KEMI
Swedish Chemicals Agency

Chemicals in textiles

– Risks to human health and the environment

Report from a government assignment

REPORT 6/14

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KEMI
Swedish Chemicals Agency

The Swedish Chemicals Agency is a supervisory authority under the Ministry of the Environment. We work in Sweden, the EU and internationally to develop legislation and other initiatives to promote good health and improved environment. We monitor compliance of applicable rules on chemical products and substances in articles and we carry out inspections. We check applications for authorisation of pesticides before they can be used. Our environmental quality objective is A Non-Toxic Environment.

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Preface

This report is the presentation of a governmental assignment that was given to the Swedish Chemicals Agency in the Appropriation Directions for 2014.

The purpose of the assignment was to compile information about risk to human health or the environment from substances present in textile articles, such as clothing and household textiles. The results may be used for further work on risk reduction measures on hazardous chemical substances in textile articles.

The work has been performed in consultation with the Swedish Environmental Protection Agency and the Swedish Consumer Agency.

The screening study was mainly performed by the consultant Swerea IVF[1]. The Swedish Chemicals Agency would like to express our gratitude to Stefan Posner and Christina Jönsson at Swerea IVF, for their guidance and active effort in the screening study and in the development and evaluation of the list of chemical substances.

A reference group of representatives from relevant authorities, industry associations, the textile industry, NGOs and laboratories was invited to comment on the investigation and has been of invaluable assistance with knowledge and enthusiasm in writing this report.

The assignment was carried out at the *Development of Legislation and Other Instruments Department.* Kent Wiberg, Head of Unit was responsible for the assignment and members of the project group were Emma Westerholm, Helén Klint, Jenny Ivarsson, Jörgen Henriksson, Karin Thorán, Lars Freij, Lina Wendt-Rasch, Stellan Fischer, Patrik Ernby, and Susan Strömbom (project leader).

[1] Swerea IVF: A research institute within the Swerea group with materials, processes and production systems within manufacturing and product development as key areas

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Summary

The Swedish Chemicals Agency (Kemikalieinspektionen) was assigned by the Swedish government to compile available and relevant information about the risks to human health and the environment from hazardous substances in textile articles.

The aim of the study was to identify hazardous substances that might be present in textile articles placed on the market and which present a potential risk to humans or the environment. The intention of this report is to serve as a base for further work on developing risk reduction measures for hazardous substances in textiles at the EU level.

The study includes three main parts:

a. An overview of textile consumption in the EU and Sweden.
b. A screening study with the aim to identify hazardous substances/groups of substances of potential concern to human health and the environment.
c. A literature study of data on exposures and effects related to hazardous substances in textile.

Increasing consumption of textile articles and use of chemicals

The consumption of textile articles has increased rapidly in the EU during the last decades. Textile materials are produced in large quantities and are included in a broad variety of widely used consumer articles. **Chapter 3** presents an overview of consumption of textile materials and articles in the EU and Sweden.

Increasing production and consumption of textile articles also mean an increased use of chemicals and raw materials. Large quantities of chemical substances are used in the production of textiles, from processing of fibres and raw materials to the final touch of the finished article.

Substances used in the production of textiles can remain in the final article as minor contaminant amounts, and articles may also contain substances formed by degradation. Other substances are intentionally added to textile articles in order to provide a specified function, such as colour or easy-care. Substances in textile materials may be released from articles and expose humans and the environment. Textile articles are used in a way that both consumers the environment can be exposed to chemicals released from the articles. An overview is presented in **Chapter 4**.

Information is needed in the production- and supply chains

Although large quantities of substances are included in textile production, there is no comprehensive overview of hazardous substances that may be present in textile articles placed on the market.

To assess the chemical risks related to the use of textile articles it is necessary to have information about the identity of the substances and their hazardous properties. Access to information on the contents of hazardous substances in textile materials and articles is important for the manufacturers, importers and suppliers along the production and supply chains.

The requirement in the REACH Regulation, Article 33 (**Section 2.1.1**) concerning the duty on suppliers to provide information on hazardous substances in articles is limited to *Substances of Very High Concern* that are listed on the Candidate list. Thus, this duty to provide information does not included e.g. dermal allergens.

The majority, approximately 80%, of the textile articles consumed in the EU are imported from a non-EU country, and it is also common to import semi-finished textile materials while the article is finally manufactured and labelled in the EU. The textile supply chains are often long and complex with a global span and important information is drastically decreasing in the many steps from producer to consumer. The flow of chemical information in the supply chains is generally not adequate. The knowledge about chemical contents in textile articles should be made more readily available by increasing and improving the information exchange along the supply chain.

One step towards improved information exchange along the supply chain is the international initiatives in the SAICM programme *Chemicals in Products* (**Section 2.3**).

The legal information requirement on suppliers of substances in articles needs to be further developed.

Identifying chemical substances related to textile articles

The study presented in **Chapter 6** was performed to identify substances with a reported use in textile production. The REACH registration (**Section 2.1.1**) is one source of knowledge since data for hazardous properties and recommended use for substances should be included in the registration. Further data was also collected from several databases.

The focus of the screening study was to identify substances of potential concern for human health and the environment. Approximately 3 500 substances were identified as relevant for use in textiles. However, the actual use and the presence in the final textile articles have not been verified for all these substances. It should be noted that this identification approach managed to cover only a part of all the substances that may be found in textile articles.

Of the identified substances about 2 000 substances are not yet registered under REACH. Due to the volume limit for registration and the limited obligations to register substances present in imported articles, the REACH registration data is insufficient for risk assessment of many substances used in textiles. In some cases REACH registration data for risk assessments was not easily accessible for evaluations of specific uses, and for about one third of the identified substances the REACH registrations was the only source indicating textile use.

Improved quality of data and increased availability in the REACH registration would facilitate and improve the decision-making regarding risk reduction measures for hazardous substances in textiles.

The focus of this study is functional chemicals as they are expected to be present in textiles at relatively high concentrations. However, auxiliary chemicals and unintended degradation products may also be present in the textile and cause harmful effects on human health and the environment, but these types of substances are not covered by screening study due to the limitations.

Substances of potential concern for human health and environment

Approximately ten percent of the identified 2 400 textile-related substances are considered to be of potential concern for human health. These substances include direct azo dyes, acid azo dyes, and fragrance. The identified direct-type dyes have properties that are associated with an increased risk of cancer and developmental effects, whereas the identified acid-type dyes and fragrances have properties that are associated with an increased risk of allergy.

The relevance of azo dyes was also confirmed by studies in the open literature. Direct azo dyes are mainly used in cotton textiles while acid azo dyes are mainly used in polyamide.

Since both cotton and polyamide are common materials on the EU market there is a potential for large-scale human exposure to direct acid azo dyes. These dyes are loosely bound to textile fibres and in particular small children sucking or chewing on textiles could be highly exposed. The dyes also have properties indicating that they are persistent in the environment and may accumulate in the aquatic food chain, which could lead to an indirect exposure of humans through dietary intake. For small children, ingestion of indoor dust, which to a large part consists of textile fibres, may also be an important exposure route to textile related substances for small children, especially since textiles constitute a large part of the surface in the indoor environment.

The presence of hazardous substances in textiles, including direct and acid type azo dyes, should be further investigated.

Carcinogenic, reprotoxic and/or sensitising substances should be avoided in articles with direct and prolonged skin contact. Although the methods we used to identify substances of potential concern involve many assumptions and limitations, the results are consistent and give reasons for further investigations, especially of direct and acid type azo dyes but also fragrances.

Substances that may cause severe health effects should be avoided in articles with direct and prolonged skin contact.

The overall scientific literature points out disperse dyes as the main cause of textile-related allergic skin reactions and disperse dyes were also identified as substances of concern in our screening study. In addition to the disperse dyes, we identified acid dyes as a group of sensitising substances of potential concern for human health that previously have not been associated with textile-allergy to any great extent. It is thus likely that the disperse dyes is not the cause of all reported cases of allergic skin reactions. Based on the findings of our screening study more than 200 allergenic textile-related substances, as for example acid-type dyes, could contribute substantially to allergic skin reactions.

The testing of dermal allergy to sensitising dye substances used in textiles should be developed.

Antibacterial biocides

Increasing volumes of biocide-treated textile articles is marketed. In a few cases it has been shown that active substances are released after washing. For example it has been shown that considerable shares of silver, triclosan and triclocarban contained in textile articles are released from biocide treated textiles from laundering. Concern is increasingly being raised about the possibilities that bacteria can develop resistance to the released antibacterial substances and that this can trigger the development of resistance to antibiotics.

The development of bacterial resistance to antibiotics is a very serious issue for human health, and any unnecessary use of biocides should therefore be avoided.

Substances of potential concern for the environment

Approximately five percent of the identified 2 400 textile-related substances are considered to be of potential concern for the environment which corresponds to about 140 substances. The evaluation of textile related substances clearly pointed out azo dyes of direct and acid application type as substance groups of potential concern for the environment.

An estimation of the environmental release of direct and acid dyes showed that 2-22 tonnes each of hazardous direct and acid dyes could be released annually to the waste water in the

EU from washing of cotton and polyamide textiles. The estimation was based on the assumption that Best Available Technique (BAT) has been used in the textile manufacturing process. If less optimal processes are used the release might be five times higher or more.

Only about ten per cent of the substances identified as being of potential concern for the environment are included in the Swedish environmental monitoring program, which means that we have little information about the actual levels in the environment. Additional monitoring of hazardous substances that are common in consumer articles, including textiles would increase the possibilities to identify environmental hazards at an early stage. The information about textile related substances of concern in this study could be used for selection of additional substances in monitoring programs.

In the open literature there were few reports on environmental effects from textile related substances, and these mainly had focus on the well documented substances silver, nonylphenol and highly fluorinated substances.

The need to further risk reduction measures for substances in textiles

Most of the of the identified substances with very serious health hazardous properties, such as carcinogenic, mutagenic and/or toxic for reproduction, have an EU-harmonised classification and several are restricted under REACH or are included on the candidate list (*substances of very high concern*). For environmental hazardous substances in general the current regulation is very weak.

REACH for instance bans the presence of carcinogenic aryl amines in consumer articles. A majority of the direct azo dyes identified in the current report can form these banned aryl amines by reductive cleavage. Banned aryl amines may still be on the market as they are listed together with suppliers in the Colour Index database.

The screening study also identified several skin sensitising substances. Many substances with sensitising properties also have harmonised classification, but in comparison with the substances of very high concern they are not as strictly restricted in the current EU legislation. Risk reduction measures for these substances should be considered, either in the current REACH legislation or new legislation. Alternatives include a ban of allergens, but also information to customers about the effect and the allergens present in the article could be envisaged.

The Swedish textile industry[2] is positive to the development of an EU regulation based on the large number of existing *Restricted Substances Lists* (RSLs) that are already applied. This would mean simplified procedures for the industry in providing coherent and communicable ways to deal with these issues business to business throughout the value chain.

The EU legislation should be developed to cover risks from substances in textile articles.

Need for further research

A review of the scientific literature is presented in **Chapter 5.** Overall, there are few scientific publications concerning harmful effects from exposures of hazardous substances in textile articles, especially for the environment. The limited number of studies most likely reflects the limited knowledge about chemical content in textiles and the difficulties to establish a correlation between exposure and effects for these types of articles.

[2] Swedish Textile and Clothing Industries Association, (TEKO).

To meet the need for more information about chemical content in textile articles, both increased information from producers and suppliers as well as extended screening studies to identify substances in textile articles would be useful**.**

Sammanfattning

Denna rapport är en redovisning av regeringens uppdrag till Kemikalieinspektionen i regleringsbrevet för 2014 att sammanställa en rapport om riskerna för hälsa och miljö med farliga kemikalier i textilier. Syftet är att rapporten ska kunna utgöra ett underlag för fortsatt riskbegränsning och utveckling av regler inom EU om farliga kemikalier i textilier.

Studien innefattar tre delar:

a. En översikt av konsumtionen av textilprodukter inom EU och Sverige
b. En screeningstudie med syfte att identifiera hälso- och miljöfarliga ämnen vars användning kan medföra potentiell risk för människor eller för miljön.
c. En genomgång av vetenskaplig litteratur för att sammanställa uppgifter från tillgängliga studier om farliga ämnen i textilprodukter relaterat till exponering och skadliga effekter på människors hälsa och på miljön.

Ökande konsumtion av textilprodukter ger ökad användning av kemikalier

Konsumtionen av textila produkter har ökat betydligt inom EU under de senaste årtiondena. Textila material produceras i stora kvantiteter och ingår i en stor mängd olika produkter som används brett i samhället. **Kapitel 3** ger en överblick över textila material och produkter som konsumeras i EU och Sverige.

Ökande konsumtion och produktion medför även ökad användning av råmaterial och kemiska ämnen. Stora kemikalievolymer används för produktion av textil, från tillverkning av textilfibrer och råmaterial till behandling av de färdiga textilvarorna.

Ämnen som används för att ge textilvaran en särskild funktion, som färg eller härdighet är avsedda att finnas kvar i den färdiga varan. Men även ämnen som används vid textil-produktionen kan i vissa fall stanna kvar i materialet i små mängder som föroreningar, och det kan även gälla ämnen som bildats vid nedbrytning av processkemikalier. Kemiska ämnen kan släppa från textilmaterialet under vissa förhållanden, och människor och miljö kan då exponeras för ämnena. **Kapitel 4** ger en översikt om bland annat olika typer av ämnen som tillsätts och kan finnas i textilprodukter samt faktorer som kan påverka att ämnen lossnar från textilier.

Information behövs i produktions- och leverantörskedjorna

Trots att kemiska ämnen används i stora volymer för tillverkning och behandling av textilmaterial finns det ingen tillgänglig sammanställning av farliga ämnen som potentiellt kan finnas i de textila varorna. Tillgång till information om innehållet av farliga ämnen är viktig för att företagen i produktions- och leverantörskedjorna ska kunna bedöma risker med kemiska ämnen i textilier.

I Reach-förordningen artikel 33 (Kap. 2.2.1) finns ett krav som rör leverantörens skyldighet att informera mottagaren om produkten innehåller ett mycket farligt ämne. Kravet är begränsat till *särskilt farliga ämnen* (SVHC) som finns upptagna på Reach:s kandidatförteckning. Det är relativt få ämnen som träffas av skyldigheten, och kravet gäller t.ex. inte för allergena ämnen i textilier.

Merparten, cirka 80 procent, av de textilprodukter som konsumeras inom EU importeras från icke-EU-länder. Det förekommer även att delar till textilvaror importeras till produkter som därefter färdigställs inom EU. Produktions- och leverantörskedjorna för textilprodukter är

långa och komplexa och har en global spännvidd, och informationen om kemiska ämnen kan minska snabbt i de många stegen utefter kedjan från tillverkning till användare.

Flödet av information om kemiska ämnen i leverantörskedjorna är i allmänhet inte tillräckligt. Kunskap om det kemiska innehållet i textilvaror bör göras mer lättillgänglig genom ökat och utvecklat informationsutbyte i hela kedjan från producent till konsument.

Ett steg mot förbättrat informationsflöde i leverantörskedjan är det internationella programmet *Chemicals In Products* som initierats av SAICM (**avsnitt 2.3**).

Krav på att leverantörer av varor som innehåller kemiska ämnen ska lämna information om de farliga ämnena behöver utvecklas ytterligare i lagstiftningen.

Identifiering av kemiska ämnen som kan förekomma i textilvaror

I **kapitel 6** presenteras en studie som utfördes i syfte att identifiera ämnen med en rapporterad användning inom textilproduktion. En viktig källa till kunskap om sådana ämnen är Reach-registreringar (**avsnitt** 2.1.1), eftersom både data om farliga egenskaper och rekommenderad användning för ämnen bör ingå i registreringen. Ytterligare uppgifter om textilrelaterade ämnen hämtades även från ett flertal databaser.

Huvudfokus för studien var att identifiera ämnen som kan utgöra en potentiell risk för människors hälsa eller miljön. Initialt identifierades cirka 3 500 ämnen med en koppling till användning i textilproduktion. Det har dock inte varit möjligt att verifiera den faktiska användningen eller förekomsten av dessa ämnen i färdiga textilvaror. Det är även viktigt att påpeka att studien endast täcker en del av alla de ämnen som kan finnas i textilvaror och inte ska ses som en fullständig lista.

Av de ämnen som identifierades har cirka 2 000 ämnen ännu inte registrerats under Reach. Den information som finns i Reach-registreringarna är i många fall inte tillräcklig för att bedöma riskerna med ämnen i textilier. Detta beror både på den volymgräns som finns i Reach för registrering och den begränsade skyldigheten att registrera ämnen som förekommer i importerade varor. I vissa fall var det svårt att få fram information kring särskilda användningsområden och för omkring en tredjedel av de identifierade ämnena var Reach-registreringen den enda källan till information om textil användning.

Förbättrad kvalitet på data och ökad tillgänglighet till information i Reach-registreringarna skulle underlätta och förbättra beslutsfattandet om riskbegränsande åtgärder för farliga ämnen i textilier.

Funktionskemikalier, som förväntas finnas i relativt höga koncentrationer i textil, har prioriterats i detta uppdrag. På grund av de prioriteringar och begränsningar som gjorts i studien har ämnen såsom processkemikalier, även kallade hjälpkemikalier, och oavsiktligt bildade nedbrytningsprodukter uteslutits. Dessa ämnen kan dock också förekomma i textil och orsaka skadliga effekter på människors hälsa och miljön.

Ämnen som kan utgöra en potentiell risk för människors hälsa

Efter bearbetning av den initiala ämneslistan identifierades 2 400 ämnen med en koppling till textil. Av dessa ämnen är det cirka tio procent som utgör en potentiell risk för människors hälsa. De potentiella riskämnena inkluderar direkta azofärgämnen, syra-azofärgämnen och doftämnen. De identifierade direkta azofärgämnena har egenskaper som är associerade med en ökad risk för cancer och fosterskadande effekter, medan de identifierade syra-azofärgämnena och doftämnena har egenskaper som är associerade med en ökad risk för allergi.

Kopplingar mellan exponering för azofärgämnen och hälsoeffekter såsom cancer bekräftades även av vetenskapliga studier. Direkta azofärgämnen används främst i bomullstextil medan syrafärgämnen huvudsakligen används i polyamid. Eftersom både bomull och polyamid är vanliga material på EU-marknaden kan en stor mängd människor vara exponerade för dessa typer av färgämnen. Direkta och syrafärgämnen är löst bundna till textilfibrer och i synnerhet små barn, som suger eller tuggar på textilier, kan vara utsatta i hög grad. Färgämnena är även svårnedbrytbara i miljön och kan ansamlas i den marina näringskedjan, vilket kan leda till en indirekt exponering av människor genom mat. För små barn kan damm inomhus utgöra en viktig exponeringsväg för textilrelaterade ämnen. Textil utgör en stor del av ytan i inomhusmiljön och textilfibrer är vanligt förekommande i damm.

Den faktiska förekomsten av farliga ämnen i textilier, inklusive azofärgämnen av direkt och syratyp, bör utredas ytterligare.

Ämnen som kan ge cancer, skador på fortplantningsförmågan eller allergi bör undvikas i varor med direkt och långvarig hudkontakt. Även om de metoder vi använde för att identifiera potentiella riskämnen innebär många antaganden och begränsningar, är resultaten konsekventa och ger skäl för ytterligare undersökningar, särskilt av azofärgämnen (direkt och syratyp) men också av doftämnen.

Ämnen som kan orsaka allvarliga hälsoeffekter bör undvikas i varor med direkt och långvarig hudkontakt.

Den vetenskapliga litteraturen pekar ut dispersionsfärgämnen som den främsta orsaken till textilrelaterade allergiska hudreaktioner. Dispersionsfärgämnen identifierades också som skadliga ämnen i vår studie. Men förutom dessa färgämnen identifierade vi även syrafärgämnen som en grupp av allergiframkallande ämnen. Syrafärgämnen har tidigare inte associerats med textilrelaterad allergi i någon större utsträckning. Det är således troligt att dispersionsfärgerna inte är orsaken till alla rapporterade fall av allergiska hudreaktioner. Baserat på resultaten av vår studie identifierade vi mer än 200 allergiframkallande textilrelaterade ämnen, inklusive syrafärgämnen, som skulle kunna bidra till uppkomsten av allergiska hudreaktioner.

Testning av hudallergi bör utvecklas för att inkludera fler allergiframkallande färgämnen som används i textilier.

Antibakteriella biocider
Marknadsföringen av biocidbehandlade textilvaror har ökat markant. Det har även visats att i en del fall kan det verksamma ämnet frigöras efter tvätt, t.ex. har studier visat att silver, triclosan och triklokarban kan frigöras i stor utsträckning från behandlade textilier vid tvätt. Den ökade användningen av biocider har även lett till en ökad oro för att bakterier ska utveckla resistens mot antibakteriella ämnena och att detta i sin tur skulle kunna påverka utvecklingen av resistens mot antibiotika.

Utvecklingen av bakteriell resistens mot antibiotika är en mycket allvarlig fråga för människors hälsa, och all onödig användning av biocider bör därför undvikas.

Ämnen som kan utgöra en potentiell risk för miljön

Cirka fem procent av de identifierade 2 400 textilrelaterade ämnena kan utgöra en potentiell risk för miljön, detta motsvarar cirka 140 ämnen. Utvärderingen av dessa ämnen visade att azofärgämnen av direkt och syratyp även kan utgöra en potentiell risk för miljön.

En beräkning av hur stora mängder direkta och syrafärgämnen som skulle kunna frigöras från textil och hamna i miljön visade att 2-22 ton vardera av direkta och syrafärgämnen kan avges årligen till avloppsvatten i EU från tvätt av bomulls- och polyamidtextilier. Beräkningen bygger på antagandet att bästa tillgängliga teknik (BAT) har använts i den textila tillverkningsprocessen; om mindre optimala processer används skulle utsläppet kunna vara fem gånger högre eller mer.

Endast cirka tio procent av de ämnen som identifierats som potentiella riskämnen för miljön ingår i det svenska miljöövervakningsprogrammet, vilket innebär att vi har väldigt lite information om de faktiska nivåerna i miljön för majoriteten av textilrelaterade ämnen. Ytterligare övervakning av farliga ämnen som är vanligt förekommande i konsumentvaror, inklusive textilier, skulle öka möjligheterna att identifiera miljörisker i ett tidigt skede. Den information om textilrelaterade ämnen som framkommit i denna studie skulle kunna användas som en grund för ytterligare ämnen att inkludera i övervakningsprogrammet.

Det finns bara ett fåtal vetenskapliga rapporter publicerade om miljöpåverkan av textilrelaterade ämnen, och de rapporter som finns fokuserar främst på väldokumenterade ämnen som silver, nonylfenol och högfluorerade ämnen.

Behov av ytterligare riskbegränsande åtgärder för ämnen i textilvaror

De flesta av de identifierade ämnen med mycket allvarliga hälsofarliga egenskaper, som cancerframkallande, mutagena eller reproduktionstoxiska ämnen har en EU-harmoniserad klassificering och flera är begränsade enligt Reach eller finns med på kandidatförteckningen (lista över ämnen med särskilt farliga hälso- eller miljöegenskaper, Substances of Very High Concern, SVHC).

I Reach finns ett förbud som gäller förekomsten av cancerframkallande arylaminer i konsumentprodukter. Flertalet av de direkta azofärgämnen som anges i denna rapport kan bilda de begränsade arylaminerna genom reduktiv spjälkning. Arylaminer skulle fortfarande kunna förekomma i produkter på marknaden eftersom de listas tillsammans med leverantörer i Colour Index database.

I studien identifierades ett flertal ämnen som kan orsaka hudallergi. För många ämnen med allergiframkallande egenskaper finns harmoniserad klassificering inom EU. Dessa ämnen kan ge betydande och långvariga besvär, men trots det är ämnena i mycket liten utsträckning begränsade genom nuvarande EU-lagstiftningen, i jämförelse med de ämnen som har särskilt hälsofarliga egenskaper *(*SVHC*).* Även för miljöfarliga ämnen är den nuvarande lagstiftningen generellt mycket svag.

Riskbegränsande åtgärder bör övervägas för fler ämnen som förekommer i textilvaror. En åtgärd kan vara förbud för hudallergener i varor som används på huden. Alternativa åtgärder kan vara information till kunder om innehåll av allergena ämnen i varan.

Den svenska textilindustrin (TEKO)[3] är positiv till utvecklingen av EU-regler som grundar sig på flertalet befintliga listor från företagen (Restricted Substances List, RSL) som redan tillämpas inom stora delar av textilbranschen. Harmoniserade regler skulle underlätta för industrin att tillhandahålla sammanhängande och kommunicerbar information mellan företag genom hela leverantörskedjan.

[3] Swedish Textile and Clothing Industries Association, (TEKO)

EU-lagstiftningen bör utvecklas för att begränsa risker med ämnen i textilvaror.

Behov av ytterligare forskning

En genomgång av den vetenskapliga litteraturen presenteras i **kapitel 5.** Totalt sett finns det relativt få vetenskapliga publikationer om skadliga effekter orsakade av exponering för farliga ämnen från textilvaror, särskilt vad gäller miljöeffekter. Det begränsade antalet studier avspeglar troligen den begränsad kunskap om det kemiska innehåll i textilvaror och svårigheterna att fastställa ett samband mellan exponering och effekter för ämnen från varorna.

För att möta behovet av mer information om kemiskt innehåll i textilvaror behövs både ökad information från tillverkare och leverantörer och breda och förutsättningslösa undersökningar för att identifiera ämnen i textilier. Ytterligare forskning behövs även om hur ämnen frigörs från textilmaterialet och den vidare spridningen i miljön, samt om exponering av människor och miljö.

1 Introduction

1.1 The assignment

The Swedish Chemicals Agency (Kemikalieinspektionen, KemI) was assigned by the Swedish government to compile available and relevant information about the risks to human health and the environment from hazardous substances in textile consumer articles.

The assignment was carried out in consultation with the Swedish Environmental Protection Agency and the Swedish Consumer Agency. Textile suppliers, researchers and other experts, both in Sweden and internationally, were invited to give comments during the work with the present report.

The policy basis for the assignment

To provide a clear structure for environmental and chemical policy, the Swedish Parliament (Riksdag) have decided on a generation Goal and 16 national environmental quality objectives, one of which is a *Non-Toxic Environment*[4]. The present study is in line with the objective a *Non-Toxic Environment*

The objective provides a long-term signal to all actors in society what the Swedish Government and Parliament wish to achieve with the chemicals policy, and the objective covers both health and environmental aspects of chemical substances.

The objective a *Non-Toxic Environment* has eight milestone targets decided by the Swedish Government which indicate steps along the road towards the changes in society that are needed to attain the environmental quality objectives and the generational goal. The target goals most relevant for this study concerns knowledge of health and environmental properties of substances (1), requirement for information on hazardous substances in articles (3) and reducing exposure of children to hazardous chemical substances (7).

Based on the environmental quality objective a *Non-Toxic Environment* an action plan for a *toxic-free everyday environment* has been developed. One of the objectives in the action plan is to protect people from direct and indirect exposure to hazardous substances in articles, including textiles. The main focus is on sensitive and vulnerable groups such as children.

1.1.1 Previous assignment

In a previous government assignment[5] the Swedish Chemicals Agency presented an overview of hazardous substances that may be present in textile articles together with a proposal on how to regulate such substances in the EU. The overview was not exhaustive and according to the conclusion there are likely a number of unrecorded substances which had not been identified. The chemical exposure from textile articles and the potential risks related to this exposure on human health or the environment were not covered by the previous assignment. The lack of knowledge about risks associated with hazardous substances in textiles complicates the decision-making regarding risk reduction measures for chemical substances in textiles. It is important to identify and prioritise such risks and this is one of the main objectives of the present report.

[4] http://www.miljomal.se/sv/Environmental-Objectives-Portal/Undre-meny/About-the-Environmental-Objectives/4-A-Non-Toxic-Environment/ (September 2014)
[5] KemI report no 3/13: Hazardous chemicals in textiles - report of a government assignment (2013)

1.2 Purpose of the assignment

The purpose of this assignment is to identify hazardous substances present in textile articles and find those substances presenting a potential risk to humans or the environment.

The results of the present report can be used as a base for further work with developing risk reduction measures for hazardous chemical substances in textiles at EU level. Available and relevant information about substances used or intended to be used in various kinds of textile articles was gathered and scrutinised. The collected information has been used to identify substances, associated with a potential risk to human health or to the environment.

The study also identifies knowledge gaps regarding the presence of hazardous substances in textile articles and human and environmental exposure. A better understanding of potential risks to human health and the environment associated with hazardous substances in textile articles will facilitate further risk reduction measures.

1.3 Scope and limitations

Focus on hazardous substances in textile articles on the EU market

Textile articles placed on the EU market fall within the scope of the assignment, including articles imported from countries outside the EU. Chemical substances that might be present in the marketed articles are the main focus of this study. Such substances could remain from the textile production process or have been added at another stage of the manufacturing of the textile article. Chemical substances that are used in textile production **and** that may remain in the textile products, intentionally or unintentionally, are included in the study. In the screening study of chemical substances in textiles the main focus has been on substances which have the most significant concentration in the final article. These are in general the substances that have a function in the final textile article, such as flame retardants, colourants or phthalates and not auxiliary chemical substances, such as nonylphenol ethoxylates. A limitation of the screening study is that substances that are degraded to hazardous substances are excluded.

Textile production is excluded

Chemical exposure of humans or the environment related to the textile production process is not included. Chemical substances from textile production have a negative impact on both health and the environment in producing countries. However, this aspect is not within the scope of this study.

Textile material

The study focuses on the pure textile material[6] of the final articles. Prints with PVC and other prints on textiles are included since the printed surface can be seen as an integrated part of the textile material itself. Also coatings and laminated films and membranes that can be seen as integral parts of textiles such as plastic coated terry, are included in the scope of textile materials. The scope does not include non-textile fibre elements such as metals in buttons and zippers or other details of metal or plastic on the textile.

Technical textiles are not within the scope of this study. Occupational exposure from the production of textile or other production and supply chain related aspects are not focused in

[6] Defined according to the Textile Fibre Regulation (EU) No 1007/2011, article 3 b

this study. However, exposures of employees at ware house and clothing stores, handling textile articles in their daily work, have been included in the review study.

Adverse effects

The study mainly focuses on the selected health effect areas cancer, reproductive and developmental disorders, including endocrine disruption, and allergic effects. The allergic reactions caused by or related to textile fibre materials, e.g. silk and wool, are not included in the report. The adverse environmental effects focused in the present report are chronic aquatic toxicity, persistence towards degradation, bioaccumulation and endocrine disruptive properties but also biocide properties and the potential for development of bacterial resistance to antibiotics are included.

1.4 General approach to the assignment

The study includes three main parts, as described below.

- **Textile consumption (Chapter 3):** An overview of textile consumption in Sweden and the EU.
- **Release and exposure of textile related chemical substances (Chapter 4):** A database screening project with the aim to identify and prioritise substances that may be present in textile articles based on risk to human health and the environment.
- **Literature survey of chemical substances in textile articles (Chapter 5):** A review of the scientific literature on chemical substances in textile articles and risks to human health and the environment.

The different parts of the study each contributes with important information that was used to identify prioritised substances and also to identify knowledge gaps about the information of substances in textiles and health and environment risks.

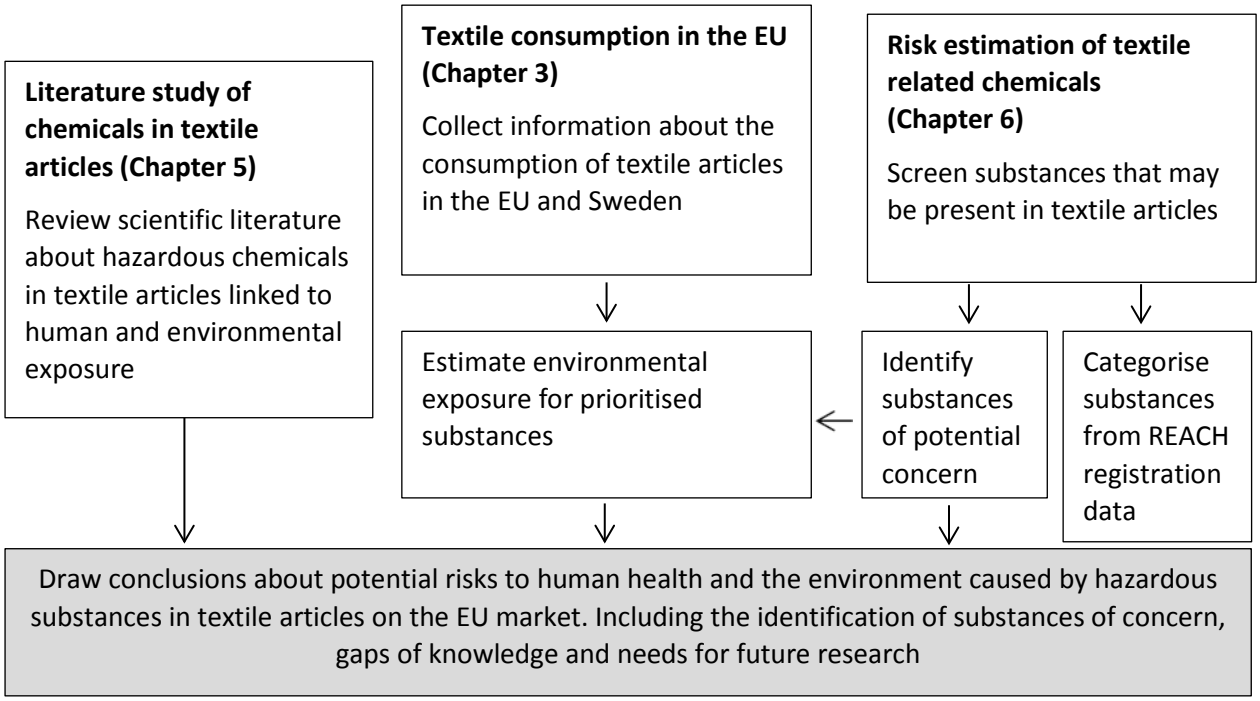

Figure 1 Flow chart describing the general approach used for the present assignment

2 Chemical management and chemical substances in textiles

It is a basic principle that companies placing products on the market have the main responsibility for preventing or avoiding chemical risks to humans and the environment. The chemicals legislation sets the basic level for chemicals control. Other incentives are economic policy instruments. Ecolabel and Green Public Procurement have the aim to support customer demands concerning the choice of chemical substances, as such or in maxtures and articles. Voluntary incentives developed by company organisations are e.g. restriction lists of hazardous chemical substances.

2.1 Chemical legislation

There are several different pieces of legislation that either regulates different parts of the life-cycle of the textile or that cover specific chemical substances that may to some extent be used in the textile manufacturing process. However, there is a lack of overall legislation that regulates the chemical content in textile articles on the EU market in order to protect humans and the environment from exposure to hazardous substances.

The aim of the chemical legislation is to prevent hazardous effects on human health or the environment. The legislation concerning obligations for suppliers of chemical substances and articles is harmonized in the EU.

2.1.1 The EU Regulation REACH

The EU regulation REACH[7] and the Regulation on Classification, Labelling and Packaging (CLP)[8] are the two fundamental Community acts governing chemical substances.

The REACH regulation includes several restrictions of hazardous chemical substances. However, REACH was not specifically designed to account for chemical substances in articles, such as textiles.

Registration of substances

A fundamental principle in REACH is that the companies are obliged to take responsibility for the chemical substances they place on the market and ensure that they are safe. REACH requires companies to obtain knowledge, about the hazards posed to health and the environment by their chemical substances. Manufacturers and importers have to register substances manufactured or imported in quantities of more than one tonne per manufacturer or importer per year.

The registration is submitted to the European Chemicals Agency (ECHA) and includes test data and an assessment of the hazardous properties and intended use of the substance. If the quantity exceeds ten tonnes per year, a special risk assessment must also be carried out for each use recommended by the registrant. It has to be apparent in this chemical safety report how the substance can be used in a safe way for humans and the environment.

[7] Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

[8] Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures amending and repealing Directive 67/548/EEC and 1999/45/EC, and Regulation (EC) No 1907/2006.

Many functional substances used in the textile production in the EU might not fall under the obligation for registration since their quantity does not exceed one tonne.

The present experience from the registered data for substances is that there is in general very poor information on the use of the substances in various materials or articles. Lack of information on use of substances has an impact on the quality of the risk assessment for the substances. The substance registrations are checked with regard to adequate information and randomly evaluated. The aim of the evaluation is to clarify whether the manufacture or use of a substance poses a health or environmental risk large enough to motivate that manufacture or use of the substance needs to be restricted in the EU.

Assessment of risk, controlled use and uncertainty in REACH

A fundamental principle of REACH is that the use of a substance must be *adequately controlled*. This can be achieved through the company registering a substance is also presenting different handling instructions and safety measures, based on information on the properties and uses of the substance. If these *exposure scenarios* are followed during use, the use is considered to be adequately controlled and is not then assessed as harming human health or the environment. If it is not possible to bring about adequately controlled use through these measures, further risk management measures in the form of authorisation or restrictions may be implemented.

However, in spite of the methods and tools for risk assessment there exist an uncertainty in the assessment and there is a need for precautionary thinking as a complement to the risk assessment model applied in REACH.

Adequately controlled exposure levels (determined using risk quotients) for both humans and the environment are established on the basis of available data concerning, for example, harmful effects where the extent of the available data is determined by the volume-based information requirements in REACH. To compensate for different types of uncertainties in the available data and for unknown variation in sensitivity among groups of exposed humans and among species populations, standard assessment factors are generally applied. The type and seriousness of the harmful effects, the extent of the exposure and the quality and extent of the available data also affect the values obtained. With regard to the estimated exposure of humans and the environment, it is generally necessary to rely on modelled data to provide a reasonable, but presumed exaggerated exposure (*reasonable worst case*).

The standard model for risk assessment is applied to substances regarding as having a threshold value for health and environmental effects, thus substances for which it is possible to establish a minimum level of exposure at which effects can occur. Other metods are used for substances without a threshold and certain categories of substances of very high environmental concern.

It can be noted that the calculated exposure levels deemed to be safe (adequately controlled) and the estimated relevant exposure of both humans and the environment are estimates which, even if they are obtained using methodology, that can provide a high level of protection, are nevertheless subject to uncertainty.

It is also evident that the exposure scenarios only deal with exposure to a single substance from a single source and do not take account of combination effects. It is therefore inadequate to deal with several important aspects of the total exposure of both humans and the environment. Further uncertainties in the risk assessment may be due to new or less well explored aspects of the problems of chemical substances that are insufficiently addressed or

not addressed at all in the regulatory framework. Examples of such areas are risks associated with endocrine disruptors, nanomaterials, combination effects, combined exposure from different sources and via different exposure routes and the special sensitivity of children to chemical exposure.

On the basis of knowledge of deficiencies and limitations in both the risk assessment and risk management models and in the scientifically based knowledge where required, it is clear that the precautionary principle should be applied to improve the protection of health and the environment.

Classification of substances

The Regulation on classification, labelling and packaging of substances and mixtures (CLP) establishes a harmonised classification of the health and environmental hazards of many substances, for example the substances to be regarded as carcinogenic and toxic to reproduction.

Substances of very high concern and the REACH Candidate list

Substances of very high concern (SVHC) means substances that have serious and often irreversible effects on human health or which are harmful to the environment, such as being carcinogenic or harmful to reproduction, substances that are endocrine disruptors or are highly allergenic, persistent substances and substances accumulating in living organisms. Such substances are successively identified and placed on *the Candidate List* and can gradually be subject to authorisation. The REACH authorisation requirements does not cover substances in articles imported to the EU since the target for the requirement are substances used in manufacturing processes in the EU.

In the REACH *Candidate list* there are substances of very high concern included which may be found in the textile articles, e.g. brominated flame retardants (such as hexabromocyclo-dodecan and decabromodiphenyl ether), a number of phthalates, nonylphenol ethoxylates (NPEO) and derivatives and perfluorooctane carboxylic acid (PFOA).

Information in the supply chain on the hazardous properties of chemical substances

Suppliers of substances and mixtures that fulfil the criteria for classification as hazardous under the CLP Regulation must provide professional users of the chemical substances with safety data sheets. The safety data sheets have to contain information on classification and on how the chemical substances and mixtures are to be used in a safe way.

In REACH Regulation, Artivle 33, there is a limited obligation to provide information to customers about substances of very high concern on the *Candidate list* when present in articles in concentrations above 0,1 percent.

Restrictions of substances in textiles

The REACH regulation may introduce restrictions as conditions for or prohibition of manufacturing, placing on the market or use of substances or mixtures. Restrictions are found in the REACH regulation Annex XVII which contains restrictions on about 60 substances and a long list of substances of very high concern (substances that are carcinogenic, harmful to the unborn child and harmful to genetic material) which may only be sold for professional use.

The restrictions posed by the REACH regulation also cover the use of some substances used in textiles. These substances are currently arylamines derived from azo dyes, brominated

flame retardants[9] and dimethylfumarate (DMFu). Several aromatic amines associated with azo dyes have been classified as carcinogenic, mutagenic and/or toxic to reproduction. A list of 22 aromatic amines that can be released from azo dyes are included by the REACH restriction and must not be found in textile articles at detectable levels, i.e. above 0.003% by weight.

The Swedish Chemicals Agency has suggested restricting nonylphenol ethoxylates (NPEO) in textile articlesthrough the restriction process in REACH. The proposal has been evaluated by the two scientific committees under the European Chemicals Agency, ECHA. The next step in the process is that the European Commission will prepare a proposal for restriction that will be included in REACH Annex XVII.

The Stockholm Convention on Persistent Organic Pollutants (POPs) also includes some requirements that are applicable to textiles, such as the requirement on PFOS, some brominated flame retardants (PBDE's) and chloroparaffines.

2.1.2 Biocides and treated articles

Biocides are pesticides used to control harmful organisms hindering these to damage products or create health or environmental risks. The EU legislation relating to biocides is aimed to improve the functioning of the inner market and to ensure a high level of protection of human and animal health as well as the environment. The EU Regulation on biocides[10] contains some provisions for the marketing of treated articles (article 58). These provisions will apply to articles placed on the market, either produced within the EU or imported.

The term *treated article* means that a biocidal substance is incorporated into an object with another original function. The article can be a solid object, for instance a bathroom mat that gets an dadditional value by the treatment of an antibacterial substances. In contrast to biocidal chemical products there is no authorisation requirement for articles treated with biocides.

According to the first requirement in the biocide regulation, treated articles may only be placed on the market if the active substances contained have been approved in the EU or are included in the corresponding review programme (transitional measures have been established for this requirement).

The second requirement is about specific information demands. If the article manufacturer claims and can substantiate that the article has biocidal properties, a statement about this claim and the name of the incorporated active substances and nanomaterials should be put on the label of the article, together with relevant instructions for use. Even if labelling is not required, consumers have the right to get the information within 45 days, free of charge, about the biocidal treatment of an article.

The ban on treated articles with non-approved active substances will apply regardless of a biocidal claim being made or not. However, unless a specific claim is made it will clearly be difficult to find out if an article has been treated for the purpose of a biocidal effect.

The implementation of the new legal requirements for treated articles will involve considerable efforts from manufacturers and importers. They need to be aware of the

[9] polybrominated biphenyls, polybrominated diphenyl ethers and octabromo diphenylether
[10] Regulation (EU) no 528/2012

obligations and gather detailed knowledge about the articles they place on the EU market. Thus, the flow of information in supply chains in general needs to develop.

Need for information from the supply chain

The implementation of the new legal requirements for biocide treated articles will involve manufacturers and importers who need to be aware of the obligations and gather detailed knowledge about the articles they place on the EU market. Thus, the flow of information in supply chains in general needs to develop.

A study was undertaken to describe the current level of knowledge in importing companies.[11] Knowledge was studied by conducting interviews with representatives from importers of different article categories, including sports clothing and bedroom textiles. The results show variable knowledge among companies. In general, the companies found that information on biocide treatment had to be requested from suppliers and that the information provided could be scarce. The number of sub-contractor levels and lack of knowledge in the supply chain were limiting factors.

2.1.3 Product Safety legislation

The Product Safety Act[12] and the Product Safety Regulation[13] aims at making sure that articles on the market do not harm humans health or safety. The act and the regulation implements the EU General Product Safety Directiv (GPSD)[14]. According to the Product Safety Act [15] the Government may implement rules on ban of marketing and export of specific articles which may present a serious risk to consumers health and safety.

Based on the General Product Safety Directiv [16] the EU Commission may decide on a temporary ban for marketing of products that can cause serious risk for the health ans safety of the consumers. The member states are obliged to implement such EU decisions.

2.2 Voluntary initiatives

ECO-labels

The aim of the voluntary textile labels is to guide professional buyers and consumers in their choices of textiles that have less negative impact on health and environment. The consumers choice are important when it comes to encouraging textile manufacturers to provide more ecolabeled products. According to the eco-textile labelling guide from 2012 there are about 100 international standards and labels, but only about 10 different kinds of textile labelling that put demands on the textile processing[17].

There are a number of voluntary systems for textile labels. For the eco-labels, a certification is needed to be established for a product. The criteria for the certification take into account the environmental impact for the whole life-cycle for a product. Some common eco-labels in this

[11] KemI PM 10/12 Biocide treated articles – assessing knowledge levels (2012)
[12] SFS 2004:451.
[13] SFS 2004:469.
[14] Directive (2001/95/EG) on General Product Safety
[15] Product Safety Act 36 §
[16] Directive (2001/95/EG) on General Product Safety, article 13.
[17] www.ecotextilelabels.com

group are GOTS standard[18], Nordic eco-label[19], EU eco-label, Oeko-Tex[20], Bra Miljöval (Good Environmental Choice) and the Bluesign[21].

Restriction lists from companies

In addition to the voluntary labels many textile companies require their suppliers to comply with so called Restricted Substances Lists (RSLs), in order to limit the amount of content of hazardous substances in textiles. The companies may have varoious requirements which may be problematic, in particular for small importing companies, to ensure that their demands are fulfilled by suppliers and sub-suppliers. One concern is also that importing companies may not have the relevant chemical knowledge of the textile products they purchase, which limits their opportunity to ask questions and also to deal with any answers they get about the chemical content in the textile articles they import.

Proactive textile companies thus use either ECO-labels or their own RSL containing hundreds of hazardous substances which are not regulated in current EU-legislation, such as in REACH, and thus go way beyond current legislation.

A more comprehensive overview over legislation and voluntary initiatives for restriction of hazardous substances in textiles is presented in the Swedish Chemicals Agency's previous report about hazardous chemical substances in textiles[22].

2.3 International programme on Chemicals in Products in SAICM

Since systems for production, distribution, use, and disposal of products increasingly span the globe, it is important that effective means of providing, accessing and exchanging chemical constituent information is available and, to the extent possible, internationally consistent. The international policy response to this global and emerging issue on the need for information on chemical substance used in products is the Chemicals in Products (CiP) programme within SAICM[23].

A goal for the CiP programme is to promote material cycles that are resource efficient and as far as possible free of hazardous substances. Access to reliable information is critical not only to protect human health and the environment, but also for the efficient functioning of markets.

The CiP-project is a multi-stakeholder process with participation from different regions, sectors and organizations. The project has included prioritization of product groups, and facilitated stakeholder dialogues. The programme has decided textiles to be one of four prioritized product groups (the others being electronics, toys and construction materials). A sector case study specifically on textiles can be found at the UNEP webpage[24].

A project funded by the Global Environment Facility, GEF, focusing on testing the CiP in the textiles sector in China has been approved. Textiles was chosen due to the many ongoing activities in the sector, which are in many ways aligned with activities proposed under the

[18] www.global-standard.org
[19] www.nordicecolabel.org
[20] www.oeko-tex.com
[21] www.bluesign.com
[22] KemI report no 3/13: Hazardous chemicals in textiles - report of a government assignment (2013)
[23] The Strategic Approach to International Chemicals Management (SAICM) is a policy framework to promote chemical safety around the world.
[24] www.unep.org/chemicalsandwaste/UNEPsWork/ChemicalsinProductsproject/tabid/56141/Default.aspx

recommendations of the CiP project, and the interest shown from several stakeholders in that sector for going forward.

A programme proposal is being developed during 2014 and is foreseen to be adopted at the next International Conference (ICCM4) in 2015.

3 Textile consumption

Summary of main findings

- The majority,approximately 80%, of textiles consumed in EU are imported from a non-EU country, where China is the largest producer. In addition, it is common that semi-finished textile materials are imported from outside the EU and then ready-finally manufactured produced and labelled in the Union. This would mean that more than 80% of the textile production involving chemical substances occurs outside the EU.
- The textile consumption in the EU is above 19 kg per person and year. The corresponding figure for Sweden is approximately 14 kg per person. The data used to estimate the EU and Swedish consumption are based on two different independent studies and therefore the figures differ somewhat.
- Most textile articles, such as clothes and bed linen, are used in close contact with the skin. Dermal exposure to chemical substances in textiles is therefore an important exposure pathway to substances in textile articles.
- The type of fibre is one factor influencing the release of substances from textile material. Cotton is the most frequently used fibre in the textile production. Nearly 40% of the textile consumption in the EU consists of this fibre. Other important fibre types are polyester, viscose and polyamide.
- In Sweden the largest amount (53%) of the textile waste is incineratedand the part of the waste placed on landfill is negible.On an EU level, the amount of landfill of the consumed textiles is about 57%.

3.1 Textile consumption in the EU

The aim of this section is to give a dimension of the problem with chemical substances in textiles by presenting the volumes of textiles consumed in the EU and to highlight the most frequent materials and textile articles on the EU market. Some of the information of material consumption is further used to estimate release of certain dyes to the environment via laundering and via landfill from textile waste (see Section 6.4). Textiles are produced in large quantities and are either the main component of or included in a wide variety of consumer articles that are widely used in the society. Textiles comprise the largest total area of all surface areas in the indoor environment, about twice as large as the combined areas of flooring, ceilings and walls[25]. A result of the high-volume use of textile articles is that a significant amount of chemical substances have the potential to be released and expose both consumers and the environment. The type of fibre is one factor influencing the release of substances from textile material (see Section 4.2). Textiles such as tops, underwear and bottoms come in close contact with the skin and these product groups are important when it comes to dermal exposure . The volumes presented in this section are therefore broken down on textile article types as well as on fibre type.

[25] The research program Chemitecs (2007-2012), www.chemitecs.se

3.1.1 Consumption by article category

The textile and clothing consumption in the EU has increased rapidly during the last decade where the majority (about 80%) was imported from outside the EU. Statistics from the European Commission (2014) show that the main suppliers in 2012 were China, which stood for 33% of the imports in terms of value, followed by Turkey (14%), Bangladesh (10%) and India (7%). According to Textile & Clothing Industries' Association (TEKO) it is common that semi-finished textiles are imported from outside the EU and then finally manufactured and labelled in the Union. Even though these textiles are "made in EU" the chemical intensive process may have taken place in a non-EU country. Based on EU statistics this would mean that more than 80% of the textile production involving chemical substances occurs outside the EU.

Information on consumption differs somewhat depending on what statistics are used. A recent study performed by the European Commission's Joint Research Centre, JRC[26] estimated the consumption in the EU as imports plus production minus exports. The percentage of consumption for the different product articles are demonstrated in Figure 2 and Figure 3.

Figure 2 Percentage breakdown of clothing textile products consumption in the EU, IMPRO Textiles (2014)

The average apparent textile consumption is estimated at close to 9 500 thousand tonnes/year or 19.1 kg/EU citizen. Clothing accounts for more than two thirds of the consumption where tops, bottoms and underwear together represented approximately 80%. Amongst household textiles, floor coverings (carpets) dominate the market (38%) followed by bed linens (16%).

The quantity of the technical textiles included in the scope of this assignment, i.e. construction and industrial textiles were not included in the report from the Joint Research Centre (JRC) due to lack of information. Even if the market share of these types of technical textiles is minor they may very well contain some hazardous substances addressed in the risk assessment in Section 6.3.

[26] European Commission, Environmental Improvement Potential of textiles (IMPRO Textiles) (2014)

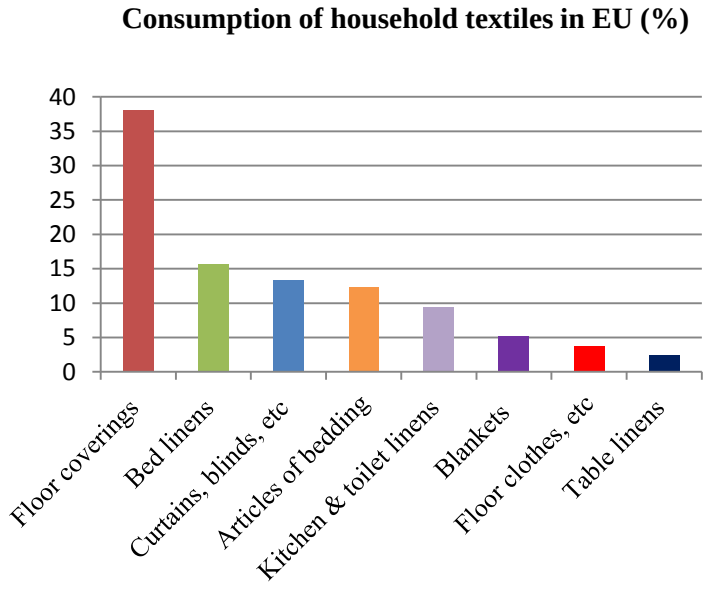

Figure 3 Percentage breakdown of household textile products consumption in the EU[27]

3.1.2 Consumption by fibre type

The following presentation of textile consumption in the EU is based on fibre type. The data are taken from the report on Environmental Improvement Potential of textiles produced by JRC in 2014. Each textile product category has been broken down into different natural and synthetic fibre types. Cotton is the most common fibre in textile production and makes up for approximately 40% of the total textile consumption in the EU (in terms of mass, see Table 1).

	Fibre type	**Percentage of textile consumption (in terms of mass)**
NATURAL	Cotton	40
	Wool	7
	Flax	0.3
	Silk	0.1
SYNTHETIC	Polyester	20
	Polyamide	13
	Viscose*	8
	Acrylic	8
	Polyurethane/Polypropylene (PU/PP)	4
	PVC	0.2

Table 1 Textile articles broken down to fibre types, IMPRO Textiles (2014)

**Viscose is man made fibre made of cellulose*

[27] European commission, Environmental Improvement Potential of textiles (IMPRO Textiles) (2014)

When viewing only clothing textiles, cotton accounts for over 43% of all fibres (in terms of mass of consumption). Polyester comes in second place with 18% of clothing textiles and viscose and acrylic make approximately 10% each. Natural fibres dominate with 54% of the clothing consumption in terms of mass.

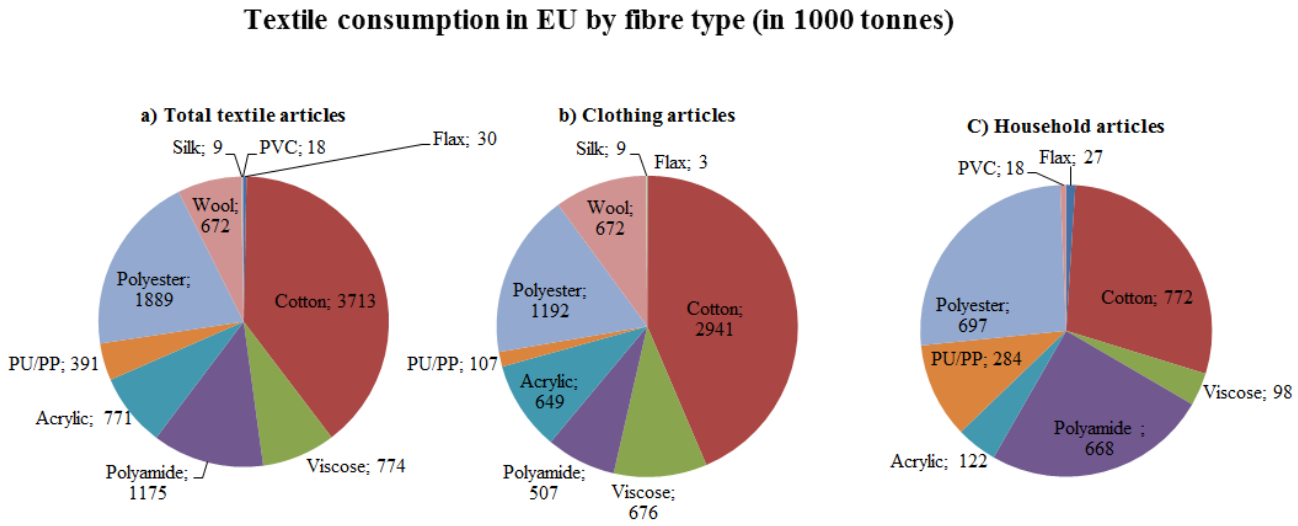

Figure 4 Textile consumption in the EU by fibre type in 1000 tonnes. The consumption is presented as statistics for total textile articles (A), clothing articles (B) and household articles (C) (Beton et al. 2014)

For household textiles, synthetic fibres make up 70% of the consumption. The most common fibre types besides cotton are polyester and polyamide. The tonnages are demonstrated in Figure 4. Some of the quantity data in Figure 4 are used in our environmental exposure estimates in Section 6.4.

It is important to point out that many clothing articles are made from blended fibres, perhaps the most common being polyester/cotton blends e.g. for shirts/blouses, but also e.g. polyester/wool for trousers. In these cases a combination of dye classes is necessary (DyStar 2014).

3.1.3 Biocide treated textiles

Articles treated with antibacterial biocides are widely marketed[28], and the effects that would be prevented was often expressed in terms as *anti-mold*, *anti-bacterial* or *anti-odour*. In the marketing, information to support the claims about biocidal effects was generally missing.

Articles intended for use in many daily activities could be found, for example kitchen ware, bathroom accessories, cleaning supplies, toys and child care articles. Textiles and clothing of many kinds were found – sportswear, underwear, shoe insoles, hats, gloves, socks, mattresses, mattress covers, pillows, bedding, towels, rugs, furniture and curtains.

Treated textile materials were for instance pure or blended cotton, wool, polypropylene, acrylics, polyamide and polyester. Non-woven cellulosic materials were mentioned for wipes

[28] KemI PM 2/12 Biocide treated articles - an Intenet survey (2012)

and other cleaning devices, towels and bandages. Other textile products were for example clothes, bed linen, carpets, filters and textiles for use in surgery and hospitals.

3.2 Textile consumption in Sweden

According to the Swedish Environmental Protection Agency [29] the apparent consumption (imports + production - exports) of clothing and household textiles in 2008 was 131 830 tonnes where only 2% came from domestic manufacturing. This means that in 2008, the Swedish population consumed on average 14.2 kilo textile per person. In comparison, the apparent consumption in Finland and Denmark was estimated to 13 and 16 kg/citizen respectively and the estimated consumption amounts in the EU are somewhat higher[30, 31].

It should be noted that the data behind the Swedish statistics are not identical to the EU statistics and should not be compared directly. The results from the independent studies are however of the same magnitude and therefore considered to be reliable.

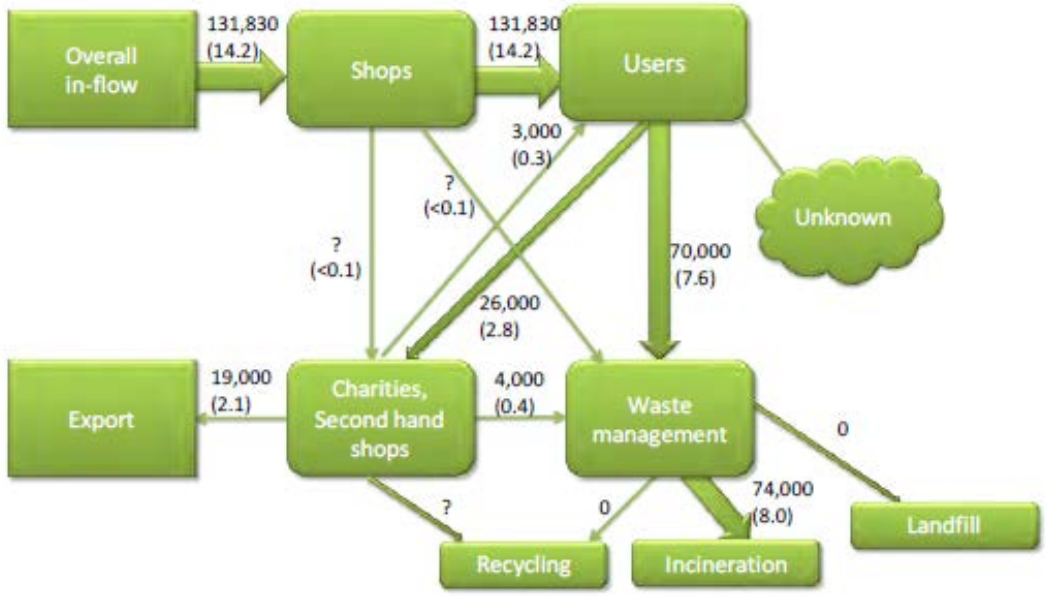

Figure 5 Textile flow in Sweden in 2010 [32]

From the year 2002 to 2012 the private consumption of clothes and shoes in Sweden increased with close to 40 per cent (in value terms), coupled with small increases in consumer prices, which indicate a large growth in the volume consumed[33].

More recent information suggests that 121 000 tonnes (12.5 kg/capita) of new textiles (primarily clothes) were consumed in 2013[34]. This could indicate a decrease in consumption

[29] The Swedish Environmental Protection Agency, Kartläggning av mängder och flöden av textilavfall (2011)
[30] NORDEN, Prevention of Textile Waste - TemaNord 2012:545 (2012)
[31] European commission, Environmental Improvement Potential of textiles (IMPRO Textiles) (2014)
[32] NORDEN, Prevention of Textile Waste - TemaNord 2012:545 (2012)
[33] Centrum för konsumtionsvetenskap, Konsumptionsrapporten (2013)
[34] Svenska Miljö Emissions Data (SMED), Konsumtion och återanvändning av textilier (2014)

but it is too early to draw any firm conclusions based on only the present report. According to the Swedish EPA[35] the textile market is sensitive to fashion trends and market fluctuations, especially when it comes to clothes. This makes it difficult to identify a trend in the textile consumption market.

According to information from 2008 approximately 26 000 tonnes (2.8 kg/citizen) used clothes and household textiles are annually collected by different charity organisations in Sweden, of which the most part is exported. [36]

3.3 Textile recycling and waste management

At the end of their lifetime textile articles can be reused, recycled or disposed of by landfilling or incineration, with and without energy recovery [37]. Collection of household textiles is not very common, unlike for clothing. Across Europe, it is estimated that between 15% and 20% of the disposed textile clothing is collected and then either reused (for a majority part in developing countries) or recycled.

The European Commission has recently adopted a legislative proposal to review recycling and other waste-related targets in e.g. the EU Waste Framework. The aim of the proposal is to help turn Europe into a circular economy, boost recycling and reuse, secure access to raw materials and create jobs and economic growth. Higher recycling rates and phasing out landfilling by 2025 for recyclable waste ought to include textiles, although not specifically mentioned[38]. This means that at EU level it is expected that the reuse and recycling rate will increase whereas the rate going to landfilling will decrease during the next ten years.

From a Swedish perspective the consumption (imports - exports) of clothing and household textiles increased more than 40% (in terms of mass) during the period 2000 to 2009. This suggests that textile waste will also increase. A forecast estimated that textile waste in Sweden could increase from 70 000 tonnes today to 134 000 tonnes by 2030 unless action is taken[39].

In the Nordic countries most used textiles either end up in the wardrobe, or in an incinerator, while only a small part is reused and recycled[40]. Taking Sweden as an example, approximately 14 kg of textiles are consumed per person and year (in 2008). Of this amount, approximately 8 kg (which is 53%) is incinerated and 3 kg (20%) is reused by charity organisations and a very small percentage is recycled (thus estimated to be 0%). The remaining 4 kg (27%) is accumulated (e.g. in a wardrobe) or undergoes other waste processing where it is difficult to measure the quantities involved. See Figure 5.

Recycled textile materials may in some cases contain higher amounts of some hazardous substances, e.g. certain phthalates, than virgin material. The textile material that is collected and put into the recycling systems today often has been placed on the market long before the present legal requirements on substances entered into force. A test performed by the Swedish Chemicals Agency in 2012 [41] indicates that reused material may contain high amounts of

[35] Personal communication with Staffan Ågren at the Swedish Environmental Protection Agency, (July 2014)
[36] The Swedish Environmental Protection Agency, Kartläggning av mängder och flöden av textilavfall (2011)
[37] European commission, Environmental Improvement Potential of textiles (IMPRO Textiles) (2014)
[38] European commission, moving towards a circular economy, http://ec.europa.eu/environment/circular-economy/, (september 2014)
[39] Svenska Miljö Emissions Data (SMED) PM angående framtidsprognoser för prioriterade avfallsströmmar (2012)
[40] Svenska Miljö Emissions Data (SMED), Kartläggning av mängder och flöden textilavfall.(2011)
[41] Unpublished data from the textile dialogue: http://www.kemi.se/sv/Innehall/Branschdialoger/Branschdialoger/ (2014)

banned substances, e.g. certain phthalates were found in much higher concentrations in a second-hand t-shirt (only one second-hand t-shirt was tested) than in 29 new t-shirts.

In Figure 6 the textile waste management of clothing on EU level is illustrated[42]. At EU level, the amount of landfill of the consumed textile clothing is about 57% according to Beton et al., whereas in Sweden landfill is negligible in comparison with incineration. The quantity of 57% is used in our environmental exposure estimates in Section 6.4. Wasted textiles may leak hazardous substances from landfill areas.

Figure 6 End-of-life routes of textile waste in the EU27

[42] European commission, Environmental Improvement Potential of textiles (IMPRO Textiles) (2014)

4 Chemical substances in textile articles – release and exposure

Textiles include very broad categories of products and are used in a way that both consumers and the environment are directly or indirectly exposed to their chemical content. Large quantities of chemical substances are used in the manufacture of textiles, from processing of fibres and raw materials to the final touch of the finished article. In a study from 2009, it was estimated that the consumption of chemical substances for producing 1 kg of cotton t-shirts is around 3 kg[43]. Substances used in the manufacture and finishing of textiles can remain in the final article, intentionally or unintentionally, but it is difficult to know exactly which substances are present and to what concentration levels since the supply chains are long and complex with a global span. Information regarding chemical substances in textiles is therefore often decreasing when going down the supply chain. Several of the chemical substances used in textile manufacturing have hazardous properties and may be harmful to human health and/or the environment, while others are currently not considered as hazardous.

4.1 Chemical substances used in production of textiles

The chemical substances used in the manufacture of textile can be categorised into functional (or effect) chemical substances, auxiliary chemical substances and chemical substances not intentionally added.

Functional (effect) chemical substances

Functional/effect chemical substances are added to the textile to contribute to the design or give the final article certain properties, e.g. colourants and crease resistant agents. These substances are therefore intended to remain in the final article and are expected to be present at certain concentrations in order to achieve the desirable function. Some examples of functional chemical substances are:

- Dyestuffs and pigments
- Crease resistant agents
- Anti-shrinking agents
- Oil, soil and water repellents
- Plasticisers
- Flame retardants
- Biocides for defined functionalities in articles, e.g. antibacterial agents
- Stabilisers
- Stiffening agents
- Reactive resins for various finishing treatments

The environmental load[44] of the textile production from functional chemical substances represent approximately 5% of the total environmental load of all chemical substances used in the textile production [45]. For the functional chemical substances to work it is essential that they are compatible to the material, i.e. that they have good solubility in the material and/or bind adequately to the fibre. In order to sustain the desired functionality in the final textile article during the usage phase the functional chemical substances should have the most

[43] Kartläggning av kemikalieanvändning i kläder, Swerea IVF Uppdragsrapport 09/52 (2009)
[44] Environmental load describes the consumption of raw materials and chemicals. It can be described as in units such as tons per year.
[45] EURATEX, E.-D. , (2000). "Textile Industry BREF document (Chapter 2-6)".

favourable ageing characteristics possible[46]. Some functional chemical substances react after use but still have their function. For example the flame retardant TBBPA reacts during polymerisation of the fibre material and is no longer present but still has its function as flame retardant due to the presence of the bromine.

Biocides targeting microorganisms are increasingly being used for the treatment of textile materials and finished articles. Such treatment is intended to protect the material against deterioration by for example, preventing bacterial growth and odour in sport clothing.

Auxiliary chemical substances

Auxiliary chemical substances, also known as process chemical substances, are necessary to make textile processes work, but they do not provide any desired properties to the final article and are therefore not meant to remain in the finished textile.
Some examples of auxiliary chemical substances are:

- Organic solvents
- Surfactants
- Softeners
- Salts
- Acids and bases
- Biocides as preservatives in the process or during storage and transport

Unintended chemical substances - contaminants and degradation products

Chemical substances that are not intended to remain in the finished article, such as contaminants and degradation products, have no function in neither the textile production process nor in the finished textile. Unintended chemical substances which remain in the final article often have a relatively low concentration, compared with the concentrations of functional chemical substances, but may sometimes be of concern for human health and the environment. Some examples of unintended chemical substances are:

- Formaldehyde released from certain reactive resins
- Polyaromatic hydrocarbons (PAH) impurities in pyrolysed products e.g Carbon Black
- Arylamines derived from certain azo dyestuffs and pigments
- Toxic metals (e.g heavy metals) due to impurities from the raw material

Remains of the auxiliary chemical substances, as well as unreacted raw materials and impurities (i.e., unintended chemical substances) in those may, however, be found in the finished articles as a contaminant and can cause health and/or environmental problems. An auxiliary chemical substance which remains in the final article generally has a relatively low concentration, compared with the concentration of a functional chemical substance.

The properties of the chemical may influence the extent to which a chemical remains in the textile product, for example:

- Normally, substances with high water solubility are removed in the washing processes completely or to a certain extent.
- Volatile substances may evaporate during treatment into finished textiles.

[46] Swerea IVF: A research institute within the Swerea group with materials, processes and production systems within manufacturing and product development as key areas

- Normally, auxiliary chemical substances should be removed after use in the actual process steps. The functionality of these chemical substances is to facilitate carrying out the dyeing and finishing process without any residual incorporation into the material.
- Auxiliary chemical substances should be completely removed after use or degrade during the process, for example bleaching agents.

This means that most surfactants, i.e. detergents, emulsifiers and other water-soluble chemical substances such as inorganic salts, alkalis, acids etc., are normally washed out, provided that the applied washing steps are performed in an effective way. This may not always be the case, shown by nonylphenol ethoxylates as one example (see Section 5.2.1).

4.2 Release of chemical substances from textile articles

Substances that are present in textile articles can be released in several ways during use and subsequently be available for exposure of humans and the environment. During normal wear and tear, when textile articles are used and washed, and ultimately are disposed of as waste, chemical substances will be released from the articles, as such or in fibres.

The release patterns include migration, leaching, evaporation and particulate releases (see Figure 7), and are dependent on several factors:

- the inherent chemical/physical properties of the substance
- how the substance is incorporated into the textile
- the type of fibre
- the handling of the textile

Chemical/physical properties which are supporting releases are medium to high vapour pressure and water solubility. Substances with a high vapour pressure are prone to evapourate to the air whereas it is more likely that water soluble substances leach to water/sweat/saliva. Lipid solubility can influence the migration to and uptake by the skin.

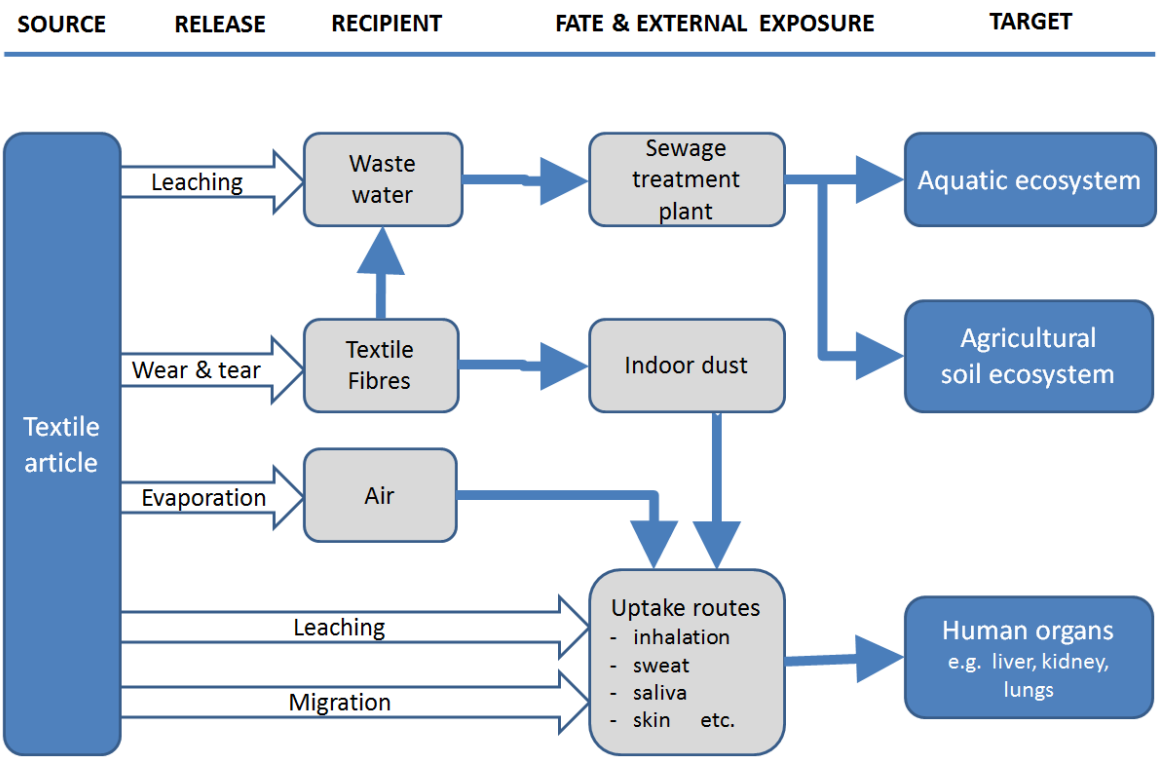

Figure 7 Relevant potential chemical release pattern from textiles

The release of a substance may occur in molecular form and/or in the form of fibre particles with molecules bound to them. Particulate releases are due to wear and tear during use and washing of the clothes, and consist of fibre fragments. The way which a chemical is incorporated into the textile material will influence in which form it is released. Substances which bind loosely to the material (e.g. plasticisers, stabilising agents, direct dyes) will have high molecular releases during use, while strongly bound substances, e.g. reactive dyes, will have fibre-mediated releases. Residues of process chemical substances or other impurities or contaminants are often loosely bound to the material. The binding affinity can also vary for different fibre types and textile materials. Other factors that can trigger release include, high humidity, high temperature, outdoor use (UV-radiation) and high physical stress (wear and tear).

It has been shown that considerable shares of silver, triclosan and triclocarban contained in textile articles are released from biocide treated textiles after some washing rounds[47]. The release of active substances during use and disposal of treated articles can give exposure contributions that normally are not accounted for in risk assessments (see 5.3.1).

[47] KemI PM 1/12 Antibacterial substances leaking (2012)

4.3 Exposure to chemical substances from textile articles

4.3.1 Human exposure

The frequent every-day use of textile articles may lead to exposure among people of all ages to the chemical content in textiles. Thus, if textile articles contain hazardous substances at levels which could entail a significant degree of human exposure, the health effects may be wide-spread among the general population.

Human exposures to substances in textiles are mainly by dermal contact but substances might also be released from the textile fibres causing exposure through inhalation or unintentional ingestion of dust. For small children unintentional ingestion of dust as well as oral exposure through sucking or chewing on textile are considered as important exposure routes.

Textiles comprise the largest total area of all surface areas in the indoor environment, about twice as large as the combined areas of flooring, ceilings and walls. In comparison, electronics, shoes and toys combined, equal around one and a half percent of the textile area. Sheets, towels, curtains, draperies, garments of various kinds and upholstered furniture are the main article categories contributing to the huge area of textiles which is around six times larger than all pavements. The release of chemical substances from textiles to the indoor environment through wear and tear is related to this very large area and the chemical exposures from textiles therefore potentially of high importance[48].

Dermal exposure

Most textile articles, such as clothes and bed linen, are used in close contact with the skin, see Figure 2 and Figure 3 in Section 3.1.1. Textile articles, such as clothes and bed linen, are used in close contact with the skin. Dermal exposure is therefore a central exposure pathway for exposure to substances in textile articles. Retail workers handling large volumes of textile articles can also have a substantial dermal exposure of the hands.

When textile articles are in direct contact with the skin, substances in the textile can migrate from the material and penetrate the skin. Dermal exposure depends on several factors including the type of material and amount of available substance, physico-chemical properties of the substance, such as water and fat solubility, skin penetration rate and the characteristics of the exposed area[49]. If irritating substances are present in the textiles or if the skin is thin or damaged this can increase the dermal uptake. Dermal exposure is particularly important for sensitising substances and contact allergy is a well-known problem related to the use of textile articles.

Oral exposure

Oral exposure by mouthing of textiles is normally a minor pathway except for small children who often put things in their mouths and for which this mouthing behaviour may lead to significant exposures. Substances can migrate from the textile to saliva and the degree of migration is dependent on the type of material and amount of available substance, physic-chemical properties of the substance, including water solubility, and how the article is

[48] Personal communication with Sverker Molander, Professor at the department of Energy and Environment at Chalmers University. Representative for the Chemitecs program (2007-2012), www.chemitecs.se

[49] ECHA Guidance on information requirements and chemical safety assessment Chapter R.15: Consumer exposure estimation, 2012.

handled[50]. Water soluble compounds are for example more likely to migrate to the saliva and more of a substance is released if the article is chewed on.

Textile articles release fibres through daily wear and tear and these fibres end up in indoor dust to a large extent. It is however difficult to assess the extent of exposure and effects related to substances bound to textile fibres in dust as the composition of dust varies largely. Due to the mouthing behaviour of small children and the fact that they often stay close to the floor, dust is in some cases an important source of exposure for children[51].

Indirect oral exposure via diet may also be a contributing exposure pathway for humans to hazardous substances in textiles. Textile-related substances are released to the environment via washing, fibre loss and waste treatment and can subsequently contaminate human sources of food and drinking water.

Inhalation exposure

Inhalation exposure may occur when substances or fibres are released from the textile and reach the breathing zone. Volatile compounds are more likely to be released from textiles and the emission rate is usually highest for new articles and subsides over time [52]. The final steps of textile processing often include heating of the textile for drying and fixation. Depending on the effectiveness of this process, the levels of volatile substances can be affected. In some cases volatile substances are intentionally added to give a certain function to the textile article, such as the addition of fragrances to so called cosmetic textiles. People may also be exposed to chemical substances through inhalation of textile fibres that are released from the article through normal wear and tear.

Chemical exposure through inhalation is mainly relevant to retail workers handling new textile articles and/or in poorly ventilated indoor areas with large quantities of textiles. Warehouses for textile articles, clothing stores, furniture stores and public facilities with a lot of textile furnishing are examples of places were inhalation of chemical substances from textiles might be a problem for human health.

4.3.2 Environmental exposure

Environmental exposure includes release to wastewater during washing of textiles. Substances emitted from the textiles reach the wastewater treatment plants and if they are poorly degradable they will be released with the treated wastewater effluents or end up in the sludge. Humans might indirectly be exposed to chemical substances via the environment. Environmental risks associated with chemical substances in textiles are mainly expected to occur in the aquatic compartment.

Environmental exposure of chemical substances from textile articles will mainly occur due to leaching via laundering, via chemical substances on textile fibres released due to wear and tear, and from textile waste. Other sources including evaporation of chemical substances from textiles and consumer treatment of finished textiles, such as home-dying, water resistant impregnation or bleaching may also result in environmental exposure.

[50] RIVM, Chemicals in Toys - A general methodology for assessment of chemical safety of toys with a focus on elements, 2008.
[51] Björklund et.al, Brominated flame retardants and perfluoroalkyl acids in Swedish indoor microenvironments (2011)
[52] ECHA Guidance on information requirements and chemical safety assessment Chapter R.17: Estimation of exposure from articles (2012)

When textile articles are washed chemical substances may leach from the material and enter the waste water and end up in the municipal waste water treatment plants (WWTPs) with the subsequent exposure of the chemical substances to the degrading organisms therein. If the chemical substances are not retained in the sludge, evaporated or degraded in the WWTP they will be released to the environment via the WWTP effluent water and aquatic ecosystems will be exposed. Furthermore, application of sludge from WWTPs on soil may result in exposure to organisms in the terrestrial ecosystems. In case the chemical substances are taken up into edible parts of crops this may result in an exposure of humans via food.

In addition, not all households are connected to WWTPs. Without the removal and degrading capacity of WWTPs, everything that will be released from textiles during washing in these households may reach the aquatic compartment.

Consumer use of textiles leads to a certain degree of fibre loss from the material, during for example laundering. Substances which bind strongly to the textile fibres follow the fate of the fibres. Textile fibres may end up in the waste water and spread to the environment as described above or in household dust which will be disposed of via vacuum cleaning dust bags and deposited in dumps/landfills or burned. In case of waste disposals, the chemical substances will probably via leachate mainly expose aquatic organisms. If the waste is incinerated, all ecosystems may be exposed to the combustion gases but the contribution from this source is not considered important for this study.

In case textiles are recycled, remaining substances get into the recycling system and end up in new products unless they areremoved in the recycling facilities. There is a knowledge gap today about which substances and at what concentration range substances remain in the textile article at the end-of-life. Most likely the main part of process chemical substances have been washed out from the textile article before it becomes waste, whereas functional chemical substances are not. Examples of functional chemical substances are brominated flame retardants in furnishing fabrics, water, oil and soil-repellent treatments in sports apparel and outdoor textiles as well as phthalates in printed parts of the textile and colourants/dyes.

The importance of consumer use of textiles as a source of the chemical substances detected in the environment is largely unknown for the absolute majority of these chemical substances. One exception to this is the nonylphenol ethoxylates and their degradation product nonylphenol, for which washing of textiles has been identified as an important source of exposure to the aquatic environment.

4.3.3 Assessment of risk and controlled use

A fundamental principle of REACH (see Section 2.1) is that the use of a substance must be *adequately controlled* when placed on the market. This can be achieved through the company registering a substance also presenting different handling instructions and safety measures, based on information on the hazardous properties and uses of the substance. If these *exposure scenarios* are followed during use, the use is considered to be adequately controlled and is not then assessed as harming human health or the environment. If it is not possible to bring about adequately controlled use through these measures, further risk management measures in the form of authorisation or restrictions may be implemented.

What is expected to be *adequately controlled* use from an environmental perspective is established in REACH through a standard model. This model is based on a calculated level of a substance in the environment being related to the concentration of the substance that is not expected to lead to any toxic effect on living organisms. If this risk quotient is less than 1, the use concerned is considered to be safe. In a corresponding way, use is assessed as *adequately*

controlled from a health perspective if the quotient between calculated exposure in a predicted exposure situation, i.e. an exposure scenario, and the exposure at which no toxic effect on humans is expected is less than 1.

In spite of the methods and tools for risk assessment there exist an uncertainty in the assessment why there is a need for precautionary thinking as a complement to the risk assessment model applied in REACH.

"Adequately controlled" exposure levels (determined using risk quotients) for both humans and the environment are established on the basis of available data concerning, for example, harmful effects where the extent of the available data is determined by the volume-based information requirements in REACH. To compensate for different types of uncertainties in the available data and for unknown variation in sensitivity among groups of exposed humans and among species populations, standard assessment factors are generally applied. The type and seriousness of the harmful effects, the extent of the exposure and the quality and extent of the available data also affect the values obtained. With regard to the estimated exposure of humans and in the environment, it is generally necessary to rely on modelled data to provide a reasonable, but presumed exaggerated exposure (*reasonable worst case*).

Taken together, it can be noted that the calculated exposure levels deemed to be safe (adequately controlled) and the estimated relevant exposure of both humans and the environment are estimates which, even if they are obtained using methodology that can provide a high level of protection, are nevertheless subject to uncertainty. Quotients between these quantities become even more uncertain, and an absolute limit for a risk quotient of less than one for when a particular exposure situation is to be regarded as "safe" from the point of view of health and the environment is therefore impossible to justify scientifically. The procedure can be described rather as a scientifically substantiated policy decision. This means that assessments that produce risk quotients of less than one in many cases need to be refined by further information being obtained on harmful effects and exposure. An alternative to this is to tighten the conditions for use, which provides a modified exposure scenario.

Conditions that must be fulfilled for use to be regarded as adequately controlled are stated in the exposure scenario. The conditions consist of risk management measures and operating conditions such as requirements for the use of gloves, ventilation, respiratory protection, protective clothing etc. The conditions may also indicate the maximum volume or period of exposure, method of application etc.

The standard model for risk assessment is applied to substances regarding as having having a threshold value for health and environmental effects, thus substances for which it is possible to establish a minimum level of exposure at which effects can occur. Other metods are used for substances without a threshold and certain categories of substances of very high environmental concern.

It is also evident that the exposure scenarios only deal with exposure to a single substance from a single source and do not take account of combination effects. It is therefore inadequate to deal with several important aspects of the total exposure of both humans and the environment.

On the basis of knowledge of deficiencies and limitations in both the risk assessment and risk management models and in the scientifically based knowledge where required, it is clear that the precautionary principle should be applied to improve the protection of health and the environment.

5 Review of literature related to hazardous chemical substances in textile articles

A systematic survey of available and relevant literature of health effects and environmental effects associated with exposure to hazardous substances in textile articles was conducted according to the method described in Annex 2. The review include both scientific studies and governmental reports. The results are presented in Section 5.1 for human health effects and in Section 5.2 for environmental effects. For some chemical substances associated with textiles – e.g. silver, nonylphenol ethoxylates and highly fluorinated polymers, there are more published data on environmental effects and theese are described in more detail.

The literature review presented in this section gives an overview of the current state of knowledge and is a complement to the identification of potential risks with hazardous substances in textile articles. However, it should be noted that this area is not well studies and that that the number of scientific studies about potential risks from hazardous substances in textile articles are few, especially environmental risks [53].

[53] The references to the scientific literature of this Chapter is presented in Chapter 8.

5.1 Review of health effects related to human exposure to hazardous substances in textile articles

Summary of main results

- Most research articles about health effects of chemical substance in textile articles concern allergic skin reactions. Disperse dyes, used for staining synthetic fibres, are the most common causes of textile allergy in the literature. The overall evidence indicates that contact allergy to disperse dyes is a clinically relevant problem.
- The most recent evidence shows that 3.6% of the patients that suffer from contact allergy are allergic to disperse dyes. Many patients are allergic to other substances in the commercial dye than the actual dye molecule. It is difficult to determine the extent of the problem because standard patch tests do not include the most relevant substances and because there is a lack of information from the industry about the use of allergenic substances in textile production.
- Correlations between exposure to hazardous substances in textile and an increased risk of cancer and developmental disorders are difficult to determine due to long time delay between exposure and effect.
- Cancer has been associated mainly with exposure to carcinogenic aryl amines which can be formed as a cleavage product from textile azo dyes.
- Most literature about cancer effects of chemical substance in textiles concerns exposure in the textile industry during textile production and there is very limited information about consumer exposure.
- Reproductive toxicity has mainly been associated with exposure to textile articles in the context of brominated flame retardants, highly fluorinated water and stain repellants, phthalates and antibacterial agents
- The use of articles treated with antibacterial biocides is increasing. There are indications that bacterial resistance to biocides can contribute to accelerating the problem of resistance to antibiotics.
- It has been shown that biocides may be released from textiles during laundry.

5.1.1 Health effects of sensitising substances in textile articles

The potential link between exposure to sensitising substances in textile articles and allergic reactions has recently been investigated by consultant RPS on behalf of the European Commission DG Enterprise and Industry [54]. The authors concluded that textile dyes, textile finishing resins and some other textile-related substances can cause allergic skin reactions but variations in study results and a lack of recent data makes it difficult to determine the true prevalence.

The report also emphasises that information about concentrations of sensitising and irritating chemical substances used and remaining on the finished textile article is lacking from the textile industry. This makes it difficult to draw a conclusion on whether there is a link between hazardous substances in finished textiles and contact dermatitis. We refer to the report from DG Enterprise for an in depth and comprehensive review of the recent state of

[54] European Comission DG Enterprise, Study on the Link Between Allergic Reactions and Chemicals in Textile Products. (2013)

knowledge regarding textile dermatitis from textile articles. In the present report, we present a concise overview including some additional and more recent data.

Textile dermatitis

Textile dermatitis is a skin reaction typically characterised by inflammation, redness and itching of the skin after direct contact with a textile. The condition is mainly associated with synthetic materials and a recent study lists trousers and skirts, underwear, shirts, nylon stockings and sportswear as the most problematic garments [1].

There are two kinds of textile dermatitis, allergic and irritant, which often coexist and show similar symptoms [2]. Allergic textile dermatitis involves specific activation of the immune system to a foreign substance that penetrates the skin. Allergic reactions are specific to the individual and although some substances are known to be more allergenic than others, allergic textile dermatitis is hard to predict. The development of an allergic reaction occurs in two phases, the sensitisation phase when the immune system recognises the substance and mobilises a response and the elicitation phase when the immune system causes an allergic reaction. This means that the symptoms of allergic textile dermatitis usually develop over time and not at the first contact with the allergen.

Irritant textile dermatitis is caused by a substance that directly damages and irritates the skin and a reaction can occur upon the first exposure to a substance. Skin reactions due to irritant substances are more easy to predict based on the substance's inherent hazardous properties. It is difficult to distinguish irritant and allergic textile dermatitis in a clinical setting and in the present report we include both conditions in the term textile dermatitis [2].

Prevalence of textile dermatitis

We found ten publications from epidemiological studies of textile dermatitis among patients that seek care at dermatological clinics, published from 2004 until today. The number of patients enrolled in the studies ranged from 277 up to 3 325 and the prevalence data varied between 1.5% and 32.6% [1, 3-11]. The most recent study, a large European multicentre study, found that 3.6% of the tested patients had a contact allergy to disperse dyes which was assessed as clinically relevant in one third of the cases. This study, along with others, show that allergic reactions to textile dyes are more common among women than men and also more common in southern Europe compared with the northern parts [1]. The available prevalence data are not based on a random population sample and the prevalence among the general population is not known.

According to the literature, textile dermatitis mostly occurs among consumers as lesions on the upper body, caused by tight clothing in synthetic material [1, 12]. However, occupational exposure may also be a problem, especially hand lesions from wearing work gloves [1]. In addition to prevalence data from clinical studies a survey among 858 patients with contact allergy in Sweden and Belgium showed that eighteen per cent of the patients suspected textiles as a cause of their skin problems, and that synthetic materials were the most common textiles to give skin problems [13].

The large variation in prevalence in clinical studies may be explained by differences in patient selection and study design, especially due to differences in the substances included in the patch tests that are used for testing the patients [10, 12, 14]. Moreover, a review of previous epidemiological studies also shows inconsistency in the reported prevalence and the collected data do not indicate whether textile dermatitis is becoming more or less common, although several publications states that the problem is growing [12].

Today, it is not possible to diagnose patients that are allergic to textile dyes or other allergenic textile substances by using the commercial available patch tests that are used routinely in clinics. Patients with contact dermatitis are normally diagnosed by using the European base line series[55]. This series does not include any textile dyes or other textile related substances, with the exeption of formaldehyde. Allergy to textile related substances can therefore only be diagnosed in pateints that enrole in clinical studies or in rare cases when the doctor specifically suspect a textile substance as the allergen, and even those cases only a limited number of dyes and finishes are included in the patch tests[56] [7, 14-16]. It is also possible that the substances used for diagnostical purposes differ in composition and purity from the substances used in textile production making it even more difficult to identify the true allergen. There are also most probably a large number of unrecorded cases that never seek medical care for their problems. It is thus likely that many cases of contact allergy to textile related substances remain undiagnosed in the clinics.

Classification of sensitising substances

A substance shall be classified as a skin sensitiser according to the CLP Regulation (EC) No 1278/2008 if it shows allergenic properties in toxicity tests or when there is sufficient evidence in humans that the substance can cause skin allergy. According to ECHA[57] skin sensitisation is generally regarded as a threshold effect, although in practise it may be very difficult to derive a threshold and to set a safe level of exposure (DNEL) for sensitising substances.

Skin sensitising substances in textile articles

Textiles dyes and finishing resins are the types of textile related substances that are most commonly reported to cause textile dermatitis[58]. This is also reflected in the scientific literature which is dominated by clinical studies of skin allergies caused by textile disperse dyes and formaldehyde releasing finishing resins. There is only a very limited number of scientific studies investigating allergic reactions to other types of textile related chemical substances and it is possible that the problem with textile dermatitis caused by such substances may be overlooked.

Textile dyes

Disperse dyes constitute the most frequently reported cause of textile dermatitis and among these Disperse Blue 124, Disperse Blue 106 and Disperse Yellow 3 stand out as extra problematic with a prevalence exceeding 1% in screening studies at dermatology clinics [12]. Also, there are a number of case studies showing that allergic reactions to dispersion dyes in textile articles is a clinically relevant problem [15-19]. One study did however show that about twentyfive per cent of the patients diagnosed as having contact allergy to disperse dyes did not react to the dye molecule but to other substances in the dye. This indicates that commercial textile dyes may contain allergenic substances whose identities are unknown to us. Disperse dyes are used to stain synthetic fabrics made from polyester, acetate and nylon and not for natural fabrics such as cotton, wool or flax. The dye molecules are lipophilic and based on an azobenzene or an anthraquinone with a functional group attached to it. Problems

[55] http://www.chemotechnique.se/products/series/european-baseline-series/
[56] http://www.chemotechnique.se/products/series/textile-colours-amp-finish/
[57] Guidance on information requirements and chemical safety assessment, APPENDIX R. 8-10 (2012)
[58] European Comission DG Enterprise, Study on the Link Between Allergic Reactions and Chemicals in Textile Products. (2013)

with bad colour fastness often arise when the dying procedure is not carried out under optimal conditions or if the dye is not suited for the specific material. In such cases disperse dyes easily rub off from the textile and migrate onto the skin of the person wearing the garment.

Nineteen dispersion dyes are listed as allergens by the EU ecolabel and some of these are also covered by the Oeko-Tex Standard 100 criteria [59], [60]. The EU ecolabel and the Oeko-Tex standard are voluntary initiatives but many manufacturers, importers and retailers conform to them which has led to a decreased use of the most well-known allergenic disperse dyes. Market surveillance analyses indicate that the allergenic disperse dyes listed by EU ecolabel are rarely found in clothes on the EU market,[61]. However, only a limited number of samples coming from a very large market were examined and it cannot be excluded that disperse dyes exist in other areas of the textile market or that other not known allergenic dyes may be used in textile production.

There are a only a few reports of textile dermatitis caused by other types of textile dyes (acid dyes, basic dyes, direct dyes, mordant dyes, naphtol dyes, vat dyes, reactive dyes, solvent dyes, sulphur dyes, and pigments) and most of these reports were published before 2004 and do not concern consumer exposure [20]. We did, however, find occasional case reports of patients that suffered from textile dermatitis caused by reactive and basic dyes in clothing [21, 22]. There are also reports from epidemiological studies that textile dermatitis patients show positive test results to some basic dyes, reactive dyes and acid dyes [1, 7, 8].

Textile finishing resins

Textiles are treated with finishing resins to reduce shrinking and wrinkling and to improve the quality, texture and appearance of the fabric. Many finishing resins can release formaldehyde which is volatile and can be emitted from the fabric and cause textile dermatitis. Textile dermatitis caused by formaldehyde in clothes was commonly reported in the past and has historically been a well-known problem [23, 24]. Today, many EU countries have national regulations on formaldehyde in textiles in order to minimise the risk to human health [62]. Stronger legislation together with voluntary restrictions have led to a decreased frequency of formaldehyde induced textile dermatitis and according to some reports it is no longer considered to be a problem for consumer health[63]. There are, however, some reports indicating that there are still reasons to be concerned about formaldehyde releasing textile finishing resins. Epidemiological studies from 2004 until today show that 2.3-8.2 percent of all textile dermatitis patients are sensitised to formaldehyde and one study shows that formaldehyde allergy is more common among people that were exposed at work [1, 6-8]. Statistics from the EU rapid alert system for exchange of information about products posing a serious health risk for consumers (RAPEX) show that formaldehyde represents about three percent of all notifications of hazardous substances in textile articles from 2009 until today [64]. Moreover, a survey of formaldehyde in textile articles carried out by the Joint Research

[59] http://ec.europa.eu/environment/ecolabel/documents/factsheet_textiles.pdf
[60] https://www.oeko-tex.com/en/manufacturers/concept/oeko_tex_standard_100plus/oeko_tex_standard_100plus.xhtml
[61] Danish Ministry of the Environment, Environmental Protection Agency, Survey of Selected Allergenic, Disperse Dyes in Clothes , Survey of chemical substances in consumer products, No. 129 (2014)
[62] European Comission DG Enterprise, Study on the Link Between Allergic Reactions and Chemicals in Textile Products. (2013)
[63] BfR, Introduction to the problems surrounding garment textiles (2012)
[64] Statistics were taken from RAPEX weekly notifications on clothing, textiles and fashion items from January 2009 to April 2014 (http://ec.europa.eu/consumers/safety/rapex/alerts/main/index.cfm?event=main.search). Only products within the scope of the assignment were included in the statistics.

Centre (JRC) in 2007 showed that 11% of the articles intended to be in direct contact with the skin contained more than 30 mg formaldehyde per kg textile, which is the limit value for the EU eco label and Oeko Tex.

Other allergenic substances in textiles

A great number of substances other than dyes and finishing resins are used for textile production including softeners, water repellents, flame retardants and biocides. The overall literature does, however, indicate that such substances are a rare cause of textile dermatitis since there are only a few publications on the subject. We found one scientific study that matched the scope of this study, a case report about textile dermatitis caused by sodium metabisulfite in a pair of blue jeans [25]. The literature review performed on behalf of the European Commission, DG Enterprise and Industry came to a similar result and concluded that textile dermatitis is mainly caused by dyes and finishing resins. Still, as with non-disperse dyes it is possible that there are unrecorded cases of sensitising substances since only a fraction of all textile related substances have undergone toxicity testing and are included in standard patch tests.

Textile related respiratory allergy

Textile articles may contain respiratory sensitisers and irritants that can cause symptoms, such as asthma, bronchitis and irritation in the upper airways. The risks of respiratory symptoms linked to chemical substances in textiles, are most likely limited to certain groups exposed in an occupational setting [26].We did not identify any reported cases of airway problems among consumers caused by chemical substances in textile articles.

Respiratory diseases are a major occupational problem in the occupational exposure in textile industry and the available literature points out textile dye powder as a potent respiratory sensitiser [27]. A major part of the scientific publications addresses respiratory health effects from exposure to cotton dust and it is difficult to differentiate whether the problems are caused by dust particles or if it is due to chemically induced toxicity. Still, this type of risk is of less relevance when evaluating risks from the use of textile articles.

5.1.2 Health effects of carcinogenic, mutagenic and reprotoxic substances in textile articles

Carcinogenic effects

Substances are defined as carcinogenic if they induce tumours, increase tumour incidence and/or malignancy or shorten the time to tumour occurrence. Chemically induced carcinogenesis can involve mutagenic and genotoxic events as well as non-genotoxic events. Mutagenicity means the induction of permanent changes of the DNA molecule, whereas genotoxicity is a broader term that refers to all types of alterations of the genetic material including structural changes and segregation of DNA. Non-genotoxic events are considered to have a threshold, in contrast to mutagenic and genotoxic effects where linear dose-response relationships are generally assumed. A consequence of a linear dose-response relationship is that no “safe” dose can be determined.

As the development of cancer involves several sequential steps over a long period of time it is hard to establish causative relationships between specific exposures and the development of cancer. Most of the literature about carcinogenic effects related to chemical substances in textiles report cancer risks from occupational exposure in the textile industry. Exposure to

textile dust and textile production chemical substances is much higher for workers in the textile industry compared with down-stream consumers. Some of the information might however still be of relevance for consumers exposed to chemical substances in textile articles as well as for workers handling large volumes of such articles.

Several reports on carcinogenicity and mutagenicity related to exposure to dyes were identified in the literature search, of which azo dyes constituted the major part. None of these specifically concerned exposure to textile articles, but the overall literature indicates that exposure to carcinogenic textile dyes can be relevant for consumers in contact with textile articles. Several azo dyes as well as other types of textile dyes such as anilines and anthraquinones, are classified as carcinogenic and/or mutagenic [65]. Studies have shown that single azo dyes and industrial effluents contaminated with azo dyes can cause mutagenic and genotoxic effects in cultured cells [28-30]. A recent study showed that mutagenic reactive-type azo dyes can migrate from cotton fibres to artificial sweat in an experimental setting. The dyes were mutagenic in their formulated form whereas the dye/sweat solutions were not found to be mutagenic [31].The carcinogenic and mutagenic properties of the azo dyes are attributed to aromatic amines, which can be released from dyed articles after reductive cleavage of the dye.

There are also a few reports of carcinogenic and mutagenic effects of other types of dyes, including mordant dyeing using chromium salts or other techniques using chromium as oxidation or fixing agents [32, 33].

Aside from the carcinogenic effects of textile dyes, there are very few studies on carcinogenic effects of other types of textile related chemical substances. There have been some concerns about the potential health effects of consumer exposure to nano particles in textile articles [34]. Two experimental studies show that textile related nano materials, such as titanium dioxide UV filter and antibacterial nanosilver particles can cause mutagenic and genotoxic effects in cultured cells [35, 36]. More studies on textile related nano materials and development of reliable test methods for nano toxicity, including skin penetration studies, are needed to assess the safety of nano particles in textile articles.

Effects on reproduction and development

Reproductive toxicity is often associated with endocrine disrupting substances with a direct effect on reproductive organs and developing processes, but effects on the reproductive system may also be an indirect result of a more general toxicity affecting the health status and well-being of an individual. Either way, such effects are of importance to the overall ability to reproduce. In recent literature, reproductive toxicity has mainly been associated with exposure to textile articles in the context of four categories of substances: brominated flame retardants, impurities or degradation products of highly fluorinated polymeric water and stain repellents, phthalates and antibacterial agents.

A review of epidemiological studies found suggestive evidence of health effects linked to exposure to brominated flame retardants, including neurobehavioural and developmental disorders, reproductive health effects and alterations in thyroid function[37]. Reproductive toxicity related to the exposure of brominated flame retardants has also been observed in animal studies [38-42].

[65] REGULATION (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures

For the substances that can be present as impurities or be formed as degradation products from highly fluorinated polymeric water and stain repellents, reproductive toxicity has been observed in animal studies [43, 44], while epidemiological studies have not reported any associations between human levels in maternal or umbilical cord blood and reproductive effects such as congenital cryptorchidism, birth weight or thyroid hormones [45-47].

Adverse reproductive effects, or early markers of such effects, have been observed after exposure to several different phthalates found in consumer articles, including textiles [66]. The observed reproductive effects were all related to an anti-androgenic mode of action and can be assumed to be additive, indicating the need to consider the combined effects after exposure to phthalates [48, 49].

Triclosan, triclocarban and silver nano particles can be added to textile articles as antibacterial agents. Effects of exposure to triclosan have been observed in reproductive toxicity models and triclosan has also been found to disrupt thyroid hormone homeostasis [50, 51, 52.]. Potential effects on neuronal development and physiological function have been indicated in cultured cortical neurons exposed to silver nano particles [53].

Furthermore, exposure to textile azo dyes has been found to affect parameters in a reproductive toxicity assay with varying potency [54, 55]. Also, in the occupational setting, an increased risk of miscarriages has been observed in women textile workers exposed to synthetic and natural fibres [56]. The relevance of these findings for human consumer exposure to hazardous chemical substances in textiles articles is, however, unclear.

5.1.3 Development of antibiotic resistance from antibacterial biocides

Biocides are increasingly being used for the treatment of textile materials and finished articles and this targets some form of microorganisms. Such treatment is intended to protect the material against deterioration by for example, preventing bacterial growth and odour in sport clothing (see Section 3.1.3).

In a preliminary literature study it was found that the main source of information regarding biocide treated materials was patents.[67] More than 6 000 patents were referred to for textiles, as compared to 2 000 for paper.The patent documents contain technical and legal information about inventions that may potentially be of economic interest, but they do not necessarily indicate that these inventions are used in practice already.

Preliminary literature searches in SciFinder[68] for the use active substances that potentially are of relevance also gave substantial amounts of references. Silver was an extreme with more than 250.000 references, but for most of the active substances there were more than a thousand references. That kind of citation frequency probably indicates some technical interest for the use of a substance.

The study showed that, in spite of frequent citation for some specific active substances and material types, the use of biocides in treated materials is not well documented in the literature. The information flow concerning biocide treatment needs to be developed in the supply chain for textiles.

[66] ECHA, Background document to the opinion on the Annex XV dossier proposing restrictions on four phthalates (2012)
[67] European Patent Office
[68] CAS, Chemical Abstracts Service Home Page

Exposure of antibacterial biocides from treated articles may influence the results of risk assessments of the substance. The release of active biocide substances during use and disposal of treated articles can give exposure contributions that normally are not accounted for in risk assessments. It has been shown that considerable shares of silver, triclosan and triclocarban contained in textile articles are lost after some washing rounds[69].

Antibacterial biocides and development of antibiotic resistance

New concerns relating to human health and the environment may be appearing due to the use of biocides in consumer articles. Such concern is increasingly being raised about the development of bacterial resistance to the active substances in disinfectants and preservatives. Loss of sensitivity to common disinfectants will influence the possibilities to prevent the spread of contagious diseases in the first place. But if such substances are used for treatment of finished articles instead of their main use in health care, the slow releases from an abundance of articles will give a constant low exposure to the microorganisms in wastewater systems.

It is known that continual release to the environment of an antibacterial substance in sub-lethal concentrations creates the perfect condition for bacteria to develop resistance to the substance. Even very low concentrations of antibacterial substances may create a selection pressure for resistant bacteria. The growth and reproduction of the sensitive wild type bacteria is inhibited, while bacteria with decreased sensitivity survive and can pass on their resistance genes. Because of this, resistance can be maintained and even increase over bacteria generations.

Furthermore, there are strong indications that resistance caused by antibacterial substances can potentially accelerate the development of resistance to antibiotics. Selection pressure created by a biocide may not only select biocide resistant bacteria but also those that are resistant to antibiotics. Although no minimal selective concentrations have been established for biocide substances, as for antibiotics, it is quite possible that diffuse releases from biocide treated articles can trigger the development of resistance to antibiotics. The scientific background does not allow a more firm statement.[70]

The role of antibacterial biocides in antibiotic resistance development is not sufficiently studied, but has been identified and assessed, based on available data, by the Scientific Committee on Emerging and Newly Identified Health Risks.[71] The problem of resistance to antibiotics is developing rapidly, all over the world, with increasing numbers of deaths by diseases and infections that are no longer curable.

[69] KemI PM 1/12 Antibacterial substances leaking (2012)
[70] Norden, Tema Nord 2014:513 Articles treated with antibacterial agents (2014)
[71] SCENIHR, Scientific Committee on Emerging and Newly Identified Health Risks, Assessment of the Antibiotic Resistance Effects of Biocides, Opinion adopted at the 28th plenary on 19 January 2009.

5.2 Review of environmental effects related to hazardous substances in textile articles

Summary of main results

- Overall, there is a lack of studies about the chemical release from consumer textile articles into the environment and the effects caused by such releases.
- Two studies have shown that textile consumer articles and synthetic plastic fibers may leach substances that are acutely toxic to aquatic organisms.
- The aquatic toxicity varied largely between different textile articles and the identity of the substances that caused the toxicity is not revealed in the studies.
- Two studies suggest that laundry of consumer textile articles may be an important source of textile fibres in the aquatic ecosystem.
- In a risk assessment of the active substance silver zinc zeolite, the use in treated textiles contributed with the major exposure part. It was concluded that sediment organisms exposed to discharges from waste water treatment plants are at risk.

A literature survey of publicly available scientific literature was performed in order to get an overview of reported environmental effects related to exposures to hazardous substances in textile articles.

There are several reports about the potential environmental hazards following production of textile articles due to release of toxic chemical substances during production[72] as well as studies demonstrating the toxicity of textile wastewaters [57-60]. However, there is little available information on the potential environmental risks relating to release of hazardous substances following use of textile articles (e.g. leaching following laundry) which is the focus of the present report. One study was found where the aim was to investigate the toxicity of chemical substances released from textiles [61]. 52 samples of different textiles were tested for acute leachate toxicity to *Daphnia magna*. The toxicity varied with a factor of more than 180, indicating release of toxic chemical substances from some textiles. It was not possible to detect any difference between fibre type and toxicity but a significantly higher toxicity was found for printed versus unprinted cotton and cotton/linen textiles, while the opposite was found for synthetic textiles. Only 7 eco-labelled textiles were tested and 5 of them were made of cotton, so an evaluation of toxicity related to this aspect could not be made. However, eco-labelled products were evenly distributed on a toxicity scale, which means that eco-labelling in its present form does not necessarily protect users or the environment from exposure to toxic chemical substances.

Similar results were obtained in a study by Lithner et al. (unpublished manuscript, available in doctoral thesis) [62].where the acute toxicity of water leachates from synthetic textiles made from different plastic fibres was investigated. Nine of the 25 plastic fibre textiles leached enough chemical substances to cause acute toxicity to *Daphnia magna* (48-h EC50s ranging between 1 and 210 g/L) during short term (3 d) leaching in water at 50°C. The most toxic leachates were found among the technical and furniture fabrics. The toxicity identification evaluations performed on the two most toxic leachates, one acrylic fibre impregnated with long-chain fluorinated polymeric water and oil repellent and a polyester fibre coated with plasticised PVC, indicated hydrophobic organics as the major toxicants.

[72] Greenpeace, Dirty Laundry - Unravelling the corporate connections to toxic water pollution in China (2011)

No further studies on the toxicity of chemical substances leaching from textiles were found which illustrates an important knowledge gap.

5.2.1 Textile related substances of known potential environmental concern

Silver

A risk assessment of the use of silver zinc zeolite as a biocide product has been carried out by Sweden as reporting Member State under the work programme for review of active substances in biocidal products under Directive 98/8/EC. No formal decision on the inclusion or non-inclusion of silver zinc zeolite has yet been made.

In the risk assessment the exposure was assessed based on cumulative exposure to silver. For the purpose of environmental exposure assessment, biocidal silver products were divided into different groups where treated textile was one. It was assumed, that all silver content in treated textiles was released within two years, the supposed average life length of consumer textiles. These assumptions were based on the above mentioned washing study, where on average 60 percent of the silver from different textiles was released after 10 washes.

The risk assessment showed that the use of silver zinc zeolite in treated textiles contributed to the major part of the identified risk (i.e. a PEC/PNEC >1) for sediment organisms exposed via discharges from waste water treatment plants. It was, however, stated that the identified risk might be refined by a long term test with sediment organisms. Nevertheless, this indicates a potential concern about the use of silver as a biocide in textiles.

Nonylphenol ethoxylates and nonylphenol

Numerous studies have reported measured levels of nonylphenol ethoxylates (NPEO) and in some cases also its degradation product nonylphenol (NP) in textiles. The majority of the NP/NPEO found in the environment originates from releases to waste water, which via the waste water treatment plants reaches the environment. Washing of textiles is considered to be an important source of the NP/NPEO[73] detected. Both NPEO and NP are very toxic to aquatic life with long lasting effects.

Nonylphenol has been identified as a “priority hazardous substance” in the EU Water Framework directive, WFD[74], which means that use should be ceased or emissions, discharges and losses should be phased out by 2020.

Both nonylphenol and nonylphenol ethoxylates are also included on the Candidate List of Substances of Very High Concern due to the endocrine disruptive properties of NP.

The Swedish Chemicals Agency has submitted a restriction proposal on NPEO in textile articles, which has been evaluated by the two scientific committees under the European Chemicals Agency, ECHA[75]. According to the Committees’ adopted opinions the proposed restriction is considered the most appropriate EU wide measure to address the identified risks. The two opinions of the ECHA Committees together with relevant background documents have been sent to the European Commission. The Commission will deliver a draft amendment

[73] Swedish REACH restriction proposal on NPEO in textile articles

[74] Directive 2000/60/EC of the European Parliament and of the Council. The Water Framework Directive was established as a framework for the Community action in the field of water policy

[75] This is a process involving several steps. The original proposal has been somewhat modified during the process.

of the restriction list in Annex XVII of REACH. The final decision involves the Member States and the European Parliament.

Highly fluorinated polymeric water and stain repellants

Per- or polyfluorinated substances are due to its effective oil and water repellence and stain release properties used in a variety of industrial and household applications, including textiles.

These type of compounds are widely distributed in the environment and there are indications that some of them are increasing for instance in the arctic region. They all have in common that they are stable against degradation. Some will degrade slowly or not at all, while others will transform into persistent substances, such as the PBT-substances perfluorooctane sulfonyl (PFOS) and perfluorooctanate (PFOA).

In the past, fluorinated polymers based on PFOS were used. PFOS in textiles has been banned in EU since 2008. Today the industry is moving towards shorter chained chemistry (from C8 to C6, where C stands for carbon). Fluorotelomers are commonly used for waterproofing effects and dirt-repellent surfaces. Fluorotelomers can be converted to Perfluoroalkylated acid (such as PFOA[76]) through oxidation. Treatment of textiles with fluorinated substances does not occur within the Nordic countries of any type of textiles (with a potential exception for the carpet industry) [77]. Treated textiles are nevertheless available on the EU market through import, since the majority (about 80%) of the textile consumed within the EU is imported from outside the EU. The importance of textiles as compared with other sources (with regard to the levels of highly fluorinated substances found in the environment) is presently not well known. A Norwegian report estimated the annual emission of PFOA in Norway from a range of consumer products – carpets 12 kg, coated and impregnated paper 1.3 kg, textiles 0.5 kg and paint and lacquer 1 kg [78]. The annual long range transport of PFOA into Norway was in the same study estimated to range between 130-380 kg. In a recent report from UBA a worst case scenario for Germany estimates that PFAS-containing outdoor jackets contribute with an annual amount of 0.27 kg PFOA[79]. Thus, it is clear that textile articles at least to some degree contribute to the total amount of fluorinated substances found in the environment.

5.2.2 Textile fibre loss during laundering and impacts of textile fibres on the environment

There are few studies on fibre loss during laundering. In a study conducted in 1999 a weight loss of 0.3-4.6% was measured after 100 laundering cycles of sheets in different materials[80].

Microplatics may be a potential environmental problem since it can affect aquatic animals following ingestion [63]. This is however out of the scope of this study, since the focus in the present report is on chemical risks to the environment. In addition to the potential physical impacts of plastic fragments, concern has been raised about the potential for plastics to adsorb hydrophobic chemicals which may be released inside the organisms exerting toxicity [65].

[76] C8 telomers can be convereted to PFOA through oxidation
[77] TemaNord, Per- and polyfluorinated substances in the Nordic Countries (2013)
[78] Statens forureningstilsyn, Survey of national sources - PFOA in Norway (2007)
[79] Umwelt Bundesamt, Understanding the exposure pathways of per- and polyfluoralkyl substances (PFASs) via use of PFASs-containing products – risk estimation for man and environment (2014)
[80] AUTEX Research Journal Vol 1, No.1, 1999, Life Cycle Assessment, Environmental profile of cotton and polyestercotton fabric. Eija M.Kalliala, and Pertti Nousiainen Tampere University of Technology, PO Box 527, 33101 Tampere, Finland, Europe.

However, further research is needed in order to elucidate if this is an important exposure route for chemicals.

5.3 Additional need for further research

The few scientific publications concerning harmful effects from exposures of hazardous substances in textile articles, especially for the environment, most likely reflects the limited knowledge about chemical content in textiles and the difficulties to establish a correlation between exposure and effects for these types of articles. There is a need for more research about substances in articles, the release of substances from the textile materials as well as human and environmental exposure to chemicals in textiles. There is also a need for more research within the field of recycling in order to identify which materials and articles are suitable to recycle/reuse; one of the main barriers for companies today when it comes to using recycled material is the lack of knowledge on which hazardous substances can be found in the recycled material.

To meet the need for more information about chemical content in textile articles, both increased information from producers and suppliers as well as non-target screening studies to identify substances in textile articles would be useful**.** In order to study the exposures that are most relevant for human health and the environment, researchers need information about what kind of substances that are found in textiles.

Ongoing research – some examples

On behalf of the Swedish Environmental Protection Agency two projects are ongoing to quantify the textile fibre content in the effluent from laundering, and from wastewater treatment plants respectively. The first project, conducted at Umeå University, has as target to chemically analyse and quantify the release of fibres during laundering of selected clothing. The project also aims to quantify the release of 126 organic substances released during laundering[81]. The second project is carried out by IVL, the Swedish Environmental Research Institute, and consists of measuring the levels of micro plastic particles, including synthetic fibres, in and downstream of the treatment plant 82.

Researchers at the Stockholm University are conducting non-target screening studies of substances in textile articles within the framework of the project “Textiles – A route of human exposure to hazardous chemicals”. The project has so far resulted in two publications about quinolones, benzothiazole and benzotriazole derivates in clothing textiles[8384]. Further data from the non-target screening as well as additional studies of chemicals releases from laundry are expected to be generated from the project.

RIVM (The Netherlands National Institute for Public Health and the Environment) is currently working on a project where they prioritise hazardous substances used in textiles for further assessment of human health risks by using IUCLID registration data from ECHA to determine the use in textiles and to use the classification and DNELs for prioritisation.

[81] Peter Haglund, Umeå universitet and Jan Christiansson, Naturvårdsverket (personal communication)
[82] Kerstin Magnusson, Fredrik Norén, IVL och Jan Christiansson, Naturvårdsverket (personal communication)
[83] Luongo, G., G. Thorsen, and C. Ostman, Quinolines in clothing textiles-a source of human exposure and wastewater pollution? Anal Bioanal Chem, 2014.
[84] Avagyan, R., et al., Determination of benzothiazole and benzotriazole derivates in tire and clothing textile samples by high performance liquid chromatography-electrospray ionization tandem mass spectrometry. J Chromatogr A, 2013. 1307: p. 119-25.

An upcoming project from the Nordic Council of Ministers on recycling and biological treatment with a Life Cycle Assessment for textiles has as objective to use life cycle assessment (LCA) to gather knowledge about the environmental effects of various methods of recycling and energy recovery of used textiles. The outcome can be used in order to understand how to utilize resources in the most efficient manner.

An upcoming project, financed by the Nordic Council of Ministers initiated by the Nordic Waste Group (NAG), has as objective to use life cycle assessment (LCA) to gather knowledge about the environmental effects of various methods of recycling and energy recovery of used textiles. The outcome can be used in order to understand how to utilise resources in the most efficient manner.

6 Identification and risk estimation of substances in textile articles

Summary of the main results:

- Approximately 3 500 textile related substances were identified; More than 2 000 of these substances have not been fully registered under REACH.
- About 1 000 substances are expected to be confidential in REACH registrations.
- Approximately ten percent of the textile related substances analysed here are identified to be of high potential concern for human health and five percent of the number of textile related substances to be of high potential concern for the environment.
- Substances of high potential concern for human health mainly include direct and acid type azo dyes, and fragrances.
- Many flame retardants and plasticisers were identified as having concern for human health due to exposure via fibre loss/ dust.
- Acid and direct type azo dyes were also identified as substances of high potential concern for the environment.

The risk estimation was carried out as a database screening study involving both computer-based screening tools as well as manual screening with expert judgment analysis. The methods for the risk estimation process were developed in order to achieve an unbiased study which is not limited to well-known and already regulated substances. This approach has the advantage of providing an opportunity to identify substances of concern with new or emerging use in society as well as substances with a wide-spread use that have not been studied before. Figure 8 shows an overview of the different steps in the screening process.

6.1 Inventory of hazardous textile-related substances

We began by screening selected databases and information sources with the purpose to compile an inventory list of substances which are reported to be used in textile production and that may be present in textile articles. The list is based on information from several different sources, including the IUCLID 5 database of registered substances in REACH, national authority databases and chemical lists from the textile industry and organisations (see Annex).

The substances included on the inventory list were given a hazard score from 0 to 10; where 10 represents the most hazardous substances. The criteria for hazard scores were developed by using substance classifications in the CLP[85] regulation together with the health hazard scenarios and environmental hazard scenarios developed by ECHA for the IT-screening program[86,87]. The criteria include both harmonised classification according to the CLP Regulation Annex VI as well as self-classification reported in the REACH registration.

[85] The regulation for classification, labelling and packaging (EC) No 1272/2008
[86] ECHA Screening Scenarios Human Health: Scenarios To Be Implemented For Searching Potential Substances Of Concern For Substance Evaluation And Regulatory Risk Management (2014)
[87] ECHA Screening Scenarios to be Implemented for Searching Potential PBT/VPVB Substances and Potential EDS (2014)

Harmonised classifications are more thoroughly evaluated than self-classifications and may therefore be more reliable. However, the major part of the textile related substances does not have a harmonised classification and would have been missed if self-classifications were not included in the criteria. The criteria for hazard scores are described in detail in Annex 4-5.

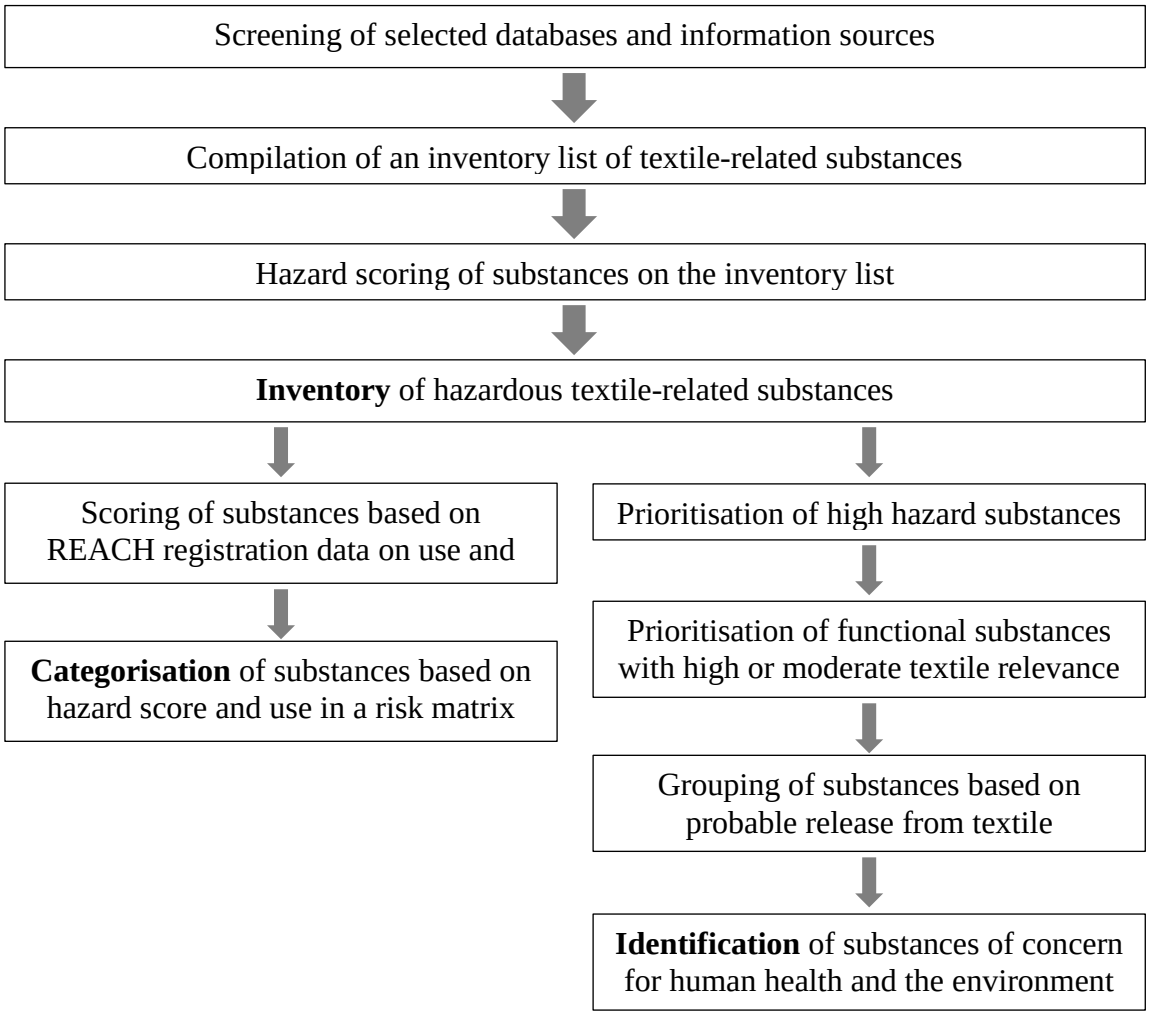

Figure 8 Schematic overview of the process of prioritisation for risk estimation of textile related substances. Based on an inventory of hazardous textile-related substances a categorisation using REACH registration data was made as well as an expert judgment analysis identifying substances of potential concern for human health and the environment.

The hazard scores could then be used to categorise and prioritise substances for further analyses, either based on human health hazard or environmental hazard. It was not possible to assign a hazard score to all substances in the inventory list. The absence of a score indicates either that the substance has no relevant hazardous properties or that it has not been tested for hazardous properties. It should be noted that a substance may be categorised as having low environmental hazard and at the same time as highly hazardous with regard to human health, and vice versa, since different criteria have been used for the environmental and human health hazard prioritisations.

The inventory list of hazardous textile-related substances was used as a starting point for two separate studies:

- Identification of textile-related substances of potential concern based on expert judgment.
- Categorisation of textile-related substances based on REACH registration data.

6.2 Identification of textile related substances of potential concern based on expert judgment

6.2.1 Methods

For a more in depth investigation of the potential risks with textile related substances, a subset of the inventory list was further analysed with the help of more comprehensive data and expert judgment analysis. In this part of the study we focused on substances with a health hazard score of 8 to 10 or an environmental hazard score of 6 to 10 (see Annex 4 and 5).

These scores represent hazardous properties which are prioritised for this assignment; carcinogenicity, mutagenicity, reproductive toxicity, endocrine disruption and sensitisation as well as chronic aquatic toxicity, persistence and bioaccumulating properties.

The analysis involved a manual screening of the list including a rough estimation of substance-specific textile relevance and probable release from the textile. The assessments were performed by Swerea IVF according to the assessment method described in detail in Annex 6. The information sources used for the assessments are listed in the same annex. Also Swerea IVF based the assessments on experiences from research activities within the field of textile industry, on site visits/work, long-term relation/dialogue with textile companies and long term work with authorities and associations. A brief description of the different steps is given below.

Prioritisation of substances based on textile relevance

Substances with a health hazard score of 8 to 10 or an environmental hazard score of 6 to 10 were further evaluated in order to assess potential textile relevance, i.e. the likelihood that they are present in textile articles based on known use for textile production (see Annex 4-5). Only the so-called functional or effect chemical substances, with a relatively high concentration in the final textile article, were prioritised for further analysis (see Annex 6).

Prioritisation of substances based on probable release from textile

For functional hazardous substances a subsequent assessment of probable release from textile was performed. The substances were divided in three groups based on chemical and physical properties; high, moderate or low probability of release from textile.

1. **High probability of release:** Substances that are loosely bound to textile fibres or unbound fractions that can easily migrate to e.g. sweat and saliva or inhalable air, i.e. volatile and/or water soluble substances.
2. **Moderate probability of release:** Substances with a moderate physical binding to the textile fibre, i.e. semi volatile substances and/or substances with limited water solubility.

3. **Low probability of release:** Substances with covalent or strong physical bonding to the textile fibres. These substances are mainly released from textiles in fibre-bound form.

The addition of detergents during laundry may alter the solubility of substances and a substance classified as “moderate” may leach to the same extent as a substance classified as high in the presence of a detergent.

Methodological limitations

By using the methods described above we were able to roughly estimate the concern for human health and the environment in relation to a very large number of substances in a time efficient manner. It must, however, be emphasised that this approach involves many assumptions and should be seen as a tool for prioritisation of substances. The results give important information that contributes to the overall estimation of risks with hazardous substances in textile articles and to identify substances of concern. In order to draw definite conclusions about risks or absence of risks a more comprehensive risk analysis must be carried out that involves case by case risk assessments and more detailed parameters.

Substances which are not classified (or self-classified) or included in the information sources for the screening study will be overlooked in the analysis. Lack of classification may be because the substance does not fulfil the classification criteria but may also be due to missing or inconclusive data about the substance which means that the hazard is unknown. Further, it should be noted that the information sources that were used to identify substances may not be complete and that additional substances may fulfil the criteria for inclusion in the analysis. For instance, the colour index data base was not available for inclusion in this assignment. It contains about 10 000 dyestuffs that may be used to dye textiles but it is not known how many of these that are actually used in textile production today.

Toxicity to microorganisms, which can be a critical property for biocides, is not included in the environmental hazard criteria. One example is the many different forms of silver used as biocides in clothes and known to be hazardous to the environment.

For the screening of substances that are hazardous to the environment we used the criteria defined in Annex 5. However, this methodology has limitations. One is that only substances that are classified according to defined toxicity endpoints will be identified. The fact that a substance is not classified for one/several/all of the defined endpoints does not necessarily mean that it is non-classified based on sufficient data, but rather that data are lacking. Another limitation is that the screening of bioaccumulation, which was performed according to an ECHA guidance document (ECHA 2008), used log K_{OW} and when no experimental log K_{OW} was available the value was derived using (Q)SAR. Due to the large number of chemical substances screened, no individual assessment was performed whether or not the predicted log K_{OW}-values used were reasonable. In addition, while log K_{OW} may be a useful surrogate to estimate bioaccumulation for some types of chemical substances for certain ranges of log K_{OW}-values, it is less or not useful for other types of compounds where other properties than lipid solubility influence the uptake (e.g. fluorinated substances).

The focus of this method is on functional chemical substances, as they are expected to be present in textiles at relatively high concentrations compared with auxiliary chemical substances and unintended chemical substanses. This focus will have consequences on which types of substances that are identified as potential textile-related substances of concern. Auxiliary chemical substances such as nonylphenol ethoxylates (with the degradation product

nonylphenol), which have been identified as problematic to aquatic organisms in Europe, will not be identified although washing of textiles has been identified as an important source. The focus on functional chemical substances will also lead to the inability to identify substances that are not intentionally added to the textile but are formed as degradation products throughout the life-time of the textile, such as perfluorinated alkyl sulfonates formed through degradation of fluorinated polymers used as water and stain repellents or formaldehyde released from textile-finishing resins.

6.2.2 Results

The initial screening of textile-related substances in selected information sources (see Annex 3) generated an inventory list of about 3 500 substances that may be used in textile production. The substances on the inventory list were prioritised for further analysis using a tiered approach in order to identify substances of concern for human health and the environment. About 1000 substances of the substances on the inventory list are expected to be confidential[88] in the REACH registrations. These substances were excluded from the part of the study where we identified substances of concern. leaving about 2 450 substances to be analysed. However, the confidential substances were included in the risk categorisation of textile-related chemical substances in Section 6.3 below.

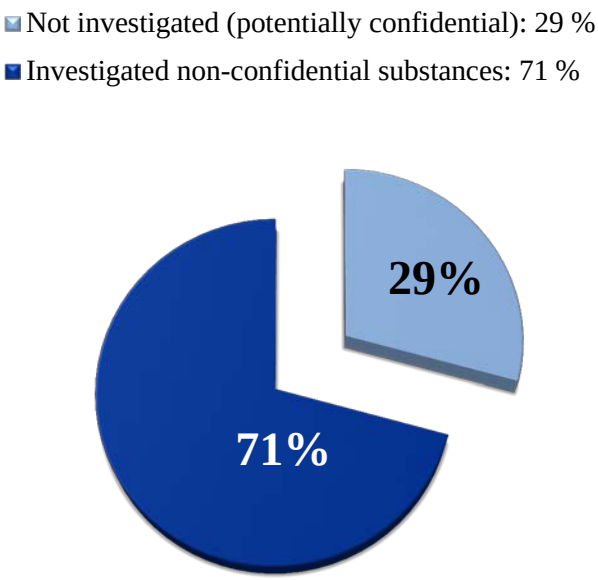

Figure 9 Approximately 3 500 substances were identified during the inventory of hazardous textile-related substances; 71%, corresponding to about 2 450 non-confidential substances, were further investigated.

[88] According to Article 118 REACH, the precise use of substances may be regarded as confidential for the protection of the commercial interests.

Figure 10 below shows an overview of the prioritisation process and describes the refinement steps applied to the inventory list of hazardous textile-related substances in order to identify a limited number of substances of potential concern.

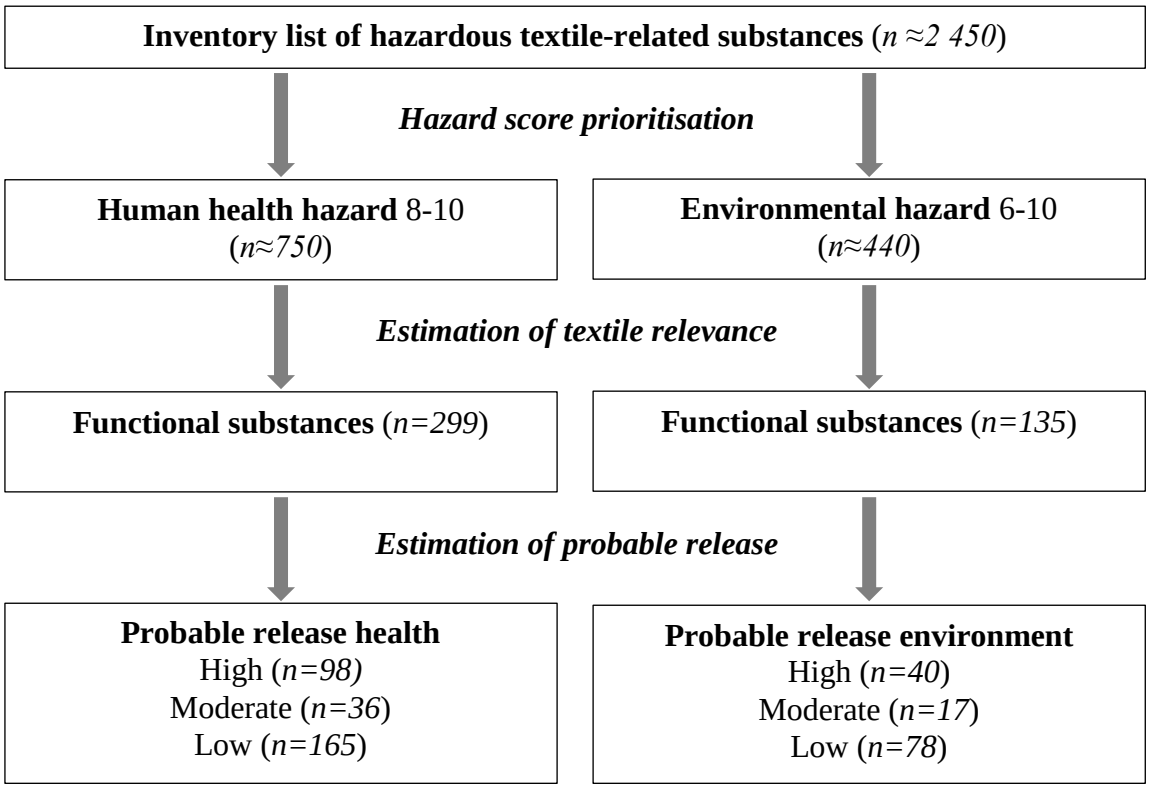

Figure 10 Overview of how the inventory list of hazardous textile-related substances was prioritised to identify a limited number of substances of concern. Potentially confidential substances were excluded from this analysis. Numbers in brackets correspond to the numbers of substances still considered after each refinement step.

Prioritisation of substances based on hazardous properties

The hazard scoring resulted in about 440 substances with an environmental hazard score of 6-10 and about 750 substances with human health hazard score 8-10. These substances are here considered as high hazard substances and are prioritised for a more in depth risk analysis. The selection criteria were developed to identify substances with the following health hazard properties; carcinogenicity, mutagenicity, toxic to reproduction, endocrine disrupting properties and sensitisation and also substances that are persistent in the environment and/or may bioaccumulate in the food chain (see Annex 4-5).

Prioritisation of substances based on relevance for textile articles

High hazard substances were grouped based on their relevance for textile articles and functional substances were prioritised for further analysis. The focus in this report is on textile articles, and therefore this method focuses on functional chemical substances as they are intentionally added to the textiles and are expected to remain in the finished articles at relatively high concentrations. In total, 368 functional substances were found; 299 health hazardous functional substances and 135 environmental hazardous functional substances. Some substances are both health hazardous and environmental hazardous and therefore the

sum of the environmental and health hazardous substances exceeds the total number of 368 (see also Figure 11). A consequence of the selection of functional substances is that other potentially problematic chemicals, such as unintended chemical substances and process chemical substances, with the example nonylphenol ethoxylate and its degradation product nonylphenol, will not be identified.

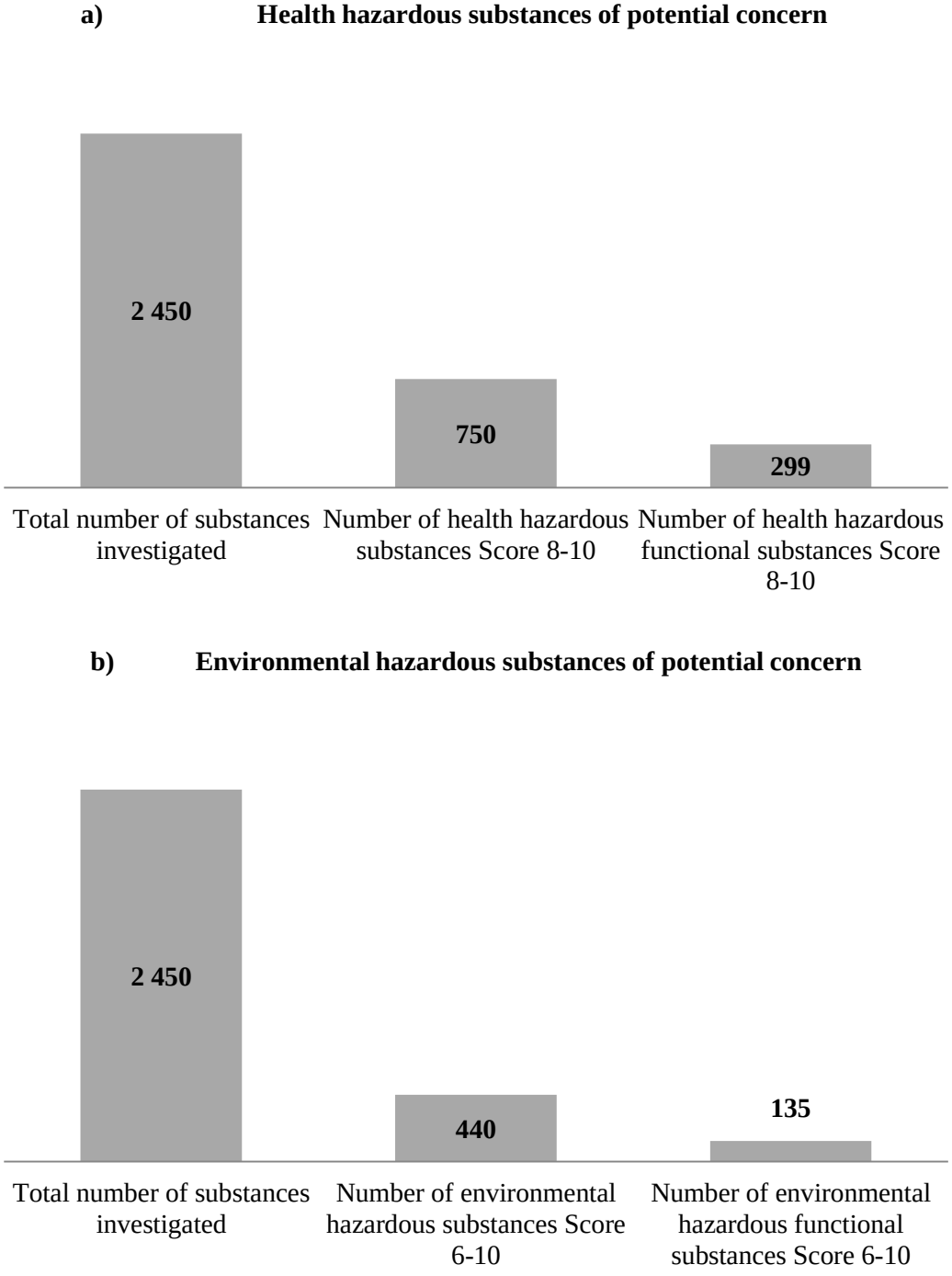

Figure 11 A limited number of substances of potential concern were identified after prioritisation of the total number of investigated textile-related substances based on health hazard scores (a) and environmental hazard scores (b) as well as prioritisation of functional substances.

Prioritisation of substances based on probability of release from textile

The functional substances with relevant hazard scores were prioritised for further analysis. These substances were grouped based on the probability of release from the textile; high or moderate probable release of substances in their molecular form via migration or emission from textile articles or low probability of release of substances in fibre-bound form via e.g. dust or waste. The substances were grouped based on probability of release for substances of potential concern for human health and the environment, respectively (Figure 12). The results from the grouping of substances of potential concern for human health and the environment based on release-type are also described in more detail below. The methods and criteria for grouping substances based on probability of release are described in Annex 6. The identities of substances in each category are listed in Annex 7.

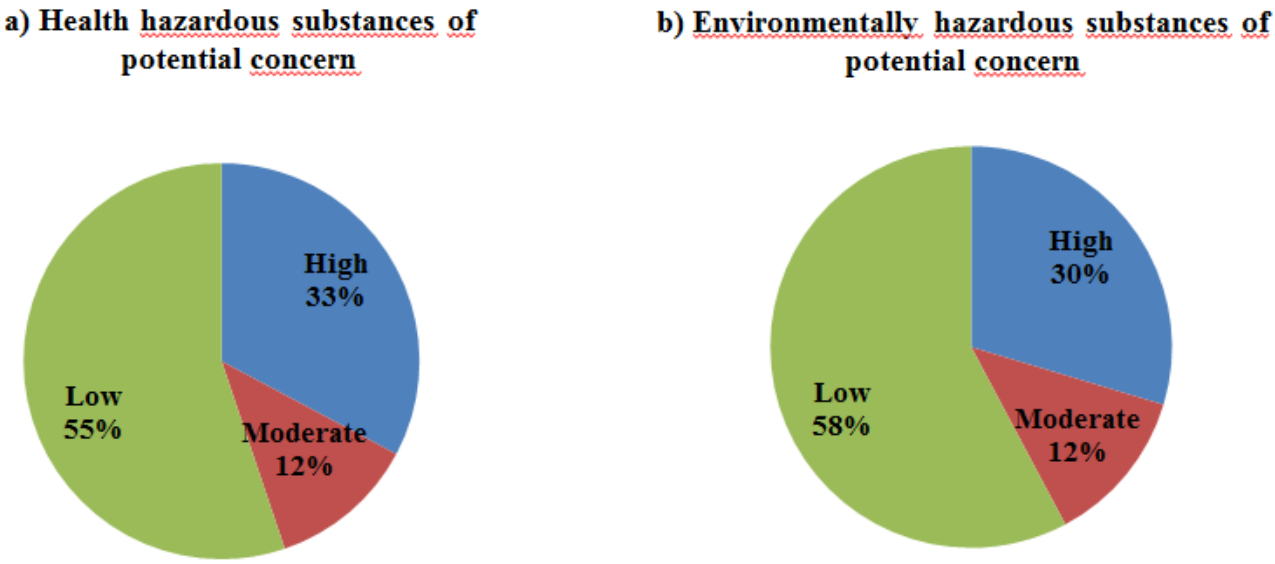

Figure 12 Grouping of the functional substances into low, medium and high probability of release for substances of potential concern for human health (a) and the environment(b).

Identified substances of potential concern for human health

High probability of release: Based on the described prioritisations, 98 high hazard substances with a high probability of release from textile articles were identified (Figure 10 and Figure 12). The majority of the identified substances were azo dyes of direct or acid application type and fragrances. The human exposure to these substances can occur through inhalation of volatile substances, direct skin contact with textiles or orally through sucking and chewing on textiles. In addition to their highly hazardous properties for human health, 19 of the 98 substances also have high environmental scores, indicating that they are persistent and have a potential for bioaccumulation, which can contribute to indirect exposure of humans via food and drinking water.

Direct dyes are used to dye cellulose fibres, such as highly consumed cotton and viscose materials, and acid dyes are used to dye polyamide. Cotton is the most highly consumed textile fibre for clothing articles in the EU, indicating that consumers can be highly exposed to especially direct dyes. Both direct and acid dye molecules bind very loosely to the fibres and can therefore easily migrate from the fabric to, for example, skin and saliva. A majority of the identified direct dyes are classified as carcinogenic, mutagenic or toxic to reproduction,

whereas most of the acid dyes are classified as sensitising. Many of the identified dyes are either restricted or regulated under REACH or included on the candidate list. However, this mainly applies to substances with carcinogenic, mutagenic or reprotoxic properties and not to the sensitising substances. Both direct and acid dye molecules bind very loosely to the fibres and can therefore easily migrate from the fabric to for example skin and saliva. A migration rate of dyes in textiles of about 1ng-1µg/cm^2 has been estimated in a report by the Bundesinstitute für Risikobewertung (BfR)[89]. This is however a rough estimation not specific for a certain type of dye and with the assumption that the latest dyeing techniques are used.

The chemical class of azo dyes includes a large number of dyes according to information in the Colour Index database. After intake into the human body the azo dyes may be cleaved by means of reduction during metabolism and then form the corresponding aromatic amines from which they had been synthesised. Intestinal bacteria are capable of azo cleaving but the liver also produces corresponding enzymes. Furthermore, there are indications from experiments that azo cleavage also takes place during skin passage and that skin bacteria are capable of cleaving azo dyes[66, 90, 91.]

The direct and acid dye molecules are generally large and complex molecules and increasing size increases the binding to the textile fibres. Substances with a molecular weight above 700 g/mol have been considered unable to penetrate the skin. Still, these dyes are classified as highly hazardous to health, indicating that the effects of concern have been observed in experimental studies. They could also be absorbed after oral exposure, through sucking or chewing on textile, and possibly cleavage to aryl amines.

Approximately 25% of the azo dyes in the Colour Index (corresponding to about 500 dyes) are synthesised based on carcinogenic amines regulated under REACH. A majority of the azo dyes identified in the current report can form banned aryl amines by reductive cleavage. Our assessment shows that they are still on the market, as they are listed together with suppliers in the Colour Index database, although the actual presence in articles is not known. Market surveillance has found aromatic amines above the limit value in 3-12% of analysed textile and leather samples and it can be assumed that these dyes are occasionally still present, particularly in imported textiles (BfR 2012).

Another 25% of the azo dyes in the Colour Index database can be cleaved into non-regulated aryl amines. A recent study (Brüschweiler et al 2014) has identified 15 of the non-regulate aromatic amines as (potentially) carcinogenic and/or genotoxic and 11 as may cause sensitisation by skin contact. This indicates that the problem with carcinogenic and/or sensitising aryl amines may be larger than previously considered.

The large group of identified fragrances with a high probability of release is mainly associated with a sensitising potential and identified as substances with medium textile relevance, indicating that one of many uses is for textile articles. Fragrances can be added to textile articles to make them smell good, either to produce so called cosmetic textiles or to cover unpleasant smells arising from other substances. Due to their sensitising properties, all identified fragrances are subjected to either restrictions or special information requirements

[89] BFR, Introduction to the problems surrounding garment textiles (2012)
[90] SCCNFP/0495/01: Opinion concerning the safety review of the use of certain azodyes in cosmetic products, adopted by the SCCNFP during the 19th plenary meeting, 27 February 2002.
[91] Environment Canada Health Canada, The Chemicals Management Plan Substance Groupings Initiative Aromatic Azo- and Benzidine-Based Substances, (2012).

under the cosmetics regulation (EC) No1223/2009), although they are not regulated for other types of applications.

Moderate probability of release: The group of substances with a moderate probability of release contains 36 substances, mainly plasticisers, flame retardants and pigments. Most of these substances are either regulated under REACH (although not specifically in articles) or included on the candidate list. Human exposure to these substances can also occur through inhalation of volatile substances, direct skin contact with textiles or through sucking and chewing on textiles, although most likely to a lower extent than for the substances with a high probability of release.

Low probability of release: The group of textile related substances that associated with a low probability of release contain 165 substances, mainly disperse dyestuffs, pigments, plasticisers stabilisers and flame retardants. Many of the identified substances with carcinogenic, mutagenic or reprotoxic properties are either restricted or regulated under REACH (although not specifically in articles) or included on the candidate list, whereas sensitising substances are generally not regulated. These substances are strongly bound to textile fibres and are likely released in fibre-bound form and can therefore be highly relevant in relation to exposure to dust. Intake of dust has been identified as an important exposure source of small children to e.g. flame retardants, highly fluorinated compounds and phthalates, both in domestic areas and day care centres. In older children and adults, intake via food contributes to the majority of the exposure to these types of substances. The origin of these substances in the dust is hard to assess, but phthalates in PVC flooring have been suggested as the main source of phthalates in dust [92]. As textiles constitute a large part of the surface in the indoor environment[93], release of fibre-bound substances from textiles can still contribute to the chemical content of dust.

Disperse dyes are found among the substances strongly bound to fibres, but a low-quality dyeing process can increase the free fraction available for exposure of humans. Disperse dyes are generally small lipophilic molecules and should hence be readily absorbed through skin.

Identified substances of potential concern to the environment

High probability of release: This group of 40 substances consist of direct and acid dyestuffs, which are used to dye fibres of cellulose (e.g. cotton) and proteins (all fibre made by animals, e.g. wool), respectively. The majority of these compounds have a high expected environmental hazard because they are predicted to be persistent in the environment and bioaccumulate along the aquatic food chain. Some also have a harmonised classification as toxic to aquatic organisms and/or mammals based on experimental toxicity data. There are available Swedish monitoring data for one of these substances, a fragrance called (R)-p-mentha-1,8-diene with CAS number 5989-27-5.

Moderate probability of release: This group of 17 substances mainly consists of plasticisers/softeners and various chromates. Swedish monitoring data are available for 8 of them. According to Swedish biomonitoring data a majority of them are present in the environment indicating that they may pose a risk to the environment.

[92] KemI Report 8/13, Barns exponering för kemiska ämnen I förskolan (2013)
[93] Personal communication with Sverker Molander, Professor at the department of Energy and Environment at Chalmers University. Representative for the Chemitecs program (2007-2012), www.chemitecs.se

Low probability of release: Substances with an estimated low probability of release, 78 identified substances, mainly consist of disperse dyestuffs (which are used to dye fibres of polyester), flame retardants and plasticisers. Swedish monitoring data indicating presence in the environment are only available for seven of them.

The identified substances of potential concern and their specific inclusion in the REACH regulation and Oeko Tex 100 standard

About one third of the above identified 368 substances are due to specific requirements under the chemical regulation REACH (see Figure 13).

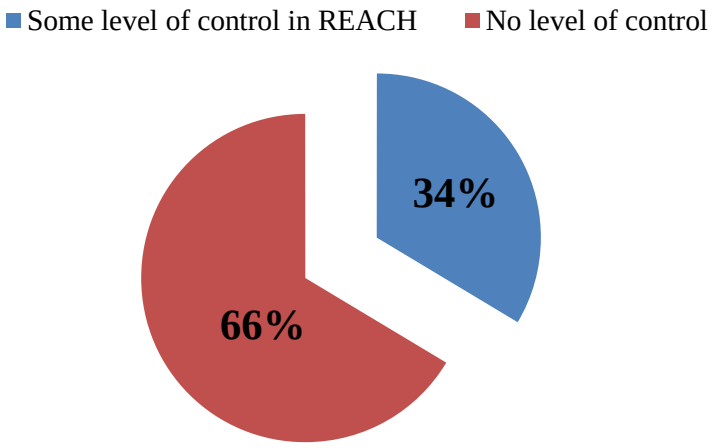

Figure 13 Substances/groups of substances with some level of control under REACH (registered substances, included in the candidate list, in Annex XIV or in Annex XVII) and no level of control.

To go more into detail, out of the 368 substances, REACH restrictions include 53 substances (Annex XVII), see Figure 14 below. There are 42 substances included in the REACH candidate list and currently 12 of these are selected for authorization (Annex XIV). Unlike restrictions in REACH, the authorization system does not apply to substances in imported articles, and the system is therefore inadequate for control of hazardous substances in imported textile articles.

In comparison with voluntary initiatives, such as Oeko-Tex 100, as many as 156 of the 368 substances have some kind of restriction in Oeko-Tex-100. However, it is voluntary for companies to comply with such standards and restriction lists, but it shows that voluntary initiatives may go beyond the current REACH restrictions for specific substances/groups of substances.

The Swedish textile industry[94] is positive to developing the EU legislation on the basis of the voluntary initiatives that are already applied, such as the large number of *Restricted substances lists* (RSLs) and Oeko-Tex 100. This would mean simplifying procedures for the industry to provide a coherent and communicable way to deal with these issues business to business throughout the value chain.

[94] Swedish Textile and Clothing Industries Association (TEKO).

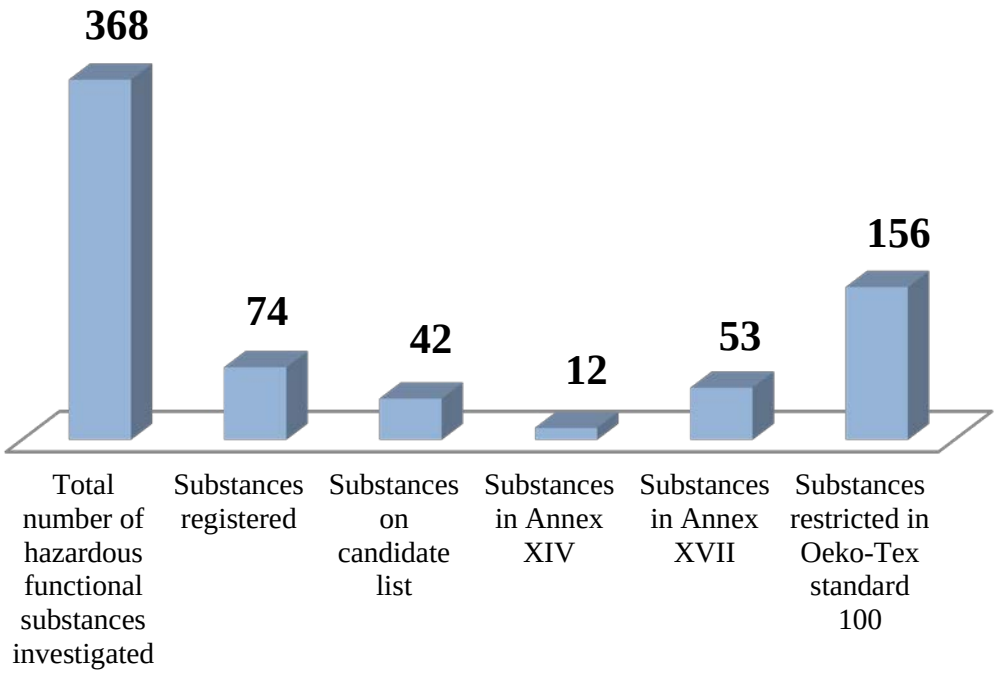

Figure 14 Total number of hazardous functional substances investigated and their restrictions in REACH and Oeko-Tex 100

Many of the identified substances with very serious health hazardous properties, such as carcinogenic, mutagenic and/or toxic for reproduction, have an EU-harmonised classification and several are restricted under REACH or are included on the candidate list (*substances of very high concern*) (see Figure 15 below). REACH for instance bans the presence of carcinogenic aryl amines in consumer articles. A majority of the direct azo dyes identified in the current report can form these banned aryl amines by reductive cleavage (see Annex 7 of the present report).

When it comes to allergens and environmentally hazardous substances, REACH does not specifically restrict many of the identified substances. Only 13 of of the 235 allergens identified are restricted in REACH on the candidate list, in Annex XIV or in Annex XVII, whereas 98 of the 235 allergens are restricted in Oeko-Tex standard 100. The environmentally hazardous substances are restricted to the same extent in REACH as in Oeko-Tex standard 100 (this does not mean that the same substances are regulated in REACH as in Oeko-Tex 100), see Figure 15.

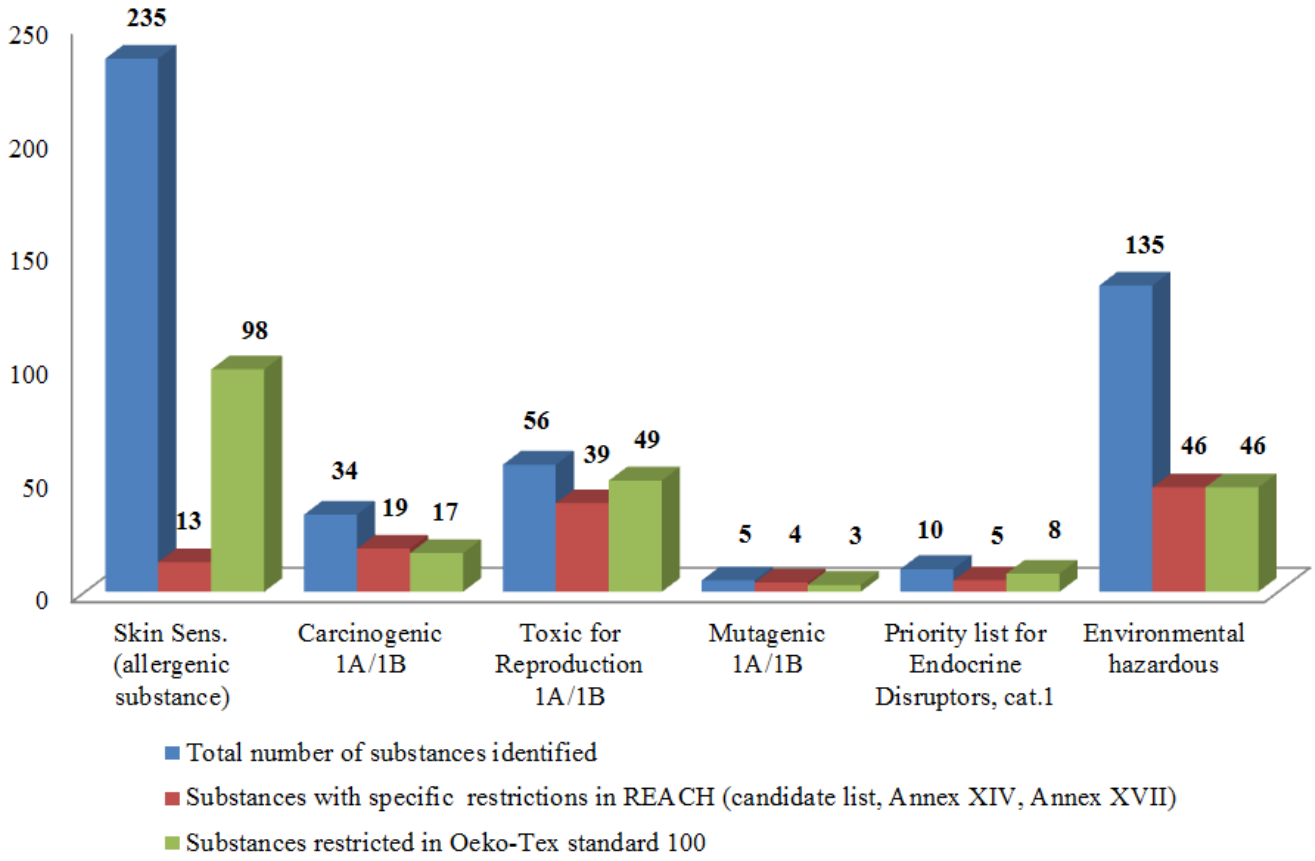

Figure 15 Hazardous functional substances identified in the study and their restrictions in REACH and Oeko-Tex 100

6.3 Categorisation of textile-related substances based on REACH registration data

6.3.1 Methods

To make a rough estimate of the number of textile related chemical substances that may pose a risk to human health and the environment we performed a computer based screening of the inventory list using data registered under REACH available in the IUCLID 5 database (searched Jan. 2014). Substances reported to act as functional chemical substances (see Section 4.1 for a definition) were ranked based on hazardous properties for human health and the environment as described in Section 6.2.1. The substances were also ranked based on a use score derived from reported textile use descriptors in the REACH registration dossier[95] multiplied with the quantity of the substance reported to be used within the EU in order to take volume into account. This results in a score representing the estimated extent of textile-

[95] The textile use score is based on the following IUCLID Use descriptors: Article category 5 ("Fabrics, textiles and apparel"), Product category 34 ("Textile dyes, finishing and impregnating products; including bleaches and other processing aids"), Sector of use 5 ("Manufacture of textiles, leather, fur") and Environmental release categories 10 ("Wide dispersive outdoor use of long-life articles and materials") and 11 ("Wide dispersive indoor use of long-life articles and materials").

related use in the EU. The majority of the textile articles sold on the EU market is not produced within the EU, and therefore the extent of use score does not provide a good estimate of the overall use or the actual presence of substances. Still, no other data related to the extent of use are available. Based on the uncertainties in the use scores, these numbers were only used to derive rough estimates for ranking purposes and not for any further calculations or analysis.

The substances were plotted in a risk matrix and categorised in nine different groups where substances with a high hazard score combined with a high score of estimated extent of use are more likely to pose a risk to human health and/or the environment based on available data from REACH registrations.

6.3.2 Results

When we matched the inventory list with data from the IUCLID 5 database it was shown that only 1 533 of the 3 480 substances were registered in REACH as substances with a reported use in textile production. The remaining 1 958 substances may have low volume uses that do not need to be registered yet under REACH or may not have textile as a reported use in the registration.

The 1 533 substances that were identified in IUCLID 5 were assigned a score representing the estimated hazard and extent of use in textile articles based on data from the REACH registrations. The substances could then be categorised based on their human health or environmental hazard score and the score for estimated use in textile. The substances for which enough information was available for categorisation were plotted in risk matrices (Figure 16). The risk matrices illustrate the number of substances in each category, ranging from high to low risk, and can contribute to the identification of substances of concern in textile articles.

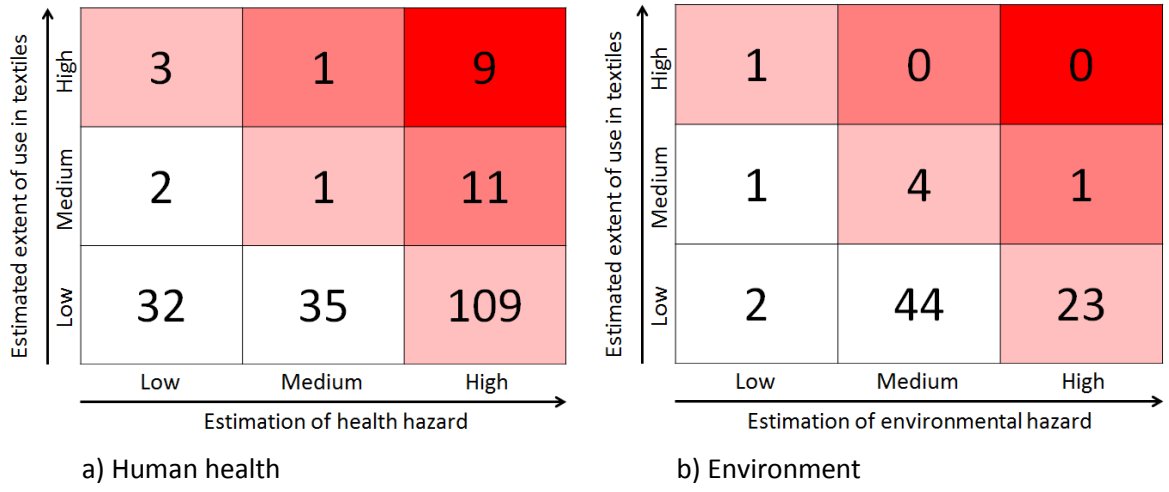

Figure 16 Risk matrices describing the estimated number of textile relevant substances in respective risk category, for human health (a) and the environment (b), ranging from high risk (red) to low risk (white). The allocation of substances was based on hazard scores in combination with data about use in textiles and volumes in the EU retrieved from REACH registrations. The numbers indicate number of substances per risk category.

Description of substances in the highest potential risk categories

Based on the described categorisation, nine substances were allocated to the highest risk category for human health (Figure 8). For eight of these substances the connection to textile production s based on potential confidentiality in the REACH registration, indicating that IUCLID 5 data are not always easily accessible for evaluations of specific uses. The non-confidential substance in the highest risk category is carbon black (CAS no 1333-86-4). Carbon black has been registered by a large number of companies for a wide variety of uses, including as a pigment in textile production. The main reported use (about 80%) is however as an additive, filler or pigment for rubber. A detailed manual scrutiny of registered data for the eight substances with a potentially confidential connection to textile production revealed that this information actually was publicly available. These substances were however registered for a wide range of uses and the connection to textile was thus considered as unspecific. Expert judgment analysis of the eight substances identified one substance with relevance for textile production, namely the pigment iron hydroxide oxide (CAS no 51274-00-1).

Twelve substances were found in the second highest human health risk category (Figure 8), of which nine are reported as potentially confidential. The three non-confidential substances are 2,6-di-tert-butyl-p-cresol (CAS no 128-37-0) with registered uses as a biocide and stabiliser, diboron trioxide (CAS no 1303-86-2) with registered uses as a flame retardant and biocide, and dimethyl phthalate (CAS no 131-11-3) with registered uses as a stabiliser. The confidential substances in these risk categories were mainly colouring agents but also have reported uses as flame retardants, impregnating agents and biocides. Carbon black and dimethyl phthalate are also identified as substances of potential concern based on expert judgment (Section 6.2 and Annex 2-6), while 2,6-di-tert-butyl-p-cresol and diboron trioxide were considered to be of low textile relevance and therefore not further analysed as substances of concern.

Based on the criteria for environmental hazard, 2,6-di-tert-butyl-p-cresol (CAS 128-37-0), was the only substance that was allocated to the second highest risk categories for potential environmental risk (Figure 16). This is also mentioned above.

6.4 Estimation of environmental exposures to acid dyes and direct dyes

Summary of results

Substances in textiles can be widespread through broad use and laundry. Unknown hazardous substance may present potential risks to human health and the environment. In addition hazardous substances may leak from textile waste on landfill. We estimated the environmental release of direct and acid dyes from cotton and polyamide in the EU based on consumption data and information about dye content. From the calculations it was estimated that:

- 2 000-22 000 kg of hazardous acid dyes are annually released to the waste water in the EU from washing of polyamide textiles. If all acid dyes used in polyamide are included the amount is above 110 tonnes.
- 2 000-22 000 kg of hazardous direct dyes are annually released to the waste water in the EU from washing of cotton textiles. Including all direct dyes used in cotton the quantity is above 110 tonnes.
- If less optimal processes are used during the textile production the release might be five times higher or above.

This section aims to present two examples of releases of chemical substances to the environment from the use of textiles.

As described in Section 4.3.2 there are different pathways for chemical substances to reach the environment during use. One important route is laundering, when chemical substances enter the waste water treatment system and thus have the potential to be released to the environment via the effluent water at the municipal waste water treatment plants (WWTPs). Application of sludge from the WWTPs on soil may cause a risk of indirect exposure of humans via food.

Below we are giving two theoretical examples of how repeated washing of textile articles may lead to environmental exposure to hazardous chemical substances. The examples are based on data on textile consumption in the EU described in Section 3.1. We have chosen acid and direct dyes as illustrative examples as they were identified as prioritised substances in textile articles based on their hazardous properties and estimated exposure (see Section 6.2.2). The key point is to tie dye usage to fibre type (DyStar 2014). Acid dyes are mainly used for polyamide (EC 2003) and up to 90% of the polyamide textiles on the European market are coloured by acid dyes. Direct dyes are commonly used for cotton (especially for cotton-polyester blends, EC 2003) due to their many advantages, such as low cost, short dyeing time, wide colour ranges and excellent dye penetration (Liu et al. 2010). According to information from stakeholders it can be assumed that approximately 15-20% of the consumed cotton in the EU is coloured by this type of dye. It is important to emphasise that these are only two out of the numerous of hazardous chemical substances that may be released from textile articles to the environment.

To be able to conduct these estimates it has been necessary to make assumptions. These are based on identification and prioritisations of chemical substances in the present report, the

literature as well as consultation with relevant stakeholders[96, 97]. According to stakeholders, the coloured textile consists of approximately 2% (w/w) colourant. The fixation degree (which determines the potential for release) is 80-95% for acid dyes in polyamide and 70-95% for direct dyes in cotton (Carmen et al. 2012). This means that 5-20% of the acid dyes and 5-30% of the direct dyes have the potential to be released to the waste water during either the production or the service life of the textile. According to the industry (DyStar 2014) approximately 1% of the colourant is released during laundering. However, this probably implies a best available technique process during manufacturing that provides high fastness values. In cases with less optimal processes there is a potential for a higher release rate during the service life, above 5% (Posner 2014 and Rahbar et al. 2007). This suggests that if considering a realistic worst case scenario the release could be higher. It is also important to emphasise that a lower release during the consumption phase suggests a higher release to the waste water and the environment at the production site (i.e. for most part outside the EU). In these release examples we have excluded textiles that unlikely will be submitted to washing.[98] The release of dyes during laundering depends on different factors such as washing frequency and wash temperature which differ between individual consumers and also from country to country (Beton et al. 2014). However, here we are calculating on a general scenario with equal release for all textiles and washing conditions.
It is estimated that approximately 2-20% of the different acid and direct dyes are hazardous to human health and/or the environment. The lower part (2%) assumes that all hazardous direct dyes were identified in this assignment. The upper part (20%) assumes that the number of hazardous direct dyes identified in this assignment represent an average of the total number in the Colour Index Database. Thus the upper part of the range is most likely more realistic. The breakdown approach is presented in Table 2 below.

Direct dyes found in Colour Index Database	Direct dyes considered in this assignment	Direct dyes identified as hazardous for human health and/or the environment in this assignment	Estimation assuming all hazardous dyes on the market are identified within this assignment	Estimation assuming same percentage hazardous colourant in Colour Index Database
1568	135	25	25/1568= 2%	25/135= 20%

Table 2 Breakdown approach - Percentage hazardous direct dyes in textiles

It has only been possible to separate the hazardous direct dyes from the total direct dyes and thus it is here assumed that the correlation is similar for acid dyes. Another assumption is that the percentage of hazardous colourant is applicable also when it comes to volumes on the market. According to our evaluation of available and received information a majority of the colourant assessed as hazardous within this assignment are used in the EU. This is most likely the case even for textiles produced outside the Union. Therefore it is here expected that the percentage of hazardous chemical substances can be related to volumes used. The broad range demonstrates the uncertainties behind these estimations. In Section 3.1.2 we present the textile

[96] Swerea IVF: A research institute within the Swerea group with materials, processes and production systems within manufacturing and product development as key areas
[97] The Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers (ETAD)
[98] European Commission, Environmental Improvement Potential of textiles (IMPRO Textiles) (2014).

consumption in the EU by fibre type based on a report from the European Commission (see Figure 4). If excluding non-washable textiles we can estimate the quantity that annually is laundered within EU. For the examples presented here we are focusing on two fibre types (cotton and polyamide) and only two different types of chemical substances. Our calculations show that approximately 3 700 000 tonnes cotton and above 610 000 tonnes polyamide are washed in the EU. This gives a potential release of acid dyes and direct dyes to the environment in the EU in the amount of above 220 tonnes per year. Of these 4-44 tonnes are assessed as hazardous. If taking less optimal manufacturing processes into account this amount might be five times higher or more (i.e. more than 1100 tonnes of which 20-220 tonnes are assessed as hazardous, see Table 3.

Approximately 82% of the waste water in the EU is currently put through secondary treatment[99] which means that a part of the acid dyes and direct dyes are released more or less directly to the environment after laundering. The major quantity will however reach the WWTPs where the chemical substances have the potential to end up in the sludge or be released to the surface water by the effluent.

When it comes to the amount of hazardous colourants that can be released to the environment from the textile ending up in landfill, these are also estimated in the table below in the last column. The amount of landfill of the consumed textiles in the EU is 57.1% according to a report by the European Commission Joint Research Centre [100]. The other assumption is that around 10% of the dye in the textile is being released during either production or laundering[101], which suggests that 90% will eventually, when the textile is completely degraded, leach to the environment.

Data on how much of dyes that could be released to the environment from fibre loss (the figures of 0.3% and 4.6% in the study identified in Section 5.2.2) were not included in the calculations above.

[99] European Comission, The Seventh Report on the Implementation of the Urban Waste Water Treatment Directive, 91/271/EEC (2013)
[100] European Commission, Environmental Improvement Potential of textiles (IMPRO Textiles) (2014).
[101] A rough estimation based on a fixation degree of between 70-95 for direct dyes and 80-95% for acid dyes.

Functional chemical in fibre type	Textile consumption in the EU of fibre type in question (tonne/year)	Percentage colourant used in the textile manufacturing process (%)	Percentage of textile coloured by the colourant (%)	BAT-scenario (1% release during service life) Amount colourant released in the EU (tonne/year)	Realistic worst case scenario (5% release during service life) Amount colourant released in the EU (tonne/year)	Percentage of colourant known as hazardous (%)	BAT-scenario (1% release during service life) Amount hazardous colourant released during laundering. (tonne/year)	Realistic worst case scenario (5% release during service life) Amount hazardous colourant released during laundering. (tonne/year)	Amount hazardous colourant potentially released during landfill (tonne/year)
1. Acid dyes in polyamide	614 000	2%	90	111	553	2-20	2-22	10-110	114-1136
2. Direct dyes in cotton	3 696 000	2%	15	111	554	2-20	2-22	10-110	114-1140

Table 3 Example of quantity chemical release during laundering

7 Conclusions

7.1 Consumption of textile articles has increased

The consumption of textile articles has increased rapidly in the EU during the last decades. Textile materials are produced in large quantities and are parts of a broad variety of widely used consumer articles. The consumption of textile articles in the EU is 19 kg per person and year, and the corresponding figure in Sweden is approximately 14 kg (**Chapter 3**).

7.2 Large amounts of chemical substances

Increasing production and consumption of textile articles also mean an increased use of chemicals and raw materials. Large amounts of substances are used in textile production. In a desk study[102] it was estimated that around 3 kg chemicals are needed to produce 1 kg of cotton t-shirts.

Substances used in the production of textiles can remain in the final article as minor contaminant amounts, and articles may also contain substances formed by degradation. Other substances are intentionally added to textile articles in order to provide a specified function, such as colour or easy-care.

Substances in textile materials may be released from articles and expose humans and the environment. The release of substances from textile materials depends on physical properties of the substances and the material, including how the substance is attached to the textile fibres. Also the use patterns, such as wear and tear and laundering, influence the release of substances. Textile articles are used in a way that both consumers and the environment are directly or indirectly exposed to chemicals released from the articles.

Chapter 4 presents an overview of various kinds of substances used in textile production and manufacturing, and factors influencing release and exposure.

Since the knowledge on the chemical content of textiles in general is poor there may be hazardous substances present in the textile articles causing exposure of humans and the environment. To assess the chemical risks related to the use of textile articles it is necessary to have comprehensive information about the identity of the substances and their hazardous properties.

7.3 Information is needed in the production and supply chains

Information on chemical substances included and remaining in the textile articles is necessary for assessing chemical risk to humans and to the environment, and to identify if there is a need for risk reduction measures. Access to information on the contents of hazardous substances in textile materials and articles is important for the manufacturers and importers along the supply chain.

The requirement[103] in REACH (Section 2.1.1) concerning the duty on suppliers to provide information on hazardous substances in articles is limited to *substances of very high concern*

[102] Kartläggning av kemikalieanvändning i kläder, Swerea IVF Uppdragsrapport 09/52 (2009)
[103] REACH Regulation, Article 33.

listed on the Candidate list, present in concentrations above 0,1%. Thus, the duty to provide information does not included e.g. dermal allergens.

The majority, approximately 80%, of the textile articles consumed in the EU are imported from a non-EU country, and it is also common to import semi-finished textile materials while the article is finally manufactured and labelled in the EU. The textile supply chains are often long and complex with a global span and important information is drastically decreasing in the many steps from producer to consumer. The knowledge about chemical contents in textile articles should be made more readily available by increasing and improving the information exchange along the supply chain.

One step towards improved information exchange along the supply chain is the internationally developed SAICM programme *Chemicals in Products* which has active support from stakeholders (Section 2.3).

The flow of chemical information in the supply chains is generally not adequate due to long and complex production and supply chains of global span. The legal information requirement on suppliers of substances in articles needs to be further developed.

7.4 Identifying chemical substances related to textile articles

Although large quantities of different substances are included in textile production, there is no comprehensive overview of hazardous substances that may be present in textile articles placed on the market.

In this study two main sources were used for identifying substances in textiles: different databases, such as companies' restriction lists, Swerea IVF's database and the SIN-list from ChemSec, **and** data from REACH registrations regarding production volumes, chemical properties and intended uses of substances.

Based on these sources, approximately 3 500 substances were identified as relevant for use in textiles. The actual use and presence in textile articles have not been verified for all substances. It should be noted that this only covers a part of all the substances that may be found in textile articles and as an example of this we only identified about eight percent of all direct dyes that are available for use in textile production according to the Colour Index database.

Substances that are added to textile articles in order to provide a specified function, such as colour or easy-care, are by definition present at relatively high levels in the finished textile articles, and these were prioritised in this study, based on potential risk. The identification of textile-related substances and subsequent analysis is presented in **Chapter 6**.

REACH registration requirements

The REACH registration (Section 2.1.1) is one source of knowledge since data for hazardous properties and recommended use for substances should be included in the registration. REACH requires that substances, as such or in a mixture, produced in or imported to the EU in volumes more than 1 tonne per company and year, are registered to the ECHA. The obligation to register or notify substances present in articles imported to the EU is very limited, in contrast to the import of substances as such or in mixtures.

Of the 3 500 identified substances about 2 000 substances are not yet registered in REACH and thus basic data for risk assessment is not available from this source. This group may contain substances that are of concern for human health and the environment, but also

substances that are safe to use. More data on chemicals will continuously be made available with additional registrations and stricter information requirements under REACH.

Some problems with using REACH registration data for risk assessments were identified. Information from the IUCLID 5 database was in some cases not easily accessible for evaluations of specific uses and for about one third of the identified substances the REACH registrations was the only source indicating textile use.

For several of the functional textile-related substances, including dyes, the volume does not exceed 1 tonne and there is no obligation to register these substances under REACH.

Thus, little information is available regarding substances that may be used in the vast majority of the textile production. In general, there are insufficient data on hazardous properties and use for many substances registered under REACH. Improved quality of data in the REACH registration would facilitate and improve the decision-making regarding risk reduction measures for hazardous substances in textiles.

Due to the volume limit for registration and the limited obligations to register substances present in imported articles, the REACH registration data is insufficient for risk assessment of many substances used in textiles.

REACH registration data on the use of substances in textile processes should as far as possible be easily accessible, as the lack of availability for example complicates the decision-making in the supply chain regarding substitution.

Limitations of the study identifying substances in textile articles

The focus of the screening study in the present report is functional chemicals, as they are expected to be present in textiles at relatively high concentrations compared with auxiliary chemicals and unintended chemicals.

Other substances in textiles that may not yet have been identified are degradation products that may be present due to textile manufacturing processes, such as chemicals formed through bleaching of cotton. It is very difficult to get information about this kind of substances. Examples of auxiliary chemicals that were not identified with the present prioritisation approach are nonylphenol ethoxylates and its degradation product nonylphenol. These substances are known to be problematic in the aquatic environment in the EU and laundry of textiles has been identified as an important emission source. Degradation products of highly fluorinated substances were not identified although highly fluorinated substances are used in a variety of industrial and household applications and it is clear that textile articles contribute to the total amount of fluorinated substances found in the environment.

Based on the limitations set by the prioritisation steps in the identification of substances of potential concern for the present report, there are most probably additional important process/auxiliary chemicals and degradation products with relevance for human health and the environment.

Due to the limits of the screening study other substances than functional chemicals, such as auxiliary chemicals or substances formed by degradation, were not identified. These kinds of substances may cause harmful effects on human health and the environment and should be considered for risk reduction measures.

7.5 Substances of potential concern for human health and environment

The conclusions regarding substances of potential concern are based on the analysis described in **Chapter 6**. Recent supporting evidence published in the open literature (presented in **Chapter 5)** has also been taken into consideration.

7.5.1 Substances of potential concern for human health

Approximately ten percent of the identified 2 400 textile-related substances are considered to be of potential concern for human health. The substances of potential concern for human health include direct azo dyes, acid azo dyes, and fragrances. The identified direct-type dyes have properties that mainly are associated with an increased risk of cancer and developmental effects, whereas the identified acid-type dyes and fragrances have properties that mainly are associated with an increased risk of allergy. The relevance of azo dyes was also confirmed by studies in the open literature.

Direct azo dyes are mainly used in cotton textiles while acid azo dyes are mainly used in polyamide. As both cotton and polyamide are common materials on the EU market, cotton is the main fibre type in clothing articles consumed within the EU, there is a potential for large-scale human exposure to direct and acid azo dyes. These dyes are loosely bound to textile fibres and in particular small children sucking or chewing on textiles could be highly exposed. The dyes also have properties indicating that they are persistent in the environment and may accumulate in the aquatic food chain, which could lead to an indirect exposure of humans through dietary intake.

For small children, ingestion of indoor dust, which to a large part consists of textile fibres, may also be an important exposure route to textile related substances, especially since textiles constitute a large part of the surface in the indoor environment.

The methods we used to identify substances of potential concern involve many assumptions and limitations but the results are consistent and give reasons for further investigations, especially of direct and acid type azo dyes but also fragrances. In line with a precautionary approach (Section 2.1.1), it can be concluded that substances that may cause severe health effects, e.g. carcinogenic, reprotoxic or sensitising substances, should be avoided in articles with direct and prolonged skin contact.

The study also identified some well-known and well-investigated brominated flame retardants, phthalates and antibacterial agents, indicating that the prioritisations made were relevant.

Approximately ten percent of the identified 2 400 textile-related substances are considered to be of potential concern for human health.

The presence of hazardous substances in textiles, including direct and acid type azo dyes, should be further investigated. Substances that may cause severe health effects should be avoided in articles with direct and prolonged skin contact.

Disperse dyes and allergic skin effects

A majority of the recent publications in the open literature related to risks from hazardous substances in textile articles to human health concern allergic skin reactions to disperse dyes. Disperse dyes were identified as substances of concern in our screening study, but we also identified acid dyes as a group of sensitising substances, substances that previously have not been associated with textile-allergy to any great extent. It is thus likely that the disperse dyes

is not the cause of all reported cases of allergic skin reactions. Based on the findings of our screening study more than 200 allergenic textile-related substances, as for example acid-type dyes, could contribute substantially to allergic skin reactions.

None of the substances with allergenic properties that were identified in our screening study are currently included in patch tests at dermatological clinics. Information on which allergens could be present in textile articles would improve the possibilities for dermatological clinics to identify which substance/s patients are allergic to.

The testing of dermal allergy to sensitising dye substances used in textiles should be developed.

Antibacterial biocides may contribute to resistance to antibiotics

Biocide-treated textile articles are available on the EU market, mostly without any information about the active substances used or with proofs of the claimed biocidal effects. In a few cases it has been shown that active substances are released after washing. For example it has been shown that considerable shares of silver, triclosan and triclocarban contained in textile articles are released from biocide treated textiles from laundering. There is however little information about their release during use and disposal of treated textiles.

Concern is increasingly being raised about the possibilities that bacteria can develop resistance to the released antibacterial substances and that this can trigger the development of resistance to antibiotics (**Section 5.1.3).**

The development of bacterial resistance to antibiotics is a very serious issue for human health, and any unnecessary use of biocides should be avoided.

7.5.2 Substances of potential concern for the environment

Approximately five percent of the 2 400 identified textile-related substances are considered to be of potential concern for the environment, with only a few substances restricted under REACH. The evaluation of textile related substances clearly pointed out azo dyes of direct and acid application type as substance groups of potential concern for the environment.

An estimation of the environmental release of direct and acid dyes showed that 2-22 tonnes each of hazardous direct and acid dyes could be released annually to the waste water in the EU from washing of cotton and polyamide textiles. The estimation was based on the assumption that Best Available Technique (BAT) has been used in the textile manufacturing process. If less optimal processes are used the release might be five times higher or more. The calculations also indicate a need for substantially more studies on the release of substances during laundry and studies evaluating the importance of textiles as compared to other sources of chemicals detected in the environment.

About 130 textile-related functional substances of potential concern for the environment were identified. Only about ten percent of these are included in Swedish the environmental monitoring programs, which means that we have little information about the actual levels in the environment. Additional monitoring of hazardous substances that are common in consumer articles, including textiles would increase the possibilities to identify environmental hazards at an early stage. The information about textile related substances of concern in this study could be used for the selection of additional substances in monitoring programs.

The few reports on environmental effects from textile related substances were focused on well-known substances: silver, nonylphenol and highly fluorinated substances.

Approximately five percent of the identified textile-related substances that have a function in the final article are considered to be of potential concern for the environment with only a few restricted under REACH.

7.5.3 The need for further risk reduction measures for substances in textiles

Most of the identified substances with very serious health hazardous properties, such as carcinogenic, mutagenic and/or toxic for reproduction, have an EU-harmonised classification and several are restricted under REACH or are included on the candidate list (*substances of very high concern*). REACH for instance bans the presence of carcinogenic aryl amines in consumer articles. A majority of the direct azo dyes identified in the current report can form these banned aryl amines by reductive cleavage, but our assessment shows that they may still be on the market as they are listed together with suppliers in the Colour Index database. The exact use of these dyes in textile articles on the EU market is, however, not known.

The screening study also identified several allergens skin sensitising substances. Many substances with sensitising properties (allergens) also have harmonised classification, but in comparison with the substances of very high concern they are not as strictly restricted in the current EU legislation. Risk reduction measures for these substances should be considered, either in the current REACH legislation or new legislation. Alternatives include a ban of allergens, but also information to customers about the effect and the allergens present in the article could be envisaged.

For environmental hazardous substances in general the current regulation is very weak. Nevertheless, more environmentally hazardous substances than allergens are restricted in REACH **(Section 6.2.2).**

The Swedish textile industry[104] is positive to developing the EU legislation on the basis of the voluntary initiatives that are already applied, such as the large number of *Restricted substances lists* (RSLs) and Oeko-Tex 100. This would mean simplifying procedures for the industry to provide a coherent and communicable way to deal with these issues business to business throughout the value chain.

The EU legislation should be developed to cover risks from substances in textile articles.

7.6 Additional need for further research

A review of scientific literature related to hazardous substances in textile is presented in C**hapter 5**. Overall, there are few scientific publications concerning harmful effects from exposures of hazardous substances in textile articles, especially for the environment. The limited number of studies most likely reflects the limited knowledge about chemical content in textiles and the difficulties to establish a correlation between exposure and effects for these types of articles. There is a need for more research about substances in articles, the release of substances from the textile materials as well as human and environmental exposure to chemicals in textiles. There is also a need for more research within the field of recycling in order to identify materials and articles that are suitable to recycle/reuse. One of the main barriers for companies today when it comes to using recycled material is the lack of knowledge on which hazardous substances can be found in the recycled material.

To meet the need for more information about chemical content in textile articles, both increased information from producers and suppliers, as well as non-target screening studies to

[104] Swedish Textile and Clothing Industries Association (TEKO).

identify substances in textile articles, would be useful**.** In order to study the exposures that are most relevant for human health and the environment, researchers need information about what substances that might found in textiles.

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60. Gomez, N., et al., *Effects of discharges from the textile industry on the biotic integrity of benthic assemblages.* Ecotoxicol Environ Saf, 2008. **69**(3): p. 472-9.
61. Dave, G. and P. Aspegren, *Comparative toxicity of leachates from 52 textiles to Daphnia magna.* Ecotoxicol Environ Saf, 2010. **73**(7): p. 1629-32.
62. Lithner, D., *Environmental and Health Hazards of Chemicals in Plastic Polymers and Products*, in *Plant and Environmental Sciences*. 2011, University of Gothenburg.

9 Terms and abbreviations

Terms

Article	An object which during production is given a special shape, surface or design, which determines its function to a greater degree than does its chemical composition
Candidate List	List of SVHC substances which are included in the list in accordance with Article 59 of the REACH Regulation. Substances are candidates for inclusion in Annex XIV to REACH, which means that authorisation will be required in order to use them.
Chemical products	A chemical product encompasses substances and preparations.
Combination effects	Combined effect of exposure of humans or the environment to a mixture o substances, which could be greater than the individual effects of the substances.
Cumulative exposure	Additive exposure from several sources
Endocrine disrupting chemicals, EDC	Substances which affect the hormonal systems and can cause severe damage to organisms, populations or ecosystems.
Exposure scenario	The set of conditions, including operational conditions and risk management measures, that describe how the substance is manufactured o used during its life-cycle and how the manufacturer or importer controls, c recommends downstream users to control, exposures of humans and the environment These exposure scenarios may cover one specific process or use or several processes or uses as appropriate
In vitro	Tests that are carried out in tests tubes or on uncultivated cells.
Nanomaterial	Substances in the size range 1-100 nanometres.
Patch test	A method used to determine whether a specific substance causes allergic inflammation of a patient's skin.
Precautionary principle	Fundamental principle within environmental and chemical policy which means that, if there is a threat of serious or irreversible damage to the environment, the absence of scientific proof may not be used as an excuse to delay cost-effective measures in order to prevent environmental impact
Registrant	The manufacturer or the importer of a substance or the producer or importer of an article submitting a registration for a substance.
Substitution principle	Fundamental principle within chemical control which means that hazardou substances must be replaced by less hazardous substances wherever possible. May also involve the use of a different technique or method.
Substances of very high concern, SVHC	Substances which have serious and often irreversible properties. In the report, the term normally refers to substances which are carcino-genic, mutagenic or toxic to reproduction (CMR, category 1A or 1B), substances which are persistent, bioaccumulative and toxic (PBT) and substances which are very persistent and very bioaccumulative (vPvB).
Textile fibre	Definition in Textile Fibre Regulation (EU) no 1007/2011. See Annex 1

Abbreviations

CAS	Chemical Abstract Service,
Chemitecs	Research programme, www.chemitecs.se
ChemSec	The International Chemical Secretariat, www.chemsec.org
CLP	Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures amending and repealing Directive 67/548/EEC and 1999/45/EC, and Regulation (EC) No 1907/2006.
CMR substances	Substances that are carcinogenic, mutagenic or toxic to reproduction
DNEL	Derived no effect level
ECHA	European Chemicals Agency
EDC	Endocrine disrupting chemicals
EU	European Union
GPSD	General Product Safety Directive
IUCLID	International Uniform Chemical Information Database at ECHA
Log Kow	Value for the solubility of substances in fat
PAH	Polycyclic aromatic hydrocarbons
PBT vPvB	Persistent, bioaccumulative and toxic substances Very persistent and very bioaccumulative substances
PFOS	*Perfluorooctane sulphonate*, a perfluorinated organic substance
REACH	Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals, establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC .
SAICM	Strategic Approach to International Chemicals Management. Global agreement on sustainable chemicals management.
SVHC	Substances of very High Concern
WWTP	Waste water plant treatment
POP	Persistent Organic Pollutants. PBT-substances that can be transported over long distance in the environment
QSAR	Quantitative Structure-Activity Relationship

Annexes

Annex 1: Definitions

Definition of textile fibre

Textile fibres are defined according to article 3 b in the Textile Fibre Regulation (EU) No1007/2011).

Textile fibre means either of the following:

(i) a unit of matter characterised by its flexibility, fineness and high ratio of length to maximum transverse dimension, which render it suitable for textile applications;

(ii) a flexible strip or tube, of which the apparent width does not exceed 5 mm, including strips cut from wider strips or films, produced from the substances used for the manufacture of the fibres listed in Table 2 of Annex I and suitable for textile applications;

Annex 2: Methodology; systematic literature survey of human health and environmental effects of textile-related substances

Systematic survey of human health effects

To retrieve relevant scientific knowledge about hazardous substances in textile articles and human health risks we performed a systematic literature survey using the database PubMed - Medline. We focused the literature survey on the effect areas cancer, mutagenicity and reproductive (CMR) effects as well as on skin or respiratory allergy and skin irritation. The selected effect areas correspond to the highest prioritised effect areas for the identification of potential risks with hazardous chemical substances in textile articles (Chapter 5).

The general question of issue for the literature search was:

"Is there a link between exposure to hazardous chemical substances in textile articles and an increased risk of cancer/reproductive effects/allergy?"

We began with a broad initial search in order to capture as many relevant publications as possible followed by a manual screening of abstracts where we excluded publications that did not fit the question of issue or the scope of the assignment. To identify as many relevant studies as possible, we build a search string for each effect area based on a selected number of keywords (see table below). The keywords were selected based on previous governmental reports and review articles. Publications older than ten years were excluded from the review as were also *In vitro* studies, with the exception of mutagenesis assays which we considered relevant for chemically induced carcinogenic effects. After the manual screening of abstracts and selection of relevant publications all articles were scrutinised and the complete findings are summarised in Section 5.1.

Search string	No. of publications
Skin or respiratory allergy : ((((Allergy or Sensitisation or dermatit* or urticaria or asthma or rhinitis)) AND (Textile or cotton or polyester or viscose or fleece or nylon or wool)) AND exposure) NOT in vitro	91
Skin irritation: ((((Irritation or dermatit* or urticaria)) AND (Textile or cotton or polyester or viscose or fleece or nylon or wool)) AND exposure) NOT in vitro	43
Cancer: ((((Cancer OR Endocrin* OR Mutagen* OR carcinogen*)) AND (Textile OR cotton OR polyester OR viscose OR fleece OR nylon OR wool)) AND exposure) NOT in vitro[a]	296
Reproductive/developmental effects :((((Reproduct* OR Endocrin* OR Development* OR Teratogen*)) AND (Textile OR cotton OR polyester OR viscose OR fleece OR nylon OR wool)) AND exposure) NOT in vitro	268

Table A2:1 *Search strings used for identification of relevant publications within each selected effect area*

[a]In vitro studies were included in the review of mutagenicity.

Systematic survey of environmental effects

In order to get an overview of the scientific knowledge about hazardous substances in textile articles and environmental risks a systematic literature survey using the database CAplus was performed by the Royal Institute of Technology (KTH) library. The following strings were used.

Search words	No. of publications
(fish or daphnia or algae or macrophyte or invertebrate or amphibian) AND (Textile or cotton or polyester or viscose or fleece or nylon or wool) [All Sources(Environmental Science)]	1
(wash* or laundry) AND (leach*) [All Sources(Environmental Science)]	0
(leach*) AND (Textile or cotton or polyester or viscose or fleece or nylon or wool))[All Sources(Environmental Science)]	0

Table A2:2 *Search strings used for identification of relevant publications*

Annex 3: Databases and additional sources scrutinised in January 2014 during the inventory of substances potentially present in textile articles

- Substances registered in the IUCLID[105] system under REACH with relevance for textile production (about 1 250 substances).
- Swerea IVF chemical database[106] of substances that may be found in textiles (about 290 substances).
- Substances with textile relevance found on the SIN list developed by the NGO ChemSec[107] (274 substances).
- Substances identified through the Chemitecs programme[108] (about 680 substances).
- The Swedish Chemical Agency's Commodity Guide[109](about 400 substances)
- The Swedish Chemical Agency's Products Register, to which manufacturers and importers are obliged to report products subject to chemical substances control (about 530 substances, including 130 confidential substances)
- A number of restricted substances lists from different Swedish companies and from international voluntary initiatives[110], also including the Virke[111] list (about 500 substances in total).
- Substances identified in the European Commission, DG Enterprise 2013 report "Study on the Link between Allergic Reactions and Chemical substances in Textile Products final report" (Draft no. 5) (about 330 substances).

[105] IUCLID is a system for saving and exchanging data on hazardous properties of chemicals registered under REACH.
[106] Swerea IVF is a research institute within the Swerea group with materials, processes and production systems within manufacturing and product development as key areas.
[107] Chem Sec, International Chemical Secretariat, is a non-profit organisation founded in 2002. The SIN list originates from an NGO-driven project aiming at facilitating the transition to a non-toxic environment.
[108] The Chemitecs programme (2007-2012; http://chemitecs.se) aiming at increasing the understanding and knowledge about emissions of organic substances from articles.
[109] The Commodity Guide is a database on the composition of goods, providing estimates of materials and substances that may exist in various articles in Sweden. Quantitative information is also available.
[110] Of the voluntary initiatives are amongst others the AFIRM Group included. The Roadmap to Zero Discharge has not been included, but may partly be included in the companies' own lists
[111] A report developed by the Norwegian organisation Virke together with the textile industry

Annex 4: Development of health hazard scores for ranking of substances on the inventory list

For the prioritisation process we ranked all identified substances on the inventory list by giving each substance a score from 0.5 to 10, where 10 represents properties considered as most hazardous in the context of textile articles. The ranking score was developed based on:

- Harmonised classification in the CLP Regulation (EC) No 1272/2008, Annex VI.
- Self-classification in the ECHA registration database, the strictest self-classification was used for ranking of substances.
- Screening scenarios prepared by ECHA for human health screening activities needed to serve the Substance Evaluation and Regulatory Risk Management processes [112].
- Classification as EDC according to the interim criteria in Regulation EU/528/2012.
- The European Commission priority list over potential endocrine disrupting substances [113].

The ranking means that we do not make a strict division of substances as hazardous or non-hazardous. However, substances given hazard score equal to or higher than 8 are counted as particularly hazardous which imply that we consider it not possible to determine a safe level of exposure.

Substances with a hazard score from 8 to 10 (particularly hazardous substances) include those that fall under the REACH criteria for substances of very high concern (SVHC), including substances classified as carcinogenic, mutagenic or reprotoxic (CMR) category 1 or as sensitising to the skin or the respiratory tract. The Swedish Chemicals Agency is of the opinion that endocrine disrupting compounds (EDCs) are of equal concern as CMR 1A or 1B substances and we aim to include EDCs, as particularly hazardous substances in the assignment. In the absence of EU criteria for EDCs we assign a high hazard score (8) to substances that fall for the interim criteria or are listed as category 1 on the European Commission priority list.

From an enforcement perspective, it is problematic to regulate substances that lack harmonised classification because different companies may reach different conclusions as the data sets used for classification may differ from one company to another. Since the present report does not focus on the enforcement perspective we have chosen to include both substances with a harmonised classification and substances that are classified by a registrant.Substances were given a higher score based on harmonised classification as compared with the corresponding self-classification.

The criteria for ranking scores are presented in Table A4:1.

[112] Screening scenarios human health: Scenarios to be implemented for searching potential substances of concern for substance evaluation and regulatory risk management (Echa, 2014)
[113] http://ec.europa.eu/environment/chemicals/endocrine/strategy/substances_en.htm

CLP classification	Self-classification	ECHA screening scenarios	Score
Muta 1A/1B		HH9	10
Carc 1A/1B, Repro1A/1B, Skin sens			9.5
	Muta 1A/1B	HH10, HH36, HH14	9
	Carc 1A/B, Repro1A/B, Skin sens	HH37, HH40	8.5
	Interim criteria for ED[114] Priority list for ED cat. 1[115]	HH13, HH5	8
Muta 2		HH41, HH32	7.5
Repro 2, Carc 2, Skin corr		HH6, HH1, HH31, HH44, HH38	7
Skin irrit	Muta 2	HH33, HH15	6.5
Resp sens, STOT RE1	Repro 2, Carc 2, Skin corr	HH2, HH45, HH19, HH52, HH63, HH65	6
	Skin irrit	HH16, HH23	5.5
	Resp sens, STOT RE1	HH20, HH53, HH27, HH39	5
		HH24	4.5
STOT RE 2		HH28	4
Acute tox 1		HH56	3.5
Acute tox 2	STOT RE 2		3
Acute tox 3	Acute tox 1	HH66, HH57, HH67, HH64, HH68	2.5
Acute tox 4	Acute tox 2	HH48, HH49, HH50, HH51, HH61, HH62	2
	Acute tox 3	HH58, HH59, HH69	1.5
	Acute tox 4	HH70	1

Table A4:1 *Criteria for health hazard ranking scores for prioritisation of chemical substance in textiles. Criteria that represent particularly hazardous substances are marked in grey*

[114] Regulation (EC) No 1107/2009: Annex II Point 3.6.5

[115] European commission, DG environment priority list of substances for further evaluation of their role in endocrine disruption (accessed Sep 2014)

Annex 5: Criteria employed for the development of environmental hazard related prioritisation scores for chemical substance in textiles

Since the number of chemicals that may be associated with textiles is large, so is also the range of hazards posed by the individual chemical substances, ranging from low to high. For the prioritisation process the substances were ranked on a scale from zero to ten, where ten represents the most hazardous substances. The most commonly available information of environmental hazard of a specific substance is the aquatic toxicity which may be measured in both short- and long-term tests with endpoints such as mortality, growth, reproduction, etc. The toxicity is measured in organisms which are expected to represent different trophic levels, such as algae, invertebrates and fish. In addition to environmental toxicity, also substances fulfilling the T in the PBT-criteria according to Annex XIII are included. However, not only the toxicity *per se* is of relevance as regards environmental hazards. Also properties such as persistence towards degradation, bioaccumulation and endocrine disruptive properties are of importance. The resulting ranking scores are presented in table A5:1. Criteria that represent particularly hazardous substances are marked in grey.

Hazard category	Available information	Environmental hazard score
High	Candidate list (PBT – article 57 d, vPvB – article 57 e, Equivalent level of concern of having probable serious effects to the environment – article 57 f); Stockholm Convention (Annex A-C); ESIS>PBT-list (PBT, vPvB, POP)	10
	PB (screening criteria) AND Aquatic chronic 1/CMR (Cancer and Muta 1-2, Repro 1-3) AND/OR ED in COM list	9
	P (screening criteria) AND Aquatic chronic 1/CMR (Cancer and Muta 1- 2, Repro 1-3) OR B (screening criteria) AND Aquatic Chronic 1/CMR (Cancer and Muta 1-2, Repro 1-3)	8
	Aquatic Chronic 1	7
	PB (screening criteria)	6
Medium	P (screening criteria) AND Aquatic chronic 2 OR B (screening criteria) AND Aquatic chronic 2	4
	P (screening criteria) AND Aquatic chronic 3 OR B (screening criteria) AND Aquatic chronic 3	3,5
	P (screening criteria) AND Aquatic chronic 4 OR B (screening criteria) AND Aquatic chronic 4	3

	P (screening criteria) OR Aquatic chronic 3 B (screening criteria) OR AND Aquatic chronic 2	2.5
	Aquatic Chronic 3	2
	Aquatic Chronic 4	1.5
	Aquatic Acute 1	1
Low	not P (screening criteria) AND not B (screening criteria) AND no harmonised aquatic toxicity classification	0
Unknown	Substances for which PB screening has not been possible due to lack of CAS# AND no harmonised aquatic toxicity classification	-

Table A5:1: *Environmental hazard ranking scores for prioritisation of chemical substances in textiles*

Annex 6: Description of the expert judgment/ consultant study; assessment of textile relevance and subsequent assessment of probability of release

Substances with a health hazard prioritisation score of 10-8 or an environmental hazard prioritisation score of 10-6 were evaluated for their potential relevance to textiles, i.e. the likelihood that they are present in textile articles. The assessment model, as described in table A6:1 below, is based on four relevance levels; high, medium, low and no relevance to textiles.

Relevance level	**Textile use assessment**	**Estimated concentration range[a] (mg/kg textile material)**
High	Functional chemical substances with a known use in textiles	<100 - 5000<
Moderate	Functional chemical substances that may be used in textiles (also used in other applications)	<10 - 1000<
Low	Auxiliary chemicals or unintended chemicals such as raw materials, intermediates, contaminants and degradation products. None of these chemicals are functional chemical substances	<100
No	No known use in textiles	<LOD

Table A6:1 *Assessment scheme of relevance level for chemical substances to textiles indicating estimated concentration ranges in the final article*

[a]*In the high and moderate relevance levels there may be substances that occur beyond the given concentration rate*
LOD= Limit of detection

Source: Expert judgment and references listed in table A6:3.

Substances with the highest level of relevance to textiles are directly applied to textile materials as the main use. Moderate textile relevance substances are also directly applied to textiles but only as one of several other common uses. Low level substances have indirect uses in textiles, meaning that they are not added to the textile material, but appear as raw materials and intermediates for high and medium relevant textile chemical substances manufacturing, as impurities or degradation products. For petroleum related substances, they are considered as low relevance due to the fact that wide range of textile raw materials, auxiliary chemical substances and functional chemical substances are petroleum based. The last category of substances has no relevance to textiles meaning that there is no known and documented use in textiles. For this category of substances there may be some uncertainties due to data gaps of potential uses in textiles but then only for minor not publicity known textile uses.

Additionally a simple model was created to assess the probability of release of substances of high and moderate relevance to textile articles. This model is described in table A6:2 below, and is adapted to a range of possible release and emission scenarios that may be relevant for textile articles during use and as waste. The probability of release of the assessed substances

relates to the degree of physical and chemical bonding to the textile fibres; for dyes the term degree of fixation is used. When the bonding is weak or the fixation is low, i.e. when high migration or emissions of the substance from textile articles can be expected, the physical properties of the substance itself become important for the probability of release, mainly water solubility and volatility.

A substance with high water solubility will easily dissolve in sweat or saliva which may lead to a high dermal or oral exposure. It is also likely to be easily rinsed off during laundering and ends up in the aquatic environment, unless degraded or removed via sludge or evaporation in the WWTPs. Highly volatile substances easily emit from textiles which may cause a high exposure through inhalation. Semi water soluble or semi volatile substances still will give rise to a moderate probability of release.

For moderate probability of release, this estimation of probable release is not fully valid in the case of release to the environment. The addition of detergents during laundry can for instance alter the solubility of substances and a substance classified as "moderate" may leach to the same extent as a substance classified as "high" in the presence of a detergent.

Probability of release	**Physical chemical properties determining release**[a]
High	No bonding to the textile material High volatility or high water solubility
Moderate	Physical bonding to the textile material Semi volatility or limited water solubility
Low	Covalent or strong physical bonding to the textile material Only extractable residues Particle bound (dust) substances with no volatility and/or water solubility

Table A6:2 *Assessment of probable release of the identified relevant effect (functional) chemical substances*

[a]*For dyestuffs (colourants and dyes) the degree of fixation determines the potential for migration/ emissions from the textile material (see Table A6:4 [degree of fixation %]); for salts the water solubility is considered; for organic substances the volatility is considered.*

Table A6:3: *References used for the assessment of textile relevance*

1. Safety data sheets, product information sheets and product evaluation reports:
    a. http://nj.gov/health/eoh/rtkweb/documents/fs/0397.pdf
    b. http://echa.europa.eu/documents/10162/b1176fd0-799d-4c08-a908-755a1c82181f
    c. http://www.inchem.org/documents/sids/sids/100447.pdf
    d. http://echa.europa.eu/documents/10162/22bf49d3-e951-44b8-a45a-6973d3dc62f6
    e. http://ntp.niehs.nih.gov/ntp/roc/twelfth/profiles/dichloroethane.pdf
    f. http://ntp.niehs.nih.gov/ntp/roc/twelfth/profiles/butadiene.pdf
    g. http://www.ec.gc.ca/ese-ees/C1B0BBD3-7844-4F5E-B2FB-CBAD1E7E055E/DBE_FSAR_EN.pdf
    h. http://ntp.niehs.nih.gov/?objectid=E87DF5EF-BDB5-82F8-FA723E226ECF2AE8
    i. http://www.inchem.org/documents/sids/sids/Chloroprene.pdf
    j. http://echa.europa.eu/documents/10162/13640/svhc_axvrep_france_cmr_pentaas_20083006_en.pdf
    k. http://echa.europa.eu/documents/10162/50218bf9-ba0f-4254-a0d9-d577a5504ca7
    l. http://echa.europa.eu/documents/10162/13640/svhc_axvrep_norway_cmr_leadas_20083006_en.pdf
    m. http://www.chem.unep.ch/irptc/sids/OECDSIDS/VINYLCHL.pdf
    n. http://echa.europa.eu/documents/10162/13638/svhc_axvrep_michlers_ketone_pub_en.pdf
    o. http://pubs.usgs.gov/circ/circ1292/pdf/circ1292_appendix4.pdf
    p. http://www.inchem.org/documents/sids/sids/98077.pdf
    q. http://www-users.cs.york.ac.uk/~pcc/coshh/new/White-Spirit-MSDS.pdf
    r. http://nj.gov/health/eoh/rtkweb/documents/fs/0308.pdf
    s. http://www.atsdr.cdc.gov/toxfaqs/tfacts136.pdf
    t. https://www.ec.gc.ca/ese-ees/default.asp?lang=En&n=BA416AA1-1#a6
    u. http://www.ilo.org/oshenc/part-xviii/guide-to-chemicals/item/1036-azides?tmpl=component&print=1
    v. http://monographs.iarc.fr/ENG/Monographs/vol79/mono79-21.pdf
    w. http://www.google.se/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=4&ved=0CEoQFjAD&url=http%3A%2F%2Fwww.ehs.ucsf.edu%2Fsites%2Fehs.ucsf.edu%2Ffiles%2FDiepoxybutane%2520CAS%2520No.1464-53-5.doc&ei=gbFkU8mWJInm4QSplYDwDQ&usg=AFQjCNFlpU_cK6V-_kTCKZ2Qo66POGDsdQ&sig2=4n_YWYK2BwKqcjkjHiXFrA
2. Study on the Link Between Allergic Reactions and Chemicals in Textile Products, European Commission DG Enterprise, 2013 http://ec.europa.eu/enterprise/sectors/textiles/files/studies/study-allergic-reactions-textile_en.pdf
3. ECHA database: information on chemicals, http://echa.europa.eu/information-on-chemicals
4. ECHA database: Table of substances/group of substances, which are restricted by Annex XVII to REACH Regulation http://echa.europa.eu/sv/addressing-chemicals-of-concern/restrictions/list-of-restrictions/list-of-restrictions-

table;jsessionid=8C170B7EF35B0F66A175F80BE3DB23AE.live1?p_p_id=substancetypelist_WAR_substanceportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_pos=1&p_p_col_count=2&_substancetypelist_WAR_substanceportlet_keywords=&_substancetypelist_WAR_substanceportlet_advancedSearch=false&_substancetypelist_WAR_substanceportlet_andOperator=true&_substancetypelist_WAR_substanceportlet_orderByCol=extraColumn1507&_substancetypelist_WAR_substanceportlet_orderByType=asc&_substancetypelist_WAR_substanceportlet_delta=75

5. ECHA database: Candidate List of Substances of Very High Concern for Authorisation, http://echa.europa.eu/web/guest/candidate-list-table
6. THK online database, TEGEWA, http://www.thk-online.net/
7. Colour Index International, Society of Dyers and Colourists, http://www.colour-index.com/
8. http://www.chemicalland21.com/
9. http://www.chemicalbook.com/
10. http://www.lookchem.com/
11. Petrobas global trading database, http://sites.petrobras.com.br/minisite/reach/downloads/en/records_substancias_quimicas_petrobras_reach_2010.pdf
12. Ftalater i produkter, som børn har direkte kontakt med; Kortlægning af kemiske stoffer i Förbrugerprodukter nr. 109, 2010, Danish Ministry of the Environment.

Colourant class	Sub-class	Textile & leather material applied	Degree of fixation [%]	Main aspects	Hazardous substances	Substitution
Disperse		Polyester Cellulose acetate Polyacrylic Polyamide Chloro fibres	88-99	Carriers, reductive after treatment (sulfur compounds)	Allergenic dyestuffs Carcinogenic dyestuffs Banned arylamines Chlorinated solvents	
Basic (cationic)		Polyacrylic Leather Silk	96-100	Retarder in dyeing PAC (quaternary ammonium compounds)	Carcinogenic dyestuffs Complexing agents	
Acid	Standard, 1:1 metal complex and 1:2 metalcomplex	Polyamide Silk Wool Leather	85-98 82-98 (metal complex)	Heavy metal content in dyestuffs	Carcinogenic dyestuffs Banned arylamines Toxic metals	
Mordant		Wool Silk Polyamide Leather	95-98	Chrome VI	Chromium VI	Peroxide, air oxygen, metal free agents
Reactive		Silk Wool Polyamide Cellulose	55-97	Partially low fixation degree, AOX source, low adsorption tendency of dyestuff hydrolysates in activated sludge treatment, high amount of salts (sodium chloride, sodium sulfate)	Salt emissions	
Direct		Cellulose	64-96	Salt, aftertreatment with water toxic cationic agents	Carcinogenic dyestuffs Banned arylamines Salt Copper sulfate to	Polymeric compounds instead of copper sulfate

Colourant class	Sub-class	Textile & leather material applied	Degree of fixation [%]	Main aspects	Hazardous substances	Substitution
					treat direct dyes	
Vat	Standard, Leuco vat ester	Cellulose Polyamide	75-95	Reducing agents (sulfur compounds), partially halogene containing oxidizing agents		
Sulfur		Cellulose acetate Cellulose	60-95	Sulfur containing dyestuffs and reducing agents, partially halogene containing oxidizing agents	sodium hydrosulphite	Stabilised sodium hydrosulphite
Azoic (naphtol)		Polyester Cellulose	See reactive	See reactive	Banned arylamines salt	
Pigment		Polyester Cellulose acetate Polyacrylic Polyamide Silk Wool Cellulose Leather	100	Residues from printing process e.g binders, VOC etc	Banned arylamines Chlorinated or aromatic solvents. Aliphatic solvents Thickeners	

Table A6:4 *Colourant chart, different types of dyes/ colourants; use, degree of fixation and toxicological aspects*

Annex 7: Health and environmental hazardous substances identified in the screening project

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
1-Propene, 3-isothiocyanato-	57-06-7	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[5-amino-4-hydro1y-, tetrasodium salt	72-57-1	Direct dyestuff	H	H	1B	1A	1B				8		No	No	Yes*4	No	Not included
Dibutyltin dilaurate	77-58-7	Stabiliser	M	L	2		1A	1			Unknown		No	No	No	Yes	Restricted as DBT
Dibutyltin maleate	78-04-6	Catalyst, stabiliser	H	L	2		1A	1			Unknown		No	No	Yes	Yes	Restricted
Phosphoric acid, tris(2-methylphenyl) ester	78-30-8	Flame retardant, plasticiser/softener	M	L				1			4	x	No	No	No	No	Restricted
Triethyl phosphate	78-40-0	Flame retardant, plasticiser	M	M	2	1B					Unknown		No	No	No	Yes	Restricted
Linalool	78-70-6	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
4,4'-isopropylidenediphenol	80-05-7	Stabiliser	M	L			2	1	1		Unknown	x	No	No	No	No	Not included
2-(4-tert-butylbenzyl)propionaldehyde	80-54-6	Fragrance	M	H			1B	1			Unknown		No	No	No	Yes	Restricted as fragrance
9,10-Anthracenedione, 1,4-diamino-2,3-dichloro-	81-42-5	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Benzenesulfonamide, N-(4-amino-9,10-dihydro-3-metho1y-9,10-dio1o-1-anthracenyl)-4-methyl-	81-68-5	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Dicyclohexyl phthalate	84-61-7	Plasticiser/softener	H	M			1B	1	1		9	x	No	No	No	Yes	*Restriced from 2015*

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Diethyl phthalate	84-66-2	Plasticiser	M	M			2	1	1		9	x	No	No	No	Yes	*Restriced from 2015*
Diisobutyl phthalate	84-69-5	Plasticiser/softener	H	M			1B		2		Unknown	x	Yes	Yes	No	Yes	Restricted
Dibutyl phthalate	84-74-2	Plasticiser	M	M			1B		1		9	x	Yes	Yes	Yes	Yes	Restricted
1,2-Benzenedicarbo1ylic acid, dihe1yl ester	84-75-3	Plasticiser	H	M			1B		2		2.5		Yes	No	Yes	No	Restricted
Benzyl butyl phthalate	85-68-7	Plasticiser	H	M			1B		1		9	x	Yes	Yes	Yes	Yes	Restricted
Coumarin	91-64-5	Frargance	M	H		2		1		SEv HH36	Unknown		No	No	No	Yes	Restricted as fragrance
3-hydroxy-2-naphthanilide	92-77-3	Azoic dyestuff	H	M				1		SEv HH36	Unknown		No	No	No	Yes	Restricted
Eugenol	97-53-0	Fragrance	M	H				1		SEv HH36; SEv HH50; SEv HH56	Unknown		No	No	No	Yes	Restricted
Phenol, 2-methoxy-4-(1-propenyl)-	97-54-1	Fragrance	M	H				1			Unknown	x	No	No	No	No	Restricted as fragrance
Benzyl alcohol	100-51-6	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
N-(1-methylethyl)-N'-phenyl-1,4-benzenediamine	101-72-4	Antioxidant	M	L				1			Unknown	x	No	No	No	Yes	Not included
1-Heptanol, 2-(phenylmethylene)-	101-85-9	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Octanal, 2-(phenylmethylene)-	101-86-0	Fragrance	M	H				1			2.5		No	No	No	No	Restricted as fragrance

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2-Propenoic acid, 3-phenyl-, phenylmethyl ester	103-41-3	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
1-Penten-3-one, 1-(4-metho1yphenyl)-	104-27-8	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Cinnamyl alcohol	104-54-1	Fragrance	M	H				1		SEv HH36; SEv HH62	Unknown		No	No	No	Yes	Restricted as fragrance
Cinnamaldehyde	104-55-2	Fragrance	M	H				1			Unknown		No	No	No	Yes	Restricted as fragrance
Citronellol	106-22-9	Fragrance	M	H	2	2		1		SEv HH36; SEv HH50	Unknown		No	No	No	Yes	Restricted as fragrance
Geraniol	106-24-1	Fragrance	M	H				1		SEv HH36; SEv HH50	Unknown		No	No	No	Yes	Restricted as fragrance
Octanal, 7-hydroxy-3,7-dimethyl-	107-75-5	Fragrance	M	H				1		SEv HH36; SEv HH62; SEv HH51	Unknown		No	No	No	No	Restricted as fragrance
2-Octynoic acid, methyl ester	111-12-6	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Tris(2-chloroethyl) phosphate	115-96-8	Flame retardant, plasticiser/softener	M	M		2	1B				2.5	x	Yes	Yes	No	Yes	Restricted
Bis(2-ethylhexyl) phthalate	117-81-7	Plasticiser/softener	H	M			1B		1		9	x	Yes	Yes	Yes	Yes	Restricted

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
1,2-Benzenedicarbo1ylic acid, bis(2-metho1yethyl) ester	117-82-8	Plasticiser	H	M			1B				Unknown		Yes	No	No	No	Restricted
1,2-Benzenedicarbo1ylic acid, dioctyl ester	117-84-0	Plasticiser/softener,solvent	H	M			2	1	3b		8	x	No	No	Yes	No	Restricted
Benzyl salicylate	118-58-1	Fragrance	M	H				1		SEv HH36; SEv HH48	Unknown		No	No	No	Yes	Restricted as fragrance
2,4,6-tribromophenol	118-79-6	Flame retardant	M	L			2	1			8	x	No	No	No	Yes	Restricted for product class I-III
2H-1-Benzopyran-2-one, 3,4-dihydro-	119-84-6	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Heptanal, 2-(phenylmethylene)-	122-40-7	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
4-phenylbutenone	122-57-6	Fragrance	M	H				1		SEv HH36; SEv HH62; SEv HH56	Unknown		No	No	No	Yes	Restricted as fragrance
Tetrakis(hydroxymethyl)phosphonium chloride	124-64-1	Flame retardant, plasticiser/softener, solvent	H	M			1B	1		SEv HH59	Unknown		No	No	No	Yes	Restricted for product class I-III
3-Buten-2-one, 3-methyl-4-(2,6,6-trimethyl-2-cyclohexen-1-yl)-	127-51-5	Fragrance	M	H				1			2.5		No	No	No	No	Restricted as fragrance
Dinaphtho[1,2,3-cd:3',2',1'-lm]perylene-5,10-dione, 16,17-dimetho1y-	128-58-5	Vat dyestuff	H	L							6		No	No	No	No	Not included
Dipentyl phthalate (DPP)	131-18-0	Plasticiser	H	M			1B		1		9	x	Yes	No	No	No	Restricted

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Methanone, bis(2,4-dihydro1yphenyl)-	131-55-5	UV Stabiliser	H	L				1	1		9		No	No	No	No	Not included
Ethyl acrylate	140-88-5	Fragrance	M	H				1		SEv HH62; SEv HH50	Unknown		No	No	No	Yes	Restricted as fragrance
Diethyl maleate	141-05-9	Fragrance	M	H				1		SEv HH36	Unknown		No	No	No	Yes	Restricted as fragrance
6,10-dimethylundeca-3,5,9-trien-2-one	141-10-6	Fragrance	M	H				1		SEv HH36	Unknown		No	No	No	Yes	Restricted as fragrance
29H,31H-phthalocyaninato(2-)-N29,N30,N31,N32 copper	147-14-8	Pigment	M	L				1			Unknown		No	No	No	No	Not included
Mequinol	150-76-5	Fragrance	M	H				1		SEv HH31	Unknown		No	No	No	Yes	Restricted as fragrance
1,3-Naphthalenedisulfonic acid, 6,6'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[4-amino-5-hydro1y-, tetrasodium salt	314-13-6	Direct dyestuff	H	H		1B	1B				8		No	No	No	No	Not included
[4-[4,4'-bis(dimethylamino)benzhydrylidene]cyclohexa-2,5-dien-1-ylidene]dimethylammonium chloride	548-62-9	Basic dyestuff	H	M		1B					8		Yes	No	No	Yes	Not included
Benzenamine, 4-[(4-aminophenyl)(4-imino-2,5-cyclohe1adien-1-ylidene)methyl]-, monohydrochloride	569-61-9	Basic dyestuff	H	M		1B					Unknown		No	No	Yes	No	Not included
Methanaminium, N-[4-[[4-(dimethylamino)phenyl]phenylmethylene]-2,5-cyclohe1adien-1-ylidene]-N-methyl-, chloride	569-64-2	Pigment	M	L			2				8		No	No	No	No	Not included

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1-Naphthalenesulfonic acid, 3,3'-[[1,1'-biphenyl]-4,4'-diylbis(azo)]bis[4-amino-, disodium salt	573-58-0	Direct dyestuff	H	H		1B	2				8		Yes	No	Yes	No	Restricted
Bromoethylene	593-60-2	Flame retardant	M	H		1B					Unknown		No	No	No	Yes	Restricted for product class I-III
Diisopentyl phthalate	605-50-5	Plasticiser	M	M			1B	1			2.5		Yes	No	No	No	*Restricted from 2015*
Benzenamine, 4-[(4-aminophenyl)(4-imino-2,5-cyclohe1adien-1-ylidene)methyl]-2-methyl-, monohydrochloride	632-99-5	Basic dyestuff	H	L		1A					8		No	No	No	No	Restricted
Ethanaminium, N-[4-[[4-(diethylamino)phenyl]phenylmethylene]-2,5-cyclohe1adien-1-ylidene]-N-ethyl-, sulfate (1:1)	633-03-4	Basic dyestuff	H	L			2				8		No	No	No	No	Not included
Dibutyltin dichloride	683-18-1	Stabiliser	H	L	2		1B	1			7		Yes	No	Yes	Yes	Restricted
2H-1-Benzopyran-2-one, 3,4,5,6,7,8-he1ahydro-	700-82-3	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Benzenamine, 4-[(4-nitrophenyl)azo]-	730-40-5	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Restricted
Dimethyl methylphosphonate	756-79-6	Flame retardant, plasticiser/softener, solvent	H	M	1B		2			SEv HH31; SEv HH14	Unknown		No	No	No	Yes	Restricted
N-(1,3-dimethylbutyl)-N'-phenyl-1,4-benzenediamine	793-24-8	Antioxidant	M	L				1			Unknown	x	No	No	No	Yes	Restricted
Dioctyltin oxide	870-08-6	Stabiliser	H	L			2			SEvHH 31 HH31	8		No	No	Yes	Yes	Restricted
3-Buten-2-one, 4-(4-metho1yphenyl)-	943-88-4	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance

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Irganox 565	991-84-4	Antioxidant	M	L				1			Unknown		No	No	No	No	Not included
1-Naphthalenesulfonic acid, 3,3'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[4-amino-, disodium salt	992-59-6	Direct dyestuff	H	H		1B					8		No	No	*Yes**4	No	Not included
2,7-Naphthalenedisulfonic acid, 4-amino-5-hydro1y-3-[(4-nitrophenyl)azo]-6-(phenylazo)-, disodium salt	1064-48-8	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
Dibutyltin di(acetate)	1067-33-0	Stabiliser	H	L	2		1A	1			Unknown		No	No	No	Yes	Not included
3,5,9-Undecatrien-2-one, 3,6,10-trimethyl-	1117-41-5	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Bis(pentabromophenyl) ether	1163-19-5	Flame retardant	M	L	2		1B				9	x	Yes	No	No	Yes	Restricted
Borax [ISO]	1303-96-4	Flame retardant	M	M			1B				Unknown		Yes	No	No	No	Restricted for product class I-III
Borax [ISO]	1303-96-4	Flame retardant, biocide	M	L			1B				Unknown		Yes	No	No	No	Restricted for product class I-III
Cadmium sulphide	1306-23-6	Pigment	M	L	2	1B	2				1.5		Yes	No	Yes	No	Limitations for Cd
Ciantimony trioxide	1309-64-4	Catalyst, flame retardant synergist	M	L		2	1A				8		No	No	No	Yes	Not included
Orange lead	1314-41-6	Pigment, stabiliser	M	L			1A				Unknown		Yes	No	Yes	No	Limitations for Pb
Dinaphtho[1,2,3-cd:1',2',3'-lm]perylene-9,18-dione, bromo-	1324-17-0	Vat dyestuff	H	L							6		No	No	No	No	Not included

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Benzenesulfonic acid, 2,2'-(1,2-ethenediyl)bis[5-nitro-, disodium salt, reaction products with 4-[(4-aminophenyl)azo]benzenesulfonic acid, sodium salts	1325-54-8	Direct dyestuff	H	H				1		SEv HH67	2.5		No	No	No	No	Not included
Cuprate(2-), [29H,31H-phthalocyaninedisulfonato(4-)-N29,N30,N31,N32]-, disodium	1330-38-7	Direct dyestuff	H	H				1			2.5		No	No	No	No	Not included
Cuprate(3-), [29H,31H-phthalocyaninetrisulfonato(5-)-N29,N30,N31,N32]-, trisodium	1330-39-8	Direct dyestuff	H	H				1			Unknown		No	No	No	No	Not included
Tris(methylphenyl) phosphate	1330-78-5	Flame retardant, plasticiser/softener, solvent	H	L			1B	1			8	x	No	No	No	Yes	Restricted for product class I-III
Lead sulfochromate yellow	1344-37-2	Pigment	M	L		1B	1A	1			7		Yes	Yes	Yes	Yes	Limitations for Cr VI and Pb
C.I. Fluorescent Brightener 393	1533-45-5	Fluorescent Brightener Agent	M	L				1			Unknown		No	No	No	No	Not included
Acetamide, N-[5-[bis[2-(acetylo1y)ethyl]amino]-2-[(2-chloro-4-nitrophenyl)azo]phenyl]-	1533-78-4	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Benzenemethanaminium, N-[4-[[4-(dimethylamino)phenyl][4-[ethyl[(3-sulfophenyl)methyl]amino]phenyl]methylene]-2,5-cyclohe1adien-1-ylidene]-N-ethyl-3-sulfo-, hydro1ide, inner salt, sodium salt	1694-09-3	Acid dyestuff	H	H		2					8		No	No	No	No	Not included
1H-Pyrazole-3-carbo1ylic acid, 4,5-dihydro-5-o1o-1-(4-sulfophenyl)-4-[(4-sulfophenyl)azo]-, trisodium salt	1934-21-0	Acid dyestuff	H	H			2	1			Unknown		No	No	No	No	Not included

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2,7-Naphthalenedisulfonic acid, 4-amino-3-[[4'-[(2,4-diaminophenyl)azo][1,1'-biphenyl]-4-yl]azo]-5-hydro1y-6-(phenylazo)-, disodium salt	1937-37-7	Direct dyestuff	H	H		1B	2				9		Yes	No	Yes	No	Not included
Octadecyl 3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate	2082-79-3	Antioxidant	M	L				1		SEv HH50	Unknown	x	No	No	No	No	Not included
Benzenamine, 2-methyl-4-[(2-methylphenyl)azo]-, monohydrochloride	2298-13-7	Azoic dyestuff	H	M		2					8		No	No	No	No	Not included
Propanamide, N-[2-[(2-bromo-6-cyano-4-nitrophenyl)azo]-5-(diethylamino)phenyl]-	2309-94-6	Disperse dyestuff	H	L		1B		1			9		No	No	No	No	Not included
C.I. Vat Red 1	2379-74-0	Vat dyestuff	H	L				1			Unknown		No	No	No	No	Not included
1-Naphthalenesulfonic acid, 3-[[4'-[(6-amino-1-hydro1y-3-sulfo-2-naphthalenyl)azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-4-hydro1y-, disodium salt	2429-72-3	Direct dyestuff	H	H		2		1			Unknown		No	No	Yes*4	No	Not included
2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimetho1y[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[5-amino-4-hydro1y-, tetrasodium salt	2429-74-5	Direct dyestuff	H	H	2	1B					8		No	No	Yes*4	No	Not included
Benzoic acid, 5-[[4'-[[2,6-diamino-3-[[8-hydro1y-3,6-disulfo-7-[(4-sulfo-1-naphthalenyl)azo]-2-naphthalenyl]azo]-5-methylphenyl]azo][1,1'-biphenyl]-4-yl]azo]-2-hydro1y-, tetrasodium salt	2429-81-4	Direct dyestuff	H	H		1B					8		No	No	Yes*4	No	Restricted
Benzoic acid, 5-[[4'-[(7-amino-1-hydro1y-3-sulfo-2-naphthalenyl)azo][1,1'-biphenyl]-4-yl]azo]-2-hydro1y-, disodium salt	2429-82-5	Direct dyestuff	H	H		1B					8		No	No	Yes*4	No	Restricted

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Benzoic acid, 5-[[4'-[(2-amino-8-hydro1y-6-sulfo-1-naphthalenyl)azo][1,1'-biphenyl]-4-yl]azo]-2-hydro1y-, disodium salt	2429-84-7	Direct dyestuff	H	H		1B					8		No	No	Yes*4	No	Restricted
Methanaminium, N-[4-[[4-(dimethylamino)phenyl]phenylmethylene]-2,5-cyclohe1adien-1-ylidene]-N-methyl-, ethanedioate, ethanedioate (2:2:1)	2437-29-8	Basic dyestuff	H	L			2	1			7		No	No	No	No	Not included
2-(2´-Hydroxy-5´-methylphenyl)-benzotriazole	2440-22-4	UV Stabiliser	H	L				1			Unknown	x	No	No	No	Yes	Not included
Benzenamine, 4,4'-carbonimidoylbis[N,N-dimethyl-, monohydrochloride	2465-27-2	Basic dyestuff	H	L		2					8		No	No	No	No	Not included
9,10-Anthracenedione, 1,4-diamino-, N,N'-mi1ed 2-hydro1yethyl and Me derivs.	2475-46-9	Disperse dyestuff	H	L				1			Unknown		No	No	No	No	Restricted
1,4-Benzenedisulfonic acid, 2-[[4-[[4-[[1-hydro1y-6-(phenylamino)-3-sulfo-2-naphthalenyl]azo]-1-naphthalenyl]azo]-6-sulfo-1-naphthalenyl]azo]-, tetrasodium salt	2503-73-3	Direct dyestuff	H	H							6		No	No	No	No	Not included
Acetamide, N-[2-[(2-bromo-6-cyano-4-nitrophenyl)azo]-5-(diethylamino)phenyl]-	2537-62-4	Disperse dyestuff	H	L				1			6		No	No	No	No	Not included
Methanaminium, N-[4-[[4-(dimethylamino)phenyl][4-(phenylamino)-1-naphthalenyl]methylene]-2,5-cyclohe1adien-1-ylidene]-N-methyl-, chloride	2580-56-5	Basic dyestuff	H	L	2	1B					8		Yes	No	No	No	Not included
2-(3-(4-amino-9,10-dihydro-3-sulpho-9,10-dioxoanthracen-4-yl)aminobenzenesulphonyl)vinyl) disodium sulphate	2580-78-1	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Benzenamine, 4-[(4-nitrophenyl)azo]-N-phenyl-	2581-69-3	Disperse dyestuff	H	L				1			6		No	No	No	No	Restricted
Benzoic acid, 5-[[4'-[[2,6-diamino-3-methyl-5-[(4-sulfophenyl)azo]phenyl]azo][1,1'-biphenyl]-4-yl]azo]-2-hydro1y-, disodium salt	2586-58-5	Direct dyestuff	H	H							6		No	No	Yes*4	No	Not included
2,7-Naphthalenedisulfonic acid, 3,3'-[[1,1'-biphenyl]-4,4'-diylbis(azo)]bis[5-amino-4-hydro1y-, tetrasodium salt	2602-46-2	Direct dyestuff	H	H		1B	2				8		No	No	Yes	No	Restricted
1,3-Naphthalenedisulfonic acid, 6,6'-[(3,3'-dimetho1y[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[4-amino-5-hydro1y-, tetrasodium salt	2610-05-1	Direct dyestuff	H	H		1B					8		No	No	Yes*4	No	Not included
Dibutyltin bis(2-ethylhexanoate)	2781-10-4	UV Stabiliser	H	L	2		1B	1			8		No	No	No	Yes	Not included
C.I. Pigment Red 170	2786-76-7	Pigment	H	L				1		SEv HH36	Unknown	x	No	No	No	Yes	Not included
Acetamide, N-[4-[(2-hydro1y-5-methylphenyl)azo]phenyl]-	2832-40-8	Disperse dyestuff	H	L		2		1			Unknown		No	No	No	No	Restricted
1-Naphthalenesulfonic acid, 3,3'-[(3,3'-dimetho1y[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[4-amino-, disodium salt	2868-75-9	Direct dyestuff	H	H							6		No	No	Yes*4	No	Not included
Benzoic acid, 5-[[4'-[[2,4-dihydro1y-3-[(4-sulfophenyl)azo]phenyl]azo][1,1'-biphenyl]-4-yl]azo]-2-hydro1y-, disodium salt	2893-80-3	Direct dyestuff	H	H		1B					8		No	No	Yes*4	No	Not included
2,9-bis[4-(phenylazo)phenyl]anthra[2,1,9-def:6,5,10-d'e'f']diisoquinoline-1,3,8,10(2H,9H)-tetrone	3049-71-6	Pigment	H	L							6		No	No	No	Yes	Not included
N,N'-bis(1,4-dimethylpentyl)-1,4-benzenediamine	3081-14-9	Stabiliser	M	L				1			Unknown		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Ethanol, 2,2'-[[3-methyl-4-[(4-nitrophenyl)azo]phenyl]imino]bis-	3179-89-3	Disperse dyestuff	H	L				1			8		No	No	No	No	Restricted
Dibutoxydibutylstannane	3349-36-8	Stabiliser	M	L	2		1B	1		SEv HH36	Unknown		No	No	No	Yes	Restricted as DBT
1-Naphthalenesulfonic acid, 8-(phenylamino)-5-[[4-[(3-sulfophenyl)azo]-1-naphthalenyl]azo]-, disodium salt	3351-05-1	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
Triclosan	3380-34-5	Biocide	M	L							9	x	No	No	No	Yes	Not included
Acetamide, N-[5-[bis[2-(acetylo1y)ethyl]amino]-2-[(2-bromo-4,6-dinitrophenyl)azo]-4-metho1yphenyl]-	3618-72-2	Disperse dyestuff	H	L							6		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 4-amino-5-hydro1y-3-[[4'-[(4-hydro1yphenyl)azo][1,1'-biphenyl]-4-yl]azo]-6-(phenylazo)-, disodium salt	3626-28-6	Direct dyestuff	H	H							6		No	No	Yes*4	No	Not included
2,7-Naphthalenedisulfonic acid, 4-hydro1y-3-[[4'-[(2-hydro1y-1-naphthalenyl)azo]-2,2'-dimethyl[1,1'-biphenyl]-4-yl]azo]-, disodium salt	3701-40-4	Acid dyestuff	H	H							6		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 4-[(2,4-dimethylphenyl)azo]-3-hydro1y-, disodium salt	3761-53-3	Acid dyestuff	H	H	2	2					8		No	No	Yes*4	No	Restricted
Propanenitrile, 3,3'-[[4-[(2-chloro-4-nitrophenyl)azo]phenyl]imino]bis-	4058-30-4	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 4-amino-5-hydro1y-6-[[4'-[(4-hydro1yphenyl)azo][1,1'-biphenyl]-4-yl]azo]-3-[(4-nitrophenyl)azo]-, disodium salt	4335-09-5	Direct dyestuff	H	H		1B					9		No	No	Yes*4	No	Restricted
C.I. Acid Green 25	4403-90-1	Acid dyestuff	H	H				1			Unknown		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Benzenesulfonic acid, 3,3'-[(9,10-dihydro-9,10-dio1o-1,4-anthracenediyl)diimino]bis[2,4,6-trimethyl-, disodium salt	4474-24-2	Acid dyestuff	H	H							6		No	No	No	No	Not included
2,6,10-Dodecatrien-1-ol, 3,7,11-trimethyl-	4602-84-0	Fragrance	M	H				1			2.5		No	No	No	No	Restricted as fragrance
Stannane, dibutylbis[(1-o1ooctyl)o1y]-	4731-77-5	Stabiliser	H	L	2		1B				8		No	No	No	No	Restricted as DBT/DOT
Benzenepropanol, .beta.-methyl-4-(1-methylethyl)-	4756-19-8	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Benzenesulfonamide, 3-nitro-N-phenyl-4-(phenylamino)-	5124-25-4	Disperse dyestuff	H	L				1			6		No	No	No	No	Not included
Propanenitrile, 3-[[2-(acetylo1y)ethyl][4-[(2,6-dichloro-4-nitrophenyl)azo]phenyl]amino]-	5261-31-4	Disperse dyestuff	H	L				1			6		No	No	No	No	Not included
N-(4-chloro-2,5-dimethoxyphenyl)-3-hydroxy-4-[[2-methoxy-5-[(phenylamino)carbonyl]phenyl]azo]naphthalene-2-carboxamide	5280-68-2	Pigment	M	L				1		SEv HH36	6		No	No	No	Yes	Not included
Citral	5392-40-5	Fragrance	M	H				1			Unknown		No	No	No	Yes	Restricted as fragrance
1,3-Naphthalenedisulfonic acid, 7-hydro1y-8-[[4-(phenylazo)phenyl]azo]-, disodium salt	5413-75-2	Acid dyestuff	H	H		2					8		No	No	Yes*4	No	Not included
Pigment Yellow 14	5468-75-7	Pigment	H	L				1			Unknown		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
2,2'-[(3,3'-dichloro[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[N-(4-chloro-2,5-dimethoxyphenyl)-3-oxobutyramide]	5567-15-7	Pigment	H	L							6		No	No	No	Yes	Not included
Stannane, dibutylbis[(1-o1ooctadecyl)o1y]-	5847-55-2	Stabiliser	M	L	2		1A				8		No	No	No	No	Restricted as DBT/DOT
(R)-p-mentha-1,8-diene	5989-27-5	Fragrance	M	H				1			8	x	No	No	No	Yes	Restricted as fragrance
Benzenamine, 4-[(4-aminophenyl)azo]-2-metho1y-5-methyl-	6232-57-1	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Not included
Phenol, 4-[[4-(phenylazo)phenyl]azo]-	6250-23-3	Disperse dyestuff	H	L							6		No	No	No	No	Restricted
Phenol, 2-methyl-4-[[4-(phenylazo)phenyl]azo]-	6300-37-4	Disperse dyestuff	H	L							6		No	No	Yes*4	No	Not included
1,3-Naphthalenedisulfonic acid, 8-[[4'-[(4-etho1yphenyl)azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-7-hydro1y-, disodium salt	6358-29-8	Direct dyestuff	H	H		1B					8		No	No	Yes*4	No	Not included
2,7-Naphthalenedisulfonic acid, 3-[[2,2'-dimethyl-4'-[[4-[[(4-methylphenyl)sulfonyl]o1y]phenyl]azo][1,1'-biphenyl]-4-yl]azo]-4-hydro1y-, disodium salt	6358-57-2	Acid dyestuff	H	H							6		No	No	No	No	Not included
1,4-Benzenediamine, N-(2,4-dinitrophenyl)-	6373-73-5	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Restricted
Benzenesulfonic acid, 5-[(2,4-dinitrophenyl)amino]-2-(phenylamino)-, monosodium salt	6373-74-6	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
[1,1'-Biphenyl]-2,2'-disulfonic acid, 4,4'-bis[(4,5-dihydro-3-methyl-5-o1o-1-phenyl-1H-pyrazol-4-yl)azo]-, disodium salt	6375-55-9	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Benzoic acid, 5-[[4'-[[4,5-dihydro-3-methyl-5-o1o-1-(4-sulfophenyl)-1H-pyrazol-4-yl]azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-2-hydro1y-, disodium salt	6420-03-7	Direct dyestuff	H	H		1B					8		No	No	No	No	Not included
C.I. Direct Violet 28	6420-06-0	Direct dyestuff	H	H							6		No	No	No	No	Not included
2-Naphthalenesulfonic acid, 4-hydro1y-7-[[[[5-hydro1y-6-[(2-metho1yphenyl)azo]-7-sulfo-2-naphthalenyl]amino]carbonyl]amino]-3-[(2-methyl-4-sulfophenyl)azo]-, trisodium salt	6420-44-6	Direct dyestuff	H	H							6		No	No	Yes*4	No	Not included
C.I. Direct Violet 32	6428-94-0	Direct dyestuff	H	H							6		No	No	No	No	Not included
Pigment red 22	6448-95-9	Pigment	H	L	2			1			Unknown		No	No	No	No	Not included
1,3-Naphthalenedisulfonic acid, 8-[[3,3'-dimethyl-4'-[[4-[[(4-methylphenyl)sulfonyl]o1y]phenyl]azo][1,1'-biphenyl]-4-yl]azo]-7-hydro1y-, disodium salt	6459-94-5	Acid dyestuff	H	H		1B					8		No	No	Yes*4	No	Not included
2-Naphthalenesulfonic acid, 6-[(2,4-diaminophenyl)azo]-3-[[4-[[4-[[7-[(2,4-diaminophenyl)azo]-1-hydro1y-3-sulfo-2-naphthalenyl]azo]phenyl]amino]-3-sulfophenyl]azo]-4-hydro1y-, trisodium salt	6473-13-8	Direct dyestuff	H	H							6		No	No	No	No	Not included
2-Naphthalenesulfonic acid, 3,3'-[cyclohe1ylidenebis[(2-methyl-4,1-phenylene)azo]]bis[4,6-dihydro1y-, disodium salt	6507-79-5	Acid dyestuff	H	H							6		No	No	No	No	Not included
2,9-Triphenodioxazinedisulfonic acid, 6,13-dichloro-3,10-bis(phenylamino)-, disodium salt	6527-70-4	Direct dyestuff	H	H		2					8		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
C.I. pigment red 112	6535-46-2	Pigment	H	L	2			1		SEv HH36	Unknown		No	No	No	Yes	Not included
Benzoic acid, 5-[[4'-[(2,6-diamino-3-methyl-5-sulfophenyl)azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-2-hydro1y-, disodium salt	6637-88-3	Direct dyestuff	H	H							6		No	No	Yes*4	No	Restricted
4-[(2,5-dichlorophenyl)azo]-N-(2,3-dihydro-2-oxo-1H-benzimidazol-5-yl)-3-hydroxynaphthalene-2-carboxamide	6992-11-6	Pigment	H	L							6		No	No	No	Yes	Not included
Lead	7439-92-1	Pigment, stabiliser	M	L	2	2	1A				Unknown	x	No	No	Yes	Yes	Limitations for Pb
Lead sulphate	7446-14-2	Pigment	M	L			1A				Unknown		No	No	Yes	Yes	Limitations for Pb
1H-Indene-1,3(2H)-dione, 2-(3-hydro1y-2-quinolinyl)-	7576-65-0	Disperse dyestuff	H	L	2	2		1			8		No	No	No	No	Not included
Chromic acid, lead(2+) salt (1:1)	7758-97-6	Pigment	M	L		1B	1A				7		Yes	Yes	Yes	No	Limitations for Cr VI and Pb
Sodium chromate	7775-11-3	Pigment, mordant dyestuff	M	M	1B	1B	1B	1			7		Yes	Yes	No	Yes	Restricted
Potassium dichromate	7778-50-9	Pigment, mordant dyestuff	M	M	1B	1B	1B	1			7		Yes	Yes	No	Yes	Not included
2-Naphthalenesulfonic acid, 5(or 8)-[[3-methyl-4-[[(4-methylphenyl)sulfonyl]o1y]phenyl]azo]-8(or 5)-[[4-[(4-nitro-2-sulfophenyl)amino]phenyl]azo]-, disodium salt	8003-88-1	Acid dyestuff	H	H							6		No	No	No	No	Not included
C.I. Basic Violet 1	8004-87-3	Basic dyestuff	H	L		2					8		No	No	No	No	Not included
Pyrochlore, antimony lead yellow	8012-00-8	Pigment	M	M			1A				Unknown		Yes	No	Yes	Yes	Limitations as Pb and Sb

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Oils, costus	8023-88-9	Fragrance, softener	M	M				1			Unknown		No	No	No	No	Restricted as fragrance
Oils, verbena	8024-12-2	Fragrance, softener	M	M				1			Unknown		No	No	No	No	Restricted as fragrance
1,3,5-Triazine-2,4,6-triamine, polymer with formaldehyde	9003-08-1	Resins	H	M				1			Unknown		No	No	No	No	Not included
Urea, polymer with formaldehyde	9011-05-6	Resins	H	M				1			Unknown		No	No	No	No	Not included
Lead dinitrate	10099-74-8	Stabiliser, PA, PE	H	L			1A				Unknown		Yes	No	No	Yes	Limitations for Pb
[1,1'-Biphenyl]-2,2'-disulfonic acid, 4,4'-bis[(2-hydro1y-1-naphthalenyl)azo]-, disodium salt	10169-02-5	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
1H-Indene-1,3(2H)-dione, 2-(4-bromo-3-hydro1y-2-quinolinyl)-	10319-14-9	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Sodium dichromate	10588-01-9	Mordant dyestuff	M	M	1B	1B	1B	1			7		Yes	Yes	No	Yes	Limitations for CrVI
Pentalead tetraoxide sulphate	12065-90-6	Stabiliser	H	L			1A				Unknown		Yes	No	Yes	No	Limitations for Pb
Trilead dioxide phosphonate	12141-20-7	Stabiliser	H	L			1A				Unknown		Yes	No	Yes	No	Limitations for Pb
Tetralead trioxide sulphate	12202-17-4	Stabiliser	H	L			1A				Unknown		Yes	No	Yes	No	Limitations for Pb
C.I. Disperse Blue 35	12222-75-2	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Restricted
Copper, 5-(acetylamino)-4-hydro1y-3-[[2-hydro1y-4-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]azo]-2,7-naphthalenedisulfonic acid comple1	12226-38-9	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included

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Acetamide, N-[5-[bis[2-(acetylo1y)ethyl]amino]-2-[(2-bromo-4,6-dinitrophenyl)azo]-4-etho1yphenyl]-	12239-34-8	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Chromate(3-), bis[3-hydro1y-4-[(2-hydro1y-1-naphthalenyl)azo]-1-naphthalenesulfonato(3-)]-, disodium hydrogen	12392-64-2	Acid dyestuff	H	H				1			6		No	No	No	Yes	Not included
Dioxobis(stearato)trilead	12578-12-0	Stabiliser	H	L			1A				9		Yes	No	Yes	Yes	Not included
Lead chromate molybdate sulfate red	12656-85-8	Pigment	M	L		1B	1A	1			7		Yes	Yes	Yes	Yes	Limitations for Pb
Propanenitrile, 3-[[4-[(2,6-dichloro-4-nitrophenyl)azo]phenyl]ethylamino]-	13301-61-6	Disperse dyestuff	H	L				1			6		No	No	No	No	Restricted
Stannane, dibutylbis[(1-o1o-9-octadecenyl)o1y]-, (Z,Z)-	13323-62-1	Stabiliser	H	L	2		1A				8		No	No	No	No	Restricted as DBT/DOT
Stannane, dibutylbis[(1-oxohexadecyl)oxy]-	13323-63-2	Stabiliser	H	L	2		1A				8		No	No	No	No	Restricted as DBT/DOT
Tetradecahydro-7-isopropyl-1,4a-dimethylphenanthren-1-methanol	13393-93-6	Fragrance	M	H				1		SEv HH36	2.5		No	No	No	Yes	Restricted as fragrance
Titanium dioxide	13463-67-7	pigment	M	L		1B					Unknown		No	No	No	No	Not included
Tris[2-chloro-1-(chloromethyl)ethyl] phosphate	13674-87-8	Flame retardant	H	M		2					8	x	No	No	No	Yes	Restricted
9,10-Anthracenedione, 1,5-diamino-4,8-dihydro1y-2-(4-metho1yphenyl)-	13698-89-0	Disperse dyestuff	H	L							6		No	No	No	No	Not included
2,3-He1anedione, 5-methyl-	13706-86-0	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance

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1,2-Benzenedicarbo1ylic acid, 3,4,5,6-tetrabromo-	13810-83-8	flame retardant	M	L							6		No	No	No	No	Restricted for product class I-III
Cuprate(4-), [3-[[8-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]-1-hydro1y-3,6-disulfo-2-naphthalenyl]azo]-4-hydro1y-1,5-naphthalenedisulfonato(6-)]-, tetrasodium	14692-76-3	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Ethanol, 2-[ethyl[3-methyl-4-[(5-nitro-2-thiazolyl)azo]phenyl]amino]-, acetate (ester)	15141-18-1	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Restricted
Methyl (Z,Z)-8,8-dibutyl-3,6,10-trioxo-2,7,9-trioxa-8-stannatrideca-4,11-dien-13-oate	15546-11-9	Stabiliser	H	L	2		1B	1			Unknown		No	No	No	Yes	Restricted as DBT/DOT
5,7,12-Trioxa-6-stannahexadeca-2,9-dienoic acid, 6,6-dibutyl-4,8,11-trioxo-, butyl ester, (Z,Z)-	15546-16-4	Stabiliser	H	L							8		No	No	No	No	Restricted as DBT/DOT
Cuprate(2-), [5-[[4'-[[2,6-dihydro1y-3-[(2-hydro1y-5-sulfophenyl)azo]phenyl]azo][1,1'-biphenyl]-4-yl]azo]-2-hydro1ybenzoato(4-)]-, disodium	16071-86-6	Direct dyestuff	H	H		1B					8		No	No	Yes	No	Not included
Dipotassium hexafluorotitanate	16919-27-0	Flame retardant	H	M				1		SEv HH62; SEv HH50	Unknown		No	No	No	No	Restricted for product class I-III
Dipotassium hexafluorozirconate	16923-95-8	Flame retardant	H	M						SEv HH62; SEv HH50	Unknown		No	No	No	No	Restricted for product class I-III
Tetrasodium 4-amino-5-hydroxy-3,6-bis[[4-[[2-(sulphonatooxy)ethyl]sulphonyl]phenyl]azo]naphthalene-2,7-disulphonate	17095-24-8	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
9,10-Anthracenedione, 1-amino-4-hydro1y-2-pheno1y-	17418-58-5	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
C.I. Reactive Red 2	17804-49-8	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
2-Hexene, 1,1-dimetho1y-, (E)-	18318-83-7	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
2,2-(1,4-Fenylen)bis((4H-3,1-benzoxazin-4-on)	18600-59-4	UV Stabiliser	H	L				1			Unknown		No	No	No	No	Not included
2-Heptenal, (E)-	18829-55-5	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Phenol, 4-[[2-metho1y-4-[(4-nitrophenyl)azo]phenyl]azo]-	19800-42-1	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Dimethyl [3-[(hydroxymethyl)amino]-3-oxopropyl]phosphonate	20120-33-6	Flame retardant precursor	H	L				1			Unknown		No	No	No	No	Restricted for product class I-III
9,10-Anthracenedione, 1,8-dihydro1y-4-nitro-5-(phenylamino)-	20241-76-3	Disperse dyestuff	H	L				1			6		No	No	No	No	Not included
Disodium 6-acetamido-4-hydroxy-3-[[4-[[2-(sulphonatooxy)ethyl]sulphonyl]phenyl]azo]naphthalene-2-sulphonate	20262-58-2	Reactive dyestuff	H	L				1		SEv HH36; SEv HH38	2.5		No	No	No	No	Not included
[1,1'-Biphenyl]-4,4'-bis(diazonium), 3,3'-dimethoxy-	20282-70-6	Azoic dyestuff	H	M		2					8		No	No	No	No	Not included
2,2'-[(2,2',5,5'-tetrachloro[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[N-(2,4-dimethylphenyl)-3-oxobutyramide]	22094-93-5	Pigment	H	L							6		No	No	No	Yes	Not included
Ethanol, 2,2'-[[3-chloro-4-[(2,6-dichloro-4-nitrophenyl)azo]phenyl]imino]bis-	23355-64-8	Disperse dyestuff	H	L				1			6		No	No	No	No	Restricted
Acetamide, N-[2-[(2-cyano-4,6-dinitrophenyl)azo]-5-(diethylamino)phenyl]-	24170-60-3	Disperse dyestuff	H	L							6		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Formaldehyde, polymer with 4-(1,1-dimethylethyl)phenol	25085-50-1	Resins	H	M				1			Unknown		No	No	No	No	Not included (limit on formaldehyde)
Trixylyl phosphate	25155-23-1	flame retardant	M	M			1B	1			6		Yes	No	No	Yes	Restricted
Hexabromocyclododecane	25637-99-4	Flame retardant, Plasticiser	H	L			2			SEv HH31; SEv HH67	9		Yes	Yes	No	Yes	Restricted
Benzenesulfonic acid, 4-[4,5-dihydro-4-[[2-metho1y-5-methyl-4-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]azo]-3-methyl-5-o1o-1H-pyrazol-1-yl]-, disodium salt	25664-81-7	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
2-Anthracenesulfonic acid, 1-amino-9,10-dihydro-4-[5-[(2-hydro1yethyl)sulfamoyl]-3,4-1ylidino]-9,10-dio1o-, monosodium salt	25797-81-3	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
2-Anthracenesulfonic acid, 4,4'-[methylenebis(4,1-phenyleneimino)]bis[1-amino-9,10-dihydro-9,10-dio1o-, disodium salt	25826-34-0	Acid dyestuff	H	H							6		No	No	No	No	Not included
2-(2H-Bensotriazol-2-yl)-4,6-bis(1,1-dimetylpropyl)fenol	25973-55-1	UV Stabiliser	M	L						SEv HH62	Unknown	x	No	No	No	No	Not included
4,6,10-Dodecatrien-3-one, 7,11-dimethyl-	26651-96-7	Fragrance	M	H				1			2.5		No	No	No	No	Restricted as fragrance
Ethanesulfonic acid, 2-[[4-[3-(4-chlorophenyl)-4,5-dihydro-1H-pyrazol-1-yl]phenyl]sulfonyl]-, sodium salt	27441-70-9	Pigment, optical brightener	H	L				1			Unknown		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
1H-Pyrazolium, 1,5-dimethyl-3-[(2-methyl-1H-indol-3-yl)azo]-2-phenyl-, methyl sulfate	29508-48-3	Basic dyestuff	H	L							6		No	No	No	No	Not included
Benzonitrile, 2-[[4-[bis[2-(acetylo1y)ethyl]amino]phenyl]azo]-5-nitro-	30124-94-8	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Not included
9,10-Anthracenedione, 1,5-diamino-4,8-dihydro1y(4-metho1yphenyl)-	31288-44-5	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Propanenitrile, 3-[ethyl[4-[(4-nitrophenyl)azo]phenyl]amino]-	31482-56-1	Disperse dyestuff	H	L							6		No	No	No	No	Not included
9,10-Anthracenedione, 1,5-diaminobromo-4,8-dihydro1y-	31810-89-6	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Not included
3-Cyclohexene-1-carbo1aldehyde, 4-(4-hydro1y-4-methylpentyl)-	31906-04-4	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Benzene, 1,1'-o1ybis-, pentabromo deriv.	32534-81-9	Flame retardant	M	L							9		No	No	No	No	Restricted
Benzene, 1,1'-o1ybis-, octabromo deriv.	32536-52-0	Flame retardant	M	L			1B				10	x	No	No	Yes	No	Restricted
1,3,6-Naphthalenetrisulfonic acid, 7-[[2-[(aminocarbonyl)amino]-4-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]phenyl]azo]-	35642-64-9	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
4-[[4-(aminocarbonyl)phenyl]azo]-3-hydroxy-N-(2-methoxyphenyl)naphthalene-2-carboxamide	36968-27-1	Pigment	M	L	2			1		SEv HH36	9		No	No	No	Yes	Not included
Propanenitrile, 3-[[2-(benzoylo1y)ethyl][4-[(4-nitrophenyl)azo]phenyl]amino]-	40690-89-9	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Di(1,2,2,6,6-pentamethyl-4-piperidinyl) decanedioate	41556-26-7	UV Stabiliser	H	L				1			Unknown		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Chromate(1-), bis[2-[(4,5-dihydro-3-methyl-5-o1o-1-phenyl-1H-pyrazol-4-yl)azo]benzoato(2-)]-, sodium	41741-86-0	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
Pentazinc chromate octahydroxide	49663-84-5	Pigment	M	L	2	1A	2	1			Unknown		Yes	No	No	No	Limitations for Cr VI
Chromate(1-), bis[2-(3-chlorophenyl)-2,4-dihydro-4-[[2-hydro1y-5-(methylsulfonyl)phenyl]azo]-5-methyl-3H-pyrazol-3-onato(2-)]-, sodium	51147-75-2	Acid dyestuff	H	H				1			2.5		No	No	No	No	Limitations for Cr VI
Acetic acid, lead salt, basic	51404-69-4	Pigment, mordant dyestuff	M	M		2	1A				Unknown		Yes	No	Yes	No	Limitations for Pb
Acetamide, N-[2-[(2-bromo-4,6-dinitrophenyl)azo]-5-(di-2-propenylamino)-4-metho1yphenyl]-	51868-46-3	Disperse dyestuff	H	L				1			6		No	No	No	No	Not included
C.I. Disperse Blue 148	52239-04-0	Disperse dyestuff	H	L							6		No	No	No	No	Not included
2-Naphthalenesulfonic acid, 5,5'-[(1-methylethylidene)bis(4,1-phenyleneo1ysulfonyl-2,1-phenyleneazo)]bis[6-amino-4-hydro1y-, disodium salt	52333-30-9	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
Chromate(2-), [3-[(4,5-dihydro-3-methyl-5-o1o-1-phenyl-1H-pyrazol-4-yl)azo]-4-hydro1ybenzenesulfonato(3-)][1-[[2-hydro1y-5-(phenylazo)phenyl]azo]-2-naphthalenolato(2-)]-, disodium	52587-68-5	Acid dyestuff	H	H				1			2.5		No	No	No	No	Limitations for Cr VI
Acetamide, N-[2-[(2-bromo-4,6-dinitrophenyl)azo]-5-(diethylamino)phenyl]-	52697-38-8	Disperse dyestuff	H	L				1			6		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Cuprate(4-), [4-hydro1y-7-[[4-[(2-hydro1yethyl)amino]-6-[[5-hydro1y-6-[(2-hydro1y-5-sulfophenyl)azo]-7-sulfo-2-naphthalenyl]amino]-1,3,5-triazin-2-yl]amino]-3-[(4-metho1y-2-sulfophenyl)azo]-2-naphthalenesulfonato(6-)]-, tetrasodium	52953-36-3	Direct dyestuff	H	L							6		No	No	No	No	Not included
Propanenitrile, 3-[[4-[(2,6-dibromo-4-nitrophenyl)azo]phenyl]ethylamino]-	55281-26-0	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Tetrakis(hydroxymethyl)phosphonium sulphate(2:1)	55566-30-8	Flame retardant, cellulose	H	M			1B	1			Unknown		No	No	No	Yes	Restricted for product class I-III
Acetamide, N-[2-[(2-bromo-4,6-dinitrophenyl)azo]-5-(diethylamino)-4-metho1yphenyl]-	56548-64-2	Disperse dyestuff	H	L				1			6		No	No	No	No	Not included
Trisodium bis[3-hydroxy-4-[(2-hydroxy-1-naphthyl)azo]-7-nitronaphthalene-1-sulphonato(3-)]chromate(3-)	57693-14-8	Acid dyestuff	H	H				1		SEv HH36	2.5		No	No	No	Yes	Not included
Acetamide, N-[5-(diethylamino)-2-[(3,5-dinitro-2-thienyl)azo]phenyl]-	58979-46-7	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Not included
methyl N-[4-[(2-bromo-6-chloro-4-nitrophenyl)azo]phenyl]-N-(3-methoxy-3-oxopropyl)-beta-alaninate	59709-38-5	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Resin acids and Rosin acids, sodium salts	61790-51-0	Resins	M	M				1		SEv HH67; SEv HH62	Unknown		No	No	No	No	Not included
C.I. Disperse Blue 124	61951-51-7	Disperse dyestuff	H	L				1			Unknown		No	No	No	No	Restricted

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data available	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
2,7-Naphthalenedisulfonic acid, 4,4'[1,4-phenylenebis[imino(6-chloro-1,3,5-triazine-4,2-diyl)imino]]bis[5-hydro1y-6-[(2-sulfophenyl)azo]-	61951-82-4	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
C.I. Disperse Red 167	61968-52-3	Disperse dyestuff	H	L							6		No	No	No	No	Not included
C.I. Reactive	61968-93-2	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Sulfurous acid, lead salt, dibasic	62229-08-7	pigment	H	L			1A				Unknown		Yes	No	Yes	No	Limitations for Pb
Siloxanes and Silicones, di-Me	63148-62-9	Water repellent, softener	M	M			2				8		No	No	No	No	Not included
3-Pyridinecarbonitrile, 5-[(2-cyano-4-nitrophenyl)azo]-6-[(2-hydro1yethyl)amino]-4-methyl-2-[[3-(2-pheno1yetho1y)propyl]amino]-	63833-78-3	Disperse dyestuff	H	L				1			6		No	No	No	No	Not included
2-Naphthalenesulfonic acid, 7-[[4-chloro-6-[(3-sulfophenyl)amino]-1,3,5-triazin-2-yl]amino]-4-hydro1y-3-[(4-metho1y-2-sulfophenyl)azo]-, trisodium salt	64181-81-3	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Benzoic acid, 5-[[4'-[[2,6-diamino-3-methyl-5-[(4-sulfophenyl)azo]phenyl]azo]-3,3'-dimethyl[1,1'-biphenyl]-4-yl]azo]-2-hydro1y-, disodium salt	64743-15-3	Direct dyestuff	H	H							6		No	No	Yes*4	No	Not included
2-Naphthalenecarbo1amide, 4-[(4-chloro-2-methylphenyl)azo]-N-(2-etho1yphenyl)-3-hydro1y-	65907-69-9	Disperse dyestuff	H	L							6		No	No	No	No	Not included
Acetamide, N-[2-[(2-chloro-4,6-dinitrophenyl)azo]-5-(diethylamino)phenyl]-	66557-45-7	Disperse dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Acetamide, N-[2-[(2-bromo-4,6-dinitrophenyl)azo]-5-(ethylamino)-4-metho1yphenyl]-	67674-22-0	Disperse dyestuff	H	L							6		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
2-Hexene, 1,1-dietho1y-, (E)-	67746-30-9	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Propanenitrile, 3,3'-[[4-[(2,6-dichloro-4-nitrophenyl)azo]phenyl]imino]bis-	67923-43-7	Disperse dyestuff	H	L							6		No	No	No	No	Not included
1,3-Naphthalenedisulfonic acid, 7-[[2-(acetylamino)-4-[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]phenyl]azo]-, disodium salt	68155-62-4	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 4-amino-6-[[5-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]-2-sulfophenyl]azo]-3-[(2,5-disulfophenyl)azo]-5-hydro1y-, pentasodium salt	68259-02-9	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
1,2-Benzenedicarbo1ylic acid, di-C7-11-alkyl esters, branched and linear	68515-42-4	Plasticiser	M	M			1B				2.5		Yes	No	No	No	Restricted
1,2-Benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich	68515-48-0	Plasticiser	H	M			2			SEv HH23; SEv HH24; SEv HH28; SEv HH62	8		No	No	Yes	Yes	*Restricted from 2015*
Ethanol, 2-[ethyl[3-methyl-4-[(5-nitro-2-thiazolyl)azo]phenyl]amino]-	68516-81-4	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Restricted
Chromate(2-), [4-hydro1y-3-[(2-hydro1y-4-nitrophenyl)azo]-1-naphthalenesulfonato(3-)][1-[(2-hydro1y-4-nitrophenyl)azo]-2-naphthalenolato(2-)]-, disodium	68541-71-9	Acid dyestuff	H	H				1			2.5		No	No	No	No	Limitations for Cr VI
Oils, fig-leaf	68916-52-9	Fragrance	M	H				1			2.5		No	No	No	No	Restricted as fragrance

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
2-Naphthalenesulfonic acid, 7-[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]-4-hydro1y-3-[(4-metho1y-2-sulfophenyl)azo]-, disodium salt	68959-17-1	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
[Phthalato(2-)]dioxotrilead	69011-06-9	Stabiliser	M	L			1A				Unknown		Yes	No	No	No	Limitations for Pb
Cuprate(3-), [7-[[4-[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]-2-hydro1yphenyl]azo]-8-hydro1y-1,3,6-naphthalenetrisulfonato(5-)]-, trisodium	69121-25-1	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
1,3,6-Naphthalenetrisulfonic acid, 7-[[2-[(aminocarbonyl)amino]-4-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]phenyl]azo]-, trisodium salt	70161-14-7	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
1,4-Benzenedisulfonic acid, 2-[[4-[[4-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]-5-sulfo-1-naphthalenyl]azo]-7-sulfo-1-naphthalenyl]azo]-, tetrasodium salt	70161-16-9	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
2-Anthracenesulfonic acid, 1-amino-4-[[3-[[(chloroacetyl)amino]methyl]-2,4,6-trimethylphenyl]amino]-9,10-dihydro-9,10-dio1o-, monosodium salt	70209-96-0	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 5-[[4-[(2-bromo-1-o1o-2-propenyl)amino]benzoyl]amino]-3-[[5-[(2-bromo-1-o1o-2-propenyl)amino]-2-sulfophenyl]azo]-4-hydro1y-, trisodium salt	70210-00-3	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
1,4-Benzenedisulfonic acid, 2-[[4-[[4-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]-5-sulfo-1-naphthalenyl]azo]-2,5-dimethylphenyl]azo]-, trisodium salt	70210-13-8	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 5-[[4-chloro-6-(methylphenylamino)-1,3,5-triazin-2-yl]amino]-4-hydro1y-3-[(2-sulfophenyl)azo]-, trisodium salt	70210-20-7	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
2-Naphthalenesulfonic acid, 5-[[4-[(2-bromo-1-o1o-2-propenyl)amino]-2-sulfophenyl]azo]-4-hydro1y-6-(methylamino)-, disodium salt	70210-39-8	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
2-Naphthalenesulfonic acid, 6-amino-5-[[4-[(2-bromo-1-o1o-2-propenyl)amino]-2-sulfophenyl]azo]-4-hydro1y-, disodium salt	70210-40-1	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
2-Anthracenesulfonic acid, 1-amino-4-[[3-[(2,3-dibromo-1-o1opropyl)amino]-2,4,6-trimethyl-5-sulfophenyl]amino]-9,10-dihydro-9,10-dio1o-, disodium salt	70210-42-3	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Chromium, [3-hydro1y-4-[(2-hydro1y-1-naphthalenyl)azo]-7-nitro-1-naphthalenesulfonato(3-)]-	70236-49-6	Metal complex dyestuff	H	L				1			2.5		No	No	No	No	Limitations for Cr VI
Chromate(2-), [3-[4,5-dihydro-4-[(2-hydro1y-5-nitrophenyl)azo]-3-methyl-5-o1o-1H-pyrazol-1-yl]benzenesulfonato(3-)][1-[[2-hydro1y-5-(phenylazo)phenyl]azo]-2-naphthalenolato(2-)]-, disodium	70236-62-3	Acid dyestuff	H	H				1			2.5		No	No	No	No	Limitations for Cr VI

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Benzenesulfonic acid, 4-chloro-3-[4-[[2-[(2-chloropheno1y)sulfonyl]phenyl]azo]-2,5-dihydro-5-imino-3-methyl-1H-pyrazol-1-yl]-, monosodium salt	70247-68-6	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Benzenesulfonic acid, 4-[4-[[5-[(2-bromo-1-o1o-2-propenyl)amino]-2-sulfophenyl]azo]-4,5-dihydro-3-methyl-5-o1o-1H-pyrazol-1-yl]-2,5-dichloro-, disodium salt	70247-70-0	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
C.I. Reactive orange 13	70616-89-6	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
1,5-Naphthalenedisulfonic acid, 2-[[6-[(4,6-dichloro-1,3,5-triazin-2-yl)methylamino]-1-hydro1y-3-sulfo-2-naphthalenyl]azo]-, trisodium salt	70616-90-9	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Chromate(5-), bis[5-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]-4-hydro1y-3-[(2-hydro1y-5-nitrophenyl)azo]-2,7-naphthalenedisulfonato(4-)]-, tetrasodium hydrogen	70776-54-4	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Limitations for Cr VI
Cobaltate(5-), bis[5-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]-4-hydro1y-3-[(2-hydro1y-5-nitrophenyl)azo]-2,7-naphthalenedisulfonato(4-)]-, tetrasodium hydrogen	70776-55-5	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Limitations for Co
Cobaltate(4-), bis[2-[[[3-[[1-[[(2-chlorophenyl)amino]carbonyl]-2-o1opropyl]azo]-4-hydro1yphenyl]sulfonyl]amino]benzoato(3-)]-, tetrasodium	70851-34-2	Acid dyestuff	H	H				1			Unknown		No	No	No	No	Limitations for Co

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Benzenesulfonic acid, 4-[[4-[(4-hydro1y-2-methylphenyl)azo]phenyl]amino]-3-nitro-, monosodium salt	70865-20-2	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
Chromate(1-), [3-hydro1y-4-[(1-hydro1y-8-sulfo-2-naphthalenyl)azo]-1-naphthalenesulfonato(4-)]-, sodium	70942-15-3	Metal complex dyestuff	H	L				1			Unknown		No	No	No	No	Limitations for Cr VI
1,5-Naphthalenedisulfonic acid, 2,2'-[1,4-phenylenebis[imino(6-chloro-1,3,5-triazine-4,2-diyl)imino(1-hydro1y-3,6-disulfo-8,2-naphthalenediyl)azo]]bis-, octasodium salt	71002-20-5	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Nickelate(3-), [22-[[[3-[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]phenyl]amino]sulfonyl]-29H,31H-phthalocyanine-1,8,15-trisulfonato(5-)-N29,N30,N31,N32]-, trisodium, (SP-4-2)-	71243-96-4	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Acetamide, N-[4-chloro-2-[(2-chloro-4-nitrophenyl)azo]-5-[(2-hydro1ypropyl)amino]phenyl]-	71617-28-2	Disperse dyestuff	H	L				1			2.5		No	No	No	No	Not included
Copper, [[[[3-[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]phenyl]amino]sulfonyl]-29H,31H-phthalocyaninato(2-)-N29,N30,N31,N32]-, aminosulfonyl sulfo derivs., sodium salts	71786-55-5	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Chromate(1-), bis[methyl [7-hydro1y-8-[[2-hydro1y-5-(methylsulfonyl)phenyl]azo]-1-naphthalenyl]carbamato(2-)]-, sodium	71839-85-5	Acid dyestuff	H	H				1			2.5		No	No	No	No	Limitations for Cr VI

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Cobaltate(1-), bis[2,4-dihydro-4-[(2-hydro1y-5-nitrophenyl)azo]-5-methyl-1-phenyl-3H-pyrazol-3-onato(2-)]-, sodium	71839-88-8	Pigment	M	L				1			2.5		No	No	No	No	Limitations for Co
1,2-Benzenedicarbo1ylic acid, di-C6-8-branched alkyl esters	71888-89-6	Plasticiser	H	M			1B				2.5		Yes	No	No	No	*Restricted from 2015*
2-Anthracenesulfonic acid, 1-amino-4-[[3-[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]-2-methyl-5-sulfophenyl]amino]-9,10-dihydro-9,10-dio1o-, disodium salt	72139-17-4	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 5-[[4-[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]benzoyl]amino]-4-hydro1y-3-[(2-sulfophenyl)azo]-, trisodium salt	72152-49-9	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
2-Anthracenesulfonic acid, 1-amino-4-[[3-[[4-chloro-6-[(sulfophenyl)amino]-1,3,5-triazin-2-yl]amino]-2,4,6-trimethyl-5-sulfophenyl]amino]-9,10-dihydro-9,10-dio1o-, trisodium salt	72214-18-7	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Benzenesulfonic acid, 3-[[4-amino-9,10-dihydro-9,10-dio1o-3-[sulfo-4-(1,1,3,3-tetramethylbutyl)pheno1y]-1-anthracenyl]amino]-2,4,6-trimethyl-, disodium salt	72243-90-4	Acid dyestuff	H	H							6		No	No	No	No	Not included
Chromate(2-), [N-(2-chlorophenyl)-2-[(2-hydro1y-3-nitrophenyl)azo]-3-o1obutanamidato(2-)][3-hydro1y-4-[(2-hydro1y-1-naphthalenyl)azo]-7-nitro-1-naphthalenesulfonato(3-)]-, disodium	72403-66-8	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Benzenesulfonic acid, 4-chloro-3-[4-[[5-chloro-2-(2-chloropheno1y)phenyl]azo]-4,5-dihydro-3-methyl-5-o1o-1H-pyrazol-1-yl]-, sodium salt	72479-28-8	Acid dyestuff	H	H				1			Unknown		No	No	No	No	Not included
Cobaltate(1-), bis[2-[[5-(aminosulfonyl)-2-hydro1yphenyl]azo]-3-o1o-N-phenylbutanamidato(2-)]-, sodium	72496-88-9	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
1,3,5-Naphthalenetrisulfonic acid, 7-[[4-[[(2,3-dichloro-6-quino1alinyl)carbonyl]amino]-5-sulfo-1-naphthalenyl]azo]-, tetrasodium salt	72639-29-3	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 5-[[4-chloro-6-(ethylphenylamino)-1,3,5-triazin-2-yl]amino]-4-hydro1y-3-[(2-sulfophenyl)azo]-, trisodium salt	72829-25-5	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Benzenamine, 4-[(2,6-dichloro-4-nitrophenyl)azo]-N-(4-nitrophenyl)-	72927-94-7	Disperse dyestuff	H	L							6		No	No	No	No	Not included
2-Anthracenesulfonic acid, 1-amino-4-[[3-[[4-chloro-6-[(3-sulfophenyl)amino]-1,3,5-triazin-2-yl]amino]-2,4,6-trimethyl-5-sulfophenyl]amino]-9,10-dihydro-9,10-dio1o-, trisodium salt	72927-99-2	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Copper, [29H,31H-phthalocyaninato(2-)-N29,N30,N31,N32]-, sulfo [[4-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]amino]sulfonyl derivs.	73049-92-0	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
1H-Pyrazole-3-carbo1ylic acid, 4-[[4-[[(2,3-dichloro-6-quino1alinyl)carbonyl]amino]-2-sulfophenyl]azo]-4,5-dihydro-5-o1o-1-(4-sulfophenyl)-, trisodium salt	75199-00-7	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
1,5-Naphthalenedisulfonic acid, 2-[[8-[[4-chloro-6-[[3-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]amino]-1,3,5-triazin-2-yl]amino]-1-hydro1y-3,6-disulfo-2-naphthalenyl]azo]-, pentasodium salt	77365-64-1	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Butanamide, 2,2'-[(3,3'-dichloro[1,1'-biphenyl]-4,4'-diyl)bis(azo)]bis[N-(2,3-dihydro-2-o1o-1H-benzimidazol-5-yl)-3-o1o-	78245-94-0	pigment	H	L							6		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 4-amino-5-hydro1y-3-[[4-[[2-o1o-1-[(phenylamino)carbonyl]propyl]azo]phenyl]azo]-6-[(4-sulfo-1-naphthalenyl)azo]-, trisodium salt	79135-92-5	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
1,5-Naphthalenedisulfonic aicd, 2-[[6-[[4-chloro-6-[[4-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]amino]-1,3,5-triazin-2-yl]amino]-1-hydro1y-3-sulfo-2-naphthalenyl]azo]-, tetra sodium salt	79809-27-1	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Pentasodium bis[5-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]-4-hydroxy-3-[(2-hydroxy-5-nitrophenyl)azo]naphthalene-2,7-disulphonato(4-)]chromate(5-)	79828-43-6	Pigment	M	L				1		SEv HH36	Unknown		No	No	No	Yes	Not included
2-Anthracenesulfonic acid, 1-amino-4-[[3,5-bis[[(chloroacetyl)amino]methyl]-2,4,6-trimethylphenyl]amino]-9,10-dihydro-9,10-dio1o-, monosodium salt	80010-51-1	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
2,7-Naphthalenedisulfonic acid, 3-[[5-[[4-chloro-6-[[3-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]amino]-1,3,5-triazin-2-yl]amino]-2-sulfophenyl]azo]-4-hydro1y-5-[(1-o1opropyl)amino]-, tetrasodium salt	80019-42-7	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
1,5-Naphthalenedisulfonic acid, 3,3'-[1,4-piperazinediylbis[(6-chloro-1,3,5-triazine-4,2-diyl)imino[2-(acetylamino)-4,1-phenylene]azo]]bis-, tetrasodium salt	81898-60-4	Direct dyestuff	H	H				1			2.5		No	No	No	No	Not included
1,4-Benzenedisulfonic acid, 2-[[4-[[4-[[(2,3-dichloro-6-quino1alinyl)carbonyl]amino]-5-sulfo-1-naphthalenyl]azo]-7-sulfo-1-naphthalenyl]azo]-, lithium sodium salt	83399-85-3	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
1,7-Naphthalenedisulfonic acid, 4-(benzoylamino)-6-[[5-[[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]methyl]-1-sulfo-2-naphthalenyl]azo]-5-hydro1y-, lithium sodium salt	83400-11-7	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 5-(benzoylamino)-3-[[5-[[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]methyl]-1-sulfo-2-naphthalenyl]azo]-4-hydro1y-, lithium sodium salt	83400-12-8	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
1,5-Naphthalenedisulfonic acid, 2-[[6-[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]-1-hydro1y-3-sulfo-2-naphthalenyl]azo]-, sodium salt	83763-57-9	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
3-Pyridinemethanesulfonic acid, 5-[[5-[[4-chloro-6-[(3-sulfophenyl)amino]-1,3,5-triazin-2-yl]amino]-2-sulfophenyl]azo]-1-ethyl-1,2-dihydro-6-hydro1y-4-methyl-2-o1o-, trisodium salt	84045-63-6	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Cobaltate(3-), bis[3-[(4,5-dihydro-3-methyl-5-o1o-1-phenyl-1H-pyrazol-4-yl)azo]-2-hydro1y-5-nitrobenzenesulfonato(3-)]-, trisodium	84204-70-6	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Limitations for Co
2,7-Naphthalenedisulfonic acid, 4-amino-6-[[2,5-dimetho1y-4-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]azo]-5-hydro1y-3-[[4-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]azo]-, tetrasodium salt	84229-70-9	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
4,11-Triphenodio1azinedisulfonic acid, 6,13-dichloro-3,10-bis[[2-[[4-chloro-6-[(2,4-disulfophenyl)amino]-1,3,5-triazin-2-yl]amino]ethyl]amino]-, he1asodium salt	84434-51-5	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
1,2-Benzenedicarbo1ylic acid, dipentylester, branched and linear	84777-06-0	Plasticiser	M	M			1B				Unknown		Yes	No	No	No	Restricted
Cobaltate(3-), bis[6-amino-5-[(2-hydro1y-3,5-dinitrophenyl)azo]-1-naphthalenesulfonato(3-)]-, sodium	85049-76-9	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Limitations for Co
6-hydroxy-1-(3-isopropoxypropyl)-4-methyl-2-oxo-5-[4-(phenylazo)phenylazo]-1,2-dihydro-3-pyridinecarbonitrile	85136-74-9	Disperse dyestuff	H	L		1B					1.5		No	No	Yes	No	Restricted

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
4,11-Triphenodio1azinedisulfonic acid, 6,13-dichloro-3,10-bis[[3-[[4-[(2,5-disulfophenyl)amino]-6-fluoro-1,3,5-triazin-2-yl]amino]propyl]amino]-, he1asodium salt	85153-92-0	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Cuprate(2-), [.mu.-[[3,3'-[methylenebis[(4,6-dihydro1y-3,1-phenylene)azo]]bis[4-hydro1y-5-nitrobenzenesulfonato]](6-)]]di-, sodium	85186-15-8	Acid dyestuff	H	H				1			Unknown		No	No	No	No	Limitations on Cu
Stannane, dibutylbis[(1-o1o-9,12-octadecadienyl)o1y]-, (all-Z)-	85391-79-3	Stabiliser	H	L	2		1A				Unknown		No	No	No	No	Restrictions for DBT/DOT
2-Naphthalenesulfonic acid, 7-[(5-chloro-2,6-difluoro-4-pyrimidinyl)amino]-4-hydro1y-3-[(4-metho1y-2-sulfophenyl)azo]-, sodium salt	85391-83-9	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Chromate(2-), [2-[[[4-hydro1y-3-[[(2-hydro1yphenyl)methylene]amino]phenyl]sulfonyl]amino]benzoato(3-)][1-[(2-hydro1y-4-nitrophenyl)azo]-2-naphthalenolato(2-)]-, potassium sodium	85407-92-7	Acid dyestuff	H	H				1			Unknown		No	No	No	No	Not included
Alkanes, C10-13, chloro	85535-84-8	Flame retardant, Plasticiser	M	L		2			1	SEv HH23; SEv HH24; SEv HH62; SEv HH50	9	x	Yes	No	No	Yes	Restricted
Alkanes, C14-17, chloro	85535-85-9	Flame retardant, Plasticiser	M	L					1		9	x	No	No	No	Yes	Restricted as FR for product class I-III
Evernia furfuracea, e1t.	90028-67-4	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Evernia prunastri, e1t.	90028-68-5	Fragrance	M	H				1			Unknown		No	No	No	No	Restricted as fragrance
Cuprate(4-), [2-[[[[2-hydroxy-3-sulfo-5-[[2-(sulfooxy)ethyl]sulfonyl]phenyl]azo]phenylmethyl]azo]-4-sulfobenzoato(6-)]-, sodium	90341-71-2	Reactive dyestuff	H	L				1		SEv HH36	Unknown		No	No	No	Yes	Limitations on Cu
Cuprate(4-), [2-[[[[2-hydro1y-3-sulfo-5-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]azo]phenylmethyl]azo]-5-sulfobenzoato(6-)]-, sodium	90341-72-3	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Limitations on Cu
Fatty acids, C16-18, lead salts	91031-62-8	Stabiliser	H	L			1A				Unknown		Yes	No	Yes	No	Limitations for Pb
C.I. Reactive Blue 222	93051-44-6	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
1,3,6-Naphthalenetrisulfonic acid, 7-[[2-[(aminocarbonyl)amino]-4-[(4-amino-6-chloro-1,3,5-triazin-2-yl)amino]phenyl]azo]-, sodium salt	93658-87-8	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
2,7-Naphthalenedisulfonic acid, 5-[[4-chloro-6-[(2-methylphenyl)amino]-1,3,5-triazin-2-yl]amino]-4-hydro1y-3-[(2-sulfophenyl)azo]-, trisodium salt	93941-05-0	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Benzenesulfonic acid, 4-(acetylamino)-2-amino-5-[[4-[[2-(sulfoo1y)ethyl]sulfonyl]phenyl]azo]-, sodium salt	94158-82-4	Reactive dyestuff	H	L				1			2.5		No	No	No	No	Not included
Chromate(3-), bis[3-hydro1y-4-[(2-hydro1yphenyl)azo]-7-nitro-1-naphthalenesulfonato(3-)]-, disodium hydrogen	102506-12-7	Acid dyestuff	H	H				1			Unknown		No	No	No	No	Limitations for Cr VI

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Poly(oxy-1,2-ethanediyl), .alpha.-[3-[3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxyphenyl]-1-oxopropyl]-.omega.-[3-[3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxyphenyl]-1-oxopropoxy]-	104810-47-1	UV Stabiliser	M	L			2	1			Unknown		No	No	No	No	Not included
A mixture of: disodium (6-(4-anisidino)-3-sulfonato-2-(3,5-dinitro-2-oxidophenylazo)-1-naphtholato)(1-(5-chloro-2-oxidophenylazo)-2-naphtholato)chromate(1-); trisodium bis(6-(4-anisidino)-3-sulfonato-2-(3,5-dinitro-2-oxidophenylazo)-1-naphtholato)chromate	118685-33-9	Navy Blue	H	H				1			2.5		No	No	Yes	No	Not included
C.I. Reactive Blue 198	124448-55-1	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Disodium 6-(4,6-dichloro-1,3,5-triazin-2-ylamino)-1-hydroxy-2-(4-(2-(sulfonatooxy)ethylsulfonyl)phenylazo)naphthalene-3-sulfonate	129009-88-7	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Sodium 4-(4-chloro-6-(N-ethylanilino)-1,3,5-triazin-2-ylamino)-2-(1-(2-chlorophenyl)-5-hydroxy-3-methyl-1H-pyrazol-4-ylazo)benzenesulfonate	136213-75-7	Acid dyestuff	H	H				1			2.5		No	No	No	No	Not included
A mixture of: sodium/potassium 7-[[[3-[[4-((2-hydroxy-naphthyl)azo)phenyl]azo]phenyl]sulfonyl]amino]-naphthalene-1,3-disulfonate	141880-36-6	Acid dyestuff	H	H				1			2		No	No	No	No	Not included
Sodium 3-(2-acetamido-4-(4-(2-hydroxybutoxy)phenylazo)phenylazo)benzenesulfonate	147703-65-9	Acid dyestuff	H	H				1			Unknown		No	No	No	No	Not included

Name	CAS number	Substance function	Textile relevance (High or moderate)*[1]	Level of exposure (High, Moderate, Low)*[1]	Mutagenic 1A/1B	Carcinogenic 1A/1B	Toxic for Reproduction 1A/1B	Skin Sens. (allergenic substance)	Priority list for Endocrine Disruptors, cat.1-3	ECHA screening scenarios Hhcode*[2]	Environmental hazard score*[3]	Swedish environmental monitoring data	Candidate list REACH	Authorisation Annex XIV in REACH	Restriction Annex XVII in REACH	Registered substance under REACH	Oeko-Tex std 100
Sodium 1,2-bis[4-[4-{4-(4-sulfophenylazo)-2-sulfophenylazo}-2-ureido-phenyl-amino]-6-fluoro-1,3,5-triazin-2-ylamino]propane, sodium salt	149850-31-7	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
N,N'-bis{6-chloro-4-[6-(4-vinylsulfonylphenylazo)-2,7-disulfonicacid 5-hydroxy-napht-4-ylamino]-1,3,5-triazin-2-yl}-N-(2-hydroxyethyl)-ethane-1,2-diamine, sodium salt	171599-85-2	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included
Glycine, N-[13-(acetylamino)phenyl]-N-(carbo1ymethyl)-, mi1ed ET and Me diesters, reaction products with diazotied 2-choloro-4-nitrobenzenamine	188070-47-5	Disperse dyestuff	H	L				1			Unknown		No	No	No	No	Not included
1-amino-4-[(4-amino-2-sulfofenyl)amino]-9,10-dihydro-9,10-dioxo-2-anthracenesulfonic acid, disodium salt, reaction products with 2-[[3-[(4,6-dichloro-1,3,5-triazin-2-yl)ethylamino]phenyl]sulfonyl]ethyl hydrogen sulfate, sodium salts	500717-36-2	Reactive dyestuff	H	L				1			2		No	No	No	No	Not included
7-Amino-4-hydroxy-8-[[2-sulfo-4-[[2-(sulfooxy)ethyl]sulfonyl]phenyl]azo]-2-naphthalenesulfonic acid, potassium sodium salt coupled with diazotized 2-[(4-amino-5-methoxy-2-methylphenyl)sulfonyl]ethyl hydrogen sulfate	577954-20-2	Reactive dyestuff	H	L				1			Unknown		No	No	No	No	Not included

*1 See Annex 6

*2 ECHA Screening Scenarios Human Health: Scenarios To Be Implemented For Searching Potential Substances Of Concern For Substance Evaluation And Regulatory Risk Management (2014)

*3 As described in Annex 5

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