the knowledge:

- Find out more about what substances are used in textile production and why they are used. Search for information through industry associations, research institutes and colleges of higher education that specialise in textiles.
- Obtain information on what substances are of very high concern and should be phased out. The Swedish Chemicals Agency's risk assessment tool Prio at www.kemi.se provides guidance and information on which substances should be phased out under the REACH Regulation and according to the objective of a non-toxic environment. The environmental organisations' listing of substances that should be phased out can be found in the "Reach Sin List".
- Find out what rules apply to chemicals in textiles.

Decide what range of textiles your company wishes to have with respect to the chemical aspects

- Prioritise materials that lead to reduced risks. Omit functions that require hazardous substances or choose less hazardous alternatives.
- Prioritise products of high quality that last a long time.
- Think carefully about the environmental impact of your operations, all the way from raw material to manufacturing, use and final disposal.

Make demands

- Demand good social and environmental conditions on plantations and in factories. Stipulate requirements for wastewater treatment, for example. Seek assistance from organisations that work on CSR (Corporate Social Responsibility) issues. Make sure that there are environmental management systems and routines for control of chemicals.
- Demand information on the content of chemicals in products. Have hazardous substances been used, and if so which ones? How are the risks associated with hazardous substances managed?
- Draw up agreements on which substances, groups of substances, materials and functions are not allowed to occur in manufacturing or in finished products. Prioritise phasing out substances of very high concern.
- Check that the agreement is followed, for instance by random sample analysis for unacceptable substances.
- Establish good and regular contacts with the suppliers.
- Seek the assistance of industry organisations. Join forces with other companies to improve the clarity and impact of the requirements.

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