KEMI
Swedish Chemicals Agency

PM 1/17

Sensitizers in textiles and toys

A consultant study conducted by Swerea IVF

kemikalieinspektionen.se

KEMI
Swedish Chemicals Agency

The Swedish Chemicals Agency is supervisory authority under the Government. We work in Sweden, the EU and internationally to develop legislation and other incentives to promote good health and improved environment. We monitor compliance of applicable rules on chemical products, pesticides and substances in articles and carry out inspections. We also provide guidance regarding enforcement and inspections to municipalities and county administrative boards. We review and authorise pesticides before they can be used. Our environmental quality objective is A Non-toxic Environment.

Article number: 511 235.

Preface

On behalf of the Swedish Government, the Swedish Chemicals Agency has developed an action plan for a non-toxic everyday environment. The action plan highlights textiles and toys as prioritized groups of consumer articles in the work towards a non-toxic everyday environment.

The lack of knowledge about hazardous chemicals in consumer articles, such as textiles and toys, often pose an obstacle when assessing the risks for consumers. This lack of knowledge may also hamper the development of risk reducing measures against hazardous substances in consumer articles and can reduce the chances of getting through proposals in the EU Commission and their advisory committees.

The purpose of the present study is to gain more knowledge about some skin sensitising substances that previously have been identified as potential substances of concern in textiles[1] and toys[2]. Thus, this study is an in-depth analysis of the results from two previous studies conducted on behalf of the Swedish Chemicals Agency. This PM is intended as a knowledge base for future risk management on skin sensitising substances in textiles and toys.

The Swedish Chemicals Agency commissioned Stefan Posner and Sandra Roos at the Research institute Swerea IVF to carry out the study. Stefan Posner had previously conducted the two studies on textiles and toys that this study is based on. Contact persons at the Swedish Chemicals Agency were Helén Klint and Anna Nylander. Responsible for the commission were Ing-Marie Olsson Ressner, head of unit for Proposals for Classification and Restriction at the Swedish Chemicals Agency.

The conclusions and recommendations presented in the study are those of the author and do not necessarily reflect the view of the Swedish Chemicals Agency.

[1] KemI report 6/14: Chemicals in textiles - Risks to human health and the environment
[2] KemI PM 6/12: Literature survey of chemicals in toys

Table of contents

Summary **6**

1 Introduction **8**

1.1 Scope and purpose 8
1.2 Substance overview 8
1.3 Textile material 11
1.4 Materials in toys 11
1.5 Chemical categories 13
1.6 Method 14

2 Current knowledge of the identified sensitizers **16**

2.1 Bisphenol A, CAS 80-05-7 16
2.2 N-isopropyl-N-phenyl-p-phenylenediamine, CAS 101-72-4 17
2.3 Ethyl acrylate, CAS 140-88-5 18
2.4 Mequinol, CAS 150-76-5 19
2.5 Citral, CAS 5392-40-5 21
2.6 (+)-(R)-limonene, CAS 5989-27-5 22
2.7 Sodium chromate, CAS 7775-11-3 23
2.8 Potassium dichromate, CAS 7778-50-9 24
2.9 Sodium dichromate, CAS 10588-01-9 25
2.10 2,2-(1,4-phenylene)bis((4H-3,1-benzoxazine-4-one), CAS 18600-59-4 26
2.11 Direct yellow 162, CAS 81898-60-4 27
2.12 Reactive Blue 204, CAS 85153-92-0 28
2.13 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, CAS 136213-75-7 28
2.14 A mixture of: sodium/potassium 7-[[[3-[[4-(2-hydroxynaphthyl)azo)phenyl]azo]phenyl]sulfonylamino]-naphthalene-1,3-disulfonate (Acid Red 447), CAS 141880-36-6 29
2.15 Sodium 3-(2-acetamido-4-(4-(2-hydroxybutoxy)phenylazo)phenylazo)benzene sulfonate, CAS 147703-65-9 30
2.16 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 (Reactive Red 264), CAS 171599-85-2 31
2.17 Glycine, N-[13-(acetylamino)phenyl]-N-(carbo1ymethyl)-, mi1ed ET and Me diesters, reaction products with diazotied 2-choloro-4-nitrobenzenamine, CAS 188070-47-5 32
2.18 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, CAS 500717-36-2 33
2.19 Methyl methacrylate, CAS 80-62-6 34
2.20 Specific uses in materials 34
2.21 Butyl methacrylate, CAS 97-88-1 35
2.22 Glutaral, CAS 111-30-8 36
2.23 Zinc bis(dibutyldithiocarbamate), CAS 136-23-2 37
2.24 2-hydroxyethyl methacrylate, CAS 868-77-9 38
2.25 (S)-p-mentha-1,8-diene (*d*-Limonene), CAS 5989-54-8 39
2.26 A mixture of: 2,2,6,6-tetramethylpiperidin-4-yl-hexadecanoate; 2,2,6,6-tetramethylpiperidin-4-yl-octadecanoate, CAS 86403-32-9 40

2.27 A mixture of: trans-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran; cis-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran, CAS 131766-73-9 41
2.28 RED RA 10463, CAS 170222-39-6 42
2.29 A mixture of: 3,5-dimethylthio-2,4-toluenediamine; 3,5-dimethylthio-2,6-toluenediamine, CAS 106264-79-3 43
2.30 Tert-butyl acrylate, CAS 1663-39-4 44
2.31 Nabam, CAS 142-59-6 45
2.32 Isobutyl methacrylate, CAS 97-86-9 46
2.33 Cobalt, CAS 7440-48-4 47
2.34 2,3-epoxypropyl phenyl ether, CAS 122-60-1 48
2.35 Methenamine, CAS 100-97-0 49
2.36 N,N',N'',N'''-tetrakis(4,6-bis(butyl-(N-methyl-2,2,6,6-tetramethylpiperidin-4-yl)amino)triazin-2-yl)-4,7-diazadecane-1,10-diamine, CAS 106990-43-6 50
2.37 Thiram, CAS 137-26-8 51
2.38 4,4'-methylenedi-o-toluidine, CAS 838-88-0 52
2.39 3,3'-dichlorobenzidine, CAS 91-94-1 53
2.40 4-methyl-m-phenylenediamine, CAS 95-80-7 54
2.41 Solvent Yellow 3, CAS 97-56-3 55
2.42 Formaldehyde, CAS 50-00-0 56
2.43 Methylene bis(thiocyanate), CAS 6317-18-6 57
2.44 2,3,5,6-Tetrachloro-4-(methylsulfonyl)pyridine, CAS 13108-52-6 58
2.45 Folpet, CAS 133-07-3 59
2.46 Specific uses in materials 59
2.47 4,4'-Isopropylidenediphenol, oligomeric reaction products with 1-chloro-2,3-epoxypropane, CAS 25068-38-6 60
2.48 Beryllium, CAS 7440-41-7 61
2.49 Nickel, CAS 7440-02-0 62
2.50 Potassium chromate, CAS 7789-00-6 63
2.51 Disulfiram, CAS 97-77-8 64
2.52 Octyl gallate, CAS 1034-01-1 65
2.53 Propyl gallate, CAS 121-79-9 66
2.54 Dodecyl gallate, CAS 1166-52-5 67
2.55 Kathon CG, CAS 55965-84-9 68
2.56 Solvent Yellow 14, CAS 842-07-9 69
2.57 Cobalt dichloride, CAS 7646-79-9 70
2.58 Phthalic anhydride, CAS 85-44-9 71
2.59 1,4,5,8-tetraaminoanthraquinone (Disperse Blue 1), CAS 2475-45-8 72

3 Conclusions 73

4 Recommendations 74

5 References 75

Appendix 1 Summary of the substances 80

Summary

The purpose of this study is to make an in depth investigation on 58 identified substances which are potentially relevant to textiles and/or toys and are harmonized hazard classified as skin sensitizers (H317) according to the EU Regulation 1272/2008 (CLP Regulation). The study includes a literature survey focused on the use of each substance in consumer textile articles or toys available on the EU market. This study also includes literature data on measured concentrations of the substances in consumer textiles or toys. Based on the chemical properties of each substance, information on emissions and migration of the substances has been evaluated. The selection of substances was made by the Swedish Chemicals Agency and based on previous reports on chemicals in textiles (Swedish Chemicals Agency, 2015a; van der Putte et al., 2013) and chemicals in toys (Swedish Chemicals Agency, 2012).

In the study, a literature survey was done, in which chemical and physical data, as well as information on uses in textiles and toys was identified. Also studies where concentrations of the substances in articles had been measured were included in order to get data on actual use and concentration of the substances. One aim of this study is to understand how the 58 identified substances may be exposed to the user in contact with textiles and toys that may contain these substances. Therefore, a theoretical consideration of these substances based on their chemical and physical characteristics (e.g. vapour pressure, water solubility and partition coefficient) were made. This may indicate their possible ability to migrate through materials to the site of exposure, e.g. skin or gastrointestinal tract.

Many of the studied substances have multiple uses in the production process. They are often related to specific materials and/or functions and not to the product groups such as textiles and/or toys. Only a few chemicals have directly been linked to textiles and/or toys such as certain types of dyes, e.g reactive dyes used for cotton and disperse dyes used in polyester. In those cases where only materials or only primary uses of these chemicals are identified in litterature sources e.g adhesives and fragrants we may assume that textiles and/or toys may contain these substances but these assumptions are far from certain since there are no reliable sources to refer to in these cases.

Some of the substances lacked physical and chemical data which made it impossible to assess their possible exposure routes. There are still considerable data gaps for some substances, in particular physical/chemical data for dyestuffs or comprehensive specific use information for some process chemicals. The lack of data may have to do with market trade secret information or just the fact that no tests have been carried out (or the results from the tests haven’t been published). In order to reduce data gaps for these and other sensitising substances and their possible uses in textiles and/or toys, more comprehensive source/reference information on specific uses of these chemicals is required.

Conclusively since a number of the studied substances could be referred to textiles and/or toys, there is every reason to take the presence of these substances in textiles and/or toys seriously and conduct further measures to improve our knowledge and procedures for future prevention of these chemicals in especially high risk uses for textiles and toys from an exposure perspective.

Sammanfattning

Syftet med denna studie är att göra en grundlig undersökning av 58 ämnen som tidigare indentifierats som potentiellt relevanta för textilier och/eller leksaker och som har en harmoniserad klassificering som hudsensibiliserande (H317) i enlighet med EU-förordningen 1272/2008 (CLP-förordningen). Studien omfattar en litteraturstudie med fokus på användning av varje ämne i textila varor eller leksaker som kan finnas på marknanden inom EU. Studien innehåller i vissa fall litteraturdata på uppmätta halter av dessa ämnen. Sannolikheten för att ämnena ska avges från material har också utvärderats baserat på dess kemiska och fysikaliska egenskaper. Urvalet av ämnen gjordes av Kemikalieinspektionen och är baserade på tidigare rapporter; Kemikalier i textilier (Kemikalieinspektionen 2015a; van der Putte et al, 2013) och Kemikalier i leksaker (KemI, 2012).

Studien genomfördes bland annat genom att sammanställa tillgänglig information om kemiska och fysikaliska data samt användning och förekomst i de olika materialen. Ett syfte med studien är att få en djupare kunskap om människors exponering för dessa 58 hudsensibiliserande ämnen som tidigare identifierats som relevanta för textilier och leksaker.

Många av de studerade ämnena har flera användningsområden och de är ofta relaterade till specifika material och/eller funktioner och inte till varugrupper såsom t ex textilier och/eller leksaker. Endast ett fåtal av ämnena har textilier och/eller leksaker som främsta användningsområde, dessa inkluderar vissa typer av färgämnen, t ex reaktiva färgämnen som används för bomull och dispersionsfärgämnen som används för polyester.

Några av ämnena saknade fysikaliska och kemiska data och det var därför svårt att bedöma sanolikheten för exponering. Det finns således fortfarande stora kunskapsluckor, i synnerhet fysikaliska/kemiska data för färgämnen och för vissa processkemikalier. Bristen på information kan ha att göra med affärshemligheter eller bara det faktum att inga tester har utförts, alternativt att inga resultat från testerna har publicerats. För att minska kunskapsluckorna för dessa och andra allergiframkallande ämnen och deras möjliga tillämpning i textilier och/eller leksaker, krävs det mera kunskap om specifika användningar.

Slutligen, eftersom ett antal av ämnena som ingick i studien kan användas i tillverkning av textilier och/eller leksaker, finns det all anledning att ta förekomsten av dessa ämnen på allvar. Det behöver därför genomföras ytterligare åtgärder för att förbättra både kunskap och metoder för att i framtiden förhindra användning av dessa ämnen i leksaker och textilier.

1 Introduction

Substances that commonly cause allergy are nickel (jewelery, coins, keys, handles, and tools), chromium, and cobalt (leather, cement, and hard metal), fragrances (cosmetics), preservatives (cosmetics, paints), plastics and rubber chemicals (glues, varnishes, gloves, boots, and shoes) and hair colorants (hair products). There are about 4 000 substances known to science that may cause allergy (Liden, 2013).

1.1 Scope and purpose

The purpose of this study is to make an in depth study on 58 identified substances which are potentially relevant to textiles and/or toys and are harmonized hazard classified as skin sensitizers (H317) according to the EU Regulation 1272/2008 (CLP Regulation) (European Commission, 2008), where some of them are already regulated in EU Regulation 1907/2006 (REACH) (European Commission, 2006) and the Toys Safety Directive 2009/48/EC (European Commission, 2009). The study includes a literature survey focused on the use of each substance in textile articles or toys available on the EU consumer market. This study also includes literature data on measured concentrations of the substances in consumer textiles or toys. Based on the chemical properties of each substance, information on emissions and migration of the substances has been evaluated.

1.2 Substance overview

The selection of substances was made by the Swedish Chemicals Agency and based on previous reports on chemicals in textiles (Swedish Chemicals Agency, 2015a; van der Putte et al., 2013) and chemicals in toys (Swedish Chemicals Agency., 2012). All substances and in which references they appear are listed in Table 1.

Table 1. The list of substances included in the study and the references in which they can be found.

Substance name	**CAS no**	**Swedish Chemicals Agency, 2015** - Kemikalier i textilier - Risker för människors hälsa och miljön. KemI report 3/15	**van der Putte et al., 2013 -** Study on the Link Between Allergic Reactions and Chemicals in Textile Products	**Swedish Chemicals Agency., 2012 -** Literature survey on chemicals in toys. KemI PM 6/12
Bisphenol A	80-05-7	**x**		
N-isopropyl-N-phenyl-p-phenylenediamine	101-72-4	**x**		
Ethyl acrylate	140-88-5	**x**		
Mequinol	150-76-5	**x**		
Disperse Yellow 3	2832-40-8	**x**	**x**	**x**
Citral	5392-40-5	**x**		**x**
(+)-(R)-limonene	5989-27-5	**x**	**x**	
Sodium chromate	7775-11-3	**x**		
Potassium dichromate	7778-50-9	**x**		
Sodium dichromate	10588-01-9	**x**		
2,2-(1,4-phenylene)bis((4H-3,1-benzoxazine-4-one)	18600-59-4	**x**		

Substance name	**CAS no**	**Swedish Chemicals Agency, 2015** - Kemikalier i textilier - Risker för människors hälsa och miljön. KemI report 3/15	**van der Putte et al., 2013 -** Study on the Link Between Allergic Reactions and Chemicals in Textile Products	**Swedish Chemicals Agency., 2012 -** Literature survey on chemicals in toys. KemI PM 6/12
Direct yellow 162	81898-60-4	**x**		
Reactive blue 204	85153-92-0	**x**		
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	**x**		
A mixture of: sodium/potassium 7-[[[3-[[4-((2-hydroxynaphthyl) azo)phenyl]azo]phenyl]sulfonyl]amino] -naphthalene-1,3-disulfonate	141880-36-6	**x**		
Sodium 3-(2-acetamido-4-(4-(2-hydroxybutoxy)phenylazo)phenylazo)benzene sulfonate	147703-65-9	**x**		
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	**x**		
Glycine, N-[13-(acetylamino)phenyl]-N-(carbo1ymethyl)-, mi1ed ET and Me diesters, reaction products with diazotied 2-choloro-4-nitrobenzenamine	188070-47-5	**x**		
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	**x**		
Methyl methacrylate	80-62-6	**x**		
Butyl methacrylate	97-88-1	**x**		
Glutaral	111-30-8	**x**		**x**
Zinc bis(dibutyldithiocarbamate)	136-23-2	**x**		
2-hydroxyethyl methacrylate	868-77-9	**x**		
(S)-p-mentha-1,8-diene	5989-54-8	**x**		
A mixture of: 2,2,6,6-tetramethylpiperidin-4-yl-hexadecanoate; 2,2,6,6-tetramethylpiperidin-4-yl-octadecanoate	86403-32-9	**x**		
A mixture of: trans-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran; cis-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran	131766-73-9	**x**		
RED RA 10463	170222-39-6	**x**		

Substance name	**CAS no**	**Swedish Chemicals Agency, 2015** - Kemikalier i textilier - Risker för människors hälsa och miljön. KemI report 3/15	**van der Putte et al., 2013 -** Study on the Link Between Allergic Reactions and Chemicals in Textile Products	**Swedish Chemicals Agency., 2012 -** Literature survey on chemicals in toys. KemI PM 6/12
A mixture of: 3,5-dimethylthio-2,4-toluenediamine; 3,5-dimethylthio-2,6-toluenediamine	106264-79-3			**x**
Tert-butyl acrylate	1663-39-4			**x**
Nabam	142-59-6			**x**
Isobutyl methacrylate	97-86-9			**x**
Cobalt	7440-48-4			**x**
2,3-epoxypropyl phenyl ether	122-60-1			**x**
Methenamine	100-97-0			**x**
N,N',N",N"'-tetrakis(4,6-bis(butyl-(N-methyl-2,2,6,6-tetramethylpiperidin-4-yl)amino)triazin-2-yl)-4,7-diazadecane-1,10-diamine	106990-43-6			**x**
Thiram	137-26-8			**x**
4,4'-methylenedi-o-toluidine	838-88-0			**x**
3,3'-dichlorobenzidine	91-94-1			**x**
4-methyl-m-phenylenediamine	95-80-7			**x**
Solvent Yellow 3	97-56-3			**x**
Formaldehyde	50-00-0		**x**	**x**
Methylene bis(thiocyanate)	6317-18-6			**x**
2,3,5,6-Tetrachloro-4-(methylsulfonyl)pyridine	13108-52-6			**x**
Folpet	133-07-3			**x**
4,4'-Isopropylidenediphenol, oligomeric reaction products with 1-chloro-2,3-epoxypropane	25068-38-6			**x**
Beryllium	7440-41-7			**x**
Nickel	7440-02-0			**x**
Potassium chromate	7789-00-6			**x**
Disulfiram	97-77-8			**x**
Octyl gallate	1034-01-1			**x**
Propyl gallate	121-79-9			**x**
Dodecyl gallate	1166-52-5			**x**
Kathon CG	55965-84-9			**x**
Solvent Yellow 14	842-07-9			**x**
Cobalt dichloride	7646-79-9			**x**
Phthalic anhydride	85-44-9		**x**	
1,4,5,8-tetraaminoanthraquinone (Disperse Blue 1)	2475-45-8		**x**	

1.3 Textile material

The textile and clothing sector covers the production and consumtion of a wide range of fibre materials divided into natural and synthetic materials. Among the natural materials, cotton is the most common material, in terms of mass consumption, with approximately 40 % of the total textiles consumption in the EU followed by wool (7%) where silk (0,1%) and flux (0,1%) represent minor consumption in the EU (Swedish Chemicals Agency, 2014).

Among the synthetic textile materials polyester is the most consumed material with approximately 20% of the total textile material consumption in the EU followed by polyamide (13%), acrylic (8%), polyurethane/polypropene (4%) and PVC (0,2%).

Viscose is chemically modified cellulose and does not account to the synthetic textile materials. This material represents around 8 % of the EU's consumption of textile materials.

1.4 Materials in toys

Toys may consist of a wide range of materials including textiles, plastics, wood, leather, metal, rubber etc but also chemical products such as paints and crayons. There are also toys that contain electric devices and batteries that need to be taken into account when critical chemicals in toys are considered (Swedish Chemicals Agency., 2012).

1.4.1 Plastics

Plastic materials are polymers made from either natural or synthetic organic compounds that may contain additive substances to improve performance and give desired properties. Plastics are divided in two main categories namely thermoplastics and thermosetting polymers.

Some examples on plastic materials that can be used in toys are

Thermoplastics:

- polyethylene (PE)
- polyester (PES)
- polyvinylchloride (PVC)
- polypropylene (PP)

Thermosets:

- polyurethane (PU)
- epoxy
- polycarbonate (PC)

1.4.2 Textiles

Textile materials are common in toys, e.g stuffed animals and dolls. Textiles can be made from natural or synthetic fibres and occur in the toy as fabric, yarn, synthetic fur etc, see chapter 2.3 Textiles.

1.4.3 Leather

Real leather is created via the tanning of animal hides. The most commonly used tanning process is with trivalent chromium that may transform into hexavalent chromium that is a well known strong skin sensitizer.

Synthetic leather is usually a synthetic textile (e.g. polyester) coated with a plastic (e.g. PVC or polyurethane).

1.4.4 Wood

Wood has been used for ages as a toy material. Wood based toys are quite commonly painted or varnished on the surface where children bite and chew and may pose a risk for exposure to hazardous chemicals. Pine wood is a common wood material. Wood based composites such as plywood etc are also included in this material group.

1.4.5 Metals and alloys

Metal parts are common as construction parts as well as in electric and electronic devices. Metals can be applied as surface treatments on other materials including metal parts. Such surface treatments include metallic surface treatments such as metal plating and non metallic treatments such as enamel, paint or varnish. Brass, steel, silver, gold and chromium are common metals and alloys.

1.4.6 Rubber

Rubber is a natural or synthetic material classified as an elastomer that may be used in toys.

Some examples on different rubber materials are

- Natural rubber (NR),
- Styrene butadiene rubber (SBR),
- Nitrile rubber (NBR),
- Chloroprene rubber (CR),
- Thermoplastic polyurethane (TPU),
- Ethylene vinylacetate copolymer (EVA)
- Ethylene propylene diene rubber EPDM).

1.4.7 Paper

Cardboard paper and paper used for crafts as well as paper in books and writing paper.

Papers are often surface treated and sometimes coated with a plastic layer. Common chemicals used for paper products are pigments, glues, retention agents and fillers.

1.4.8 Chemical products

Some examples on different chemical products that are used as toys are

- Inks
- Paints
- Gels, slime etc.
- Doll cosmetics
- Pens (felt pens, crayons, pencils)
- Lubricants for mechanical and electrical toys

These toys or parts of toys have in common that chemicals are the main constituents.

1.4.9 Electronics

Electronic components in toys can contain a large variation of materials: metals, plastics, ceramics, paper, liquids etc.

1.4.10 Glass and ceramics

Ceramic materials in toys are e.g. doll´s tablewares and glass items, but are also commonly found in electronics. In this material type are also included inorganic reinforcement fibers and fillers (glass fibers etc.).

1.5 Chemical categories

The chemicals used in the manufacture of textile and toys can be divided into functional (or effect) chemicals, processing and unintentionally added chemicals. In Table 2, possible concentration ranges of the various chemical categories are listed.

Functional or effect chemicals are added to provide certain properties to the material/article, e.g dyestuffs to provide colour, topcoat to provide gloss etc. Processing or auxiliery chemicals are added to wet chemical processes to enable a process to run properly, but they don't provide any properties to the final article. However these auxiliary chemicals may be found as impurities in the final article due to e.g bad washing or similar processes for their removal from the processed material.

Table 2 Assessment of concentration ranges of functional and process chemicals in textiles and toys (Swedish Chemicals Agency, 2014)

Use categories	**Estimated concentration range (mg/kg)**
Functional chemical substances with a known use in textiles and/or toys	<100 - 5000<
Auxiliary chemicals or unintended chemicals such as raw materials, intermediates, contaminants and degradation products. None of these chemicals are functional chemical substances	<100 - 1000<
No known use in textiles and/or toys	<Limit of detection[3]

1.5.1 Functional chemicals

Functional or effect chemicals are added to give an article a specific function. Functional chemicals contribute to design or any feasible technical function in the final product, e.g. colorants. For functional chemicals there is a need for a certain concentration in the final product in order to achieve the desirable function.

Some examples of functional (or effect) chemicals are

- Colorants (dyestuffs and pigments)
- Oil, soil and water repellents
- Plasticisers
- Flame retardants
- Fragrances

[3] the lowest quantity of a substance that can be distinguished with analytical instrumentation from the absence of that substance

- Alloys
- Biocides for defined functionalities in the article e.g disinfectants
- Stabilizers e.g antioxidants, UV/light stabilizers and anti degradants.

The functional chemicals represent approximately 5% of the total chemical environmental load per year of the total amount of chemicals used in the finishing/dyeing processes. The functional chemicals that are used should have good compatibility, such as good solubility in the materials. Some effect chemicals require good affinity to the fibers, for example as dyes in cellulose. In order to sustain the desired function in the final textile product during the usage phase the functional chemical should have the most favorable ageing characteristics possible.

1.5.2 Process chemicals

The other category is called processing chemicals, also called auxiliary chemicals, that are necessary to make processes work, but they do not provide any desired properties to the final product and are therefore not meant to remain in the finished product.

Some examples of process chemicals are

- Organic solvents
- Surfactants e.g wetting and dispersing agents
- Softeners
- Curative agents
- Accelerators
- Chain extenders
- Lubricants
- Defoaming agents
- Catalysts
- Hardening agents
- Vulcanizing agents (rubber)
- Retarders (rubber)
- Complexing agents
- Salts
- Acids and bases
- Reactive resins (e.g binders and adhesives) for various finishing treatments
- Biocides as preservatives in the process or during storage and transport e.g fungicides and preservatives.
- Tanning agents (leather)
- Drying agents
- Intermediates, precursors and monomers

Remains of the process chemicals may however be found in the finished product and cause health and/or environmental problems. A process chemical which remains as impurity in the final product often has a relatively low concentration, compared with the concentration of an effect/functional chemical in the final product.

1.6 Method

A literature survey was done, in which chemical and physical data, as well as information on uses in the above mentioned materials was identified. Also studies where concentrations of the substances in articles had been measured were included in order to get data on actual use and concentration of the substances. Data on chemical and physical data was primarily taken

from the European Chemical Agency's (ECHA) registration database[4] (ECHA, 2015). Also Chemspider[5] (Royal Society of Chemistry, 2015) was frequently used for assessing chemical and physical data. For data on uses of the different substances, a search on CAS registry number was made in eChemPortal[6] (OECD, 2015), a search engine for chemical information which links to other sources of information. For dyestuffs, a search on CAS registry number was made in the Color index[7] database (Society of Dyers and Colourists (SDC) and American Association of Textile Chemists and Colourists (AATCC), 2015). If the information obtained from these sources were not considered enough, searches on CAS RN were made in Swerea IVF's database for textile related chemicals[8] (Swerea IVF, 2015) and Google (Google search engine, 2015). In some cases also a search on CAS RN was made in Scopus[9] (Elsevier, 2015). In this report, only information that was considered to be relevant for textiles or toys was included.

One aim of this study is to understand how the 58 identified substances may be exposed to the user in contact with textiles and toy products that may contain these substances. Therefore, a theoretical consideration of these substances based on their chemical and physical characteristics were made. This may indicate their possible ability to migrate through materials onto skin in direkt skin contact or taken up via the respiratory tract. These characteristics are described in Table 3.

Table 3. Chemical and physical data that is the basis for the evaluation of the migration and emissivity of the studied substances.

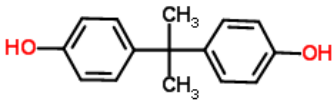
Data	**Unit**	**Which information does this parameter give?**
Characteristics of the substance		
Molecular weight	g/mol	Gives an idea if the chemical is a monomer, oligomer or polymer, which may be important for understanding e.g. bioavailability.
Melting point	ºC	Gives an indication of the state of matter for the substance in room temperature. Thus the expected physical state of the substance can be identified.
Boiling point	°C	Gives an indication of the state of matter for the substance in room temperature. Thus the expected physical state of the substance can be identified.
Vapour pressure	Pa or mm Hg	Refers to volatility, i.e. how likely emissions to air is and thus release of the substance from the article.
Water solubility	mol/m^3 or kg/m^3	Gives and indication of the substance's solubility in water and hence the ability of the substance to be dissolved from the article by e.g. sweat or saliva.
Partition coefficient of a substance between octanol and water, log Pow, n-octanol/water		Indicates the distribution of the substance between octanol and water which gives an idea on if the substance is soluble in fat. The parameter can indicate the ability of the substance to dissolve in skin fat.

[4] http://echa.europa.eu/information-on-chemicals/registered-substances
[5] http://www.chemspider.com/
[6] http://www.echemportal.org/echemportal/index?pageID=0&request_locale=en
[7] http://www.colour-index.com/
[8] http://kemikaliegruppen.se/
[9] http://www.scopus.com/

2 Current knowledge of the identified sensitizers

In this chapter, all substances, their properties and identified uses are described.

2.1 Bisphenol A, CAS 80-05-7

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2,2-bis(4-hydroxyphenyl)propane	(ECHA, 2015)
Molecular formula	$C_{15}H_{16}O_2$	(ECHA, 2015)
Molecular weight (g/mol)	228.115	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 155 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 250-252 °C (17 hPa)	(ECHA, 2015)
Vapour Pressure	Experimental: 4.12E-09 hPa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 300 mg/l (25 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 3.4 (21.5 °C)	(ECHA, 2015)

2.1.1 Specific uses in materials

Bisphenol A is primarily used in the production of polycarbonate and epoxy resins, and there are a number of minor uses including in the thermal paper and PVC industries. Polycarbonates are used in a wide range of applications. Epoxy resins are used as protective coatings, structural composites, electrical laminates, electrical applications and adhesives (Robertson, 2002). In PVC, bisphenol A can be present as an antioxidant in plasticizers (Swerea IVF, 2015).

2.1.2 Occurrence and content in materials

In the EU, 1 000 000 – 10 000 000 tonnes are produced annually (ECHA, 2015).

Bisphenol A was found in the polycarbonate shield part of pacifiers in a study from 2009 (Tönning et al., 2009). In a screening analysis, the concentrations were 1600-1900 µg/g, but the migration was low.

2.1.3 Migration and exposure potential from readymade articles

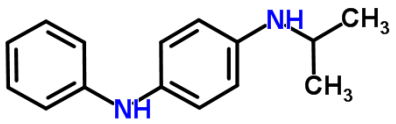
This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical

properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 4. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		**Migration and/or emission potential**
Vapour Pressure	4.12E-09 hPa (25 °C)	Non volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	300 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	3.4 (21.5 °C)	High partition constant. Indicates that this substance has high ability to dissolve in skin fat.

2.2 N-isopropyl-N-phenyl-p-phenylenediamine, CAS 101-72-4

Characteristics of the substance		**Reference**
		(Royal Society of Chemistry, 2015)
IUPAC name	N-isopropyl-N'-phenylbenzene-1,4-diamine	(ECHA, 2015)
Molecular formula	$C_{15}H_{18}N_2$	(ECHA, 2015)
Molecular weight (g/mol)	226.147	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 78.5 - 79 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 148 - 152 °C (2,67 hPa)	(ECHA, 2015)
Vapour Pressure	Experimental: 0.00007 hPa (20°C)	(ECHA, 2015)
Water Solubility	Experimental: 15 mg/l	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.77 (25°C)	(ECHA, 2015)

2.2.1 Specific uses in materials

The substance is used as a stablizer and antioxidant in rubber and is added to rubber formulations at levels of 1-2%. The rubber is shaped and moulded and then vulcanized to produce the finished article. This results in the inclusion of the substance into the rubber matrix. The main use is in the production of tyres (Robertson, 2002, Swedish Chemicals Agency., 2012).

2.2.2 Occurrence and content in materials

The annual production in Europe is 1,000 - 10,000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

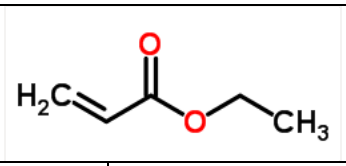
2.2.3 Migration and exposure potential from readymade articles

This substance has some critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 5. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.00007 hPa (20°C)	Non volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	15 mg/l	Medium water solubility. Indicates limited ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	2.77 (25°C)	High partition constant. Indicates that this substance has high ability to dissolve in skin fat.

2.3 Ethyl acrylate, CAS 140-88-5

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Ethyl acrylate	(ECHA, 2015)
Molecular formula	$C_5H_8O_2$	(ECHA, 2015)
Molecular weight (g/mol)	100.052	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: <-75 - -71.2 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 99-100 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 40 hPa (20.9 °C)	(ECHA, 2015)
Water Solubility	Experimental: 20 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 1.18 (25 °C)	(ECHA, 2015)

2.3.1 Specific uses in materials

Ethyl acrylate is a major monomer used in straight acrylic emulsion for textile applications, including backcoatings, fabric finishes, pigment binders, dirt release agents, and thickeners. It is also used to make emulsion polymers for paper coating and as leather finish resin (IARC, 1979,O'Neil, 2006). According to (OECD, 2004a), end-use consumer exposure to the substance is low since products only contain trace levels of acrylic acid and esters (as a result of polymerization). Ethyl acrylate emulsion (water-based) polymers are used in latex paints and coatings (Environment Canada and Health Canada, 2011). The substance can also be used as a fragrance (Swedish Chemicals Agency, 2013; van der Putte et al., 2013).

2.3.2 Occurrence and content in materials

The annual production in Europe is 100 000-1 000 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

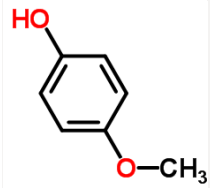
2.3.3 Migration and exposure potential from readymade articles

This substance has some critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 6. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	40 hPa (20.9 °C)	Medium volatile. Indicates that this substance has limited ability to be taken up via the respiratory tract.
Water Solubility	20 g/l (20 °C)	Medium water solubility. Indicates limited ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	1.18 (25 °C)	Low partition constant. Indicates that this substance does not have the ability to dissolve in skin fat.

2.4 Mequinol, CAS 150-76-5

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	4-methoxyphenol	(ECHA, 2015)
Molecular formula	$C_7H_8O_2$	(ECHA, 2015)
Molecular weight (g/mol)	124.052	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 55-58 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental: 242-246 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Experimental: 0,9 Pa (20 °C)	(ECHA, 2015)
Water Solubility	Weight of evidence: > 10 000 mg/l	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental weight of evidence: 1.13 (30 °C)	(ECHA, 2015)

2.4.1 Specific uses in materials

The substance is used in the manufacture of antioxidants, plasticizers, dyestuffs and as a stabilizer. It is also used as an UV inhibitor and as an inhibitor for acrylic monomers (The Finnish Environment Institute (SYKE), 2015, TOXNET, 2015a). Another identified use is as a stabilizing agent in textile lubricating oils (TOXNET, 2015a). The substance has been reported as a fragrance in textiles (Swedish Chemicals Agency, 2015a, van der Putte et al., 2013).

2.4.2 Occurrence and content in materials

The annual production in Europe is 1 000-10 000 tonnes (ECHA, 2015). In a Chinese study (Lv et al., 2013), mequinol was found in 1 of 5 tested paper toys (14.5 mg/kg) and in 3 of 4 tested plastic toys (5.6-8.9 mg/kg).

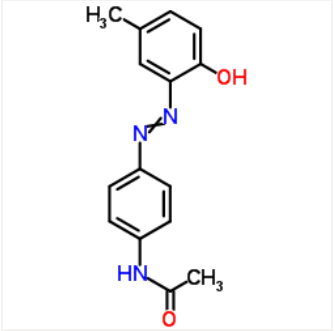
2.4.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 7. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0,9 Pa (20 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	> 10 000 mg/l	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	1.13 (30 °C)	Low partition constant. Indicates that this substance does not have the ability to dissolve in skin fat.

2.4.4 Disperse Yellow 3, CAS 2832-40-8

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	N-{4-[(2-Hydroxy-5-methylphenyl)diazenyl]phenyl}acetamide	(Royal Society of Chemistry, 2015)
Molecular formula	$C_{15}H_{15}N_3O_2$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	269.116	(Royal Society of Chemistry, 2015)
Melting point/range	268-270 °C	(Sigma-Aldrich, 2014)
Boiling Point/range	Predicted:533.9 ±50.0 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: 0.0±1.5 mmHg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	1.5-6.1 mg/l (60 °C)	(IARC, 1990)
Partition Coefficient (log Pow)	3.6	(Sigma-Aldrich, 2014)

2.4.5 Specific uses in materials

The substance is a dispersive dyestuff (Swedish Chemicals Agency, 2015a). It is used for natural and synthetic fibres, including use as pigment print (van der Putte et al., 2013). According to many references, the substance is most commonly used for the textile materials polyester, acetate, acrylic and polyamide (Society of Dyers and Colourists (SDC) and American Association of Textile Chemists and Colourists (AATCC), 2015, Swerea IVF, 2015, TOXNET, 2015b). Another identified use is as a dyestuff for plastic materials (Society

of Dyers and Colourists (SDC) and American Association of Textile Chemists and Colourists (AATCC), 2015, TOXNET, 2015b).

2.4.6 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

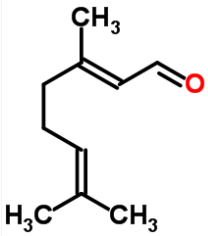
2.4.7 Migration and exposure potential from readymade articles

This substance has critical characteristics but also lack of data concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 8. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		**Migration and/or emission potential**
Vapour Pressure	Predicted: 0.0±1.5 mmHg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	1.5-6.1 mg/l (60 °C)	Low water solubility. This substance is not likely to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	3.6	High partition constant. Indicates that this substance has the ability to dissolve in skin fat.

2.5 Citral, CAS 5392-40-5

Characteristics of the substance		**Reference**
		(Royal Society of Chemistry, 2015)
IUPAC name	Reaction mass of (E)-3,7-dimethylocta-2,6-dienal and (Z)-3,7-dimethylocta-2,6-dienal	(ECHA, 2015)
Molecular formula	$C_{10}H_{16}O$	(ECHA, 2015)
Molecular weight (g/mol)	152.120	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: < 10 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 230 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 0.071 hPa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 0.42 g/l (25 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.76 (25 °C)	(ECHA, 2015)

2.5.1 Specific uses in materials

The substance is primarily used as a precursor for manufacturing of fragrance ingredients (TOXNET, 2015c), but can also be used as a fragrance ingredient in fragrance compositions (TOXNET, 2015c, Swedish Chemicals Agency, 2015a, van der Putte et al., 2013). It occurs in rubber, plastics, paper and chemicals (Swedish Chemicals Agency., 2012).

2.5.2 Occurrence and content in materials

The annual production in Europe is 1 000-10 000 tonnes (ECHA, 2015). In a Danish survey, citral was found in soap-bubbles in a concentration of 27 mg/kg (Glenswig and Pors, 2006). In the same study, emissions of citral from felt pens were analyzed to be 400 µg/m^3 air. Typical concentration range for use in fragrance compositions is 0.1-1% (TOXNET, 2015c).

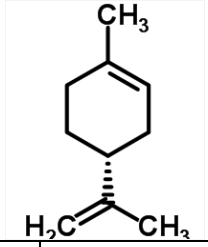
2.5.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 9. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		**Migration and/or emission potential**
Vapour Pressure	0.071 hPa (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	0.42 g/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	2.76 (25 °C)	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.6 (+)-(R)-limonene, CAS 5989-27-5

Characteristics of the substance		**Reference**
		(Royal Society of Chemistry, 2015)
IUPAC name	(4R)-isopropenyl-1-methylcyclohexene	(ECHA, 2015)
Molecular formula	$C_{10}H_{16}$	(ECHA, 2015)
Molecular weight (g/mol)	136.125	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: -73.6 °C	(ECHA, 2015)
Boiling Point/range	Experimental weight of evidence: 175.5-176 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 200 Pa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 5.69 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 4.38 (37 °C)	(ECHA, 2015)

2.6.1 Specific uses in materials

The substance is used as a fragrance (Swedish Chemicals Agency, 2015a), for instance in textiles (van der Putte et al., 2013).

2.6.2 Occurrence and content in materials

The annual European production is 10 000-100 000 tonnes (ECHA, 2015). In a Danish survey, the substance was found in an orange felt pen in a concentration of 0,21 mg/g (Lyck

Hansen et al., 2008). It was also found in erasers (Svendsen et al., 2007a). In another study, the substance was found in soap bubbles (7 mg/kg), in an eraser (22 mg/kg) and in a feltpen (800 mg/kg) (Glenswig and Ports, 2006). In a Chinese study, limonene was found in 3 out of four tested play clays, in concentrations ranging from 18 to 183 mg/kg (Lv et al., 2013).

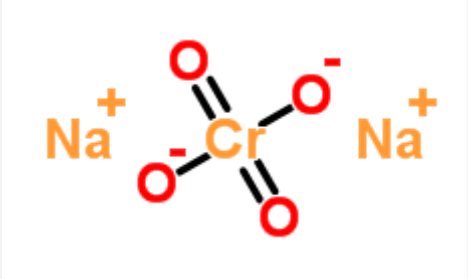
2.6.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 10. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		**Migration and/or emission potential**
Vapour Pressure	200 Pa (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	5.69 g/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	4.38 (37 °C)	High partition constant. Indicates that this substance may have high ability to dissolve in skin fat.

2.7 Sodium chromate, CAS 7775-11-3

Characteristics of the substance		**Reference**
		(Royal Society of Chemistry, 2015)
IUPAC name	disodium dioxido(dioxo)chromium	(ECHA, 2015)
Molecular formula	$CrH_2O_4 \cdot 2Na$	(ECHA, 2015)
Molecular weight (g/mol)	140.925	(Royal Society of Chemistry, 2015)
Melting point/range	Handbook data: 792 °C	(ECHA, 2015)
Boiling Point/range	not applicable	
Vapour Pressure	not applicable	
Water Solubility	Handbook data: 44.3% (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	not applicable	

2.7.1 Specific uses in materials

The substance is used for manufacture of other chromium compounds (European Chemichals Bureau, 2005). For textile materials, it is an functional chemical which is used in complex dyes, pigments and printing pastes for materials such as leather, silk and wool (Swerea IVF, 2015). It is also used as a surface treatment for steel due to its anti corrosive properties and in pigments for plastic materials (Swerea IVF, 2015).

2.7.2 Occurrence and content in materials

The annual production in Europe is 0-10 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

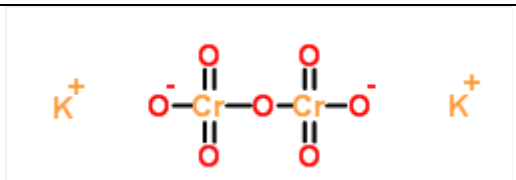
2.7.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic, which is the only applicable for metallic compounds, to emit into certain media (water and sweat) that may be relevant for some of the applications identified in this study. This critical property is described below in terms of substance's ability to migrate to skin in the identified applications and materials.

Table 11. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	not applicable	Vapour pressure is not applicable. No assumptions can be drawn.
Water Solubility	Handbook data: 44.3% (20 °C)	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	not applicable	Partition coefficient is not applicable. No assumptions can be drawn.

2.8 Potassium dichromate, CAS 7778-50-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	potassium dichromate (VI)	(ECHA, 2015)
Molecular formula	$Cr_2H_2O_7 \cdot 2K$	(ECHA, 2015)
Molecular weight (g/mol)	296.2	
Melting point/range	Experimental: 398 °C	(ECHA, 2015)
Boiling Point/range	Decomposition temperature >500 °C	(ECHA, 2015)
Vapour Pressure	not applicable	(ECHA, 2015)
Water Solubility	Experimental: approx. 115 g/l	(ECHA, 2015)
Partition Coefficient (log Pow)	not applicable	(ECHA, 2015)

2.8.1 Specific uses in materials

The substance is used in textile dyestuffs (Swerea IVF, 2015, European Chemichals Bureau, 2005, TOXNET, 2015d, van der Putte et al., 2013). The main textile materials it can be used for are polyamide, silk and wool (Swerea IVF, 2015). It can also be used in the leather tanning process (TOXNET, 2015d) and as a colouring agent in ceramics (European Chemichals Bureau, 2005, TOXNET, 2015d). It is also used for anti corrosive treatment of steel (Swerea IVF, 2015).

2.8.2 Occurrence and content in materials

The annual European production is 100-1 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

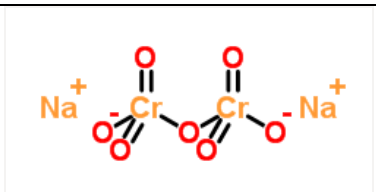
2.8.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic, which is the only applicable for metallic compounds, to emit into certain media (water and sweat) that may be relevant for some of the applications identified in this study. This critical property is described below in terms of substance's ability to migrate to skin in the identified applications and materials.

Table 12. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	not applicable	Vapour pressure is not applicable. No assumptions can be drawn.
Water Solubility	Experimental: approx. 115 g/l	Limited water solubility. Indicates limited ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	not applicable	Partition coefficient is not applicable. No assumptions can be drawn.

2.9 Sodium dichromate, CAS 10588-01-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	sodium dichromate	(ECHA, 2015)
Molecular formula	$Cr_2H_2O_7 \cdot 2Na$	(ECHA, 2015)
Molecular weight (g/mol)	263.982	
Melting point/range	Experimental:ap proximately 357 °C	(ECHA, 2015)
Boiling Point/range	Experimental: Decomposition temperature: >400 °C	(ECHA, 2015)
Vapour Pressure	not applicable	(ECHA, 2015)
Water Solubility	Experimental: approximately 2.355 g/l	(ECHA, 2015)
Partition Coefficient (log Pow)	not applicable	(ECHA, 2015)

2.9.1 Specific uses in materials

The substance is used for oxidation of vat and sulphur dyes and for finishing of wet textiles to improve their wash fastness. It is also used for preparation and finishing of acid dyes. The most common textile materials it is used for are polyamide, silk and wool. Chromium salts are also used for tanning of leather (Swerea IVF, 2015).

2.9.2 Occurrence and content in materials

The annual European production is 10 000-1 00 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

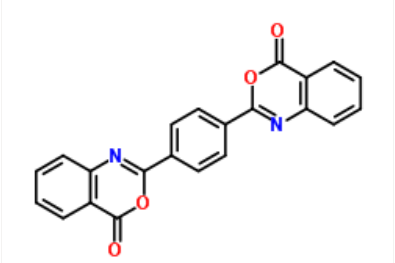
2.9.3 Migration and exposure potential from readymade articles

This substance has no critical characteristics. The only applicable characteristic for metallic compounds is water solubility that may be relevant for some of the applications identified in this study. This critical property is described below in terms of substance's ability to migrate to skin in the identified applications and materials.

Table 13. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	not applicable	Vapour pressure is not applicable. No assumptions can be drawn.
Water Solubility	approximately 2.355 g/l	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	not applicable	Partition coefficient is not applicable. No assumptions can be drawn.

2.10 2,2-(1,4-phenylene)bis((4H-3,1-benzoxazine-4-one), CAS 18600-59-4

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2,2'-(1,4-phenylene)bis-(4H-3,1-benzoxazin-4-one)	(ECHA, 2015)
Molecular formula	$C_{22}H_{12}N_2O_4$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	368.079	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 315 °C	(ECHA, 2015)
Boiling Point/range	Experimental: >456 °C	(ECHA, 2015)
Vapour Pressure	Experimental: <0.0000015 Pa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: Insoluble (<0.112 mg/l)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 4.7 (22 °C)	(ECHA, 2015)

2.10.1 Specific uses in materials

The substance is used as a UV stabilisator in, for instance, polyester (Swedish Chemicals Agency, 2015b).

2.10.2 Occurrence and content in materials

The annual European production is more than 10 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.10.3 Migration and exposure potential from readymade articles

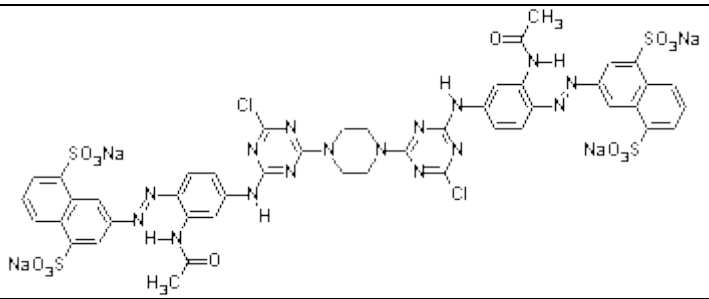
This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 14. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	Experimental:	Not volatile.

	<0.0000015 Pa (25 °C)	Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	Experimental: Insoluble (<0.112 mg/l)	No water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	Experimental: 4.7 (22 °C)	High partition constant. Indicates that this substance may have high ability to dissolve in skin fat.

2.11 Direct yellow 162, CAS 81898-60-4

Characteristics of the substance		Reference
		(Society of Dyers and Colourists (SDC) and American Association of Textile Chemists and Colourists (AATCC), 2015)
IUPAC name	no data available	
Molecular formula	$C_{46}H_{38}Cl_2N_{16}O_{14}S_4 \cdot 4Na$	(Zhejiang NetSun Co., 2015)
Molecular weight (g/mol)	1326.00	(Zhejiang NetSun Co., 2015)
Melting point/range	no data available	
Boiling Point/range	no data available	
Vapour Pressure	no data available	
Water Solubility	high	(European Commission, 2003)
Partition Coefficient (log Pow)	no data available	

2.11.1 Specific uses in materials

The substance is used as a direct dyestuff for textiles (Swedish Chemicals Agency, 2015a). The dyestuff is mostly used for cotton, polyamide, silk, viscose and wool (Swerea IVF, 2015).

2.11.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.11.3 Migration and exposure potential from readymade articles

This substance has one identified critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 15. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	no data available	
Water Solubility	high	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	no data available	

2.12 Reactive Blue 204, CAS 85153-92-0

Characteristics of the substance		Reference
IUPAC name	4,11-Triphenodioxazinedisulfonic acid, 6,13-dichloro-3,10-bis[[3-[[4-[(2,5-disulfophenyl)amino]-6-fl uoro-1,3,5-triazin-2-yl]amino]propyl]amino]-, hexasodiumsalt	(US EPA, 2015)
Molecular formula	$C_{42}H_{34}Cl_2F_2N_{14}O_{20}S_6 \cdot 6Na$	(Zhejiang NetSun Co., 2015)
Molecular weight (g/mol)	1490.00	(Chemical register, 2015)
Melting point/range	no data available	
Boiling Point/range	no data available	
Vapour Pressure	no data available	
Water Solubility	high	(European Commission, 2003)
Partition Coefficient (log P_{ow})	no data available	

2.12.1 Specific uses in materials

The substance is used as a reactive dyestuff for natural textile fibres, especially cotton (van der Putte et al., 2013).

2.12.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.12.3 Migration and exposure potential from readymade articles

This substance has one identified critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 16. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	no data available	
Water Solubility	high	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log P_{ow})	no data available	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.

2.13 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, CAS 136213-75-7

Characteristics of the substance		Reference
IUPAC name	no data available	
Molecular formula	no data available	

Molecular weight (g/mol)	no data available	
Melting point/range	no data available	
Boiling Point/range	no data available	
Vapour Pressure	no data available	
Water Solubility	high	(European Commission, 2003)
Partition Coefficient (log Pow)	no data available	

2.13.1 Specific uses in materials

The substance is an acid dyestuff (Swedish Chemicals Agency, 2015a). It is mainly used for the textile materials polyamide, silk and wool (Swerea IVF, 2015).

2.13.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.13.3 Migration and exposure potential from readymade articles

This substance has one identified critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 17. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		**Migration and/or emission potential**
Vapour Pressure	no data available	
Water Solubility	high	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	no data available	

2.14 A mixture of: sodium/potassium 7-[[[3-[[4-(2-hydroxynaphthyl)azo)phenyl]azo]phenyl]sulfonylamino]-naphthalene-1,3-disulfonate (Acid Red 447), CAS 141880-36-6

Characteristics of the substance		**Reference**
IUPAC name	1,3-Naphthalenedisulfonic acid, 7-[[[3-[[4-[(2-hydroxy-1-naphthalenyl)azo]phenyl] azo]phenyl]sulfonyl]amino]-, potassium sodium salt	(Department of health - Australian Government, 2015)
Molecular formula	$C_{32}H_{23}N_5O_9S_3 \cdot K \cdot Na$	(Department of health - Australian Government, 2015)
Molecular weight (g/mol)	777.004	(US EPA, 2015)
Melting point/range	no data available	
Boiling Point/range	no data available	
Vapour Pressure	no data available	
Water Solubility	high	(European Commission, 2003)
Partition Coefficient (log Pow)	no data available	

2.14.1 Specific uses in materials

The substance is an acid dyestuff (Swedish Chemicals Agency, 2015a). Some of the main textile materials it is used for are polyamide, silk and wool (Swerea IVF, 2015). According to (van der Putte et al., 2013) is the substance not remaining in the finished product.

2.14.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.14.3 Migration and exposure potential from readymade articles

This substance has one identified critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 18. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		**Migration and/or emission potential**
Vapour Pressure	no data available	
Water Solubility	high	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	no data available	

2.15 Sodium 3-(2-acetamido-4-(4-(2-hydroxybutoxy)phenylazo)phenylazo)benzene sulfonate, CAS 147703-65-9

Characteristics of the substance		**Reference**
IUPAC name		
Molecular formula	$C_{24}H_{24}N_5NaO_6S$	(Zhejiang NetSun Co., 2015)
Molecular weight (g/mol)	533.53	(Zhejiang NetSun Co., 2015)
Melting point/range	no data available	
Boiling Point/range	no data available	
Vapour Pressure	no data available	
Water Solubility	high	(European Commission, 2003)
Partition Coefficient (log Pow)	no data available	

2.15.1 Specific uses in materials

The substance is an acid dyestuff for textiles. Some of the most common materials are polyamide, silk and wool (Swerea IVF, 2015).

2.15.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.15.3 Migration and exposure potential from readymade articles

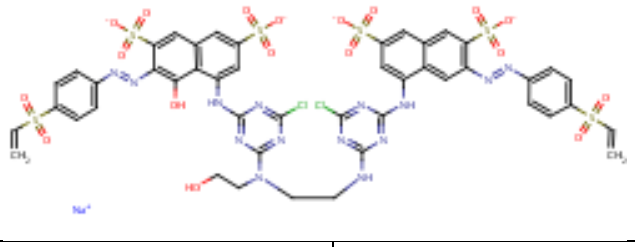
This substance has one identified critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These

critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 19. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		**Migration and/or emission potential**
Vapour Pressure	no data available	
Water Solubility	high	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	no data available	

2.16 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 (Reactive Red 264), CAS 171599-85-2

Characteristics of the substance		**Reference**
		(US EPA, 2015)
IUPAC name	no data available	
Molecular formula	$C_{46}H_{34}Cl_2N_{14}NaO_{18}S_6$	(US EPA, 2015)
Molecular weight (g/mol)	1354.977	(US EPA, 2015)
Melting point/range	Experimental: >400 °C	(National Industrial Chemicals Notification and Assessment Scheme, 1998)
Boiling Point/range	Calculated: 1040 °C	(National Industrial Chemicals Notification and Assessment Scheme, 1998)
Vapour Pressure	Calculated: $8x10^{-45}$ kPa (25 °C)	(National Industrial Chemicals Notification and Assessment Scheme, 1998)
Water Solubility	Experimental: >400 g/l	(National Industrial Chemicals Notification and Assessment Scheme, 1998)
Partition Coefficient (log Pow)	Estimated: -2 (20 °C)	(National Industrial Chemicals Notification and Assessment Scheme, 1998)

2.16.1 Specific uses in materials

The substance is a reactive dyestuff (Swedish Chemicals Agency, 2015a). According to (van der Putte et al., 2013) is it used for yarn and not remaining on the final product. It is used for dyeing of cellulose textiles (National Industrial Chemicals Notification and Assessment Scheme, 1998).

2.16.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

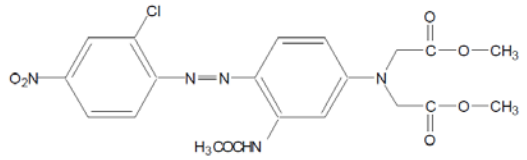
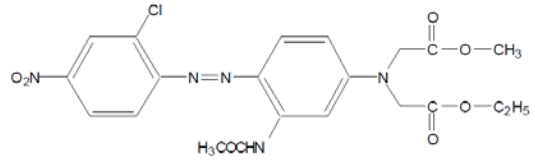
2.16.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 20. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	$8x10^{-45}$ kPa (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	>400 g/l	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	-2 (20 °C)	Low partition constant. Indicates that this substance will not have the ability to dissolve in skin fat.

2.17 Glycine, N-[13-(acetylamino)phenyl]-N-(carbo1ymethyl)-, mi1ed ET and Me diesters, reaction products with diazotied 2-choloro-4-nitrobenzenamine, CAS 188070-47-5

Characteristics of the substance		Reference
Main component 1  Main component 2 		(National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 1999)
IUPAC name	no data available	
Molecular formula	C20H20ClN5O7 and C21H22ClN5O7	(National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 1999)
Molecular weight (g/mol)	477 and 491	(National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 1999)
Melting point/range	187-194 °C	(National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 1999)
Boiling Point/range	no data available	
Vapour Pressure	4.2*10-5 kPa	(National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 1999)
Water Solubility	<1 mg/l (20 °C)	(National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 1999)
Partition Coefficient (log Pow)	3.8 (21 °C)	(National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 1999)

2.17.1 Specific uses in materials

The substance is a dispersive dyestuff (Swedish Chemicals Agency, 2015a). It can be used for dyeing of polyester, and due to the high fixation performance of the substance, emissions

during the use phase are expected to be negligible (National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 1999).

2.17.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.17.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 21. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		**Migration and/or emission potential**
Vapour Pressure	4.2*10-5 kPa	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	<1 mg/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log P_{OW})	3.8 (21 °C)	High partition constant. Indicates that this substance may have the ability to dissolve in skin fat.

2.18 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, CAS 500717-36-2

Characteristics of the substance		**Reference**
IUPAC name	no data available	
Molecular formula	no data available	
Molecular weight (g/mol)	no data available	
Melting point/range	no data available	
Boiling Point/range	no data available	
Vapour Pressure	no data available	
Water Solubility	high	(European Commission, 2003)
Partition Coefficient (log P_{OW})	no data available	

2.18.1 Specific uses in materials

The substance is a reactive dyestuff (Swedish Chemicals Agency, 2015a).

2.18.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

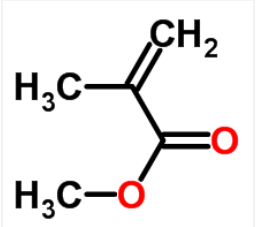
2.18.3 Migration and exposure potential from readymade articles

This substance has one identified critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 22. Critical characteristics that may result in migration and/or emissions from the identified applications and materials

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	no data available	
Water Solubility	high	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	no data available	

2.19 Methyl methacrylate, CAS 80-62-6

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	methyl methacrylate	(ECHA, 2015)
Molecular formula	$C_5H_8O_2$	(ECHA, 2015)
Molecular weight (g/mol)	100.052	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: -47 - -48°C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental: 100.36 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 37 hPa (20 °C)	(ECHA, 2015)
Water Solubility	Experimental: 15.3 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 1.38 (20 °C)	(ECHA, 2015)

2.20 Specific uses in materials

The primary use of methyl methacrylate is the production of acrylic plastics and resins for sheeting and molding compounds. These are used for many different purposes, including consumer products (Swedish Chemicals Agency., 2012). The substance can be used for production of surface coatings and plastics (TOXNET, 2015e).

2.20.1 Occurrence and content in materials

The annual European production of the substance is 100 000-1 000 000 tonnes (ECHA, 2015). In a Danish survey, the substance was found in a blue gel for hair, skin and lips (7.2 % (m/m)) (Svendsen et al., 2005). In another study, 8.9 mg/kg of the substance was found in a pop-up colorant for textiles (Hansen, 2005).

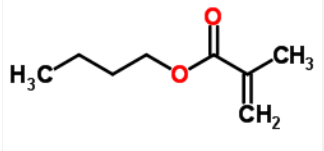
2.20.2 Migration and exposure potential from readymade articles

This substance has some critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 23. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	37 hPa (20 °C)	Medium volatile. Indicates limited ability for this substance to be taken up via the respiratory tract.
Water Solubility	15.3 g/l (20 °C)	Medium water solubility. Indicates limited ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	1.38 (20 °C)	Low partition constant. Indicates that this substance does not have the ability to dissolve in skin fat.

2.21 Butyl methacrylate, CAS 97-88-1

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	butyl methacrylate	(ECHA, 2015)
Molecular formula	$C_8H_{14}O_2$	(ECHA, 2015)
Molecular weight (g/mol)	142.099	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: -75 - - 50 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental 160-163 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Experimental: 2.12 hPa (20 °C)	(ECHA, 2015)
Water Solubility	Experimental: 360 mg/l (25 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.29 (20 °C)	(ECHA, 2015)

2.21.1 Specific uses in materials

The substance is used as a monomer for resins, solvent coatings and adhesives. It is also used for leather and paper finishing and in emulsions for textile (TOXNET, 2015f, OECD, 2004b).

2.21.2 Occurrence and content in materials

The annual European production of the substance is 10 000-100 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.21.3 Migration and exposure potential from readymade articles

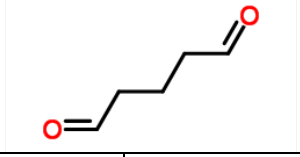
This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 24. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	2.12 hPa (20 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	360 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.

Partition Coefficient (log Pow)	2.29 (20 °C)	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.22 Glutaral, CAS 111-30-8

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Glutaraldehyde	(ECHA, 2015)
Molecular formula	$C_5H_8O_2$	(ECHA, 2015)
Molecular weight (g/mol)	100.052	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: -33 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 101.5 °C	(ECHA, 2015)
Vapour Pressure	28 hPa (25.1 °C)	(ECHA, 2015)
Water Solubility	Predicted: 167 000 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	Experimental: -0.36 (23 °C)	(ECHA, 2015)

2.22.1 Specific uses in materials

The primary use of the substance is as a biocide (National Industrial Chemicals Notification and Assessment Scheme, 1994). The substance can be used in the leather tanning process for softening of leather (OECD, 2001a, National Industrial Chemicals Notification and Assessment Scheme, 1994, Swedish Chemicals Agency., 2012).

2.22.2 Occurrence and content in materials

The annual European production is more than 1 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

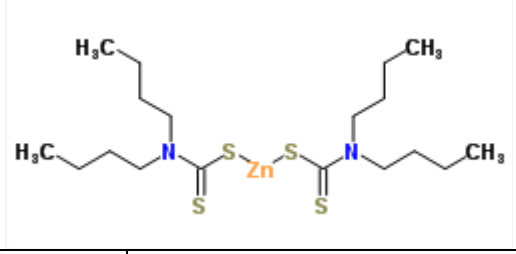
2.22.3 Migration and exposure potential from readymade articles

This substance has some critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 25. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	28 hPa (25.1 °C)	Medium volatile. Indicates that this substance have limited ability to be taken up via the respiratory tract.
Water Solubility	167 000 mg/l	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	-0.36 (23 °C)	Low partition constant. Indicates that this substance does not have the ability to dissolve in skin fat.

2.23 Zinc bis(dibutyldithiocarbamate), CAS 136-23-2

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	zinc bis(dibutyldithiocarbamate)	(ECHA, 2015)
Molecular formula	$C_{18}H_{36}N_2S_4Zn$	(ECHA, 2015)
Molecular weight (g/mol)	472.105	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 110-112 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 318 °C	(ECHA, 2015)
Vapour Pressure	Experimental: <0.0001 Pa (20 °C)	(ECHA, 2015)
Water Solubility	read-across from similar substance: <1 mg/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: >4.37 (25 °C)	(ECHA, 2015)

2.23.1 Specific uses in materials

The substance is used as an accelerator for rubber vulcanization and latex dispersions (TOXNET, 2015g).

2.23.2 Occurrence and content in materials

The annual European production is 10-100 tonnes (ECHA, 2015). In a Danish survey on chemical substances in balloons, the substance most probably was found in all tested balloons (Nilsson, 2007).

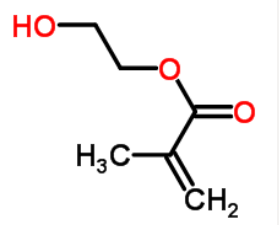
2.23.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 26. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	<0.0001 Pa (20 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	<1 mg/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	>4.37 (25 °C)	High partition constant. Indicates that this substance may have high ability to dissolve in skin fat.

2.24 2-hydroxyethyl methacrylate, CAS 868-77-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2-hydroxyethyl methacrylate	(ECHA, 2015)
Molecular formula	$C_6H_{10}O_3$	(ECHA, 2015)
Molecular weight (g/mol)	130.063	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: -12 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental: 213 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 0.08 hPa (20 °C)	(ECHA, 2015)
Water Solubility	Experimental: >100 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 0.42 (25 °C)	(ECHA, 2015)

2.24.1 Specific uses in materials

The substance is used as a monomer for synthesis of polymers and as a raw material to be polymerized in paint, adhesives and coatings (OECD, 2001b). It can also be used as an acrylic resin and as a binder for nonwoven fabrics (TOXNET, 2015h).

2.24.2 Occurrence and content in materials

The annual European production is 10 000-100 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

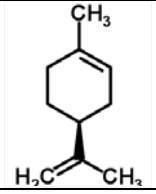
2.24.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 27. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.08 hPa (20 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	>100 g/l (20 °C)	Medium to high water solubility. Indicates limited or high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	0.42 (25 °C)	Low partition constant. Indicates that this substance does not have the ability to dissolve in skin fat.

2.25 (S)-p-mentha-1,8-diene (*d*-Limonene), CAS 5989-54-8

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	(4S)-(-)-1-methyl-4-prop-1-en-2-ylcyclohexene	(ECHA, 2015)
Molecular formula	$C_{10}H_{16}$	(ECHA, 2015)
Molecular weight (g/mol)	136.125	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: -74 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 176 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 190 Pa (20 °C)	(ECHA, 2015)
Water Solubility	read-across from similar substance: 12.3 mg/l (25 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 4.5 (25 °C)	(ECHA, 2015)

2.25.1 Specific uses in materials

The substance is mainly used for formulation of fragrance or flavor blends. Other uses are as wetting and dispersing agent, resins and adhesives, and also as adhesive agent in rubber treatment (National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 2002).

2.25.2 Occurrence and content in materials

The annual European production is 10-100 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

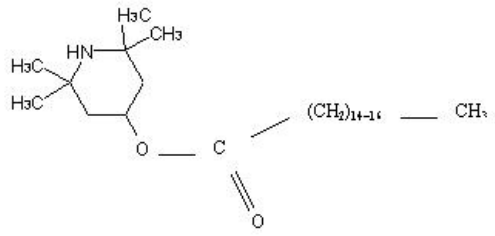
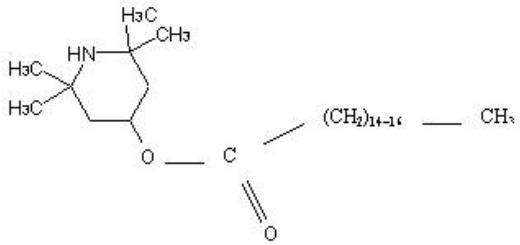
2.25.3 Migration and exposure potential from readymade articles

This substance has some critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 28. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	190 Pa (20 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	12.3 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	4.5 (25 °C)	High partition constant. Indicates that this substance may have high ability to dissolve in skin fat.

2.26 A mixture of: 2,2,6,6-tetramethylpiperidin-4-yl-hexadecanoate; 2,2,6,6-tetramethylpiperidin-4-yl-octadecanoate, CAS 86403-32-9

Characteristics of the substance		Reference
 2,2,6,6-Tetramethyl-4-piperidinyl octadecanoate  2,2,6,6-Tetramethyl-4-piperidinyl hexadecanoate		(ECHA, 2015)
IUPAC name	2,2,6,6-Tetramethyl-4-piperidinyl octadecanoate and 2,2,6,6-Tetramethyl-4-piperidinyl hexadecanoate	(ECHA, 2015)
Molecular formula		
Molecular weight (g/mol)		
Melting point/range	Experimental: 30 °C	(ECHA, 2015)
Boiling Point/range	Experimental: >350 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 0.0000021 Pa (20 °C)	(ECHA, 2015)
Water Solubility	Experimental: 0.5 mg/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log P_{OW})	Experimental: 8.9 (20 °C)	(ECHA, 2015)

2.26.1 Specific uses in materials

This mixture is called Hindered Amine Light Stabilizers (HALS) and is used as a light stabilizer in polyolefins such as polyethylene and polypropene (Clariant, 2012) .

2.26.2 Occurrence and content in materials

The annual European production is more than 100 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

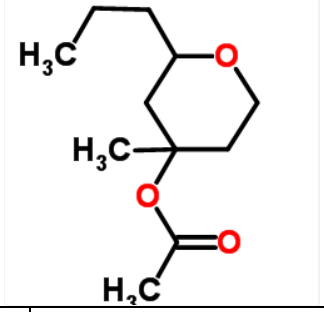
2.26.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 29. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.0000021 Pa (20 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	0.5 mg/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	8.9 (20 °C)	High partition constant. Indicates that this substance may have high ability to dissolve in skin fat.

2.27 A mixture of: trans-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran; cis-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran, CAS 131766-73-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	reaction mass of: trans-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran cis-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran	(ECHA, 2015)
Molecular formula	$C_{11}H_{20}O_3$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	200.141	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental: 238 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 42.85 Pa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 2500 mg/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.39 (23 °C)	(ECHA, 2015)

2.27.1 Specific uses in materials

The substance has been reported as used in fragrance compounds (International Fragrance Association, 2015). It is most likely predominantly used for cosmetic applications.

2.27.2 Occurrence and content in materials

The annual European production is 0-10 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

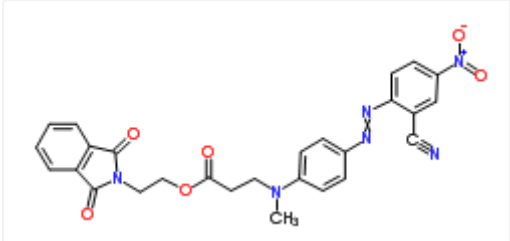
2.27.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 30. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	42.85 Pa (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	2500 mg/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	2.39 (23 °C)	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.28 RED RA 10463, CAS 170222-39-6

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2-phthalimidoethyl N-[4-(2-cyano-4-nitrophenylazo)phenyl]-N-methyl-β-alaninate	(ECHA, 2015)
Molecular formula	$C_{27}H_{22}N_6O_6$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	526.460	(Royal Society of Chemistry, 2015)
Melting point/range	NS: 171 °C	(ECHA, 2015)
Boiling Point/range	Predicted: 680-800 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	NS: 0.152 Pa (24.6 °C)	(ECHA, 2015)
Water Solubility	NS: <0.009 mg/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	NS: ca 4.1 (22 °C)	(ECHA, 2015)

2.28.1 Specific uses in materials

The substance is used for dyeing of polyester and polyester blend fibres (National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 2000).

2.28.2 Occurrence and content in materials

The annual European production is more than 1 tonne (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

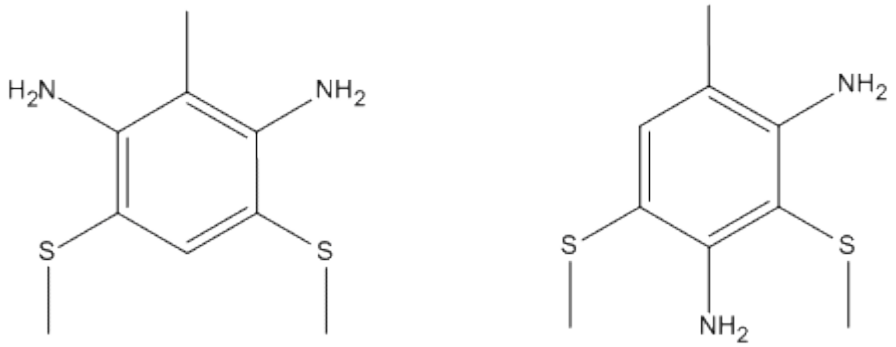
2.28.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 31. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.152 Pa (24.6 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	<0.009 mg/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	ca 4.1 (22 °C)	High partition constant. Indicates that this substance may have high ability to dissolve in skin fat.

2.29 A mixture of: 3,5-dimethylthio-2,4-toluenediamine; 3,5-dimethylthio-2,6-toluenediamine, CAS 106264-79-3

Characteristics of the substance		Reference
		(ECHA, 2015)
IUPAC name	3,5-Dimethylthio-2,4-(or 2,6-)toluenediamine	(ECHA, 2015)
Molecular formula	$C_9H_{14}N_2S_2$	(ECHA, 2015)
Molecular weight (g/mol)	214	(Albemarle, 2011).
Melting point/range	Experimental: <0 °C	(ECHA, 2015)
Boiling Point/range	Experimental: Not determinable. The mixture started to decompose at 225 °C	(ECHA, 2015)
Vapour Pressure	Experimental: <10 Pa (20 °C)	(ECHA, 2015)
Water Solubility	Experimental: 162 mg/l for isomer A, 298 mg/l for isomer B (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.37 for isomer A and 2.63 for isomer B (20 °C)	(ECHA, 2015)

2.29.1 Specific uses in materials

The substance is a process chemical used as a curative for polyurethane cast elastomers and as a chain extender for polyurethane urea and polyurea elastomers in reaction injection molding (Albemarle, 2011).

2.29.2 Occurrence and content in materials

The annual European production is 100-1000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

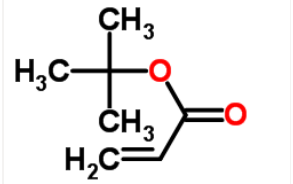
2.29.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 32. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	<10 Pa (20 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	162 mg/l for isomer A, 298 mg/l for isomer B (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	2.37 for isomer A and 2.63 for isomer B (20 °C)	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.30 Tert-butyl acrylate, CAS 1663-39-4

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Tert-butyl-acrylate	(ECHA, 2015)
Molecular formula	$C_7H_{12}O_2$	(ECHA, 2015)
Molecular weight (g/mol)	128.084	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: -69 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 119.2 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 20 hPa (23.4 °C)	(ECHA, 2015)
Water Solubility	Experimental: 2 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.32 (25 °C)	(ECHA, 2015)

2.30.1 Specific uses in materials

The substance is a monomer for acrylic resins which mainly is used in surface coatings and plastics (TOXNET, 2015j, Swedish Chemicals Agency., 2012). It could also be used as an additive in manufacturing of paper (OECD, 2005a).

2.30.2 Occurrence and content in materials

In 2005, the annual European production was 1 000–10 000 tonnes (OECD, 2005a). According to specification limits for the substance in polymers, less than 10 ppm is suspected to be present in the final polymer (OECD, 2005a). However, no data on measured concentrations of the substance in toys or textiles that could verify this were found in the literature study.

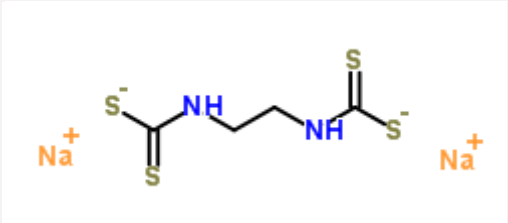
2.30.3 Migration and exposure potential from readymade articles

This substance has some critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 33. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	20 hPa (23.4 °C)	Medium volatile. Indicates that this substance have limited ability to be taken up via the respiratory tract.
Water Solubility	2 g/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	2.32 (25 °C)	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.31 Nabam, CAS 142-59-6

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	disodium;N-[2-(sulfidocarbothioylamino)ethyl]carbamodithioate	
Molecular formula	$C_4H_6N_2Na_2S_4$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	255.921	(Royal Society of Chemistry, 2015)
Melting point/range	Decomposes on heating without melting	(TOXNET, 2015j)
Boiling Point/range	no data available	
Vapour Pressure	Negligable	(TOXNET, 2015j)
Water Solubility	$2*10^5$ mg/l (room temperature)	(TOXNET, 2015j)
Partition Coefficient (log Pow)	Estimated: -4.24	(TOXNET, 2015j)

2.31.1 Specific uses in materials

The substance is a broad spectrum fungicide, which, for instance is used in leather and paper industries (TOXNET, 2015j). Biocidal agents belonging to the use phase are used to prevent microbiotic growth during transportation or smell during use (Swedish Chemicals Agency., 2012).

2.31.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

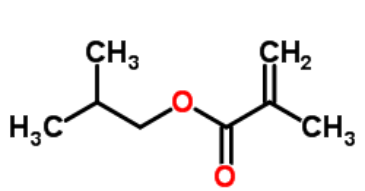
2.31.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 34. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	Negligable	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	$2*10^5$ mg/l (room temperature)	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	-4.24	Low partition constant. Indicates that this substance does not have the ability to dissolve in skin fat.

2.32 Isobutyl methacrylate, CAS 97-86-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2-Propenoic acid, 2-methyl-, 2-methylpropyl ester	(ECHA, 2015)
Molecular formula	$C_8H_{14}O_2$	(ECHA, 2015)
Molecular weight (g/mol)	142.099	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: -35 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 155 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 2.11 hPa (20 °C)	(ECHA, 2015)
Water Solubility	Experimental: 0.57 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.95 (20 °C)	(ECHA, 2015)

2.32.1 Specific uses in materials

The substance is typically used to form coatings, paint, lacquers, varnishes and inks (OECD, 2004c, Swedish Chemicals Agency., 2012). Other uses are as solvent, lubricant, fragrance, defoaming agent and adhesive. It could also be used as a fiber treating compound and paper coating agent (Swedish Chemicals Agency., 2012).

2.32.2 Occurrence and content in materials

The annual European production is 10 000-100 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.32.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 35. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	2.11 hPa (20 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	0.57 g/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	2.95 (20 °C)	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.33 Cobalt, CAS 7440-48-4

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	cobalt(2+)	(ECHA, 2015)
Molecular formula	Co	(ECHA, 2015)
Molecular weight (g/mol)	58.933	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 1495 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental: 2900 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	0 mm Hg	(Royal Society of Chemistry, 2015)
Water Solubility	Experimental: 2.94 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Not applicable	

2.33.1 Specific uses in materials

The main application of cobalt metal is as a metal alloy and it is also used for production of permanent magnets (TOXNET, 2015l, Swedish Chemicals Agency., 2012, OECD, 2010a). In the plastic industry, cobalt is used as a catalyst (TOXNET, 2015k). The substance is also used in coulorants for textiles and can be found as an impurity in dyes and pigments (Swedish Chemicals Agency., 2012, van der Putte et al., 2013).

2.33.2 Occurrence and content in materials

The annual European production is more than 10 000 tonnes (ECHA, 2015). In a Danish survey, cobalt was found in 5 out of 20 examined textiles of different types. In yellow cotton 2.2 mg/kg, in colourful polyester 21 mg/kg, in viscose 43 mg/kg, in wool 5.6 mg/kg and in cotton 48 mg/kg. (Ellebäk Laursen et al., 2003)

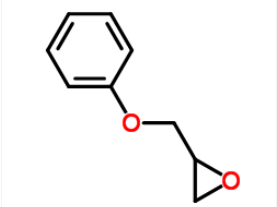
2.33.3 Migration and exposure potential from readymade articles

This substance has no critical characteristics. The only applicable characteristic for metallic compounds is water solubility that may be relevant for some of the applications identified in this study. This critical property is described below in terms of substance's ability to migrate to skin in the identified applications and materials.

Table 36. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0 mm Hg	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	2.94 g/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	not applicable	Partition coefficient is not applicable for metals.

2.34 2,3-epoxypropyl phenyl ether, CAS 122-60-1

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2-(phenoxymethyl)oxirane	(ECHA, 2015)
Molecular formula	$C_9H_{10}O_2$	(ECHA, 2015)
Molecular weight (g/mol)	150.068	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 3.5 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental: 244-246 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Experimental: 0.013 hPa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 2400 mg/l (25 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Calculated: 1.61 (25 °C)	(ECHA, 2015)

2.34.1 Specific uses in materials

The substance is used as a plasticizer for epoxy resins (TOXNET, 2015l). End applications include coating, adhesive, casting, laminating, encapsulation or foam. The substance can be found in rubber and plastics (Swedish Chemicals Agency., 2012).

2.34.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

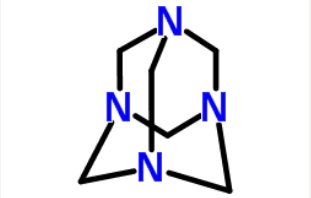
2.34.3 Migration and exposure potential from readymade articles

This substance has no critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. Critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 37. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.013 hPa (25 °C)	Not volatile.Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	2400 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	1.61 (25 °C)	Low partition constant. Indicates that this substance will not have the ability to dissolve in skin fat.

2.35 Methenamine, CAS 100-97-0

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	1,3,5,7-Tetraazatricyclo[3.3.1.1(3,7)]decane	(ECHA, 2015)
Molecular formula	$C_6H_{12}N_4$	(ECHA, 2015)
Molecular weight (g/mol)	140.106	(Royal Society of Chemistry, 2015)
Melting point/range	Sublimation at 230-270 °C	(ECHA, 2015)
Boiling Point/range	not applicable	(ECHA, 2015)
Vapour Pressure	Experimental: 0.13 Pa (20 °C)	(ECHA, 2015)
Water Solubility	>10000 mg/l	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: -2.18 (20 °C)	(ECHA, 2015)

2.35.1 Specific uses in materials

The main use of the substance is in the polymer and rubber industry, where it for instance is used for hardening phenol-formaldehyde resins and vulcanizing rubber (OECD, 2007, TOXNET, 2015n). The substance is used as a stabilizer in polyethene and PVC (Swedish Chemicals Agency., 2012). It could also be used as a preservative and for manufacturing of adhesives and coatings (TOXNET, 2015m).

2.35.2 Occurrence and content in materials

The annual European production is 10 000-100 000 tonnes (ECHA, 2015). In a Danish survey the substance was found in one marker pen (Lyck Hansen et al., 2008).

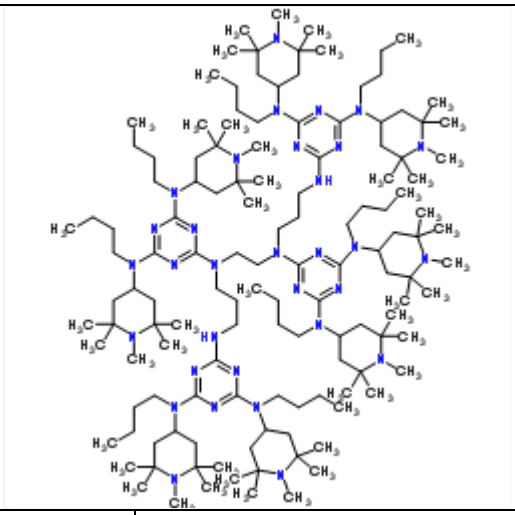
2.35.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 38. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.13 Pa (20 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	>10000 mg/l	Medium water solubility. Indicates limited ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	-2.18 (20 °C)	Low partition constant. Indicates that this substance will not have the ability to dissolve in skin fat.

2.36 N,N',N'',N'''-tetrakis(4,6-bis(butyl-(N-methyl-2,2,6,6-tetramethylpiperidin-4-yl)amino)triazin-2-yl)-4,7-diazadecane-1,10-diamine, CAS 106990-43-6

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	N,N',N'',N'''-tetrakis(4,6-bis(butyl-(N-methyl-2,2,6,6-tetramethylpiperidin-4-yl)amino)triazin-2-yl)-4,7-diazadecane-1,10-diamine	(ECHA, 2015)
Molecular formula	$C_{132}H_{250}N_{32}$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)		
Melting point/range	Experimental glass transition temperature: 99 °C	(ECHA, 2015)
Boiling Point/range	Experimental/extrapolated: >400 °C	(ECHA, 2015)
Vapour Pressure	Experimental/extrapolated: $9.6*10^{-11}$ Pa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: <0.01 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: -0.94 (25 °C)	(ECHA, 2015)

2.36.1 Specific uses in materials

The substance is used as a stabilizer in for instance polyethylene (Swedish Chemicals Agency., 2012) and can be found in plastics and textiles.

2.36.2 Occurrence and content in materials

The annual European production is 1 000-10 000 tonnes (ECHA, 2015). According to the Swedish Chemical Agency's Commodity guide, the substance can be found in rubber (0-1%), polyamide (0-0.3%), polyethene (0.1-0.5%), polyoxymethylene plastic (0-0.6%), polypropene (0.1-0.3%) and polypropene (0.1-1%) (Swedish Chemicals Agency, 2015b). However, no data on measured concentrations of the substance in toys or textiles were found in the literature study.

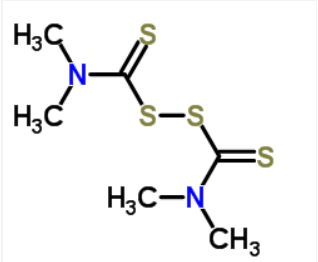
2.36.3 Migration and exposure potential from readymade articles

This substance has no critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. Critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 39. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	$9.6*10^{-11}$ Pa (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	<0.01 g/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	-0.94 (25 °C)	Low partition constant. Indicates that this substance will not have the ability to dissolve in skin fat.

2.37 Thiram, CAS 137-26-8

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	tetramethylthiuram disulfide	(ECHA, 2015)
Molecular formula	$C_6H_{12}N_2S_4$	(ECHA, 2015)
Molecular weight (g/mol)	239.988	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 144-146 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 129 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Experimental: 0.00002 Pa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 0.0171 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.1	(ECHA, 2015)

2.37.1 Specific uses in materials

The substance is used as a vulcanizing agent in the rubber industry (TOXNET, 2015o, OECD, 2010b). It is also used as complexing agent, adhesive agent, binding agent, oxidizing agent and catalyst (OECD, 2010b). The substance is a fungicide and disinfectant (Swedish Chemicals Agency., 2012) and can be used for treatment of most textile materials (Swerea IVF, 2015).

2.37.2 Occurrence and content in materials

The annual European production is 1 000-10 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

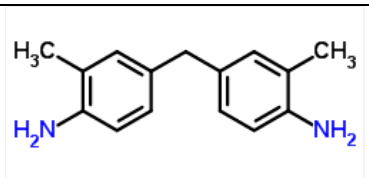
2.37.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 40. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.00002 Pa (25 °C)	Not volatile. Indicates that this substance may be taken up via the respiratory tract.
Water Solubility	0.0171 g/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	2.1	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.38 4,4'-methylenedi-o-toluidine, CAS 838-88-0

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	4,4'-methylenebis (2-methylaniline)	(ECHA, 2015)
Molecular formula	$C_{15}H_{18}N_2$	(ECHA, 2015)
Molecular weight (g/mol)	226.147	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 155-157 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 230-235 °C	(ECHA, 2015)
Vapour Pressure	Calculated: 0.00000121 hPa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 0.016 g/l (23.7 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.417 (23.7 °C)	(ECHA, 2015)

2.38.1 Specific uses in materials

The substance is an arylamine, which is a reaction product from cleavable azo dyestuffs (van der Putte et al., 2013, Swedish Chemicals Agency., 2012). The substance is banned in Europe, but might be found in different textile materials, leather and plastics (Swedish Chemicals Agency., 2012).

2.38.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.38.3 Migration and exposure potential from readymade articles

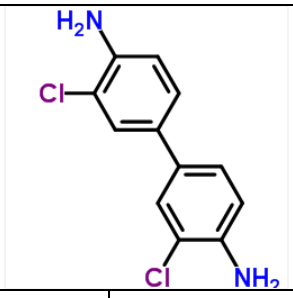
This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 41. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.00000121 hPa (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	0.016 g/l (23.7 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.

Partition Coefficient (log Pow)	2.417 (23.7 °C)	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.39 3,3'-dichlorobenzidine, CAS 91-94-1

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name		(ECHA, 2015)
Molecular formula	$C_{12}H_{10}Cl_2N_2$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	252.022	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 132.5 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental: 420 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: 4.16*10-6 mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 22.86 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	predicted: 3.51	(Royal Society of Chemistry, 2015)

2.39.1 Specific uses in materials

The substance is an arylamine, which is a reaction product from cleavable azo dyestuffs (van der Putte et al., 2013, Swedish Chemicals Agency., 2012). The substance is banned in Europe, but might be found in different textile materials, leather and plastics (Swedish Chemicals Agency., 2012).

2.39.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

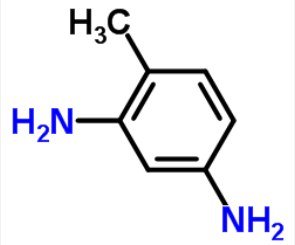
2.39.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 42. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	4.16*10-6 mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	22.86 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	3.51	High partition constant. Indicates that this substance may have the ability to dissolve in skin fat.

2.40 4-methyl-m-phenylenediamine, CAS 95-80-7

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Toluene-2,4-diamine	(ECHA, 2015)
Molecular formula	$C_7H_{10}N_2$	(ECHA, 2015)
Molecular weight (g/mol)	122.084	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 99 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 288 °C	(ECHA, 2015)
Vapour Pressure	Calculated: 0.017 Pa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 38 g/l (25 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 0.074 (25 °C)	(ECHA, 2015)

2.40.1 Specific uses in materials

The substance is an arylamine, which is a reaction product from cleavable azo dyestuffs (van der Putte et al., 2013, Swedish Chemicals Agency., 2012). The substance is banned in Europe, but might be found in different textile materials, leather and plastics (Swedish Chemicals Agency., 2012).

2.40.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

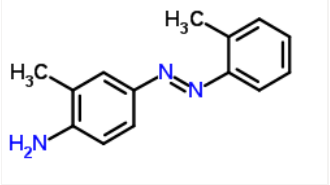
2.40.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 43. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.017 Pa (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	38 g/l (25 °C)	Medium water solubility. Indicates limited ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	0.074 (25 °C)	Low partition constant. Indicates that this substance will not have the ability to dissolve in skin fat.

2.41 Solvent Yellow 3, CAS 97-56-3

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2-Methyl-4-[(E)-(2-methylphenyl)diazenyl]aniline	(Royal Society of Chemistry, 2015)
Molecular formula	$C_{14}H_{15}N_3$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	225.127	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 102 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Predicted: 366 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: 0-1 mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 2.594 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	Predicted: 4.29	(Royal Society of Chemistry, 2015)

2.41.1 Specific uses in materials

The substance is an arylamine, which is a reaction product from cleavable azo dyestuffs (van der Putte et al., 2013, Swedish Chemicals Agency., 2012). The substance is banned in Europe, but might be found in different textile materials, leather and plastics (Swedish Chemicals Agency., 2012).

2.41.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

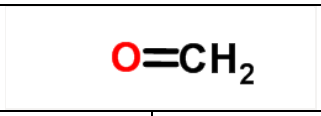
2.41.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 44. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0-1 mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	2.594 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	4.29	High partition constant. Indicates that this substance may have the ability to dissolve in skin fat.

2.42 Formaldehyde, CAS 50-00-0

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Formaldehyde	(ECHA, 2015)
Molecular formula	CH_2O	(ECHA, 2015)
Molecular weight (g/mol)	30.011	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: -16.5 - -15.5 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 99 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 5181 hPa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 550 g/l	(ECHA, 2015)
Partition Coefficient (log P_{OW})	Experimental: 0.35 (25 °C)	(ECHA, 2015)

2.42.1 Specific uses in materials

Formaldehyde has a number of different uses. One main use of formaldehyde is for production of resins for the wood, paper and textile processing industries (OECD, 2002, TOXNET, 2015r).

In textiles, it can be used in finishing processes such as shrinkageresistance, wrinkle-resistance, dirtrepellence antistatic treatment and also in dyeing and printing (van der Putte et al., 2013, Swedish Chemicals Agency., 2012). It can also be used in leather tanning (TOXNET, 2015o).

Some other product types formaldehyde can be present in are paints and lacquers (concentrations up to 10 %), adhesives (concentrations 0.1 to 10 %), biocides (concentrations 0.1 to 100 %) and disinfectants (concentrations 0.1 to 100 %) (OECD, 2002).

2.42.2 Occurrence and content in materials

The annual European production is more than 100 000 tonnes (ECHA, 2015). Information from USA exists, which state that the average concentration of free formaldehyde in textiles is 100-200 mg/kg textile. In Denmark, the normal concentration of formaldehyde is below 100 mg/kg textile and only rarely above 100 mg/kg (Ellebäk Laursen et al., 2003)

In a Danish survey of chemicals in textiles, free formaldehyde was found in viscose (43 mg/kg), wool (35 mg/kg) and in a cotton oilcloth (82 mg/kg). After one laundry, formaldehyde could only be detected in the wool item (21 mg/kg). In all, 10 different textile products were tested for free formaldehyde (Ellebäk Laursen et al., 2003).

Another Danish survey examines emissions of, for instance, formaldehyde from children tents and tunnels. 5 different tents and tunnels were tested. After 3 hours, the concentration of formaldehyde inside the tent ranged 15-163 µg/m3. After 28 days, the formaldehyde concentration inside the tent was 5-109 µg/m3. The tents were packed between the analyses.(Hansen et al., 2004).In another study, formaldehyde was found in 6 glitter glue products, in concentrations from 9.5-63 mg/g. In total, 11 types of glitter glue were analysed (Lyck Hansen et al., 2008). I a study, formaldehyde in concentrations 20-65 µg/g was found in 2 pillows for baby feeding. In the same study, formaldehyde was detected in one out of two tested nursing cushions in a concentration of 100 µg/g (Tönning et al., 2008).

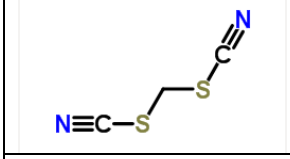
2.42.3 Migration and exposure potential from readymade articles

This substance has some critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 45. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	5181 hPa (25 °C)	Very volatile.Indi cates that this substance have high ability to be taken up via the respiratory tract.
Water Solubility	550 g/l	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	0.35 (25 °C)	Low partition constant. Indicates that this substance will not have the ability to dissolve in skin fat.

2.43 Methylene bis(thiocyanate), CAS 6317-18-6

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Methylene bis(thiocyanate)	(Royal Society of Chemistry, 2015)
Molecular formula	$C_3H_2N_2S_2$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	129.966	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 103-107 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Predicted: 288.96 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: 0-0.6 mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 27 170 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	Predicted: 0.62	(Royal Society of Chemistry, 2015)

2.43.1 Specific uses in materials

The substance is used as a fungicide and can prevent microbiotic growth during transportation or smell during use. Some materials it can be used for is rubber, plastic and textiles (Swedish Chemicals Agency., 2012).

2.43.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.43.3 Migration and exposure potential from readymade articles

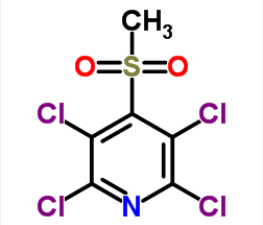
This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical

properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 46. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0-0.6 mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	27 170 mg/l (25 °C)	Medium water solubility. Indicates limited ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	0.62	Low partition constant. Indicates that this substance does not have the ability to dissolve in skin fat.

2.44 2,3,5,6-Tetrachloro-4-(methylsulfonyl)pyridine, CAS 13108-52-6

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2,3,5,6-Tetrachloro-4-(methylsulfonyl)pyridine	(Royal Society of Chemistry, 2015)
Molecular formula	$C_6H_3Cl_4NO_2S$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	292.864	(Royal Society of Chemistry, 2015)
Melting point/range	Predicted: 138 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental: 451 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: 0-1.1 mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 282.6 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	Predicted: 1.95	(Royal Society of Chemistry, 2015)

2.44.1 Specific uses in materials

The substance can be used as biocidal agent for rubber, wood, textile and leather during the use phase to prevent microbiotic growth during storage and transportation or smell during use. (Swedish Chemicals Agency., 2012).

2.44.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

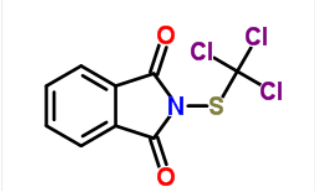
2.44.3 Migration and exposure potential from readymade articles

This substance has no critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 47. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0-1.1 mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	282.6 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	Predicted: 1.95	Low partition constant. Indicates that this substance does not have the ability to dissolve in skin fat.

2.45 Folpet, CAS 133-07-3

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2-[(Trichloromethyl)sulfanyl]-1H-isoindole-1,3(2H)-dione	(Royal Society of Chemistry, 2015)
Molecular formula	$C_9H_4Cl_3NO_2S$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	294.903	(Royal Society of Chemistry, 2015)
Melting point/range	Predicted: 189 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Predicted: 449 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: 0-0.7 mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 47.35 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	Predicted: 2.84	(Royal Society of Chemistry, 2015)

2.46 Specific uses in materials

The substance is a biocide, which for textile materials can be used to prevent microbiotic growth during transportation or smell during use (Swedish Chemicals Agency., 2012). It can be used for instance for acetate, acrylic, cotton, EVA (Ethylene vinyl acetate), flax, leather, modacrylic, polyamide, polyester, polypropylene, polyurethane (including elastane), polyvinylchloride (PVC), rubber, silk, triacetate, viscose, wool and rubber (Swerea IVF, 2015).

2.46.1 Occurrence and content in materials

According to the Commodity Guide (Swedish Chemicals Agency, 2015b) the substance can be found in hard PVC in concentrations from 0.2 to 1% and in soft PVC in concentration from 0.2 to 1%.

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.46.2 Migration and exposure potential from readymade articles

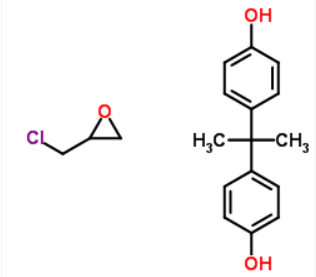
This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical

properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 48. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0-0.7 mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	47.35 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	Predicted: 2.84	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.47 4,4'-Isopropylidenediphenol, oligomeric reaction products with 1-chloro-2,3-epoxypropane, CAS 25068-38-6

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	4,4'-Isopropylidenediphenol, oligomeric reaction products with 1-chloro-2,3-epoxypropane	(ECHA, 2015)
Molecular formula	$C_{18}H_{21}ClO_3$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	320.118	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental glass transition temperature: -16 °C	(ECHA, 2015)
Boiling Point/range	Experimental decomposition temperature: 320 °C	(ECHA, 2015)
Vapour Pressure	Experimental: < 0.000000046 Pa (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 5.4-8.4 mg/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 2.918 (25 °C)	(ECHA, 2015)

2.47.1 Specific uses in materials

The substance can be used as a reactive monomer in plastics manufacturing and may be added to paints and varnishes, textile and paper coatings (Swedish Chemicals Agency., 2012). It can also occur in rubber materials (Swedish Chemicals Agency, 2015b).

2.47.2 Occurrence and content in materials

The annual European production is 100 000-1 000 000 tonnes per annum (ECHA, 2015).

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.47.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. Critical properties

are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 49. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	< 0.000000046 Pa (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	5.4-8.4 mg/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	2.918 (25 °C)	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.48 Beryllium, CAS 7440-41-7

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Beryllium	(ECHA, 2015)
Molecular formula	Be	(ECHA, 2015)
Molecular weight (g/mol)	9.012	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 1273-1283 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 2500 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: $2.59*10^{-20}$ mmHg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Experimental: <0.5 µg/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	not applicable	(ECHA, 2015)

2.48.1 Specific uses in materials

Beryllium is mostly used as a hardening agent in alloys (TOXNET, 2015u, Swedish Chemicals Agency., 2012). It can also be used in the production of brass (TOXNET, 2015p) and in electronic components (Swedish Chemicals Agency., 2012).

2.48.2 Occurrence and content in materials

The annual European production is 10-100 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

2.48.3 Migration and exposure potential from readymade articles

This substance has no critical characteristics. The only applicable characteristic for metallic compounds is water solubility that may be relevant for some of the applications identified in this study. This critical property is described below in terms of substance's ability to migrate to skin in the identified applications and materials.

Table 50. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	2.59*10-20 mmHg (25 °C)	Not volatile.Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	<0.5 µg/l (20 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	not applicable	Partition coefficient is not applicable. No assumptions can be drawn.

2.49 Nickel, CAS 7440-02-0

Characteristics of the substance		Reference
Ni		(ECHA, 2015)
IUPAC name	Nickel	(ECHA, 2015)
Molecular formula	Ni	(ECHA, 2015)
Molecular weight (g/mol)	58.693	(ECHA, 2015)
Melting point/range	Experimental: 1455°C	(ECHA, 2015)
Boiling Point/range	not applicable	
Vapour Pressure	not applicable	
Water Solubility	Experimental: insoluble	(ECHA, 2015)
Partition Coefficient (log P_{ow})	not applicable	(ECHA, 2015)

2.49.1 Specific uses in materials

Nickel is used in the production of stainless steel and for nickel plating and can be present in many different products such as jewellery, watches, piercings, accessories and buttons (OECD, 2008, TOXNET, 2015v, Wijnhoven et al., 2008). Other applications are in electronics, batteries and magnets (Swedish Chemicals Agency., 2012). Nickel can also be present in dyes and pigments (van der Putte et al., 2013, Swedish Chemicals Agency, 2013).

2.49.2 Occurrence and content in materials

The annual European production is more than 100 000 tonnes (ECHA, 2015). In a Danish survey of chemicals in textiles, nickel was found in one acrylic/nylon sample (1.1 mg/kg). In total, 15 textiles of different type were analyzed(Ellebäk Laursen et al., 2003). In another Danish survey, 26 erasers, 9 bags for children and 6 pencil cases were analyzed. Not all products were tested for nickel, but in those tested, nickel was found in concentrations from 2.8 to 26.4 µg/g, (Svendsen et al., 2007b). In an analysis study of "slimy" toys, nickel was found in two samples, a transparent liquid-filled disc with stars inside (2.96 µg/g) and a green slime with insects inside (0.83 µg/g) (Svendsen et al., 2005).

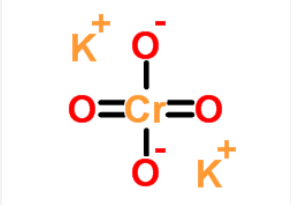
2.49.3 Migration and exposure potential from readymade articles

This substance has no critical characteristics. The only applicable characteristic for metallic compounds is water solubility that may be relevant for some of the applications identified in this study. This critical property is described below in terms of substance's ability to migrate to skin in the identified applications and materials.

Table 51. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	not applicable	Vapour pressure is not applicable. No assumptions can be drawn.
Water Solubility	insoluble	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log P_{ow})	not applicable	Partition coefficient is not applicable. No assumptions can be drawn.

2.50 Potassium chromate, CAS 7789-00-6

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Dipotassium dioxido(dioxo)chromium	(Royal Society of Chemistry, 2015)
Molecular formula	$CrH_2O_4 \cdot 2K$	(ECHA, 2015)
Molecular weight (g/mol)	193.848	(Royal Society of Chemistry, 2015)
Melting point/range	Predicted: 968 °C	(ECHA, 2015)
Boiling Point/range	not applicable	(ECHA, 2015)
Vapour Pressure	not applicable	(ECHA, 2015)
Water Solubility	39.4 % (30 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	not applicable	(ECHA, 2015)

2.50.1 Specific uses in materials

The substance is used as a corrosion inhibitor for treatment and coating of metals, for manufacture of reagents, chemicals and textiles, as a colouring agent in ceramics and in the manufacture of pigments and inks (Swedish Chemicals Agency., 2012). It is used as a mordant in dyeing of silk, wool, leather and polyamide (Swerea IVF, 2015). It can also be used in the leather finishing process and as a fungicide (TOXNET, 2015q).

2.50.2 Occurrence and content in materials

The annual European production is 10-100 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

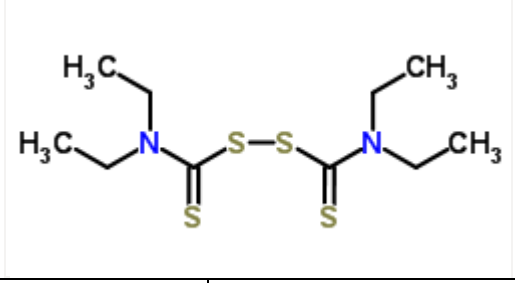
2.50.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic, which is the only applicable for metallic compounds, to emit into certain media (water and sweat) that may be relevant for some of the applications identified in this study. This critical property is described below in terms of substance's ability to migrate to skin in the identified applications and materials.

Table 52. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	not applicable	Vapour pressure is not applicable. No assumptions can be drawn.
Water Solubility	39.4 % (30 °C)	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	not applicable	Partition coefficient is not applicable. No assumptions can be drawn.

2.51 Disulfiram, CAS 97-77-8

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	1,1',1",1'"-[disulfanediylbis (carbonothioylnitrilo)]tetraethane	(ECHA, 2015)
Molecular formula	$C_{10}H_{20}N_2S_4$	(ECHA, 2015)
Molecular weight (g/mol)	296.051	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 71.5 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 117 °C	(ECHA, 2015)
Vapour Pressure	Calculated: 0.00087 mm Hg (25 °C)	(ECHA, 2015)
Water Solubility	Experimental: 4.09 mg/l (25 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 3.6 (21°C)	(ECHA, 2015)

2.51.1 Specific uses in materials

The substance is used as a rubber acceleration and vulcanizing agent (Swedish Chemicals Agency., 2012, TOXNET, 2015x). Another use is as plasticizer in neoprene (Swedish Chemicals Agency., 2012, TOXNET, 2015x).

2.51.2 Occurrence and content in materials

The annual European production is 100-1 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

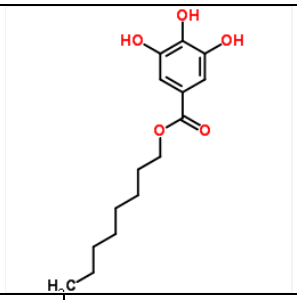
2.51.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 53. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.00087 mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	4.09 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	3.6 (21°C)	High partition constant. Indicates that this substance may have the ability to dissolve in skin fat.

2.52 Octyl gallate, CAS 1034-01-1

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Octyl 3,4,5-trihydroxybenzoate	(Royal Society of Chemistry, 2015)
Molecular formula	$C_{15}H_{22}O_5$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	282.147	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 96-102 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Predicted: 421.6 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: $1.95*10^{-8}$ mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 44.23 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	predicted: Kow=4.25	(Royal Society of Chemistry, 2015)

2.52.1 Specific uses in materials

The substance is used as an antioxidant and preservative and can be found in plastics (Swedish Chemicals Agency., 2012).

2.52.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

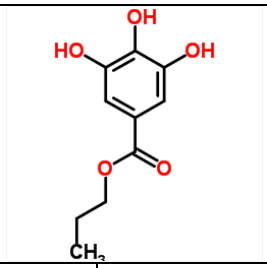
2.52.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 54. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	$1.95*10^{-8}$ mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	44.23 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	predicted: 4.25	High partition constant. Indicates that this substance may have the ability to dissolve in skin fat.

2.53 Propyl gallate, CAS 121-79-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Propyl 3,4,5-trihydroxybenzoate	(Royal Society of Chemistry, 2015)
Molecular formula	$C_{10}H_{12}O_5$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	212.068	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 130-150 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Predicted: 364 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: $4.08*10^{-7}$ mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 4176 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	Predicted: 1.79	(Royal Society of Chemistry, 2015)

2.53.1 Specific uses in materials

The substance is used as an antioxidant in pesticide formulations with typical concentrations of 0.25% in formulation (Swedish Chemicals Agency., 2012).

2.53.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

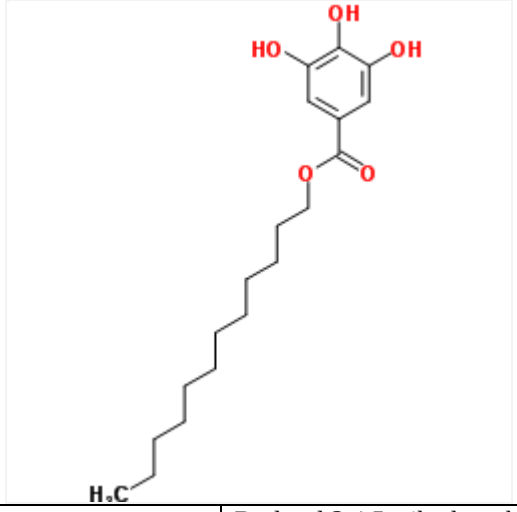
2.53.3 Migration and exposure potential from readymade articles

This substance has no critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 55. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	$4.08*10^{-7}$ mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	4176 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	Predicted: 1.79	Low partition constant. Indicates that this substance will not have the ability to dissolve in skin fat.

2.54 Dodecyl gallate, CAS 1166-52-5

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	Dodecyl 3,4,5-trihydroxybenzoate	(Royal Society of Chemistry, 2015)
Molecular formula	$C_{19}H_{30}O_5$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	338.209	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 94-98 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Predicted: 468 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: $1.02*10^{-9}$ mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 0.1371 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	Predicted: 6.21	(Royal Society of Chemistry, 2015)

2.54.1 Specific uses in materials

The substance is used as an antioxidant (Swedish Chemicals Agency., 2012).

2.54.2 Occurrence and content in materials

No data on measured concentrations of the substance in toys or textiles were found in the literature study.

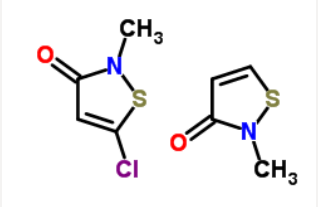
2.54.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 56. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	$1.02*10^{-9}$ mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	0.1371 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	Predicted: 6.21	High partition constant. Indicates that this substance may have the ability to dissolve in skin fat.

2.55 Kathon CG, CAS 55965-84-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2-Methyl-1,2-thiazol-3(2H)-one - 5-chloro-2-methyl-1,2-thiazol-3(2H)-one (1:1)	(Royal Society of Chemistry, 2015)
Molecular formula	$C_8H_9ClN_2O_2S_2$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	263.979	(Royal Society of Chemistry, 2015)
Melting point/range	no data available	
Boiling Point/range	100 °C	(US EPA, 1992)
Vapour Pressure	Component A: 2.4 Pa, Component B: 8.27 Pa	(US EPA, 1992)
Water Solubility	Component A: infinite, Component B: infinite	(US EPA, 1992)
Partition Coefficient (log Pow)	Component A:2.519, Component A: 0.326	(US EPA, 1992)

2.55.1 Specific uses in materials

The substance is used as a preservative in garment, technical textiles, bands, ribbons and webbings (van der Putte et al., 2013).

2.55.2 Occurrence and content in materials

A Danish study reports findings of Kathon in for instance hobby paint, finger paint, glue and soap bubbles. In three of the products, kathon was present in concentrations exceeding 0.0015% (Danish Environmental Protection Agency, 2014). It is hard to assess whether Kathon was added intentionally to the product or not.

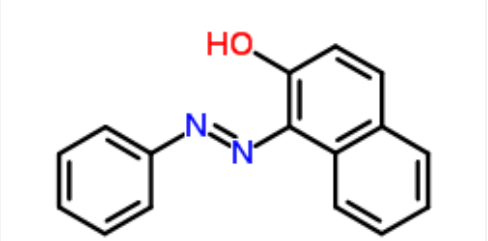
2.55.3 Migration and exposure potential from readymade articles

This substance has some critical characteristics concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 57. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	Component A: 2.4 Pa Component B: 8.27 Pa	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	Component A: infinite Component B: infinite	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	Component A:2.519 Component A: 0.326	Low to medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

2.56 Solvent Yellow 14, CAS 842-07-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	1-[(E)-Phenyldiazenyl]-2-naphthol	(Royal Society of Chemistry, 2015)
Molecular formula	$C_{16}H_{12}N_2O$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	248.095	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 129-134 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Predicted: 406 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: $9.56*10^{-8}$ mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 0.6738 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	Predicted: 5.51	(Royal Society of Chemistry, 2015)

2.56.1 Specific uses in materials

The substance is mainly used in coloring of shoes cream, plastic, resin, printing ink, in color separation of oil products and transparent paint (Swedish Chemicals Agency., 2012, Society of Dyers and Colourists (SDC) and American Association of Textile Chemists and Colourists (AATCC), 2015).

2.56.2 Occurrence and content in materials

In a Dutch survey over chemical substances in toys, 113 toys that consisted entirely or partly of plastics were examined. Solvent yellow was found in ABS plastic and in polystyrene plastic. (Voedsel en Waren Autoritet, 2005)

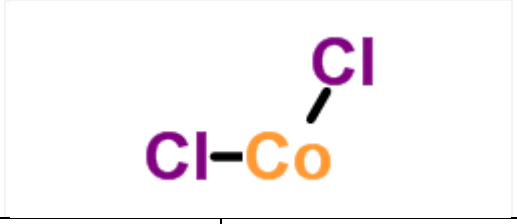
2.56.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 58. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	$9.56*10^{-8}$ mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	0.6738 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	5.51	High partition constant. Indicates that this substance may have the ability to dissolve in skin fat.

2.57 Cobalt dichloride, CAS 7646-79-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	cobalt(2+) dichloride	(ECHA, 2015)
Molecular formula	Cl_2O	(ECHA, 2015)
Molecular weight (g/mol)	128.871	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 735 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Experimental: 1049 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: $4.42*10^{-10}$ mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Experimental: 585.9 g/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Predicted: 0.85	(Royal Society of Chemistry, 2015)

2.57.1 Specific uses in materials

The substance can be used in electroplating, for painting on glass and porcelain and as a solid lubricant (TOXNET, 2015s). It is also used as drying agent in paints, lacquers, varnishes and printing inks. Another application is in the rubber industry where it is used to improve adhesion of the rubber with metal armatures (Swedish Chemicals Agency., 2012).

2.57.2 Occurrence and content in materials

The annual European production is 1 000-10 000 tonnes (ECHA, 2015). No data on measured concentrations of the substance in toys or textiles were found in the literature study.

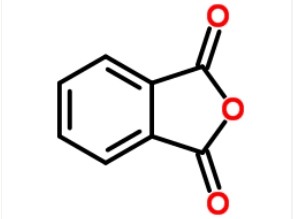
2.57.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 59. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	$4.42*10^{-10}$ mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	585.9 g/l (20 °C)	High water solubility. Indicates high ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	0.85	Low partition constant. Indicates that this substance will not have the ability to dissolve in skin fat.

2.58 Phthalic anhydride, CAS 85-44-9

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	2-benzofuran-1,3-dione	(ECHA, 2015)
Molecular formula	$C_8H_4O_3$	(ECHA, 2015)
Molecular weight (g/mol)	148.016	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 131.6 °C	(ECHA, 2015)
Boiling Point/range	Experimental: 284.5 °C	(ECHA, 2015)
Vapour Pressure	Experimental: 0.0006 hPa (26.6 °C)	(ECHA, 2015)
Water Solubility	Experimental: 16400 mg/l (20 °C)	(ECHA, 2015)
Partition Coefficient (log Pow)	Experimental: 1.6	(ECHA, 2015)

2.58.1 Specific uses in materials

The substance is used as plasticizer, in polyester and alkyd resins and as a retarder in rubber (TOXNET, 2015t). It is also used as an intermediate in the production of pigments and dyes (Swedish Chemicals Agency., 2012). It can be used in paint, lacquers and varnishes and can be found in, for instance, plastics, furniture and glues (OECD, 2005b). Another use is as tanning agent in leather processing (TOXNET, 2015t).

2.58.2 Occurrence and content in materials

The annual European production of the substance is 100 000-1 000 000 tonnes (ECHA, 2015). According to the Swedish Chemicals Agency's Commodity guide, the substance could be present in rubber materials in a concentration of 0-1% (Swedish Chemicals Agency, 2015b). In a Danish assessment of chemicals in wooden toys, the substance could be extracted from 4 out of 15 samples in concentrations 1.1-12 µg/g (Hansen and Pedersen, 2005).

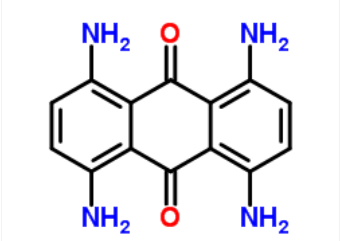
2.58.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 60. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	0.0006 hPa (26.6 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	16400 mg/l (20 °C)	Medium water solubility. Indicates limited ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	1.6	Low partition constant. Indicates that this substance will not have the ability to dissolve in skin fat.

2.59 1,4,5,8-tetraaminoanthraquinone (Disperse Blue 1), CAS 2475-45-8

Characteristics of the substance		Reference
		(Royal Society of Chemistry, 2015)
IUPAC name	1,4,5,8-Tetraamino-9,10-anthraquinone	(Royal Society of Chemistry, 2015)
Molecular formula	$C_{14}H_{12}N_4O_2$	(Royal Society of Chemistry, 2015)
Molecular weight (g/mol)	268.096	(Royal Society of Chemistry, 2015)
Melting point/range	Experimental: 332 °C	(Royal Society of Chemistry, 2015)
Boiling Point/range	Predicted: 534 °C	(Royal Society of Chemistry, 2015)
Vapour Pressure	Predicted: $1.8*10^{-8}$ mm Hg (25 °C)	(Royal Society of Chemistry, 2015)
Water Solubility	Predicted: 4.166 mg/l (25 °C)	(Royal Society of Chemistry, 2015)
Partition Coefficient (log Pow)	Predicted: 2.98	(Royal Society of Chemistry, 2015)

2.59.1 Specific uses in materials

The substance is a dyestuff used for acetate, acrylic, polyamide and polyeseter (Swerea IVF, 2015, TOXNET, 2015ac). It can also be used for surface dyeing of thermoplastics (TOXNET, 2015ac).

2.59.2 Occurrence and content in materials

According to the Swedish Chemicals Agency's commodity guide, the substance can be found in acrylic plastic, polyamide and thermoplastic polyester in concentrations 0-3% (Swedish Chemicals Agency, 2015b). There are however no data on measured concentrations of the substance in toys or textiles found in the literature study.

2.59.3 Migration and exposure potential from readymade articles

This substance has one critical characteristic concerning its ability to emit into certain media that may be relevant for some of the applications identified in this study. These critical properties are described below in terms of substance's ability to migrate and/or issue identified applications and materials.

Table 61. Critical characteristics that may result in migration and/or emissions from the identified applications and materials.

Identified chemical/physical characteristics		Migration and/or emission potential
Vapour Pressure	$1.8*10^{-8}$ mm Hg (25 °C)	Not volatile. Indicates that this substance will not be taken up via the respiratory tract.
Water Solubility	4.166 mg/l (25 °C)	Low water solubility. Indicates no or very low ability of this substance to be dissolved from the article by e.g. sweat or saliva.
Partition Coefficient (log Pow)	2.98	Medium partition constant. Indicates that this substance may have limited ability to dissolve in skin fat.

3 Conclusions

There are about 4 000 substances known to science that may cause allergy (Liden, 2013). Only a small proportion of these substances has been thoroughly studied and documented regarding their properties and uses in society. In this particular case, an indepth study has been conducted of 58 substances harmonized classified as H317 (may cause an allergic skin reaction) and their possible use in textiles and/or toys. Many of these substances have multiple uses and might be both functional and process chemicals. They are often related to specific materials and/or functions and not to the product groups such as textiles and/or toys. Only a few chemicals have directly been linked to textiles and/or toys such as certain types of dyes, e.g reactive dyes used for cotton and disperse dyes used in polyester. In those cases where only materials or only primary uses of these chemicals are identified in litterature sources e.g adhesives and fragrants we may assume that textiles and/or toys may contain these substances but these assumptions are far from certain since there are no reliable sources to refer to in these cases.

Some of the substances lacked physical and chemical data which made it impossible to assess their possible exposure routes for inhalation or skin. In a few cases for some of these substances, the metal compounds, the physical chemical data such as vapour pressure and partition constant are not relevant. There are still considerable datagaps for some of these substances in particular physical/chemical data for dyestuffs or comprehensive specific use information for some process chemicals.

Because of lack of information, it is not possible to prioritize which of the substances that possess the highest risk. One way to prioritize could be to further study the chemicals with the highest production volume. In this study, only production ranges from ECHA's registration data base have been inventoried. It should be noted that only European chemical production is included and that both textiles and toys often are produced outside Europe and not necessarily with European chemicals. Also, the same chemical can have different areas of application and be used in large volumes for other applications than textiles or toys. However, the chemicals that are produced in high volumes in Europe might give a hint on which chemicals to focus further research on. Of the chemicals included in this study, 13 are produced in volumes higher than 10 000 tonnes per year in Europe (CAS RN: 80-05-7, 140-88-5, 80-62-6, 50-00-0, 25068-38-6, 7440-02-0, 85-44-9, 5989-27-5, 10588-01-9, 97-88-1, 868-77-9, 7440-48-4, 100-97-0).

Another way to prioritize which chemicals possess the highest risk for users of textiles or toys could be to distinguish between functional and process chemicals. It is probable that functional chemicals are present in higher concentration in the articles than process chemicals. However, some of these functional chemicals such as dyestuffs may have a high degree of fixation to the material and therefore there will not be any migration or exposure to the recipient. For these kinds of highly fixed functional chemicals there is a possibility however that there is a possible exposure through exposure of debris (fluff) from the material where these chemicals may be included. Conclusively if these functional chemicals have a low degree of fixation, which is true for certain acid and direct dyestuffs, then there is an elevated risk for exposure through sweat or saliva from these chemicals.

For chemicals that appear as transformation products during processing of textiles and materials for toys e.g formaldehyde and similar volatile and water soluble chemicals, there may be an elevated risk both through inhalation but also through skin penetration with repeated exposure over time.

Conclusively since a number of the studied substances could be referred to textiles and/or toys, there is every reason to to take the presence of these substances in textiles and/or toys seriously and conduct further measures to improve our knowledge and procedures for future prevention of these chemicals in especially high risk uses for textiles and toys from an exposure perspective.

4 Recommendations

There are still considerable datagaps for some of the studied 58 substances that may has to do with market trade secret information or just lack of data that may depend on the fact that no tests have been carried out (or the results from the tests haven't been published). In order to reduce data gaps for these and other sensitising substances and their possible uses in textiles and/or toys, more comprehensive source/reference information on specific uses of these chemicals is required.This information should be provided by respective chemicals manufacturers, in combination with analytical information from tests studies carried out with validated analytical methods and would better ensure the occurrence of these chemicals in the context how common they may be in textiles and/r toys by concentration and volumes on the market.

Conclusively it is recommended to improve more transparency and availability from chemicals suppliers to make physical/chemical data and more specific use information available. Since lack of transparancy and trade secrets often applied by chemicals suppliers in combination with lack of knowledge among their customers meaning the processing facility, it may be necessary to enforce improved provisions of substance information, even transboundary enforcement and/or international standardisation to enable satisfactory risk assessments downstream to the final article in this case textiles or toys.

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Appendix 1 Summary of the substances

In this table, all examined substances are listed together with main exposure pathways, main material occurrence, whether it is relevant for textile or toys and if it is used as a functional or process chemical. For functional chemicals, there is a need for certain concentration in order to achieve the desirable function while process chemicals are used during processing and not meant to remain in the finished product. Thus, it is expected that functional chemicals in a textile or toy might be found in relatively high concentrations (depending on function) and process chemicals might be found in low concentration as residues from the process.

Substance	**CAS No**	**Main exposure pathways**	**Main material occurrence**	**Textile relevance**	**Toys relevance**	**Chemical category**
Bisphenol A	80-05-7	dermal (fat)	Plastics	x	x	Functional (stabilizer), process (monomer)
N-isopropyl-N-phenyl-p-phenylenediamine	101-72-4	dermal/oral (water), dermal (fat)	Rubber		x	Functional
Ethyl acrylate	140-88-5	dermal/oral (water), inhalation	Textile, coatings	x	x	Process
Mequinol	150-76-5	dermal/oral (water)	Plastics, textile, paper	x	x	Functional (fragrance), process (precursor)
Disperse Yellow 3	2832-40-8	dermal (fat)	Textile, plastics	x	x	Functional
Citral	5392-40-5	dermal (fat)	Plastics, paper, rubber, chemicals		x	Functional (fragrance),

						process (precursor)
(+)-(R)-limonene	5989-27-5	dermal (fat)		x	x	Functional
Sodium chromate	7775-11-3	dermal/oral (water)	Textile, steel, plastics	x	x	Process
Substance	**CAS No**	**Main exposure pathways**	**Main material occurrence**	**Textile relevance**	**Toys relevance**	**Comments**
Potassium dichromate	7778-50-9	dermal/oral (water)	Textile, steel, ceramics	x	x	Process
Sodium dichromate	10588-01-9	dermal/oral (water)	Textile, leather	x		Process
2,2-(1,4-phenylene)bis((4H-3,1-benzoxazine-4-one)	18600-59-4	dermal (fat)	Plastics		x	Functional
Direct yellow 162	81898-60-4	dermal/oral (water)	Textiles	x		Functional
Reactive blue 204	85153-92-0	dermal/oral (water)	Textiles	x		Functional
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	dermal/oral (water)	Textiles	x		Functional
A mixture of: sodium/potassium 7-[[[3-[[4-((2-hydroxynaphthyl) azo)phenyl]azo]phenyl]sulfonyl]amino] -naphthalene-1,3-disulfonate	141880-36-6	dermal/oral (water)	Textiles	x		Functional
Sodium 3-(2-acetamido-4-(4-(2-hydroxybutoxy)phenylazo)phenylazo)benzene sulfonate	147703-65-9	dermal/oral (water)	Textiles	x		Functional
N,N'-bis{6-chloro-4-[6-(4-vinylsulfonylphenylazo)-2,7-disulfonicacid 5-hydroxy-napht-4-ylamino]-1,3,5-	171599-85-2	dermal/oral (water)	Textiles	x		Functional

triazin-2-yl}-N-(2-hydroxyethyl)-ethane-1,2-diamine, sodium salt						
Glycine, N-[13-(acetylamino)phenyl]-N-(carbo1ymethyl)-, mi1ed ET and Me diesters, reaction products with diazotied 2-choloro-4-nitrobenzenamine	188070-47-5	dermal (fat)	Textiles	x		Functional
Substance	**CAS No**	**Main exposure pathways**	**Main material occurrence**	**Textile relevance**	**Toys relevance**	**Comments**
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	dermal/oral (water)	Textiles	x		Functional
Methyl methacrylate	80-62-6	dermal/oral (water), inhalation	Plastics, resins		x	Process
Butyl methacrylate	97-88-1	dermal (fat)	Resins, coatings	x	x	Process
Glutaral	111-30-8	inhalation	Leather		x	Process
Zinc bis(dibutyldithiocarbamate)	136-23-2	dermal (fat)	Rubber, latex		x	Process
2-hydroxyethyl methacrylate	868-77-9	dermal/oral (water)	Plastics, coatings	x	x	Process
(S)-p-mentha-1,8-diene	5989-54-8	dermal (fat)	Rubber		x	Process

A mixture of: 2,2,6,6-tetramethylpiperidin-4-yl-hexadecanoate; 2,2,6,6-tetramethylpiperidin-4-yl-octadecanoate	86403-32-9	dermal (fat)			x	Functional
A mixture of: trans-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran; cis-4-acetoxy-4-methyl-2-propyl-tetrahydro-2H-pyran	131766-73-9	dermal (fat)				Functional
RED RA 10463	170222-39-6	dermal (fat)		x	x	Functional
A mixture of: 3,5-dimethylthio-2,4-toluenediamine; 3,5-dimethylthio-2,6-toluenediamine	106264-79-3	dermal (fat)			x	Process
Tert-butyl acrylate	1663-39-4	dermal (fat), inhalation	Plastics, paper, coatings		x	Process
Substance	**CAS No**	**Main exposure pathways**	**Main material occurrence**	**Textile relevance**	**Toys relevance**	**Comments**
Nabam	142-59-6	dermal/oral (water)	Leather, paper		x	Process
Isobutyl methacrylate	97-86-9	dermal (fat)	Coatings		x	Process
Cobalt	7440-48-4		Metal	x	x	Functional (alloy, mordant)
2,3-epoxypropyl phenyl ether	122-60-1		Rubber, plastics		x	Functional
Methenamine	100-97-0	dermal/oral (water)	Rubber, plastics		x	Functional (stabilizer), Process (hardening agent)

N,N',N",N"'-tetrakis(4,6-bis(butyl-(N-methyl-2,2,6,6-tetramethylpiperidin-4-yl)amino)triazin-2-yl)-4,7-diazadecane-1,10-diamine	106990-43-6		Plastics, textiles	x	x	Functional
Thiram	137-26-8	dermal (fat)	Rubber, textiles	x	x	Process
4,4'-methylenedi-o-toluidine	838-88-0	dermal (fat)	Textiles, plastics, leather	x	x	Process
3,3'-dichlorobenzidine	91-94-1	dermal (fat)	Textiles, plastics, leather	x	x	Process
4-methyl-m-phenylenediamine	95-80-7	dermal/oral (water)	Textiles, plastics, leather	x	x	Process
Solvent Yellow 3	97-56-3	dermal (fat)	Textiles, plastics, leather	x	x	Process
Substance	**CAS No**	**Main exposure pathways**	**Main material occurrence**	**Textile relevance**	**Toys relevance**	**Comments**
Formaldehyde	50-00-0	dermal/oral (water), inhalation	Resins, textiles, coatings	x	x	Process
Methylene bis(thiocyanate)	6317-18-6	dermal/oral (water)		x	x	Process
2,3,5,6-Tetrachloro-4-(methylsulfonyl)py	13108-52-6		Rubber, plastics, textiles	x	x	Process

ridine						
Folpet	133-07-3	dermal (fat)	Textiles, plastics, rubber	x	x	Functional (biocide), process (biocide)
4,4'-Isopropylidenediphenol, oligomeric reaction products with 1-chloro-2,3-epoxypropane	25068-38-6	dermal (fat)	Plastics, coatings	x	x	Process
Beryllium	7440-41-7		Metals		x	Process
Nickel	7440-02-0		Steel	x	x	Functional (alloy, mordant)
Potassium chromate	7789-00-6	dermal/oral (water)	Metals, textile, leather	x	x	Process
Substance	**CAS No**	**Main exposure pathways**	**Main material occurrence**	**Textile relevance**	**Toys relevance**	**Comments**
Disulfiram	97-77-8	dermal (fat)	Rubber		x	Functional (plasticizer), process (rubber accelerator and vulcanizing agent)
Octyl gallate	1034-01-1	dermal (fat)	Plastics		x	Functional

Propyl gallate	121-79-9		Textiles	x	x	Process
Dodecyl gallate	1166-52-5	dermal (fat)	Plastics		x	Functional
Kathon CG	55965-84-9	dermal/oral (water)	Textiles	x	x	Functional
Solvent Yellow 14	842-07-9	dermal (fat)	Plastics		x	Functional
Cobalt dichloride	7646-79-9	dermal/oral (water)	Coatings, rubber		x	Process
Phthalic anhydride	85-44-9	dermal/oral (water)	Plastics, rubber		x	Functional (plasticizer), process (precursor, tanning agent)
1,4,5,8-tetraaminoanthraquinone (Disperse Blue 1)	2475-45-8	dermal (fat)	Textiles, plastics	x	x	Functional

KEMI
Swedish Chemicals Agency

Box 2, SE-172 13 Sundbyberg
+46 8 519 41 100

Visitors' and delivery address
Esplanaden 3A, Sundbyberg

kemi@kemi.se
www.kemikalieinspektionen.se