Ministry of Environment and Food of Denmark
Environmental Protection Agency

How Child Care Centres Apply Material from Used Products

Survey of chemical substances in consumer products No. 143, 2015

Title:

How Child Care Centres Apply Material from Used Products

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Contents

Preface

The project called ”How Child Care Centres Apply Material from Used Products” was carried out from March 2014 – June 2015.

This report describes the results of the project, including a survey, chemical analyses, exposure assessment and health hazards when children apply material from used products.

The project was carried out by Danish Technological Institute and DHI Denmark. The participants from Danish Technological Institute were Kathe Tønning (project manager), Kristine Slot Ravnholt Vium, Lars-Henrik Lau Heckmann and Inge Bondgaard Nielsen, and the participants from DHI Denmark were Poul Bo Larsen and Eva Høy Engelund.

A group was set up to follow the progress, development and results of the project and the group consisted of the following persons:

- Dorte Bjerregaard Lerche, the Danish Environmental Protection Agency
- Shima Dobel, the Danish Environmental Protection Agency
- Kathe Tønning, Danish Technological Institute

The project has been funded by the Danish Environmental Protection Agency.

Summary and conclusion

Citizens, museums and child care centres frequently contact the Danish Environmental Protection Agency (the Danish EPA) regarding the application of used materials and products for creative activities. In connection with inquiries, the Danish EPA recommends to exercise caution when applying material from used products for other purposes than originally intended. In order to be able to provide more satisfactory directions, the Danish EPA initiated this investigation.

The objective of this project was to carry out a survey of the used materials and products that children and young people apply for creative activities, and to show how the materials are used in order to assess the potential exposure (through inhalation, oral absorption or skin contact) to chemical substances during processing of the materials and the subsequent use of the new products.

A creative field is in question and focus is on bringing new ideas to light, and therefore it is not possible to give a timeless account. The found products and their use only give an up-to-the-minute account as informed by the interviewed child care centres and as found in the information and internet study when the investigation was carried out.

When the products and materials had been surveyed, it was by means of chemical analyses investigated if the identified product groups contain problematic substances that can be liberated during the creative production of new products and during the following use of the products.

Furthermore, the objective of this project was to assess if the potential exposure during processing and the subsequent use of the new products constitute a health risk.

Survey of products and materials
By way of introduction, information and internet studies were carried out, and they were based on books for specialists who work creatively with children and visual arts, books of inspiration and homepages dealing with the creative application of used products and materials for the production of new products.

In literature and especially through searches on the internet a very large number of applications were found for used products and materials. 71 examples were found of products and product types and their processing and applications. In the following interviews of representatives from child care centres and colleges of education, museums and other leisure time offers for children examples were used from the literature and internet study.

13 employees from 9 different types of institutions (colleges of education, child care centres, schools etc.) were interviewed by phone. 12 of the 13 institutions that were contacted to a varying degree work with used materials and products. According to the interviewed institutions, the children most often make ornamental articles that are placed on the bookshelf at home or the articles are left at the institution because they are part of an art project. The ornamental articles are often very fragile and the children play cannot play with them for very long.

The 13 interviews disclosed a total of 40 products and product types and their respective processing and applications.

An electronic questionnaire was prepared on the basis of information from the information and internet study and interviews. It was sent by e-mail to the child care centres in 5 municipalities, to art schools, museums with creative workshops and to colleges of education all over Denmark that educate teachers and youth workers. A total of 868 institutions were contacted out of which 64 filled in the questionnaire.

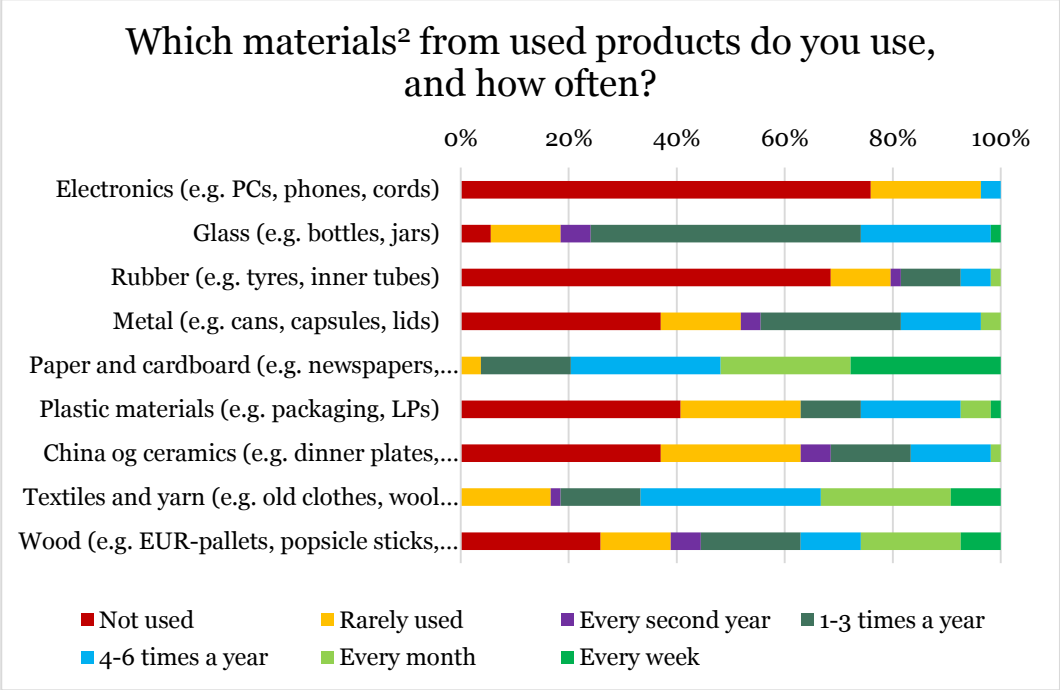


FIGURE 1 FREQUENCY OF USE OF THE VARIOUS FRACTIONS[1].

84% of the respondents stated that they apply used products for creative activities.

Some places, the application of used products is an integrated part of everyday life, but most interviewees stated that the work takes place during concentrated topics, e.g. every second month or once or twice a year. The interviewees most frequently use paper and cardboard, textiles & yarn and glass and to a minor degree electronics, rubber, plastic materials, metal, china, ceramics and wood.

According to the 13 telephone interviews, it varies for how long the children work with the activity. Some places the children work 30 min. at a time and other places up to 5 hours at a time depending on the age of the children and the individual institution. According to the questionnaire, the children spend most time with glass, paper and cardboard, plastic materials and textiles & yarn, whereas they spend least time working with electronics and wood.

The literature and internet study found that used products and materials are heated during processing. In the 13 telephone interviews and the questionnaire, only three cases of heating were disclosed.

Other types of processing such as e.g. carving, cutting, down-sizing with hammer, sawing, painting or joining with tape, nails or glue are common.

In the contacted child care centres, the new products are mainly used for ornamentation and decorations. Toys, everyday items, everyday items intended for food contact and jewellery are also made.

[1] The term ”material” has been used although electronics are made up of several materials, because in waste connections it is considered to be one material fraction.

The applied used products and materials typically originate from the children, their parents and the staff at the institutions. In the telephone interviews and the questionnaire study, the interviewed institutions found it difficult to put an age on the received materials.

However, in the questionnaire the majority of the respondents, who informed an age of the material, estimated that glass, metal, paper, plastic materials, china, ceramics and wood are 0 to 12 months old when the children use them. Regarding used electronics, rubber and textile, the majority of the respondents who informed an age of the material, estimated that the used products and materials are 1 to 5 years old or more.

Selection of products and materials and regulation

First of all, an initial delimitation was carried out of the products and materials that were identified in the survey in order to select products and materials where a possible content of problematic substances had to be further investigated in the existing literature. The survey of all found products and materials resulted in the selection of 20 products/product types that perhaps could contain and/or liberate problematic substances either during processing or during application.

Subsequently, a literature study investigated if the selected products and materials contained potentially problematic substances. The study took its starting point in surveys of chemical substances in consumer products and expert knowledge within electronics, plastic and rubber. On the basis of the collected information, 26 products from 10 product groups were selected for chemical analysis:

1. Garden hose 1, newest
2. Garden hose 2, oldest
3. Lacquered wood 1, laminated
4. Lacquered wood 2, solid wood, pale
5. Lacquered wood 3, solid wood, dark
6. LP 1
7. LP 2
8. Disposable tableware, spoons made of polystyrene (PS)
9. Disposable tableware, cups made of polystyrene (PS)
10. Bicycle tube 1
11. Bicycle tube 2
12. Bicycle tyre 1
13. Bicycle tyre 2
14. Cords 1, rubber cord, black
15. Cords 2, black cord
16. Cords 3, red cord with thick copper inside
17. Foam mattress 1, large, hard
18. Foam mattress 2, little, soft
19. Pressure-treated wood 1, dark
20. Pressure-treated wood 2, green
21. Electronics 1, large, green printed circuit board
22. Electronics 2, printed circuit board from DVD
23. Electronics 3, printed circuit board from PC keyboard
24. Electronics 4, printed circuit board from cell phone
25. Sleeping mat 1
26. Sleeping mat 2

Today, several of the potential problematic substances that according to the literature study might be present in the selected products are regulated in Denmark and the EU.

Chemical analyses
Initially, screening analyses were carried out by GC/MS and X-ray on the selected used products. 25 samples were investigated by GC/MS analysis and 4 samples by X-ray analysis.

The results of the screening analysis of the 25 samples by GC/MS for volatile and semi-volatile substances varied among the different types of products. That was expected as the selected used products differ a lot. The results also varied within the same product categories. The disposable tableware, bicycle tyres, bicycle tubes and the LPs showed uniform results, whereas the results varied for e.g. the different types of lacquer for wood, electronics/cords, foam mattresses, pressure-treated wood and sleeping mats. Phthalates were found in both garden hoses, but the levels and the substances were different. In some samples, only very few volatile or semi-volatile substances were detected and in other samples around 10 different components were detected. The screening analysis detected phthalates in a number of the samples, and one single sample (cord) with the highest content was chosen for migration test for DEHP.

The screening by GC/MS detected a number of substances that could not be identified, as the substances do not appear in the NIST library.

As expected, the X-ray screening analysis of the 4 samples revealed a content of copper in the samples of pressure-treated wood, and tin and nickel in the soldering of the printed circuit board. Bromine was not detected in the printed circuit board from the cell phone, and therefore brominated flame-retardants were not used in the investigated printed circuit board. On the other hand, phosphorus was detected in a very low concentration, which might originate from phosphorus-based flame-retardants; however, that has not been verified.

The quantitative analyses by X-ray with focus on lead detected a content of lead in one of the garden hoses, the two LPs and the red cord. The highest content was detected in the two LPs and in the red cord.

Other heavy metals were also detected, and tin was found in two of the samples and the highest content was detected in one of the garden hoses. In addition, cadmium was detected in the two LPs corresponding to 0.019 and 0.018 w/w%, respectively, (190 and 180 mg/kg, respectively).

The screening analysis by GC/MS showed a high content of hydrocarbons in the 4 samples of bicycle tubes and tyres. Due to the high content of hydrocarbons, the screening could not clarify if there could be a content of PAH in the hydrocarbon total. Quantitative analyses were carried out with focus on the 8 regulated PAHs according to REACH, Annex XVII, but they were not detected in the products.

Quantitative analyses for isocyanates were carried out, as they are not suited for GC/MS screening analysis. One single foam sample from a mattress was selected for quantitative analysis for isocyantes as it is well known that foam may contain residue of monomeric isocyantes. However, only a content of 2,4- and 2,6-TDI and MDI was detected in the foam mattress close to the detection limit of the method.

Only a rather low content of DEHP was detected by the migration test for artificial sweat in spite of the high content of DEHP in the sample.

Exposure assessment
Dependant of type of the reused materials, the content of chemical substances, the production processes for reuse and the use of the ”new” products chemical exposure of the children may occur by dermal contact, oral ingestion and by inhalation of vapours or dust that may be emitted.

In this project it was based on the analytical content decided to consider exposure scenarios for the following materials and their uses:

- Cords used for making jewellery (DEHP).
- Foam material used for costume making (TDI).
- Printed circuit boards used for robots/cars (triaryl phosphates).
- Varying use of used bike tires and bike tubes (PAH).
- Cords, LP-records and garden hoses (lead)

The materials were chosen based on the toxicological profiles of the chemicals identified in the materials (DEHP is an endocrine disruptor; TDI can induce respiratory sensitization and is a suspected carcinogen; triaryl phosphates may induce organ damage; PAHs are potent carcinogens; lead: neurotoxic, may impair learning ability in children), and/or based on especially high concentrations of the substances found in the materials (DEHP and triaryl phosphates).

The choices for the specific scenarios for reuse of the materials were based on realistic worst-case situations of the use of the materials and exposure to the substances.

For DEHP the exposure assessment from the cord was based on a measured migration rate of DEHP where a migration test was performed using artificial sweat.

For TDI in foam material the exposure assessment was based on both the quatitative content of TDI in the foam as well as on literature data on the migration rate of TDI from the foam.

For triarylphosphater in printed circuit boards the exposure assessment was based on the quantitave content of the substances in the boards, as it was not possible to perform additional migration testing in this project.

For PAH i bike tires and bike tubes and for lead in various products exposure assessments were not considered necessary as the analysed content of PAH and lead in these articles could be evalauted and compared to an EU regulatory limits for the PAH content in toys and lead content in articles.

Health and risk assessment
For the selected chemical substances tolerable exposure levels (DNEL-values) were gathered from recent expert evalautions or estimated using the methodology descriped in conncetion with the chimcal regulation REACH.

The results from the exposure assessment, the hazard charaterisation (DNELs) and the risk assessment can be summarised as indicated in the table below. If the Risk Characterization Ratio (RCR = exposure/DNEL) is above the value of 1, the exposure is considered to indicate a potential risk.

Substance	Route of exposure	DNEL value mg/kg bw/d	Highest estimated exposure mg/kg /bw/d	RCR value
DEHP	Oral	0.05	0.029 x 10^{-3}	0.0006
	Dermal	0.7	0.148 x 10^{-3}	0.00021
	Inhalation	-	-	-
TDI	Oral	-	-	-
	Dermal	0.33 µg/cm²	0.0024µg/cm²	0.007
	Inhalation	6.4 µg/m³	0.00044 µg/m³	0.00007
Tricresyl phosphate + Dicresylphenyl phosphate	Oral	0.013	At migration rates above 1.8 µg/cm²/hour from the material the RCR > 1 for dermal exposure	
	Dermal	0.013		
	Inhalation	-		

DEHP and TDI
The calcualted RCR values for the scenarios for DEHP and TDI are very, very low and it can be concluded that exposure levels from the specific sceanrios given are considerable below levels of concern.

Triarylphosphater
For the triaryl phosphates a so-called ”backwards” risk assessment was made as the migration rate at which the DNEL level would be exceeded was calculated (i.e. the RCR value exceeds 1). For the most toxic triaryl phosphates (tricresyl phosphate + dicresylphenyl phosphate) it was calcualted that the migration rate from the print circuit board should exceed 1.8 µg/cm²/hour (corresponding to 0,02 % of the total content of the substances would migrate per hour) before the scanerio would be of concern. Whether this is a realistic migration rate could be further evaluated by performing a migration test with the printed circuit board.

PAH
The risk assessment of PAH content in bike tires and bike tubes was carried out based on the concentration limits specified in the EU Commission's limits on use of plastic and rubber articles intended for children. These articles are covered by an upper content limit for specific PAH substances at 0.5 mg/kg (European Commission, 2013).
None of the regulated PAH substances were found in the bike tire and bike tube samples above the analytical detection limit of 0.5 mg/kg and thus no concern for reuse of these specific articles could be identified.

Lead
Garden hose no. 2, LP records nos. 1 and 2 and cord no. 3 all contain lead in a higher concentration than the limit value of 500 mg/kg, as indicated in the future European regulation of lead in articles, which under normal or reasonably foreseeable conditions of use can be mouthed by children (Commission Regulation (EU) 2015/628 of 22 April 2015).

The cord contains 2100 mg lead/kg, the LP records 2000 mg lead/kg and the garden hose 650 mg lead/kg. This means that if these materials are reused for articles, which under normal or reasonably foreseeable conditions of use can be mouthed by children, it is possible that they might pose a risk.

According to the survey, the cord is used for jewelry and toys, where it is expected that it could be mouthed by children. The LP records are used for the storage of fruit - it is possible that the lead will be released to the food stored in the bowl, but it is not known to what extent this occurs. The garden hose is split manually and painted.

Thus, it is possible, especially for the cord, that the reuse may pose a risk to children when the produced items are mouthed.

Overall conclusion

The objective of this project was to single out products that might constitute a risk when used for creative activities in child care centres due to their chemical substances and the way the products are used. Based on knowledge of which used products are applied by the child care centres and based on the literature survey of chemical knowledge concerning possible dangerous substances in the materials in these products, it was decided to carry out further chemical analyses and risk assessments of:

- Cords, production and use as jewellery (DEHP exposure).
- Foam materials, production and play in connection with use as “muscle filling” in Superman costume (toluenediisocyanate, TDI).
- Printed circuit boards, production and play with ”robot, electric car” (triaryl phosphates).
- Bicycle tyres and tubes, various (polycyclic aromatic hydrocarbons, PAH).
- Cords, LP-records and garden hoses (lead)

These materials and scenarios were selected as they cover contents of problematic substances and/or rather high substance concentration in the used materials.

In the light of the chemical analyses and a more detailed exposure and risk assessment of the speceific scenarios it was subsequently not possible – with the exception of lead - to point out unacceptable health related risks regarding any of the specific applications. However, in connection with the triaryl phosphates a thorough risk assessment will require further data regarding the migration of the substances from the printed circuit boards.

Thus, the project has only found the use of cord as jewellery as constituting a potential risk due to the content of lead at concentrations above 500 mg/kg.

However, it should be emphasized that all scenarios and assessments pertain to individual materials for specific types of reuse and therefore a repetition of the tests and assessment with other similar products/ materials would not necessarily give the same result. Therefore, the project cannot ”acquit” the application of used products and materials in general.

Sundheds- og risikovurdering
Resultaterne fra eksponeringsvurderingen, sundhedsvurderingen og risikovurderingen for de enkelte stoffer er sammenfattet herunder:

Substance	Route of exposure	DNEL value mg/kg bw/d	Highest estimated exposure mg/kg /bw/d	RCR value
DEHP	Oral	0.05	0.08 x 10^{-3}	0.0016
	Dermal	0.7	0.148 x 10^{-3}	0.00021
	Inhalation	-	-	-
TDI	Oral	-	-	-
	Dermal	0.33 µg/cm^2	0.0024µg/cm^2	0.007
	Inhalation	6.4 µg/m^3	0.00044 µg/m^3	0.00007
Tricresylphosphat + dicresylphenyl-phosphat	Oral	0.004	Ved migration større end 3,1 mg/cm^2/ time bliver RCR > 1 for dermal eksponering	
	Dermal	0.004		
	Inhalation	-		

DEHP and TDI
Fra beregningerne af de meget lave RCR-værdier kan det konkluderes, at eksponeringen for DEHP og TDI i forbindelse med de konkrete anvendelsesscenarier ligger betydeligt under betænkelige sundhedsmæssige niveauer.

Triarylphosphater
For triarylphosphaterne blev der i stedet for et egentligt eksponeringsestimat beregnet, hvor stor en mængde af den konkrete mængde triarylphosphat der kunne migrere ud af printpladen, førend RCR-værdien ville overstige 1. Her blev det for de mest toksiske triarylphosphater (tricresylphosphat + dicresylphenylphosphat) beregnet, at migrationshastigheden fra printpladen ikke måtte overstige 3,1 mg/cm^2/time svarende til 0,02 % af det samlede indhold.
Hvorvidt dette er en realistisk migrationshastighed, kan evt. vurderes ved at foretage en migrationstest.

PAH
Risikovurderingen af PAH-indhold i cykeldæk og cykelslanger blev foretaget ved at sammenholde de analyserede niveauer med kravene i EU-Kommissionens anvendelsesbegrænsning for plast og gummiartikler beregnet til børn. For disse artikler er der fastsat en øvre indholdsgrænse for seks specifikke PAH-stoffer på hver 0,5 mg/kg (EU-Kommissionen 2013). Da disse PAH-stoffer ikke kunne detekteres i de udvalgte cykeldæk og slanger (analyseret ved en detektionsgrænse på 0,5 mg/kg), vurderes de konkrete dæk og slanger ikke at være betænkelige at anvende.

Overall conclusion
The objective of this project was to single out products that might constitute a risk when used for creative activities in child care centres due to their chemical substances and the way the products are used. Based on knowledge of which used products are applied by the child care centres and based on the literature survey of chemical knowledge concerning possible dangerous substances in

the materials in these products, it was decided to carry out further chemical analyses and risk assessments of:

- Cords, production and use as jewellery (DEHP exposure).
- Foam materials, production and play in connection with use as “muscle filling” in Superman costume (toluenediisocyanate, TDI).
- Printed circuit boards, production and play with ”robot, electric car” (triaryl phosphates).
- Bicycle tyres and tubes, various (polycyclic aromatic hydrocarbons, PAH).

These products and scenarios were selected as they comprise very problematic substances and/or rather high contents in the used product.

In the light of the chemical analyses and a more detailed exposure and risk assessment of the speceific scenarios it was subsequently not possible to point out unacceptable health related risks regarding any of the specific applications. However, in connection with the triaryl phosphates a thorough risk assessment will require further data regarding the migration of the substances from the printed circuit plates.

The objective of this project was to identify possible risky applications of used products, but it has not been possible to point out specific applications that constitute a health hazard.

However, it should be emphasized that all scenarios concern the assessment of individual, specific used products and therefore a repetition of the test with other similar products would not necessarily give the same result. Therefore, the project cannot ”acquit” the application of used products and materials in general.

Sammenfatning og konklusion

Miljøstyrelsen får regelmæssigt henvendelser fra borgere, museer og børneinstitutioner med spørgsmål vedrørende anvendelse af brugte materialer og produkter i kreativ sammenhæng. Miljøstyrelsens har ved disse henvendelser generelt anbefalet, at man bør udvise forsigtighed, når materialer fra brugte produkter anvendes til andre formål end de formål, produkterne oprindeligt var tiltænkt. For at kunne give en mere fyldestgørende vejledning har Miljøstyrelsen igangsat nærværende undersøgelse.

Formålet med projektet har været at foretage en kortlægning af hvilke brugte materialer og produkter, som anvendes af børn og unge i kreativ sammenhæng, samt hvordan materialerne anvendes, for at kunne vurdere den potentielle eksponering (via inhalation, oralt optag og hudkontakt) af kemiske stoffer under bearbejdning af materialerne og ved den efterfølgende anvendelse af nye produkter.

Da der er tale om et kreativt område, hvor det i sagens natur handler om at få nye idéer, er det ikke muligt at give en tidsløs redegørelse. De fundne produkter og anvendelser er en beskrivelse af de produkter, som de adspurgte børneinstitutioner anvender, og som blev fundet i litteratur- og internetstudiet, på det givne tidspunkt.

Efter kortlægningen af produkter og materialer blev det vha. kemiske analyser undersøgt, om de identificerede produktgrupper indeholder problematiske stoffer som kan frigives under den kreative fremstilling af nye produkter og under den efterfølgende brug af produkterne.

Endvidere var det projektets formål at vurdere, om den potentielle eksponering under bearbejdning og efterfølgende anvendelse af nye produkter ville kunne udgøre en sundhedsrisiko.

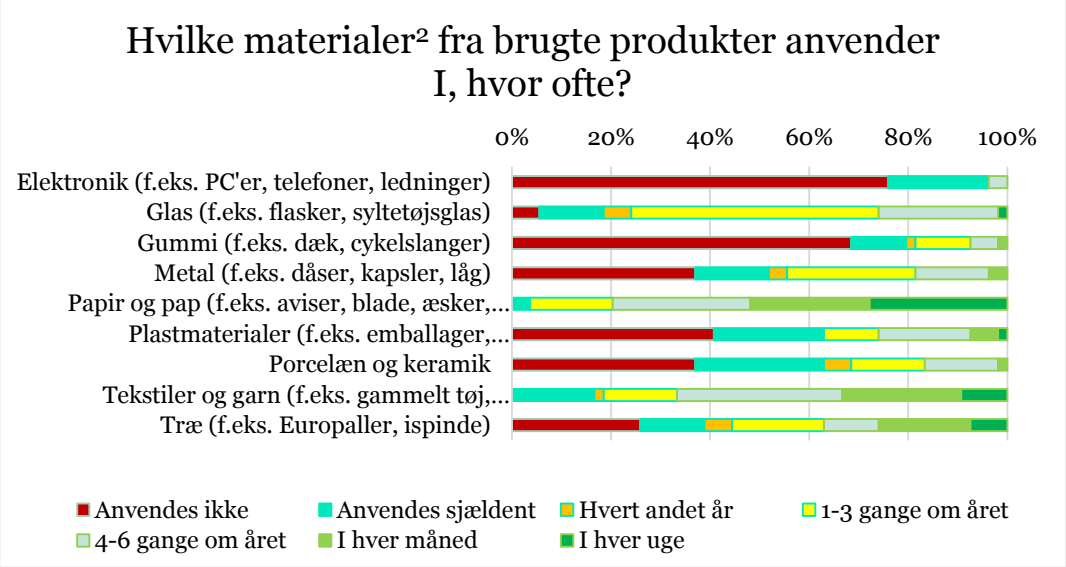
Kortlægning af produkter og materialer
Indledningsvist blev der foretaget en litteratur- og internetscreening baseret på bøger for fagpersoner, der arbejder kreativt med børn og billedkunst, inspirationsbøger samt hjemmesider, der beskæftiger sig med kreativ udnyttelse af brugte produkter og materialer til at fremstille nye produkter.

I litteraturen og især ved søgning på internettet blev der fundet et meget stort antal anvendelsesmuligheder for brugte produkter og materialer. Der blev fundet 71 eksempler på produkter og produkttyper samt tilhørende forarbejdninger og anvendelser. I de efterfølgende interviews af repræsentanter fra børne- og uddannelsesinstitutioner, museer og andre fritidstilbud til børn blev der brugt eksempler fra litteratur- og internetstudiet.

Via telefon blev der interviewet 13 medarbejdere fra 9 forskellige institutionstyper (seminarer, børneinstitutioner, skoler etc.). 12 ud af 13 kontaktede institutioner arbejder i varierende grad med brugte materialer og produkter. Ifølge de adspurgte institutioner fremstiller børnene som oftest pyntegenstande, der finder plads i reolen i børnenes egne hjem eller aldrig forlader institutionen, fordi de er en del af et kunstprojekt. Ofte er pyntegenstandene for skrøbelige til, at børnene kan lege med dem i længere tid.

I de 13 interviews blev der i alt fundet 40 produkter og produkttyper samt tilhørende forarbejdninger og anvendelser.

På baggrund af de indhentede oplysninger i litteratur- og internetstudiet og ved de gennemførte interviews blev der udarbejdet et elektronisk spørgeskema, der blev sendt via e-mail til børneinstitutioner i 5 kommuner, til kunstskoler, til museer med kreative workshops og til uddannelsesinstitutioner fordelt over hele landet, der uddanner lærere og pædagoger. I alt blev 868 institutioner kontaktet, hvoraf 64 besvarede spørgeskemaet.



84 % af de adspurgte svarede, at de anvender brugte produkter i kreativ sammenhæng.

Nogle steder er anvendelse af brugte produkter en integreret del af dagligdagen, mens de fleste har angivet, at arbejdet foregår i koncentrerede temaforløb, f.eks. hver anden måned eller en til to gange om året. De adspurgte anvender oftest papir og pap, tekstiler og garn samt glas og i mindre grad elektronik, gummi, plastmaterialer, metal, porcelæn og keramik samt træ.

Ifølge de 13 telefoninterviews varierer det, hvor længe ad gangen børnene er beskæftiget med aktiviteten. Nogle steder arbejder børnene i 30 min. af gangen og andre steder op mod 5 timer af gangen afhængigt af børnenes alder og den enkelte institution. Ifølge spørgeskemaundersøgelsen arbejder børnene tidsmæssigt længst med materialetyperne glas, papir og pap, plastmaterialer samt tekstiler og garn, mens børnene arbejder tidsmæssigt kortest med elektronik og træ.

I litteratur- og internetstudiet blev der fundet eksempler på, at brugte produkter og materialer opvarmes under forarbejdningen. I de 13 telefoninterviews og i spørgeskemaundersøgelsen sås der sammenlagt kun tre tilfælde af opvarmning.

Øvrige former for forarbejdning, som for eksempel opskæring, klipning, neddeling med hammer, savning, maling eller sammenføjning med tape, søm og lim, er almindelig.

De nye fremstillede produkter bliver ifølge de kontaktede børneinstitutioner oftest anvendt som pyntegenstande og dekorationsmateriale. Herudover fremstilles også legetøj, brugsgenstande, brugsgenstande beregnet til fødevarekontakt og smykker.
De anvendte brugte materialer og produkter stammer typisk fra institutionens børn, forældre til børnene og fra personalet i institutionen. De adspurgte institutioner havde svært ved at sætte alder på de indkomne materialer både i telefoninterviews og i spørgeskemaundersøgelsen. Dog anslog

flertallet af de respondenter i spørgeskemaundersøgelsen, som angav en alder på materialerne, at glas, metal, papir, plastmaterialer, porcelæn og keramik samt træ var 0 til 12 måneder gamle, når børnene anvender dem. Hvad angår brugt elektronik, gummi og tekstil anslog flertallet af de respondenter, som angav en alder på materialerne, at de brugte produkter og materialer var 1 til 5 år gamle eller ældre.

Udvælgelse af produkter og materialer samt regulering
Først blev der foretaget en indledende afgrænsning af de produkter og materialer, der er identificeret i kortlægningen, med henblik på at udvælge produkter og materialer, hvor evt. indhold af problematiske stoffer skulle undersøges nærmere i tilgængelig litteratur. Gennemgangen af alle fundne produkter og materialer resulterede i udvælgelsen af 20 produkter/produkttyper, der muligvis ville kunne indeholde og/eller afgive problematiske stoffer enten ved forarbejdningen eller under anvendelse.

I et litteraturstudie blev det herefter undersøgt, om de udvalgte produkter og materialer kunne indeholde potentielt problematiske stoffer. Der blev i søgningen taget udgangspunkt i kortlægningsrapporter af kemiske stoffer i forbrugerprodukter, samt ekspertviden inden for elektronik, plast og gummi. På basis af den indsamlede information blev der indenfor 10 produktgrupper udvalgt 26 produkter til kemisk analyse:

1. Haveslange 1, nyeste
2. Haveslange 2, ældste
3. Lakeret træ 1, lamineret
4. Lakeret træ 2, hel træ, lys
5. Lakeret træ 3, hel træ, mørk
6. LP-plade 1
7. LP-plade 2
8. Engangsservice, skeer i polystyren (PS)
9. Engangsservice, krus i polystyren (PS)
10. Cykelslange 1
11. Cykelslange 2
12. Cykeldæk 1
13. Cykeldæk 2
14. Ledninger 1, gummiledning, sort
15. Ledninger 2, sort ledning
16. Ledninger 3, rød ledning med tyk kobber inderst
17. Skummadras 1, stor, hård
18. Skummadras 2, lille, blød
19. Trykimprægneret træ 1, mørk
20. Trykimprægneret træ 2, grøn
21. Elektronik 1, stor, grøn printplade
22. Elektronik 2, printplade fra dvd
23. Elektronik 3, printplade fra pc-tastatur
24. Elektronik 4, printplade fra mobiltelefon
25. Liggeunderlag 1
26. Liggeunderlag 2

Flere af de potentielle problematiske stoffer, der ifølge litteraturgennemgangen kan være til stede i de udvalgte produkter, er i dag reguleret i Danmark og EU.

Kemiske analyser
Indledningsvist blev der udført screeningsanalyser ved GC/MS og røntgen på de udvalgte brugte produkter. 25 prøver blev undersøgt ved GC/MS-analyse og 4 prøver ved røntgenanalyse. Resultaterne for screeningsanalysen af de 25 prøver ved GC/MS for de flygtige og semiflygtige organiske stoffer varierede imellem de forskellige typer af produkter. Dette var som forventet, da de udvalgte brugte produkter er meget forskelligartede. Der sås også variation for resultaterne inden for samme produktkategorier. Engangsservicet, cykeldækkene, cykelslangerne og LP-pladerne viste ensartede resultater, mens der var variationer på resultaterne for f.eks. de forskellige typer af lak til træ, elektronik/ledninger, skummadrasser, trykimprægneret træ og liggeunderlag. I haveslangerne blev der påvist ftalater i begge prøver, men niveauerne og selve stofferne var forskellige.

I enkelte prøver blev der kun påvist meget få flygtige eller semiflygtige stoffer, og i andre prøver blev der er påvist op til omkring 10 forskellige komponenter. Der blev påvist ftalater i en del af prøverne ved screeningsanalysen, og en enkelt prøve (ledning) med det højeste indhold blev udvalgt til migrationstest for DEHP.

Der blev påvist en række stoffer ved screeningen ved GC/MS, der ikke kunne identificeres, da stofferne ikke forekommer i NIST-biblioteket.

Screeningsanalysen ved røntgen af de 4 prøver afslørede som forventet indhold af kobber i prøverne af trykimprægneret træ, samt tin og nikkel i lodningen på printpladen. Der blev ikke påvist brom i selve printpladen fra mobiltelefonen, og der er således ikke anvendt bromerede flammehæmmere i den undersøgte printplade. På den anden side blev der påvist fosfor i en meget lav koncentration, og dette kan eventuelt stamme fra fosforbaserede flammehæmmere, men dette er ikke verificeret.

Af øvrige tungmetaller blev der fundet tin i to af prøverne med det højeste indhold i den ene haveslange. Dertil blev der påvist cadmium i de to LP-plader svarende til hhv. 0,019 og 0,018 w/w% (hhv. 190 og 180 mg/kg).

Ved de kvantitative analyser ved røntgen med focus på bly blev der påvist indhold af bly i den ene haveslange, de to LP-plader samt i den røde ledning. De højeste indhold blev fundet i de to LP-plader samt i den røde ledning.
De 4 prøver af cykelslanger og cykeldæk viste høje indhold af kulbrinter ved screeningsanalysen ved GC/MS. På grund af det høje indhold af kulbrinter, var det ikke muligt ved screeningen at afklare, om der kunne være indhold af PAH inkluderet i summen af kulbrinterne. Der blev udført kvantitative analyser med fokus på de 8 regulerede PAH i henhold til REACH bilag XVII, men disse kunne ikke påvises i produkterne.

Der blev udført kvantitative analyser for isocyanater, da disse ikke kan påvises ved screeningsanalysen ved GC/MS. Der blev udvalgt en enkelt prøve af skum fra en madras til kvantitativ analyse for isocyanter, da det er velkendt, at skum kan indeholde rester af monomere isocyanater. Der blev dog kun påvist indhold af 2,4- og 2,6-TDI og MDI tæt på metodens detektionsgrænse i skummadrassen.

Der blev kun påvist et relativt lavt indhold af DEHP ved migrationstesten til kunstig sved på trods af det høje indhold af DEHP i prøven.

Eksponeringsvurdering
Afhængigt af materialerne, indholdsstofferne og den kreative forarbejdning ved fremstilling af nye produkter ud fra materialer i brugte produkter kan der forekomme eksponeringi forbindelse med hudkontakt (dermalt), ved indtagelse (oralt), gennem indånding af dampe eller partikler i luften (ved inhalation) eller ved en kombination heraf.

I projektet blev det valgt at udarbejde følgende eksponeringsscenarier:
Ledninger, fremstilling og brug som smykker (DEHP eksponering).
Skummaterialer, som "muskelfyld" i Supermankostume (toluendiisocyanat, TDI).
Printplader, fremstilling og leg med "robot, el-bil" (triarylphosphater).
Cykeldæk og cykelslanger, diverse (polyaromatiske kulbrinter, PAH).

Produkterne blev valgt dels på baggrund af de kemiske stoffers toksikologiske profil (DEHP er hormonforstyrrende og kan påvirke udviklingen af kønsorganerne; TDI kan fremkalde luftvejsallergi og er kræftfremkaldende i forsøgsdyr; triarylphosphater kan fremkalde organskader; PAH-stoffer er højpotente kræftfremkaldende stoffer), og dels som følge af særligt højt indhold i screeningsanalyserne (særligt for DEHP og triarylphophaterne).

Valget af scenarier/anvendelser med de brugte produkter blev foretaget ud fra betragtninger om højest muligt eksponeringspotentiale for stofferne.

Vurderingen af DEHP-eksponeringen blev baseret på resultaterne for en migrationstest med kunstigt sved.

For TDI i skummaterialer blev eksponeringsscenariet dels baseret på kvantitative analyser af TDI i den konkrete skummadras, og dels ud fra litteraturdata vedrørende migration fra tilsvarende skummaterialer.

For triarylphosphater i printplader blev eksponeringsscenariet baseret på det målte indhold i printpladerne, da der ikke kunne foretages yderligere migrationstests i projektet.

For PAH i cykeldæk og cykelslanger blev det ikke vurderet nødvendigt at beskrive et mere detaljeret eksponeringsscenarie, idet anvendelsen af disse materialer alene skulle vurderes i forhold til det målte indhold af PAH, som derpå i risikovurderingssammenhæng kunne sammenholdes med et generelt regulatorisk krav for PAH-indhold i legetøj.

Sundheds- og risikovurdering
Resultaterne fra eksponeringsvurderingen, sundhedsvurderingen og risikovurderingen for de enkelte stoffer er sammenfattet herunder:

Stof	Eksponeringsvej	DNEL-værdi mg/kg lgv/d	Højest estimerede eksponering mg/kg /kgv/d	RCR-værdi
DEHP	Oralt	0,05	$0,08 \times 10^{-3}$	0,0016
	Dermalt	0,7	$0,148 \times 10^{-3}$	0,00021
	Indånding	-	-	-
TDI	Oralt	-	-	-
	Dermalt	0,33 µg/cm²	0,0024µg/cm²	0,007

	Indånding	6,4 µg/m³	0,00044 µg/m³	0,00007
Tricresylphosphat + dicresylphenyl-phosphat	Oralt	0,004	Ved migration større end 3,1 mg/cm²/ time bliver RCR > 1 for dermal eksponering	
	Dermalt	0,004		
	Indånding	-		

DEHP og TDI
Fra beregningerne af de meget lave RCR-værdier kan det konkluderes, at eksponeringen for DEHP og TDI i forbindelse med de konkrete anvendelsesscenarier ligger betydeligt under betænkelige sundhedsmæssige niveauer.

Triarylphosphater
For triarylphosphaterne blev der i stedet for et egentligt eksponeringsestimat beregnet, hvor stor en mængde af den konkrete mængde triarylphosphat der kunne migrere ud af printpladen, førend RCR-værdien ville overstige 1. Her blev det for de mest toksiske triarylphosphater (tricresylphosphat + dicresylphenylphosphat) beregnet, at migrationshastigheden fra printpladen ikke måtte overstige 3,1 mg/cm²/time svarende til 0,02 % af det samlede indhold.
Hvorvidt dette er en realistisk migrationshastighed, kan evt. vurderes ved at foretage en migrationstest.

PAH
Risikovurderingen af PAH-indhold i cykeldæk og cykelslanger blev foretaget ved at sammenholde de analyserede niveauer med kravene i EU-Kommissionens anvendelsesbegrænsning for plast og gummiartikler beregnet til børn. For disse artikler er der fastsat en øvre indholdsgrænse for seks specifikke PAH-stoffer på hver 0,5 mg/kg (EU-Kommissionen 2013). Da disse PAH-stoffer ikke kunne detekteres i de udvalgte cykeldæk og slanger (analyseret ved en detektionsgrænse på 0,5 mg/kg), vurderes de konkrete dæk og slanger ikke at være betænkelige at anvende.

Samlet konklusion
I indeværende projekt er det søgt at udpege brugte produkter, der kunne være betænkelige at anvende til kreative formål i børneinstitutioner, som følge af de kemiske indholdsstoffer og brugen af produkterne. Ud fra indsamlet viden om, hvilke brugte produkter børneinstitutioner anvender, og ud fra litteraturgennemgang af kemisk viden vedr. mulige betænkelige indholdsstoffer i materialer i de produkter blev det besluttet at foretage nærmere kemiske analyser og risikovurderinger af:

- Ledninger, fremstilling og brug som smykker (DEHP-eksponering).
- Skummaterialer, fremstilling og leg ifm. ”muskelfyld” i Supermankostume (toluendiisocyanat, TDI).
- Printplader, fremstilling og leg med ”robot, elbil” (triarylphosphater).
- Cykeldæk og cykelslanger, diverse (polycykliske aromatiske kulbrinter, PAH).

Disse produkter og scenarier blev udvalgt, idet de omfatter særligt kritiske stoffer og/eller forholdsvise høje indholdsmængder i det brugte produkt.

Ud fra kemiske analyser og ud fra en mere detaljeret eksponeringsvurdering og risikovurdering af disse konkrete scenarier kunne der efterfølgende ikke peges på uacceptable sundhedsmæssige risici ved nogen af de konkrete anvendelser. Mht. triarylphosphaterne vil en tilbundsgående risikovurdering dog kræve yderligere data mht. til stoffernes migration fra printpladerne.

Nærværende projekt, hvor sigtet var at identificere evt. særligt betænkelige former for anvendelse af brugte produkter, har således ikke kunnet udpege nogen konkrete anvendelser, der må anses for sundhedsmæssigt betænkelige.

Det må dog klart understreges, at for alle scenarier drejer det sig om vurdering af enkeltstående, konkrete brugte produkter, hvorfor gentagelse af forsøget med andre tilsvarende produkter ikke nødvendigvis vil fremkomme med samme resultat. Projektet kan således ikke "frikende" anvendelsen af brugte produkter og materialer generelt.

1. Background

Citizens, museums and child care centres frequently contact the Danish Environmental Protection Agency (the Danish EPA) regarding the application of used materials and products for creative activities. In connection with inquiries, the Danish EPA recommends to exercise caution when applying material from used products for other purposes than originally intended. In order to be able to provide satisfactory directions, the Danish EPA initiated this investigation.

According to the chemicals legislation, the manufacturers are responsible for ensuring that the chemical substances and materials they produce and market are safe to use under the intended conditions; for instance in a consumer product or under normal circumstances. If a product, e.g., is heated or melted in connection with creative activities and in that way becomes another product, then the processing method (heating) will in most cases not be the intended use of the product. Therefore, the manufacturer will not have assessed if the product is safe to use when it e.g. is heated. A risk of liberation of chemical substances can arise when a product is used in a non-intended way.

Concurrently with an improved knowledge of the dangerous properties of substances, a number of dangerous substances have been prohibited in consumer products in Denmark and the EU. Since 2011, CMR substances have for instance been prohibited in toys (cf. Executive Order No. 13 of 10/01/2011) just as several heavy metals have been prohibited in electronics since 2006. In addition, older products can contain substances that with regard to health and/or the environment over time have been substituted although they have not necessarily been prohibited (e.g. certain phthalates).

When applying materials from used products there is a risk of unintentionally being exposed to hazardous substances that today are prohibited in new products. Likewise, inappropriate processing (e.g. heating) of material from a used product (of a later or an earlier date) can result in the liberation of substances that during normal use would not be present.

The objective of this project was to carry out a survey of which used materials and products children and young people apply for creative activities, and to show how the materials are used, in order to assess the potential exposure (through inhalation, oral absorption or skin contact) to chemical substances during the processing of the materials and the subsequent use of the new products.

Furthermore, the objective of this project was to assess if the potential exposure during processing and the subsequent use of the new products constitute a risk.

2. Survey of products and materials

2.1 Objective of the survey

The objective of the survey was to investigate which materials from used products children use in the creative production of new products, how the processing takes place and how the new products are used. The survey uncovers creative ideas and is an attempt to collect as many examples as possible of how used products are applied.

A creative field is in question, and focus is on bringing new ideas to light and therefore it is not possible to give a timeless account. The found products and their use only give an up-to-the-minute account as informed by the interviewed child care centres and as found in the information and internet studies at the time of the investigation.

The survey solely focused on children's (under 14 years of age) creative application of used products and materials.

2.2 Procedure

By way of introduction, information and internet studies were carried out, and they were based on books for specialists who work creatively with children and visual arts, books of inspiration and homepages dealing with the creative utilisation of used products and materials for the production of new products.

The next step was to interview representatives from child care centres and colleges of education, museums and other recreational centres for children.

An electronic questionnaire was prepared on the basis of information from the information and internet study and interviews. It was sent by e-mail to the child care centres in the municipalities of Lemvig, Aarhus, Odense and Vordingborg, to the regional municipality of Bornholm and to art schools, museums with creative workshops and to colleges of education all over Denmark that educate teachers and youth workers.

The survey was carried out from April – May 2014.

2.3 Information and internet study

An attempt was made to find as many different products and materials, applications and processes as possible by using general search words for the information and internet study.

In the search for literature, app. 25 books were found with chapters describing the application of used products and materials connected with creative activities. Six books were selected (Buusmann 2005, Dalbøge 2008, Johanson & Lauridsen 2005, Jørgensen 2013, Larsen 2009 and Viqué & Carrillo 2005) where the main focus was on the application of used products and materials and simultaneously they deal with activities for the target group of children (0-14 years). In addition, a specific search was carried out on the internet regarding children and their creative application of used products and materials and around 50 homepages dealing with the topic were visited.

A search was carried out on Google with different search words such as ”recycling”, ”recycled material”, ”children”, ”creative” and ”institution” as well as different combinations of the words.

In literature and especially through searches on the internet a very large number of applications were found for used products and materials. For instance, the search words ”creative ideas children recycling” gave 82,300 hits when searching on Google. The applied materials and products were categorized in nine different groups:

- Everyday items, e.g., shoes and glasses that are made of different materials
- Electronics
- Glass
- Rubber
- Metal
- Paper and cardboard
- Plastic materials
- China and ceramics
- Wood

The processing methods, described in literature and on the homepages, are categorised in three main groups in the table below:

- Classification (e.g. cut, carve, separate or down-size)
- Heating (e.g. in oven or with wood burner)
- Other types of processing (e.g. using glue, tape, nails or paint)

The products, processes and applications found in the books and on the homepages are described in Table 1. In total, 71 examples were found. The information also appears in Appendix 1, which summarises all examples found in the project.

TABLE 1 LIST OF PRODUCTS, MATERIAL, PROCESSES AND APPLICATIONS FOUND IN THE LITERATURE AND INTERNET STUDY.

Product and material types	Products	Processing	Products made	Specific product description
Everyday items	E.g. glasses, shoes and vases	Paint/decorate	Ornamental article	
Electronics	Computer parts, e.g. fixed disks, keyboards, screens and printed circuits	Separate/break	Jewellery	
		Separate/break Glue/fix	Decoration material	
	Light bulb	Separate/break	Ornamental article/toys	
	Distribution box, inside of extension cord – electronics part	Glue/fix	Ornamental article/toys	Figures
	Cords	Shape/weave/fold/fill Glue/fix	Decoration material/ ornamental article	Figures

Product and material types	Products	Processing	Products made	Specific product description
	Fairy lights	Separate/break Glue/fix	Decoration material	
Glass	Glass jars	Paint/decorate	Everyday items/ storage	Glass jars with plastic animals glued on the lid, painted
Rubber	Tyres, e.g. from bikes, cars and tractors	Cut/carve/saw Sew together	Clothing	Sandals
	Rubber tubes e.g. from bikes, cars and tractors	Cut/carve/saw Glue/fix	Everyday items/toys	Wallets Slingshots
Cork	Cork	Glue/fix	Everyday items	Notice board
Metal	Tin-opener on soft drink cans	Sew together Glue/fix	Decoration material	Decoration
	Cans for drinks, e.g., beer and soft drinks	Cut/carve/saw	Ornamental article/everyday items	Candlesticks
		Cut/carve/saw	Ornamental article/everyday items	Vases
	Wire pad (metal)	Shape/weave/fold/fill Paint/decorate	Ornamental article/toys	Decoration, e.g. hearts and seals
	Capsules	Knock flat/make hole	Decoration material/ toys/everyday items	Instruments Decoration Mat
	Food cans e.g. from peeled tomatoes, pineapple or mackerel	Knock flat/make hole	Ornamental article/everyday items	Candlesticks
		Paint/decorate	Toys/everyday items	Drums Pencil holder
	Construction products (nails, screws, springs, nuts, washers, plumbing pipes and	Glue/fix	Ornamental article/toys	Decoration of figures e.g. eyes and legs

Product and material types	Products	Processing	Products made	Specific product description
	pipe joints)			
	Cords (different types of metal)	Shape/weave/fold/ fill	Decoration material/ ornamental article	Figures
	Tin foil	Glue/fix Shape/weave/fold/fill	Decoration material	Decoration of items, balls/ bars
Paper and cardboard	Newspaper and printed matter (e.g. newspaper, periodicals and advertisements)	Soak in water	Ornamental article	Bowl/cups
		Glue/fix	Decoration material/ornamental article/everyday items	Handmade paper
		Shape/weave/fold/fill	Everyday items	Chair pads Bags for food
		Cut/carve/saw	Jewellery	Pearls
		Glue/fix	Decoration material	Decoupage
	Cartons from e.g. milk, dairy products and juice	Cut/carve/saw Paint/decorate	Ornamental article	Bird house Houses to play with
	Cardboard boxes	Paint/decorate	Toys	Houses for small dolls/ exhibits
		Paint/decorate	Storage	Boxes
	Cardboard cylinder e.g. toilet rolls	Paint/decorate	Everyday items	Pencil holder
		Shape/weave/fold/fill	Toys	Rattler (instrument)
	Paper plate	Paint/decorate	Ornamental article/toys	Basket
		Paint/decorate	Ornamental article/toys	Watch for learning the time
		Paint/decorate	Ornamental article/toys	Drum
	Tea strainer/coffee filter	Paint/decorate	Ornamental article	Ornament on glass to make it look like a vase Figurer
	Egg tray	Soaked in water	Decoration material/	Handmade

Product and material types	Products	Processing	Products made	Specific product description
			ornamental article/everyday items	paper
Plastic	Bubble wrap	Glue/fix Sew together	Decoration material	Candlesticks
	Bubble wrap	Sew together	Everyday items	Bag for swimwear
	CDs/DVDs	Cut/carve/saw Paint/decorate	Decoration material/ ornamental article/toys	
	CD cover	Paint/decorate	Ornamental article	Birthday card
	Packaging from e.g. bottles, tubs, cleaning agents and cosmetics	Cut/carve/saw Paint/decorate	Everyday items	Phone holder Pencil holder
	Packaging from food	Paint/decorate	Ornamental article/toys	Butterflies/ flowers
	Disposable tableware e.g. cutlery, cups and plates	Heat e.g. in oven	Ornamental article/ everyday items	Candlesticks Decoration
	Foam facecloth	Cut/carve/saw Glue/fix	Decoration material	
		Cut/carve/saw	Decoration material (body adornment)	Tattoo made with browning
		Paint/decorate	Toys	Stencil for paint
	Flamingo/poly-styrene e.g. boxes and small balls/filling from parcel post	Paint/decorate	Decoration material	
	Pot scourer (coloured)	Cut/carve/saw Glue/fix	Decoration material/ toys	Decoration Signs Houses to play with
	Tapes for cassette recorder or video	Separate/break	Ornamental article/toys	Decoration
	Climbing rope	Cut/carve/saw Heat e.g. in oven	Jewellery	Bracelet/ Jewellery
	LPs	Heat e.g. in oven	Everyday items in touch with food	Fruit bowl

Product and material types	Products	Processing	Products made	Specific product description
	Foamed plastics e.g. sleeping mat or foam mattress	Cut/carve/saw	Clothing	Slippers
	Foamed plastics e.g. sleeping mat or foam mattress	Cut/carve/saw Glue/fix	Toys	Weapons for roleplaying
	Plastic bottle from e.g. soft drinks or juice	Paint/decorate	Ornamental article/toys	Bowling game made into penguins
	Plastic bottles	Cut/carve/saw Heat e.g. in oven Paint/decorate	Everyday items	Storage box
	Punched pockets	Sew together	Ornamental article	Place-mat
		Paint/decorate	Everyday items	Pencil case
	Plastic bags e.g. from coffee, crisps, cat food, candy, shopping bags, bubble wrap or punched pockets	Clean Shape/weave/fold/fill Sew together	Everyday items/toys	Handbags and wallets
		Cut/carve/saw	Toys	Dragon
	Candy bag	Heat e.g. in oven	Jewellery	Pendant in necklace
	Straws	Cut/carve/saw Paint/decorate	Jewellery	Pearls; straws are cut into pieces and covered with newspaper
		Cut/carve/saw Heat e.g. in oven	Jewellery	Pearls; straws cut into pieces and they shrink to small pearls in oven
China and ceramics	China, e.g. plates, flagstone, mirrors and tiles	Separate/break Glue/fix	Decoration material	Mosaic
Textile	Dishcloths	Cut/carve/saw Glue/fix	Decoration material	Decoration
		Sew together	Toys	Figures/ Teddy bears
	Cotton wool	Paint/decorate Cut/carve/saw	Decoration material	Decoration

Product and material types	Products	Processing	Products made	Specific product description
		Glue/fix Dry with e.g. hair-dryer		
		Shape/weave/fold/fill	Toy	Stuffing
	Q-tips	Glue/fix Paint/decorate	Decoration material	Decoration
Wood	Popsicle sticks	Glue/fix	Ornamental article/toy	Airplane
	Lacquered wood e.g. wood from furniture, wooden toys and fences	Burn with wood burner	Ornamental article	Signs
	Pressure-treated wood (green or brown) e.g. from terraces and fences	Burn with wood burner	Ornamental article	Signs

In connection with the subsequent interviews with specialists who work with used materials for creative activities, the found products, materials and processes described in Table 1 were used as examples and inspiration in the guide that was prepared and during the interviews that were carried out.

2.4 Telephone interviews

A question guide was prepared for the interviews, see Appendix 2. By phone, 13 employees (from 9 different types of institutions) were interviewed. They work with used products and materials for creative activities, see Table 2.

TABLE 2 OUTLINE OF INSTITUTIONS THAT WERE INTERVIEWED.

Institution	No. of interviews
Day nursery	1
Integrated child care centre with children from 0-6 years of age	2
After School Programme (ASP)	1
School	2
Art school	1
Colleges of education for specialists (youth workers or teachers)	3
Museums with creative workshops	1
Libraries	1
Cross institutional centre[2]	1

[2] The cross institutional centre offers activities for nurseries, child care centres, integrated institutions and schools. The centre deals with food, gardens, health and nature (including recycling and reuse) with focus on development of language, education in natural sciences and social competences.

One institution that was contacted (a day nursery) only used new products and materials for creative activities, and an integrated child care centre mentioned that children from 0-2 years of age do not work with used products or materials.

The others (12 out of 13 contacted institutions) apply used products and materials to a varying degree.

The interviewed colleges of education did not state specific used products and materials and are therefore not represented in Table 3. One teacher at the training college said that the used products and materials are applied in connection with creative and innovative classes. Furthermore, recycling and the use of recycled materials appeared during the students' final exams in creative subjects. It was the teacher's impression that the students in general work with used products and materials during their teaching practice.

The identified used products and materials at the various institutions are listed in Table 3.

TABLE 3 PRODUCTS AND MATERIALS IDENTIFIED DURING TELEPHONE INTERVIEWS AND THE INSTITUTIONS THAT USE THEM.

Products and material types	Institution
Everyday items (e.g. glasses, toys and umbrellas)	ASP (After School Programme) Art school
Electronics	School Art school College of education (teacher) Library Cross institutional centre
Glass	Integrated child care centre ASP
Rubber	College of education (teacher) Cross institutional centre
Cork	School
Metal	Integrated child care centre School Art school College of education (teacher)
Paper and cardboard	Integrated child care centre ASP School Art school Museum Library Cross institutional centre
Plastic material	Integrated child care centre ASP School Art school College of education (teacher)

Products and material types	Institution
	Cross institutional centre
China and ceramics	Integrated child care centres
	Art school
Textiles	Integrated child care centre
	ASP
	School
	Art school
	College of education (teacher)
	Museum
	Library
Wood	Integrated child care centre
	Art school
	College of education (teacher)
	Museum
	Library

The products, materials, processes and applications identified during the interviews are described in Table 4. The information also appears in Appendix 1 that summarises all examples found in the project.

TABLE 4 LIST OF PRODUCTS, MATERIALS, PROCESSES AND APPLICATIONS IDENTIFIED DURING TELEPHONE INTERVIEWS.

Products and material types	Products	Processing	Products made	Specific product description
Everyday items/ consumer products	Various everyday items e.g. glasses, shoes and vases	Cut/carve/saw Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures (animals) Relief/visual arts
	Old toys	Glue/fix	Ornamental article/toys Jewellery	Robots Houses to play with Small soft toys Jewellery
	Umbrella	Glue/fix	Ornamental article/toys Jewellery	Robots Houses to play with Small soft toys Jewellery
Electronics	Computer parts e.g. fixed disc, keyboards, screens and printed circuit boards	Cut/carve/saw Glue/fix	Ornamental article/toys	Robots Animals and humans Funny machines
		Separate/break	Ornamental article	Sculptures (animals)

Products and material types	Products	Processing	Products made	Specific product description
				Relief/visual arts
	Electronic devices, e.g., wall clocks, calculators, telephones and music players	Cut/carve/saw Glue/fix	Ornamental article	Christmas decorations
	Cords	Cut/carve/saw Glue/fix	Ornamental article	Christmas decorations
		Cut/carve/saw Glue/fix	Everyday items/Jewellery	Jewellery (embroidery, bracelet and necklace) Redesign of old furniture
Glass	Glass	Glue/fix	Ornamental article/ everyday item	Pearls on a jam glass Fantasy animals Model town Pots for sowing Small lanterns made of household glass
Rubber	Rubber tubes e.g. from bicycles, cars and tractors		Everyday item/Jewellery	Jewellery (embroidery, bracelet and necklace) Redesign of old furniture
		Clean Cut/carve/saw Sew together Glue/fix	Everyday item/ Jewellery/clothing	Accessories (brooch, handbags etc.)
Cork	Cork	Cut/carve/saw Glue/fix	Ornamental article/toy	Animals and humans Houses and towns Robots
Metal	Chocolate boxes	Cut/carve/saw Glue/fix	Ornamental article Jewellery	Animals and humans Funny machines Papier mâché
	Cans for drinks, e.g., beer and soft drinks	Cut/carve/saw Grind Solder/weld	Everyday item/toy/ Jewellery	Lamp made of cans

Products and material types	Products	Processing	Products made	Specific product description
		Cut/carve/saw Glue/fix	Ornamental article/toy	Art Animals and humans Funny machines Papier mâché
	Packaging from detergents (metal)	Cut/carve/saw Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures (animals) Reliefs/visual arts
	Food cans e.g. from peeled tomatoes, pineapple or mackerel	Cut/carve/saw Grind Solder/weld	Toys/ everyday items/Jewellery	Lamp made of cans
	Metal objects e.g. figures, keys, canned beer/soft drinks	Cut/carve/saw Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures (animals) Reliefs/visual arts
		Cut/carve/saw Grind Solder/weld	Everyday items Jewellery	Jewellery (embroidery, bracelet and necklace) Redesigned old furniture
	Construction products (nails, screws, springs, nuts, washers, plumbing pipes and pipe joints)	Glue/fix	Decoration material/ornamental article/ everyday items	Pearls on a jam jar Fantasy animals Model town Pots for sowing
Paper and cardboard	Newspaper and printed matter (e.g. newspapers, magazines and adds)	Glue/fix	Ornamental article/ everyday items/Jewellery	Pearls on a jam jar Fantasy animals Model town Pots for sowing Robots Small houses Small soft toys Jewellery
	Old maps	Cut/carve/saw Glue/fix	Ornamental article/Jewellery	Animals and humans Funny machines Papier mâché
	Cartons from e.g. milk, dairy products and juice	Cut/carve/saw Glue/fix	Ornamental article/everyday items/jewellery	Animals and humans Funny machines Papier mâché,

Products and material types	Products	Processing	Products made	Specific product description
				Robots Small houses Small soft toys, Jewellery
		Cut/carve/saw Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures (animals) Reliefs/visual arts
	Cardboard	Cut/carve/saw Glue/fix	Ornamental article	Christmas decorations
		Glue/fix	Ornamental article/Jewellery	Robots Small houses Small soft toys Jewellery
	Paper	Cut/carve/saw Glue/fix	Ornamental article/ everyday item/Jewellery	Art Animals and humans Funny machines Papier mâché
		Glue/fix Dry with e.g. hair-dryer	Ornamental article Jewellery	Sculptures Reliefs Collage Jewellery
	Cardboard boxes	Glue/fix Dry with e.g. hair-dryer	Ornamental article Jewellery	Sculptures Reliefs Collage Jewellery
		Glue/fix	Ornamental article/ everyday item	Robots Small houses Small soft toys Jewellery
		Cut/carve/saw Glue/fix	Ornamental article/toy	Houses and landscapes Robots
	Cardboard cylinder e.g. toilet rolls	Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures Reliefs Collage Jewellery
	Egg trays	Glue/fix	Ornamental article/ everyday item	Fantasy animals Model town Pots for sowing
		Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures Reliefs

Products and material types	Products	Processing	Products made	Specific product description
				Collage Jewellery
Plastic material	Bubble wrap	Glue/fix Cut/carve/saw	Ornamental article/ everyday item/Jewellery	Animals and humans Funny machines Papier mâché
	Packaging from e.g. bottles, tubs, cleaning agents and beauty products	Cut/carve/saw Glue/fix Dry with e.g. hair-dryer	Ornamental article	
	Flamingo/polystyrene e.g. boxes, small balls/ filling from parcel post	Cut/carve/saw	Ornamental article/ everyday item/Jewellery	Animals and humans Funny machines Papier mâché Robots Small houses Small soft toys Jewellery
	Inside of chocolate box	Cut/carve/saw Glue/fix	Decoration material/ ornamental article/toy	Bowls and small people Scrap robots
	Plastic bottles from e.g. soft drinks and juice	Cut/carve/saw Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures (animals), Relief/visual arts
	Plastic material	Glue/fix	Ornamental article	Scrap art
	Plexiglas/acrylic	Heat (fume extractor)	Everyday item/Jewellery	Jewellery (embroidery, bracelet and necklace), Redesign of old furniture
China and ceramics	E.g. plates, flagstones, mirrors and tiles	Cut/carve/saw Glue/fix Dry with e.g. hair-dryer	Ornamental article/ Everyday items	Sculptures (animals), Reliefs/visual arts Mosaic Pearls on a jam jar Fantasy animals Model town Pots for sowing
Textile	Old clothes	Clean	Everyday	Accessories

Products and material types	Products	Processing	Products made	Specific product description
		Cut/carve/saw Sew together Glue/fix	items/Jewellery	(brooch, handbags etc.) Clothing
	Yarn and string	Glue/fix	Ornamental article/ everyday items/Jewellery	Robots Small houses Small soft toys Jewellery
		Cut/carve/saw Glue/fix	Ornamental article	Christmas decorations
	Fabric, remnants and thrums	Glue/fix	Ornamental article/ Everyday items/Jewellery	Robots Small houses Small soft toys Jewellery Fantasy animals Model town Pots for sowing
		Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures Reliefs Collage Jewellery
		Cut/carve Glue/fix	Ornamental article/ everyday items	Animals and humans Funny machines Papier mâché
	Textile, e.g. from doll clothes, other clothes and felt	Cut/carve Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures (animals) Reliefs/visual arts Christmas decorations
Wood	EUR-pallet	Cut/carve/saw Grind Glue/fix	Everyday items	Furniture
	Wood pieces	Cut/carve/saw Glue/fix Dry with e.g. hair-dryer	Ornamental article	Sculptures Reliefs Collage Jewellery
		Glue/fix	Ornamental article/ everyday item	Fantasy animals Model town Pots for sowing
Varying material	Mixed packaging	Cut/carve/saw Glue/fix	Ornamental article/toy	Robots

The identified processing methods were:

- Joining together with glue(gun), nails, tape or string (the majority of the answers)
- Separation by cutting, carving, sawing, hammering or grinding
- Drying wet items with a hair-dryer
- Soldering, welding and heating with fume extractor at one of the interviewed colleges of education

Only the colleges of education and one school (where the children have to be more than 14 years of age before they are allowed to work with heating) heated the materials during processing. The other institutions did not use heating (including soldering, welding) in the creative process.

According to the interviewed institutions, the children most often make ornamental articles that are placed on the bookshelf at home or the articles are left at the institution because they are part of an art project. The ornamental articles are often very fragile and the children cannot play with them for very long. In addition, the children at the interviewed institutions make toys and everyday items such as musical instruments, tealight lamps and flowerpots, whereas jewellery and packaging for food are only made to a small extent.

2.4.1 Frequency

At all of the interviewed institutions, the application of used products and materials is a recurring topic. In one of the integrated child care centres and at the colleges of education, the application of used products is an integrated part of everyday life, but they also have more concentrated projects. At one of the interviewed schools, used products and materials are applied every second month, whereas others apply used products and materials once or twice annually.

In each institution, it differs for how long the children work with used materials and products. The library stated that the children in average were occupied 30 min. with the activity. At the integrated child care centres, the children typically spend 45 min. to one hour on the activity, but it was also stated that it differed how long each child was occupied. One school and the art school stated that the children during projects sometimes worked with used products and materials for up to 5 hours, but normally 1½ hour was earmarked for that type of activity.

2.4.2 The origin of used products and materials

The municipal child care centres receive the used products and materials from the children in the institutions, from the children's parents and from the staff – most often on inquiry e.g. in connection with project weeks in the institution. Several of the interviewed institutions had a smaller base stock that in each case is replenished.
One college of education said that they receive the material from students, from the staff and from private companies. One teacher e.g. received used bicycle tubes from a bicycle repairer.

The museum procures its own used products and materials – usually at flea markets or recycling centres.

2.4.3 How institutions select and reject material

All interviewed institutions examine the products on receipt and some are rejected according to the knowledge and experience the employees have regarding health hazards of the materials.

The interviewed integrated child care centres, the museum and the After School Programme (ASP) do not wish to work with used electronics. In addition, one integrated child care centre and the museum did not use plastic materials. The museum also informed that the museum does not use scrap iron, painted items, malodorous products or cords.

The ASP and schools that were contacted had a more relaxed control procedure regarding received materials than the integrated child care institutions. Here the attitude was that children also have to learn to take responsibility. One of the contacted schools informed that they no longer deal with used rubber from bicycle tubes or car tyres as the municipality advised against the materials being used by children.

All of the interviewed institutions stated that products and materials were rejected if they were malodorous, unhygienic, sharp, pricking, danger marked and/or mouldering.

2.4.3.1 Inspiration

The interviewed staff members find inspiration for new projects with used materials and products either from the children, books, colleagues, suppliers of creative materials, schools of architecture, the internet, museums or art exhibitions, TV shows, spare time experience or through students being trained at the institution.

2.5 Questionnaire study

An electronic questionnaire (see Appendix 3) was developed on the basis of the results from the information and internet study and interviews with employees at the institutions. Examples of products and materials, processing, creative application of products etc. were incorporated in the questionnaire to make the questions and reply possibilities more relevant and recognisable for the persons who were interviewed.

The questionnaire study was divided into two parts. The first part concerned all applied products and materials and comprised general questions regarding the application of the used products and materials. The second part comprised clarifying questions regarding the use of the following product and material types: electronics, rubber, metal, plastic and wood. It was not possible to include all identified product and material types in the clarifying chapter of the questionnaire study as the questionnaire would have become too extensive at the risk of the interviewed persons not wanting to complete the questionnaire. To limit the questionnaire, the five product and material types assessed to have greatest risk of containing problematic substances were selected.

The municipalities of Lemvig, Aarhus, Odense and Vordingborg as well as the regional municipality of Bornholm were contacted and they all made e-mail addresses to the child care centres of the municipalities available for the electronic questionnaire study. In addition, the questionnaire was sent to selected art schools and museums that have to do with children and to colleges of education where specialists such as youth workers and teachers are educated. A total of 868 institutions were contacted with the main emphasis on municipal child care centres.

In the course of the reply period, the municipality of Odense sent a reminder to all child care centres while two reminders were sent to the other institutions that had not yet completed the questionnaire.

The contacted institutions were grouped as shown in Table 5.

TABLE 5 OUTLINE OF CONTACTED INSTITUTIONS CONNECTED WITH THE DISTRIBUTION OF THE ELECTRONIC QUESTIONNAIRE.

Institution	Total	Percentage
Nurseries, kindergartens and integrated child care centres (children aged 0-6 years)	476	55%
ASPs and youth centres	157	18%
Schools	115	13%
Visual arts/schools of arts and crafts for children and young people	98	11%
Colleges of education for specialists such as youth workers or teachers	14	2%
Museums that offer creative workshops	8	1%
Total	868	100

64 replies were received from the contacted institutions in connection with the questionnaire giving a response rate of 7.4%. The low response rate probably indicates that the employees in these institutions usually do not sit in front of a computer all day while they are at work; it probably does not indicate that used products and materials are not applied.

Table 6 below shows the distribution of respondents and the number who apply used materials and products.

TABLE 6 DISTRIBUTION OF RESPONDENTS CONNECTED WITH THE QUESTIONNAIRE STUDY AND NUMBER OF RESPONDENTS WHO APPLY USED MATERIALS AND PRODUCTS.

	No. of replies	Percentage distribution	No. applying used materials	Share applying used materials
Day nursery	5	8%	3	60%
Kindergarten	16	25%	14	88%
Integrated child care centre	28	44%	25	89%
ASP and youth centre	7	11%	7	100%
School	2	3%	0	0%
Visual arts/schools of arts and crafts for children (young people <14 years)	4	6%	3	75%
Colleges of education for specialists such as youth workers or teachers	0	0%	0	-
Museums that offer creative workshops	2	3%	2	100%
Total	64	100%	54	84%

From the replies, 84% replied that they apply used products for creative activities (54 respondents).

The two schools that answered the questionnaire both stated that they do not apply used materials and products.

Table 7 gives an outline of the applied product and material types and the institutions that use them.

TABLE 7 MATERIALS (FROM THE QUESTIONNAIRE STUDY) AND THE INSTITUTIONS THAT USE THEM. THE PERCENTAGE STATES THE SHARE THAT APPLIES USED MATERIALS COMPARED TO THE TOTAL NUMBER OF REPLIES FROM THE GIVEN TYPE OF INSTITUTION.

Product and material types	Institution	No. of institutions	Percent of total no. of replies within each type of institution
Electronics	Kindergarten	4	29%
	Integrated child care centre	6	24%
	Visual arts/school of arts and crafts	2	67%
	Museum that offers creative workshops	1	50%
	Total	**13**	**24%**
Glass	Day nursery	3	100%
	Kindergarten	14	100%
	Integrated child care centre	24	96%
	ASP and youth centre	7	100%
	Visual arts/school of arts and crafts	2	67%
	Museum that offers creative workshops	1	50%
	Total	**51**	**94%**
Rubber	Kindergarten	3	21%
	Integrated child care centre	8	32%
	ASP and youth centre	4	57%
	Visual arts/school of arts and crafts	2	67%
	Total	**14**	**26%**
Metal	Day nursery	1	33%
	Kindergarten	9	64%
	Integrated child care centre	16	64%
	ASP and youth centre	4	57%
	Visual arts/school of arts and crafts	2	67%
	Museum that offers creative workshops	2	100%
	Total	**34**	**63%**
Paper and cardboard	Day nursery	3	100%
	Kindergarten	14	100%
	Integrated child care centre	25	100%

Product and material types	Institution	No. of institutions	Percent of total no. of replies within each type of institution
	ASP and youth centre	7	100%
	Visual arts/ school of arts and crafts	3	100%
	Museum that offers creative workshops	2	100%
	Total	**54**	**100%**
Plastic material	Day nursery	1	33%
	Kindergarten	10	71%
	Integrated child care centre	15	60%
	ASP and youth centre	1	14%
	Visual arts/school of arts and crafts	3	100%
	Museum that offers creative workshops	2	100%
	Total	**32**	**59%**
China and ceramics	Day nursery	1	33%
	Kindergarten	8	57%
	Integrated child care centre	17	68%
	ASP and youth centre	5	71%
	Visual arts/school of arts and crafts	2	67%
	Museum that offers creative workshops	1	50%
	Total	**34**	**63%**
Textiles and yarn	Day nursery	3	100%
	Kindergarten	14	100%
	Integrated child care centre	25	100%
	ASP and youth centre	7	100%
	Visual arts/ school of arts and crafts	3	100%
	Museum that offers creative workshops	2	100%
	Total	**54**	**100%**
Wood	Day nursery	2	67%
	Kindergarten	9	64%
	Integrated child care centre	21	84%
	ASP and youth centre	4	57%

Product and material types	Institution	No. of institutions	Percent of total no. of replies within each type of institution
	Visual arts/school of arts and crafts	3	100%
	Museum that offers creative workshops	1	50%
	Total	**40**	**74%**

To some extent, all respondents work with paper/cardboard as well as textiles and yarn.

2.5.1 Frequency

The outline below shows to which degree the different fractions are used in the institutions that informed that they apply used materials and products.

FIGURE 2 FREQUENCY OF USE OF VARIOUS FRACTIONS[3].

Figure 2 shows that paper and cardboard as well as textiles and yarn are used by all of the institutions that stated an application of used products and materials. It also appears that electronics and rubber are not used by app. 75% and 70%, respectively, of the institutions that apply used products and materials, just as metal, plastic and china are not used in 35% - 40% of the mentioned institutions.

In addition, the questionnaire study asked the respondents to state the max. number of hours the children work with materials from used products. Table 8 shows the highest stated value among all replies for each product and each material type as well as the time interval. As several respondents only have stated a value for the max. number of hours (e.g. at number of hours a month) there is divergence between the stated number of hours a day, a week and a month.

On the other hand, the table presents the worst-case scenario for children's application of used products at the institutions where the respondents work.

TABLE 8 THE MAX. HOURS CHILDREN WORK WITH MATERIAL FROM USED PRODUCTS. THE TABLE SHOWS THE HIGHEST STATED VALUE OF THE GIVEN MATERIAL TYPE PER DAY, PER WEEK AND PER MONTH.

Products and material types	Max. hours a day	Max. hours a week	Max. hours a month
Electronics (e.g. PCs, telephones, cords)	1	-	1
Glass (e.g. bottles, jam jars)	1	15	20
Rubber (e.g. tyres, bicycle tubes)	1	1	10
Metal (e.g. cans, capsules, lids)	1	2	10
Paper and cardboard (e.g. newspapers, magazines, boxes, cartons)	2	15	32
Plastic material (e.g. packaging, LPs)	1	5	20

[3] The term "material" has been used although electronics is comprised by several materials as it in connection with waste is considered to be one material fraction.

Products and material types	Max. hours a day	Max. hours a week	Max. hours a month
China and ceramics (plates, cups, potsherds, rivets)		2	10
Textiles and yarn (e.g. old clothes, thrums)	2	15	20
Wood (e.g. EUR-pallets, popsicle sticks, scraps from workshop)	2	3	4

Table 8 shows that children in worst-case spend most time working with the material types glass, paper and cardboard, plastic materials as well as textiles and yarn, whereas they spend least time working with electronics and wood.

2.5.2 Products, processing and application of used products and materials

The questionnaire asked close questions about processing and the application of electronics, rubber, metal, plastic materials and wood. 43 (app. 80%) of the institutions that apply used materials and products replied that they at least use one of the materials, which leaves 11 (app. 20%) who neither use electronics, rubber, metal, plastic materials nor wood.

All replies concerning processing and application of produced products are listed in Table 9. The stated products, processes and applications were predetermined examples that the respondents could choose in the questionnaire; therefore, the replies from the respondents are not unique.

Examples of products, including their processing and applications, from the questionnaire, appear in Appendix 1 that summarises all examples found in the project.

The wording on products, processing and application methods of products across literature and internet studies, telephone interviews and the questionnaire study has been harmonized in Appendix 1. That means that some of the product examples in Table 9 have been changed a little in Appendix 1 (e.g. ”PC equipment” and ”Small electrical devices” are listed in Appendix 1 under ”Electronics” as ”Various devices and spare parts”).

TABLE 9 MATERIALS IN THE QUESTIONNAIRE STUDY AND THE IDENTIFIED PROCESSES AND APPLICATIONS.

Products and material types and examples	Processing	Products made
Electronics - PC equipment (screen, keyboard etc.) - Printed circuit board and other ”inside” material of electronics - Telephones - Cords - Small electrical devices (pocket calculators, music recorders etc.)	Manual separation (e.g. carving, cutting, hammering or sawing) Other processing (e.g. painting and building together (e.g. with tape, nails or glue gun)	Ornamental article (e.g. art) Jewellery (e.g. bracelet or necklace) Toys (e.g. robot, doll or car)

Products and material types and examples	Processing	Products made
Rubber - Tyres (e.g. from bicycles, cars, tractors) - Tubes (e.g. from bicycles, cars)	Manual separation (e.g. carving, cutting, hammering or sawing) Other processing (e.g. painting and building together (e.g. with tape, nails or glue gun)	Ornamental article (e.g. art) Jewellery (e.g. bracelet or necklace) Toys (e.g. robot, doll or car) Everyday item (e.g. doily)
Metal - Cans for drinks (e.g. beer, soft drinks) - Food cans e.g. from peeled tomatoes, pineapple or mackerel - Plumping pipes and pipe joints	Manual separation (e.g. carving, cutting, hammering or sawing) Other processing (e.g. painting and building together (e. g. with tape, nails or glue gun)	Ornamental article (e.g. art) Toys (e.g. robot, doll or car) Everyday item (e.g. doily) Everyday items for food
Plastic - CD/DVDs - Packaging (e.g. bottles, tubs) - Disposable tableware (e.g. cutlery, cups, plates) - Flamingo/polystyrene (e.g. boxes, small balls) - Cassette/video tapes - Foamed plastics (e.g. sleeping mat, foam mattress) - Plexiglas - Plastic bags (e.g. from coffee and candy, bubble wrap, punched pockets)	Manual separation (e.g. carving, cutting, hammering or sawing) Other processing (e.g. painting and building together (e.g. with tape, nails or glue gun)	Ornamental article (e.g. art) Jewellery (e.g. bracelet or necklace) Toys (e.g. robot, doll or car) Everyday item (e.g. doily) Everyday items for food
Wood - Lacquered or painted wood (e.g. wood from furniture, wooden toys, fences) - Clean wood (e.g. popsicle sticks, clean scraps from wood workshops) - Pressure-treated wood (green or brown e.g. from terraces,	Manual separation (e.g. carving, cutting, hammering and sawing) Heating (e.g. with soldering iron) Other processing (e.g. painting and building together (e.g. with tape, nails or glue gun)	Ornamental article (e.g. art) Jewellery (e.g. bracelet or necklace) Toys (e.g. robot, doll or car) Everyday item (e.g. doily) Everyday items for food

Products and material types and examples	Processing	Products made
fences)		

Table 9 shows that all materials are exposed to manual separation, e.g., by carving, cutting, sawing and/or hammering to pieces. Only wood is heated during processing at the institutions that participated in the questionnaire study.

All types of products and materials are used creatively in new products used for ornamental articles or toys.

The respondents also stated that electronics, rubber, plastic and wood are used to make jewellery. The staff members from 13 institutions, who work with children aged 0 – 14, had the impression that jewellery only was made to a small extent. However, that is not necessarily a conflict of interests as it cannot be concluded from the questionnaire study how often the various new products are made (e.g. if jewellery is made once a week or once a year).

In addition, it appears that rubber, metal, plastic and wood are used to make everyday items and metal, plastic and wood are used to make everyday items for food.

If all replies from the institutions are viewed in general, then all the products that are made and stated in table 9 are used by children or by children and adults.

In the questionnaire, it was not possible to identify the specific use of the various products and materials for the general application categories. However, some respondents gave specific comments in the space for remarks.

All remarks written in the space for comments in the questionnaire appear in Table 10.

TABLE 10 LIST OF REMARKS WRITTEN IN THE SPACES FOR REMARKS IN THE QUESTIONNAIRE STUDY. TEXT IN INVERTED COMMAS ARE THE RESPONDENTS' OWN WORDS.

Products and material types	Comments
Everyday items	”Used toys, pearls etc. are often quite popular.” "We purchase used furniture at the recycling shop – we don't refurbish it. We use it the way it is." ”Sometimes we purchase used toys at a recycling centre, app. 2-4 times annually.”
Tyres (e.g. from bicycles, cars, tractors)	”Tractor tyres for swings and car tyres to pile up etc.” ”We have one car tyre that we used to paint with in a former project. The children often play with it during breaks. – As mentioned, we only used the tyre to paint with by daubing paint on it and rolling it over wooden boards and using it as a sort of paint brush.”
Cans for drinks (e.g. beer and soft drinks)	”Capsules from beer and soft drink cans; manual separation for musical instruments.” ”Capsules are glued on ….”
Electronics	"Electronics are mainly used to play with, e.g. the children play with the keyboard etc. and removal of possible dangerous items is the only change that is carried out."
Wrapping plastic (e.g. bottles and pots)	"We use plastic tubs to dose paint, glue, water or other liquids. We make a hole in the plastic tubs and let the paint drip out and down on the paper." "Milk lids, e.g. for games with letters." "We sowed cress in empty packaging for tomatoes."
Flamingo/polystyrene (e.g. boxes and small balls)	"We made necklaces of the flamingo from parcels."
Garden hose	"Manual separation and painting."
Power cords	"In a project that lasted a couple of weeks, we used a few power cords. That is two years ago. The final product was exhibited and not used by anybody – only to look at."
Milk cartons and cardboard goods	"Milk cartons." "Milk cartons and egg trays." ”Egg trays - toilet and kitchen rolls for play and ornaments.”

Products and material types	Comments
Metal	"Always art products – the process is the essential part. Many hardly last till the children get home from school, but that is not what is of importance." "New lids (surplus material) are glued e.g. paper mosaic on pictures – Lids become ornamental articles." ”Products are not used as toys, but for processes where exhibitions are the main objective.”
Natural materials	"Sticks – stones – leaves etc. Whatever we find in nature. Every month."
Paper	"We received a lot of old calendars from 2013 and we daily use the reverse side as drawing paper. We have received carton from a factory."
PC equipment (screen, keyboard etc.)	"Electronics are mainly used to play with, e.g. the children play with the keyboard etc. and removal of possible dangerous items is the only change that is carried out."
Plastic	"Games for children and adults." ”Food day.” Not developed further in the questionnaire study. "Plastic milk lids, buttons, plastic bags etc. Once a year at the most and usually with new class every year. So the same children do not use the products." "We use the plastic product as flaking tool. That means that it is not changed directly to a new product, but used as a tool in the creative process."
Plastic bags (e.g. from coffee and candy, bubble wrap, punched pockets)	"For one project we used flamingo and for another project we used plastic bags that the children cut up."
Telephones	"Telephones are used as play telephones."
Various material	”Car tyres to plant flowers in. Old school tables are used to make ordinary tables.” "It could also be other recycled material. I am influenced by Regio Emilia thinking and pedagogics. That is why we are member of ReMida and will soon fetch some recycled material and make an outdoor workshop where we will work with many different materials." "Milk cartons and lids 4-6/years cardboard boxes/packaging 4-6/years." "We use milk cartons app. 3 times annually. Plastic lids

Products and material types	Comments
	from milk cartons are used a couple of times annually."
	"We use everything: milk cartons, toilet rolls, lids, packaging etc."
	"We use material from ReMida."
	"We use toilet rolls, kitchen rolls, jam jars and wood scraps to make e.g. swords."

Appendix 1 lists all the materials and products that were found and how they were processed and applied.

2.5.3 The age and origin of used products and materials

A question in the questionnaire study dealt with the age of the used products and materials when the children use them for creative activities. As appears in Figure 3, many of the respondents know nothing about the age of the materials. The majority of the respondents who have stated an age of the materials estimate that glass, metal, paper, plastic material and wood are from 0-12 months old when the children use them. Regarding used electronics and textiles, the majority of the respondents who have stated an age of the materials estimate that the used products and materials are 1 year old or more.

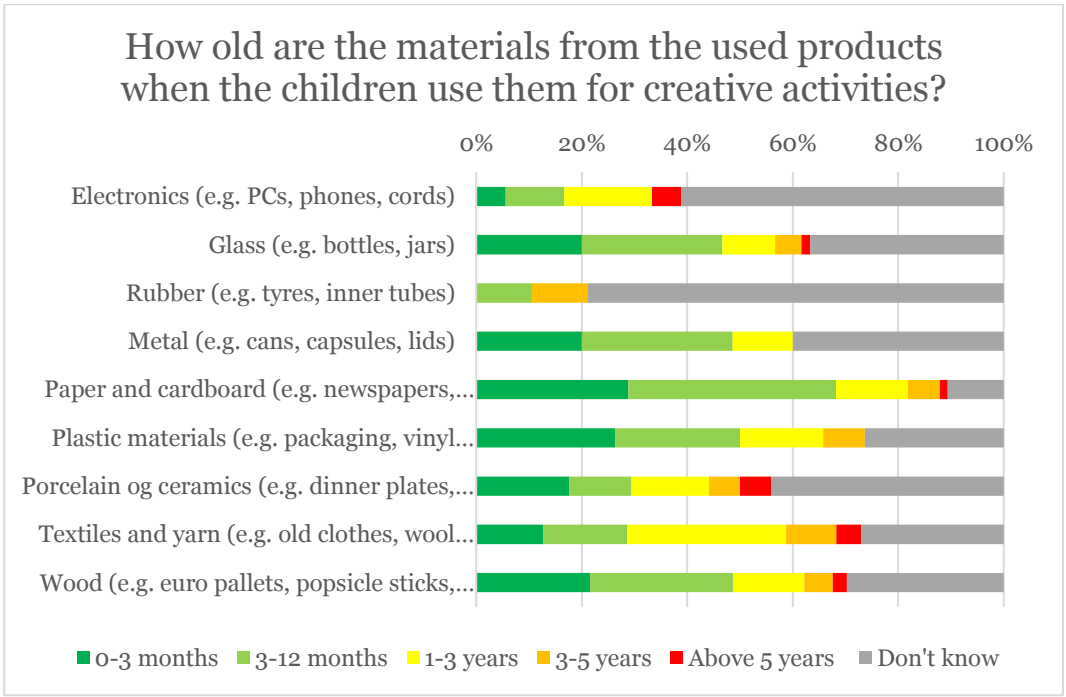


FIGURE 3 AGE OF THE USED PRODUCTS WHEN CHILDREN USE THEM FOR CREATIVE ACTIVITIES. THERE WAS A RISK THAT THE RESPONDENTS WOULD GIVE SEVERAL REPLIES WITHIN EACH MATERIAL TYPE OR LEAVE OUT SOME MATERIAL TYPES.

The institutions that answered the questionnaire mainly receive used products and materials from private persons and the employees from the institution, see Figure 4.

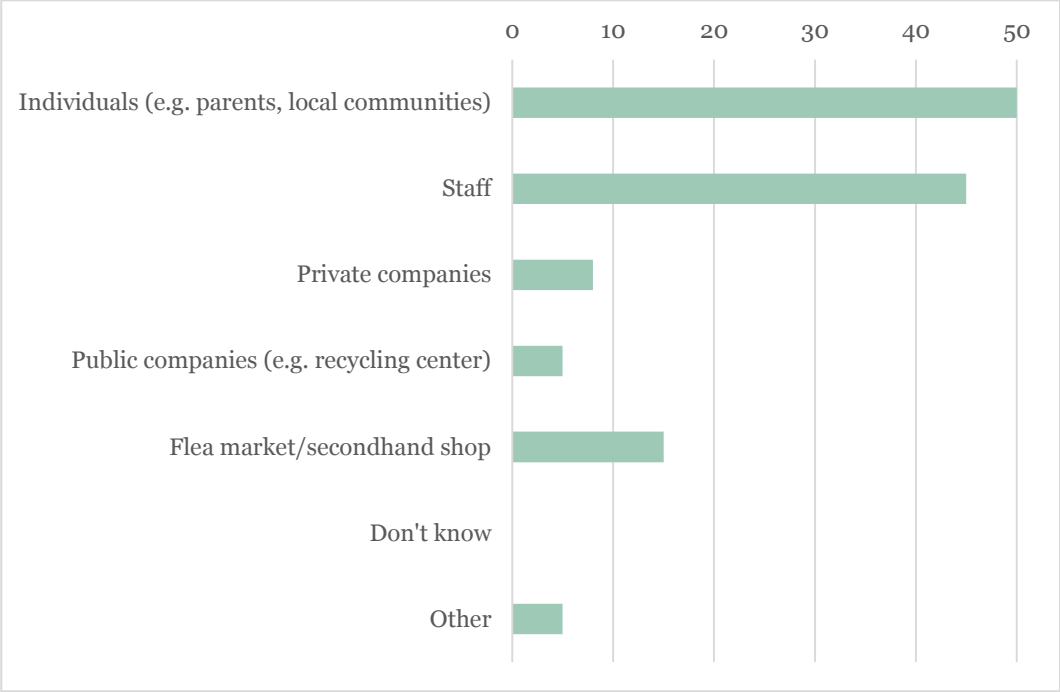


FIGURE 4 WHERE THE INSTITUTIONS GET THE USED PRODUCTS AND MATERIALS FROM AND THE NUMBER OF REPLIES.

It also appears that the material to a smaller degree comes from flea markets, recycling centres, private and municipal companies. Under ”other” it is stated that the material comes from:

- ReMida Center Odense[4]
- Things the institutions use, e.g. milk cartons
- Things the class brings (stated by a museum with a creative workshop)

2.5.4 Rejection by the institutions

In the questionnaire, the institutions were asked if they sorted used products and materials before the children use them. The result of the study shows that:

- 96% of the respondents carry out some type of sorting
- 93% discard unhygienic materials
- 85% discard sharp and sticking objects
- 69% discard materials that show signs of ageing (mouldering, crackled or the like)

In addition, the following was stated under ”other” (respondents own words):

- “We always assess the actual material and consider what it will be used for”.
- ”We do not receive a lot of material and therefore it has not been necessary to sort it out. If we did, we would for sure reject material that could be dangerous or ”too disgusting for the children to play with.”
- “Most of the material comes from ReMida or the parents and is in good condition.”
- “Size (safety compared to strangling).”
- “If it is dirty we wash it.”
- “Smudged.”
- “If we think it is not good for the children.”

[4] A centre for creative recycling that receives and stocks surplus materials from companies, which the institutions can collect for use free of charge. The ReMida centres are named after King Midas, because everything he touched turned into gold. The idea originated in the town called Reggio Emilia in Italy (www.remida.dk).

2.5.5 Inspiration

According to the respondents, the inspiration sources for new projects in which used products and materials form part are typically colleagues, students and children. The figure below shows the distribution of the received answers.

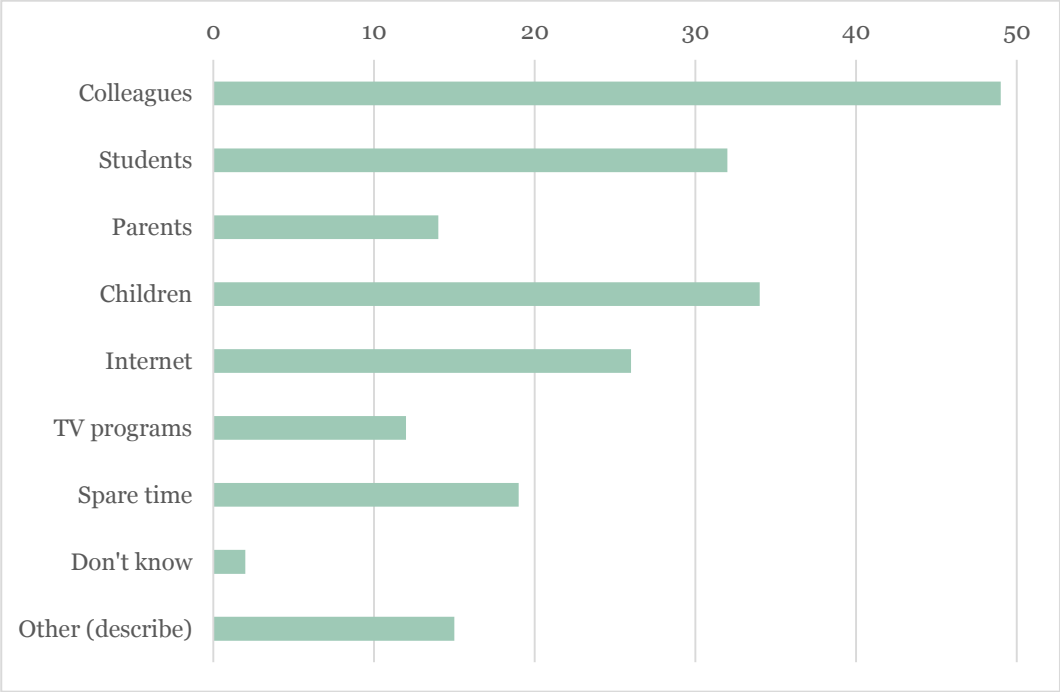


FIGURE 5 INSPIRATION SOURCES FOR APPLICATION OF USED MATERIALS AND PRODUCTS AND THE NUMBER OF REPLIES.

In addition, the following was stated under ”other”:

- ”Books and magazines”, ”Books at the library”, ”Catalogues” and ”Creative magazines etc.”
- ”Professional, educational outlook (Reggio Emilia[5])” and ”ReMida cooperation with art teacher and Reggio Emilia.”
- ”Recycling course.”
- ”The Danish painter Henry Heerup is the museums role model and he made his first waste model in 1933,” ”Inspiration comes from works of art in the museum collection,” ”Ourselves” and ”Our teachers are educated artists.”
- ”Art and museums.”
- ”Field trips.”

2.6 Summary of the survey results

The survey shows that the application of material from used products for creative activities in child care centres is widespread among the institutions that participated in this investigation. In the interviews with staff members at the institutions, 12 out of 13 interviewed institutions stated that they apply used products, whereas 84% of the interviewees in the electronic questionnaire stated that they apply used products for creative activities (64 respondents).

Some places, the application of used products forms an integrated part of everyday life, but most respondents have stated that the work takes place in concentrated projects, e.g., every second month or once or twice annually. Frequently, children’s creative application of used materials and

5 The Reggio Emilia educational philosophy arose in the Italian town called Reggio Emilia and believes that children are endowed with many different resources and competences (www.reggioemilia.dk).

products is a recurring theme in the interviewed institutions. However, according to the telephone interviews it varied for how long the children were occupied with the activity. Some places the children were occupied 30 min. at a time and other places they were occupied up to 5 hours at a time, depending on the age of the children and the individual institution.

In general, the interviewees most often and to a large extent use paper and cardboard, textiles and yarn as well as glass and to a small extent they use electronics, rubber, plastic materials, metal, china and ceramics as well as wood. The worst-case scenario from the respondents' replies shows that the children spend most hours working with materials from used products such as glass, paper and cardboard, plastic materials as well as textiles and yarn, whereas the children work less hours with electronics and wood.

The information and internet study found six examples of used products and materials that are heated during processing. In the telephone interviews and in the questionnaire study there were three cases of heating out of 13 interviews and 64 questionnaire replies. Other types of processing occur regularly and that goes for e.g. carving, cutting, down-sizing, hammering, sawing, painting or joining together with tape, nails or glue.

In the contacted child care centres, the new products are mainly used for ornamentation and decorations. Toys, everyday items, everyday items that come into contact with food and jewellery are also made.

The applied used products and materials typically originate from the children at the institutions, their parents and the staff, and they are for instance requisitioned in connection with project weeks in the institution. In the telephone interviews as well as the questionnaire study, the interviewed institutions had difficulties in putting an age on the received materials.

The majority of the respondents in the questionnaire study who have stated an age of the material estimate that glass, metal, paper, plastic materials and wood are 0 to 12 months old when the children use them. Regarding used electronics and textiles, the majority of the respondents who have stated an age of the material estimate that the used products and materials are 1 year old or more.

Before the children are allowed to work with the used materials and products, the child care centres usually sort out the materials with special regard to the safety and health of the children. The staff carries out sorting according to their knowledge and experience, which means that sorting probably takes place without greater knowledge of the chemical composition of the material.

Inspiration for the creative application of used materials and products mainly comes from colleagues, the children and from students during their practical training at the institution.

3. Selection of products and materials

This chapter describes how an initial delimitation was carried out of the products and materials that were identified in the survey. Subsequently, a literature study was carried out of the selected products and materials regarding their content of potential problematic substances. The search took its starting point in survey reports of chemical substances in consumer products and expert knowledge within electronics, plastic and rubber. On the basis of the collected information, materials/products were chosen for chemical analysis.

3.1 Initial delimitation

A complete list of products and materials from the survey appears in Appendix 1. The list was examined in order to select products and materials with a possible content of problematic substances that had to be investigated closer in the existing literature. The selection of products and materials took place according to the following three criteria:

1) Potential presence of problematic substances in the original product and in the materials the product is made of.
2) Risk of exposure to problematic substances when children process the used products and materials. There was special focus on heating, processing methods (that disclose inside parts that may consist of or be treated with problematic substances) and on down-sizing with risk of liberation of small particles.
3) Possible exposure of problematic substances during the use of the new products that are made. When examining Appendix 1, special focus was on the use of the products for jewellery, toys, clothing and everyday items in contact with food (e.g. fruit bowl) because they have a risk of dermal or oral exposure.

When examining Appendix 1, 20 product groups were selected as summarized in Table 11.

TABLE 11 DESCRIPTION OF 20 SELECTED PRODUCT GROUPS AND THE RASIONALIZATION FOR THEIR SELECETION.

Material type	Products	Processing	Application	Selection
Electronics	Various devices and spare parts (keyboard, printed circuit boards, small devices, plugs and screens)	Separate/break to pieces Cut/carve/saw Glue/fix	Toys Jewellery	Risk of presence of e.g. heavy metals, Bisphenol A and flame-retardants in materials. Risk of oral or dermal exposure as the materials are used for toys and jewellery.
Electronics	Electric bulbs	Separate/break to pieces	Toys	Incandescent bulbs are not assessed to constitute a health risk compared to problematic substances. Regarding energy saver bulbs there is a risk of inhaling mercury when the bulbs are crushed. In addition, there is risk of oral or dermal exposure as the material is used in toys.
Electronics	Cords	Cut/carve/saw Glue/fix Form/weave/fold	Everyday items Jewellery	Risk of presence of plastic softeners (e.g. phthalates) and heavy metals in the material. Risk of oral or longer dermal exposure as the material is used for everyday items and jewellery.
Rubber	Tyres (bicycles, cars and tractors)	Separate/break to pieces Cut/carve/saw Paint/decorate Glue/fix Sew together	Everyday items Toys Clothes (sandals and handbags) Jewellery	Risk of presence of polycyclic aromatic hydrocarbons (PAHs) and aromatic amines in the material. Risk of oral or longer dermal exposure as the material is used in toys, clothes and jewellery.
Rubber	Tubes (bicycles, cars and tractors)	Clean Separate/break to pieces Cut/carve/saw Sew together Glue/fix	Everyday items Toys Clothes (brooch and handbags) Jewellery	Risk of presence of PAHs and aromatic amines in the material. Risk of oral or longer dermal exposure as the material is used for everyday items, toys, clothes and jewellery.

Material type	Products	Processing	Application	Selection
Metal	Construction goods (nails, screws, nuts, washers, plumbing pipes and pipe joints)	Separate/break to pieces Cut/carve/saw Paint/decorate Glue/fix	Everyday items Toys	Risk of presence of chromium VI and heavy metals in the materials. Risk of oral or dermal exposure as the material is used for everyday items and toys.
Metal	Cans	Separate/break to pieces Cut/carve/saw Grind Soldering/welding Paint/decorate Glue/fix	Everyday items Toys Jewellery	Risk of presence of heavy metals in the material and Bisphenol A from possible epoxy coating on the inside of cans. Risk of oral or longer dermal exposure as the material is used for everyday items, toys and jewellery.
Paper	Printed matter (e.g. newspapers, magazines and advertisements)	Soak in water Cut/carve/saw Form/weave/fold Glue/fix	Everyday items Jewellery	Risk of presence of problematic substances in printer's ink, e.g. PAH. Risk of oral or longer dermal exposure as the material is used for everyday items and jewellery.
Plastic	CD and DVD	Separate/break to pieces Cut/carve/saw Paint/decorate Glue/fix	Everyday items Toys Jewellery	Risk of presence of Bisphenol A in CDs and DVDs. Risk of oral or longer dermal exposure as the material is used for everyday item, toys and jewellery.
Plastic	Packaging not approved for food (e.g. cleaning agents and cosmetics)	Separate/break to pieces Cut/carve/saw Paint/decorate Glue/fix	Ornamental articles Everyday items Everyday items for food Toys	Risk of presence of problematic substances such as softeners and other additives in the material. Risk of oral or longer dermal exposure as the material is used for everyday items, everyday items for food, toys and jewellery.

Material type	Products	Processing	Application	Selection
			Jewellery	
Plastic	Disposable tableware made of plastic (cups, cutlery, plates)	Heat and change shape	Everyday items	Risk of development and inhalation of aldehydes, PAH and other volatile substances when heating in connection with the processing. Risk of dermal exposure as the material is used for everyday items. When the material is heated there is a risk of liberation of monomer styrene and development of health hazardous oxidation products.
Plastic	Flamingo/polystyrene	Separate/break to pieces Cut/carve/saw Paint/decorate Glue/fix	Everyday items Toys Jewellery	Immediately, it has been assessed that the risk is low regarding the presence of problematic substances in the material. There is also risk of oral or longer dermal exposure as the material is used for everyday items, toys and jewellery.
Plastic	Garden hose	Manual separation and painting		Risk of presence of plasticizers (e.g. phthalates) and heavy metals in the material.
Plastic	Cassette and video tapes	Separate/break to pieces Cut/carve/saw Paint/decorate Glue/fix	Toys	Risk of presence of problematic substances as the cassette and video tapes may be made of recycled plastic. Risk of oral or dermal exposure as the products are used for toys.
Plastic	Sleeping mat and foam mattressed (foamed plastic)	Separate/break to pieces Cut/carve/saw Paint/decorate Glue/fix	Everyday items Toys Clothes (slippers) Jewellery	Risk of presence of problematic substances such as plasticizers, flame-retardants, and residue from foaming agents in the material. In addition, there is risk of oral or dermal exposure as the material is used for everyday items, toys, clothes and jewellery.
Plastic	LPs	Heat e.g. in oven	Everyday items for food	Risk of development and inhalation of hydrochloric acid, aldehydes, PAH and other volatile substances during heating in connection with processing.

Material type	Products	Processing	Application	Selection
				In addition, there is risk of oral or dermal exposure as the material is used for everyday items with food contact.
Plastic	Plexiglas	Separate/break to pieces Cut/carve/saw Paint/decorate Glue/fix Heat with fume extractor	Toys Everyday items Jewellery	Immediately, it has been assessed that there is low risk of presence of problematic substances in the substance as there rarely will be residue of the reactive and problematic monomer methyl methacrylate. Possible presence of the monomer is easy to demonstrate due to its unpleasant smell. There is risk of oral or longer dermal exposure as the material is used for toys, everyday items and jewellery. If the material is heated there is risk of liberation of the monomer methyl methacrylate and development of health hazardous oxidation products.
Plastic	Candy bags	Heat e.g. in oven	Jewellery	Risk of development and inhalation of aldehydes and other health hazardous oxidation products during heating in connection processing. Risk of longer dermal exposure as the material is used for jewellery.
Wood	Lacquered wood (e.g. wood from furniture, wooden toys, fences)	Burn with wood burner	Ornamental article	Risk of presence of heavy metals in the lacquer on the material. Risk of development and inhalation of PAH and other volatile substances during heating in connection with processing.
Wood	Pressure-treated wood (green or brown, e.g. from terraces, fences)	Burn with wood burner Separate/break to pieces Cut/carve/saw Paint/decorate Glue/fix	Everyday items Toys	Risk of presence of preservatives and heavy metals in the material. Risk of development and inhalation of PAH and other volatile substances during heating in connection with processing. Risk of oral or dermal exposure as it is used for everyday items and toys.

3.2 Literature study

The 20 product groups that were identified in the initial delimitation (see Table 11) were surveyed through a literature study for potential content of health hazardous substances.

Mainly Danish literature was used for the study and it was found through survey reports on chemical substances in consumer products (published by the Danish EPA), on the homepage *www.forbrugerkemi.dk* and through internet searches on Google. In addition, contact was taken to material experts (Nils H. Nilsson and Bjørn Malmgren-Hansen, personal communication 2014) to obtain clarifying information about chemical substances used in electronics, rubber and plastic material.

It was investigated if the problematic substances that were found in this survey are stated on the following lists:

- The list of the Danish EPA of undesirable substances (Danish EPA 2010)
- The EU SVHC candidate list (Substances of very high concern)
- The EU CoRAP list (Community Rolling Action Plan) of substances that member states investigate closer due to suspicion of health hazardous properties and with regard to getting the substance included in the EU SVHC candidate list.

Likewise, it was noted if the literature study disclosed the registration of a certain substance in the EU registry of intentions (ECHA's registration of the intention of member states to forward an Annex XV file[6] and/or propose harmonized classification and marking) or the priority list of the Norwegian *Klima- og Forurensningsdirektoratet* (Norwegian Environmental Agency). The list contains compounds to be substituted or substantially reduced.

Appendix 4 gives a summary of the information found in the literature survey on problematic substances in the 20 product types.

3.3 Final selection of products

Appendix 4 was gone over to select products and materials that according to literature can contain health hazardous substances such as substances that are suspected of being carcinogenic, mutagenic or reprotoxic. There might also be a risk of liberation of the substances when the children process the products/materials or in connection with the applicaiton of the new, produced products. A total of 10 product groups were selected for further laboratory analyses. They appear in Table 12.

TABLE 12 LIST OF SELECTED PRODUCT GROUPS.

Product groups
Various electronic devices and parts – printed circuit boards
Cords
Bicycle tyres
Bicycle tubes
Garden hoses
Disposable tableware of polystyrene
Sleeping mats

[6] Annex XV file is an explanatory statement to be prepared in connection with the proposal of an authority under the REACH regulation regarding restrictions during production, marketing and application of a certain substance.

Product groups
Foam mattress
LPs
Lacquered wood
Pressure-treated wood

3.3.1 Outline of main regulations

After the final selection of products for further laboratory analyses it was investigated to which extent the potential problematic substances that according to the literature study are assumed to be present in the selected products – see Appendix 4 – are comprised by legislation. It turned out that several of the potential problematic substances are regulated in Denmark and the EU. The investigated regulations are listed in Table 13 and it is also stated when they came into force. It is not a complete list, e.g., the regulations for toys have not been included as the interviewed institutions did not mention that they reuse toys to any appreciable degree.

TABLE 13 OUTLINE OF MAIN REGULATIONS AND WHEN THEY CAME INTO FORCE.

Product groups or substances	Statutory material	Came into force the first time
Electrical and electronic devices	RoHS Directive	1 July 2006
Food contact materials	Regulation of the European Parliament and the Council of Europe (EU) no. 1935/2004	November 1976 (Directive 76/893 /EØF), implemented in Danish legislation 1 February 1983
	Regulation of the European Commission (EU) no. 10/2011	1 May 2011
	Executive Order no. 822 of 26 June 2013	1 April 1986 (BEK no. 100 of 19/02/1986)
	Regulation of the European Commission (EU) no. 2023/2006	1 August 2008
Arsenic	REACH Regulation no. 552/2009	6 January 2003 (European Commission 2003b) Wood treated with arsenic and in use before 30 September 2007 can remain at the place of use and be used for the entire lifetime of the product.
Lead	Executive Order on Lead no. 856 of 05/09/2009	1 December 2000
Cadmium	Executive Order on Cadmium (No. 858 of 05/09/2009	1 January 1993
	REACH Regulation no. 552/2009	1 June 2007

Product groups or substances	Statutory material	Came into force the first time
Creosote	Executive Order on Creosote no. 665 of 04/07/1996 REACH Regulation no. 1907/2006	20 July 1996 26 October 2001 (European Commission 2001)
Phthalates	REACH Regulation no. 552/2009	27 December 2005
Formaldehyde	Executive Order on Formaldehyde No. 289 of 22/06/1983	1 July 1984
Organic tin compounds	REACH Regulation no. 276/2010	1 July 2010 regarding tributyltin compounds (TBT compounds) and triphenyltin compounds (TPT compounds), and 1 January 2012 regarding dibutyltin compounds (DBT compounds) and dioctyltin compounds (DOT compounds)
Polycyclic aromatic hydrocarbons (PAH)	Directive of the European Parliament 2005/69/EF	16 November 2005

A clarifying description of the final selection of the individual product and material groups, the potential problematic substances and their regulations appear in chapter 4 under each product group.

4. Description of selected products and materials

This chapter describes the surveyed information (processing, application, problematic substances and rules/regulations) of the 10 selected products and materials.

The product groups that were not selected have not been described, but information about, e.g., processing, application and possible presence of problematic substances for the product groups can be found in Table 11, Appendix 1 and Appendix 4.

4.1 Electronics – Various devices and parts

The category of electrical devices and parts comprises, e.g., keyboards, printed circuit boards, sockets, screens and small devices such as pocket calculators, music players, telephones, wall clocks, hard discs and fairy lights. The category does not comprise cords as such, as they have their own category.

The survey showed that devices and parts are separated by carving, cutting, hammering or sawing and that they are joined together with other materials by means of tape or glue. Jewellery or toys are made after processing.

4.1.1 Literature study for problematic substances

The literature study disclosed two reports in which problematic substances in new products had been investigated, e.g. in TVs, monitors, game consoles and transformers (Malmgren-Hansen et al. 2003) and printers, hair-dryers, cell phones, irons, decorative lamps, computers, TVs and multiple sockets (Mortensen 2005).

Table 14 shows the problematic substances that were found in the literature study (Appendix 4).

TABLE 14 POTENTIAL PROBLEMATIC SUBSTANCES IN ELECTRONICS – VARIOUS DEVICES AND PARTS.

Problematic substances	CAS no.	Remarks*
Problematic substances found in new TVs, monitors, game consoles and transformers (Malmgren-Hansen et al. 2003)		
Benzene	71-43-2	Found in TV and monitor Asp. Tox. 1, Skin Irrit. 2, Eye Irrit. 2, Muta. 1B, Carc. 1A, STOT RE 1
Formaldehyde	50-00-0	Found in TV, monitor, game console and transformer Acute Tox. 3, Skin Corr. 1B, Skin Sens. 1, Acute Tox. 3, Muta. 2, Carc. 1B Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010)

Problematic substances	CAS no.	Remarks*
		Included in the CoRAP list[1]
Acetaldehyde	75-07-0	Found in TV, monitor, game console and transformer Eye Irrit. 2, STOT SE 3, Carc. 2
3-carene	13466-78-9	Found in TV and monitor Self-classification: Asp. Tox. 1, Skin Irrit. 2, Skin Sens. 1
Butylated hydroxy toluene (BHT)	128-37-0	Found in TV, monitor and transformer Self-classification: Acute Tox. 4, Skin Irrit. 2, Eye Irrit. 2, STOT SE 3
Styrene	100-42-5	Found in TV, monitor and game console Skin Irrit. 2, Eye Irrit. 2, Acute Tox. 4, Repr. 2, STOT RE 1 Included in the list of the Danish EPA of undesirable substances (Danish EPA 2010)
Ethyl benzene	100-41-4	Found in TV, monitor and transformer Skin Irrit. 2, Eye Irrit. 2, Acute Tox. 4, Repr. 2, STOT RE 1, suspected of being teratogenic Included in the CoRAP list[1]
2-ethyl hexanoic acid	149-57-5	Found in transformers Repr. 2
Cyclohexanone	108-94-1	Found in monitor and transformers Acute Tox. 4, suspected of being carcinogenic
Dibutyl phthalate (DBP)	84-74-2	Found in TV, monitor, game console and transformer Repr. 1B Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the Candidate List[2]
Problematic substances found when using: printers, hair-dryers, cell phones, irons, decorative lamps, computers, TVs, multiple sockets (Mortensen 2005)		
2-Ethyl hexanoic acid	149-57-5	Repr. 2 Included in the CoRAP list[1]
2-ethylhexyl acrylate	103-11-7	Skin Irrit. 2, Skin Sens. 1, STOT SE 3
Acetaldehyde	75-07-0	Eye Irrit. 2, STOT SE 3, Carc. 2
Benzothiazol	95-16-9	Self-classification: Acute Tox. 3, Eye Irrit. 2Eye Irrit. 2, Acute Tox. 4

Problematic substances	CAS no.	Remarks*
Butylated hydroxy toluene	128-37-0	Self-classification: Acute Tox. 4, Skin Irrit. 2, Eye Irrit. 2, STOT SE 3
Dibutyl phthalate (DBP)	84-74-2	Repr. 1B Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the Candidate List[2]
Ethyl benzene	100-41-4	Skin Irrit. 2, Eye Irrit. 2, Acute Tox. 4, Repr. 2, STOT RE 1, suspected of being teratogenic
Ethyl glycol acetate	111-15-9	Repr. 2; R60-61 Xn;R20/21/22 Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the Candidate List[2]
Formaldehyde	50-00-0	Acute Tox. 3, Skin Corr. 1B, Skin Sens. 1, Acute Tox. 3, Muta. 2, Carc. 1B Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the CoRAP list[1]
Hydroxyethyl methacrylate	868-77-9	Skin Irrit. 2, Skin Sens. 1, Eye Irrit. 2 Included in the CoRAP list[1]
Kodaflex (1-isopropyl-2,2-dimethyltrimethylene diisobutyrate)	6846-50-0	Self-classification: Skin Irrit. 2
Longifolen (2-ethylhexyl acrylate)	103-11-7	Skin Irrit. 2, Skin Sens. 1, STOT SE 3
Naphtalene	91-20-3	Acute Tox. 4, Carc. 2 Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the CoRAP list[1]
Methyl methacrylate	80-62-6	Skin Irrit. 2, Skin Sens. 1, STOT SE 3 Included in the CoRAP list[1]
Phenol	108-95-2	Acute Tox. 3, Skin Corr. 1B, Muta. 2, STOT RE 2 Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010)
Phthalic acid anhydride	85-44-9	Acute Tox. 4, Skin Irrit. 2, Skin Sens. 1, Eye Dam. 1, Resp. Sens. 1, STOT SE 3

Problematic substances	CAS no.	Remarks*
Problematic substances in printed circuit boards (Remmen et al. 1999)		
Epoxy (can contain Bisphenol A)	80-05-7 (Bisphenol A)	Skin Sens. 1, Eye Dam. 1, STOT SE 3, Repr. 2 Bisphenol A is included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the CoRAP list[1] Included in the Norwegian priority list[3].
Brominated flame-retardants	-	Certain brominated flame-retardants are included in the list of the Danish EPA of undesirable substances (Danish EPA 2010)

* The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classification is in question. For self-classification, the health classification with most comments was used.
1 The EU CoRAP list (Community Rolling Action Plan) of substances that the member states investigate closer due to suspicion of health hazardous properties.
2 The EU Candidate List for approval (SVHC list, substances of very high concern).
3 *Klima- og Forurensningsdirektorat* (Norwegian Environmental Agency). Norwegian priority list of hazardous substances to be substituted or substantially reduced.

4.1.2 Selection of electronics – various devices and parts

Literature shows that there can be i.a. heavy metals, Bisphenol A and flame-retardants in electrical and electronic devices due to the high boiling points. Very volatile substances such as aldehydes and volatile substances such as styrene are expected to have evaporated out of the used products.

The materials are used for jewellery and toys, and therefore there is a risk of oral or dermal exposure.

It was suggested to only select printed circuit boards for further analysis as the probability of finding problematic substances in printed circuit boards is rather high compared to the other parts. Printed circuit boards typically contain epoxy. Epoxy is often based on diglycidyl ether of Bisphenol A and can also contain flame-retardants (Bjørn Malmgren-Hansen, personal communication 2014). Therefore, it is relevant to focus on residue of the monomer Bisphenol A in the GC/MS screening and bromine in the X-ray screening as a content of bromine can indicate content of brominated flame-retardants. In addition, there might also be plasticizers in the possibly utilized glue and that can be detected by GC/MS.

4.1.3 Regulation

The following legal text relevant to various electrical devices and parts was found:

- RoHS Directive (No. 1041 of 30/12/2012).

Pursuant to the RoHS Directive, the sale of new electrical and electronic equipment, cables and spare parts for such equipment containing more than 0.1 weight percent of the following substances has been prohibited as from 1 July 2006:

- Lead
- Mercury
- Cadmium (however, here the limit value is 0.01 weight percent)
- Hexavalent chromium
- Polybrominated biphenyls (PBB)
- Polybrominated diphenyl ethers (PBDE)

Electrical and electronic products sold before 1 July 2006 can contain the undesired substances in concentrations exceeding 0.1 weight percent (0.01 weight percent for cadmium), and therefore they constitute a greater health risk than newer products if they are separated and reused to make new products.

4.2 Electronics - Cords

Cords comprise all types of cords that provide power to electrical and electronic devices.

The survey showed that cords are separated by e.g. cutting and joining the parts to other materials with tape or glue. Jewellery or toys are made after processing.

4.2.1 Literature study for problematic substances

The literature study showed that cords can contain problematic substances (Hansen et al. 2014).

Table 15 shows the problematic substances that were found in the literature study.

TABLE 15 POTENTIAL PROBLEMATIC SUBSTANCES IN CORDS.

Problematic substances	CAS no.	Remarks*
Problematic substances that may be present in cords (Hansen et al. 2014)		
Lead and lead compounds (stabilisers in PVC)	-	PVC manufacturers in the EU expect a total substitution in 2015 (Hansen et al. 2014). Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the Norwegian priority list[3]
Dibutyltin dichloride (stabiliser in PVC)	683-18-1	Acute Tox. 3, Acute Tox. 4, Skin Corr. 1B, Acute Tox. 2, Muta. 2, Repr. 1B, STOT RE 1 Included in the Candidate List[2] Included in the Registry of Intentions[4]
Medium-chain-chlorinated paraffin (MCCP) (plasticizer and flame-retardant in PVC)	85535-85-9	Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the CoRAP list[1] Included in the Norwegian priority list[3].
Octylphenol and its ethoxylates (antioxidant)	140-66-9, 1806-26-4, 9004-87-9, 9036-19-5, 9063-89-2, 11081-15-5, 68987-90-6, 69011-84-3	140-66-9, 1806-26-4 and 11081-15-5 are included in the list of the Danish EPA of undesirable substances (Danish EPA 2010) Included in the Candidate List[2] Included in the Norwegian priority list[3].
Perfluorooctane carboxylate (PFOA) and similar compounds (dispersing agent in the plastic polytetrafluorethylene (PTFE))	-	Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the Candidate List[2] Included in the Norwegian priority list[3] Included in the list of Registry of intentions[4]
Plasticizers, e.g. phthalates, have been added to cords made of plastic (Nils Nilsson, personal communication 2014)		

Phthalates	-	Several phthalates are suspected of being hormone disrupting Several are on the Candidate List[2] Several are on the list of the Danish EPA of undesirable substances (Danish EPA, 2010)
Rubber chemicals have been added to cords made of rubber. Some types of rubber are vulcanized with organic sulphur compounds, e.g. benzothiazole. If the cord is black, then it is possible that various PAHs also are present (Nils Nilsson, personal communication 2014)		
Organic sulphur compounds, including benzothiazole	95-16-9 (Benzothiazole)	Self-classification: Acute Tox. 3, Eye Irrit. 2Eye Irrit. 2, Acute Tox. 4 (Benzothiazol)
PAHs	-	A number of PAHs are classified as being carcinogenic (Nilsson et al. 2005).

* The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classifications are in question. For self-classification, the health classification with most comments was used.
1 The EU CoRAP list (Community Rolling Action Plan) of substances that the member states investigate closer due to suspicion of health hazardous properties.
2 The EU SVHC Candidate List (substances of very high concern).
3 *Klima- og Forurensningsdirektorat* (Norwegian Environmental Agency). Norwegian priority list of hazardous substances to be substituted or substantially reduced.
4 ECHA's registration of the intention of member states to prepare an Annex XV or propose harmonized classification and marking.

4.2.2 Selection of cords

There is a risk that plasticizers (e.g. phthalates) and heavy metals (tin and lead) can be present in the material. In addition to plasticizers, cords insulated with rubber might be exposed to other chemicals that have been added to rubber.

There is also a risk of oral or longer dermal exposure as the material is used for jewellery.

4.2.3 Regulation

The following legal texts relevant to cords were found:

- RoHS Directive (No. 1041 of 30/12/2012).
- Executive Order on Lead (No. 856 of 05/09/2009).
- REACH (Regulation No. 276/2010 on change of Regulation No. 1907/2006) Annex XVII - organic tin compounds.

Pursuant to the RoHS Directive, the sale of new electrical and electronic equipment, cables and spare parts for such equipment containing more than 0.1 weight percent of the following substances has been prohibited as from 1 July 2006:

- Lead
- Mercury
- Cadmium (however, here the limit value is 0.01 weight percent)
- Hexavalent chromium
- Polybrominated biphenyls (PBB)
- Polybrominated diphenyl ethers (PBDE).

It should be noted that not all EU member states considered cords to be part of the Directive before 2011.

As a starting point, cords sold before 1 July 2006 constitute a greater health risk than newer products, as older products can contain problematic substances in concentrations higher than 0.1 weight percent (0.01 weight percent for cadmium).

Pursuant to the Executive Order on lead, import and sale of products containing lead, including lead-containing cords has been prohibited as from 1 December 2000. Cords sold before 1 December 2000 can contain lead and therefore they constitute a greater health risk than newer cords.

Pursuant to REACH, (Regulation no. 276/2010 on change of Regulation no. 1907/2006) Annex XVII trisubstituated organic tin compounds such as tributyltin compounds (TBT compounds) and triphenyltin compounds (TPT compounds) must not be used in articles after 1 July 2010 if the concentration in the article or part of it exceeds the equivalent of 0.1 weight percent tin. In addition, dibutyltin compounds (DBT compounds) must not be used after 1 January 2012 in mixtures or articles that are sold for private use, if the concentration in the mixture or the article or part of it is larger than the equivalent of 0.1 weight percent tin. There are some exceptions.

Cords sold before 1 July 2010 can contain TBT and TPT compounds, whereas cords sold before 1 January 2012 can contain DBT compounds. Therefore, cords purchased after 1 January 2012 constitute a smaller health risk than older cords regarding organic tin compounds.

4.3 Rubber - Tyres (e.g. from bicycles, cars and tractors)

The survey showed that tyres from e.g. bicycles, cars and tractors are separated by carving, cutting, hammering or sawing and that they are joined together with other materials by means of tape or glue. It was also found that the produced products were used as toys, clothes (sandals and handbags) and jewellery.

4.3.1 Literature study for problematic substances

In the literature study, problematic substances were found in new and used tyres (Nilsson et al. 2005).

Table 16 shows the problematic substances that were found in the literature study.

TABLE 16 POTENTIAL PROBLEMATIC SUBSTANCES IN RUBBER FROM TYRES.

Problematic substances	CAS no.	Remarks*
New and used tyres were investigated for the presence of PAH and aromatic amines (Nilsson et al. 2005)		
Fluoranthene	206-44-0	Found in 21 out of 21 analysed tyres Self-classification: Acute Tox. 4
Pyrene	129-00-0	Found in 21 out of 21 analysed tyres Self-classification: Skin Irrit. 2, Eye Irrit. 2, STOT SE 3
Benz(a)anthracene	56-55-3	Found in 20 out of 21 analysed tyres Carc. 1B
Chrysene	218-01-9	Found in 20 out of 21 analysed tyres Muta. 2, Carc. 1B
Benzo(b+j+k)fluoranthene	205-99-2 205-82-3 207-08-9	Found in 20 out of 21 analysed tyres Carc. 1B

Problematic substances	CAS no.	Remarks*
Benzo(e)pyrene	192-97-2	Found in 21 out of 21 analysed tyres Carc. 1B
Ben(a)pyrene	50-32-8	Found in 21 out of 21 analysed tyres Skin Sens. 1, Muta. 1B, Carc. 1B, Repr. 1B Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010)
Indeno(1,2,3-cd)pyrene	193-39-5	Found in 16 out of 21 analysed tyres Self-classification: Carc. 2
Benzo(ghi)perylene	191-24-2	Found in 21 out of 21 analysed tyres No data concerning health hazard in the ECHA C&L list
Dibenz(ah)anthracene	53-70-3	Found in 4 out of 21 analysed tyres Carc. 1B
N-(1,3-dimethylbutyl)-N´-phenyl-p-phenylendiamin (6PPD)	793-24-8	Found in 21 out of 21 analysed tyres Self-classification: Acute Tox. 4, Skin Sens. 1
N-isopropyl-N´-phenyl-p-phenylendiamin (IPPD)	101-72-4	Found in 18 out of 21 analysed tyres Acute Tox. 4, Skin Sens. 1,
N,N´-diphenyl-p-phenylendiamin (DPPD)	74-31-7	Found in 9 out of 21 analysed tyres Skin Sens. 1
1-naphthyl-phenyl-amin (PAN)	90-30-2	Found in 1 out of 21 analysed tyres Acute Tox. 4, Skin Sens. 1, STOT RE 2 Included in the CoRAP list[1]

* The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classifications are in question. For self-classification, the health classification with most comments was used.

1 The EU CoRAP list (Community Rolling Action Plan) of substances the member states investigate closer due to suspicion of health hazardous properties.

4.3.2 Selection of tyres

There is a risk that polyaromatic hydrocarbons (PAH) and aromatic amines can be present in the material.

In addition, there is risk of oral or longer dermal exposure as the material is used for toys, clothes and jewellery.

It was suggested to only select bicycle tyres for further analysis, as tyres from cars and tractors are steel reinforced and require sawing tools for processing.

4.3.3 Regulation

The following legal text relevant to rubber tyres was found:

- Directive of the European Parliament 2005/69/EF – Polycyclic aromatic hydrocarbons (PAHs).

Pursuant to the Directive of the European Parliament 2005/69/EU (European Parliament 2005b) it has since 16 November 2005 been forbidden to market and use oil-based plasticizers for rubber for the production of tyres or tyre parts if they contain:

- More than 1 mg/kg (0.0001 weight percent) Benzo[a]pyrene (BaP) or
- more than 10 mg/kg (0.001 weight percent) of all listed PAHs (Benzo[a]pyrene (BaP), Benzo[e]pyrene (BeP), Benzo[a]anthracene (BaA), Chrysene (CHR), Benzo[b]fluoranthene (BbFA), Benzo[j]fluoranthene (BjFA), Benzo[k]fluoranthene (BkFA) and Dibenzo[a,h]anthracene (DBAhA)).

In addition, tyres and treads for retreading made after 1 January 2010 must not be marketed if they contain oil-based plasticizers in amounts exceeding the stated limit values.

In this connection, tyres are for all ordinary motorized vehicles including tyres for cars, trailers, motor cycles, tractors and wagons. That means that tyres and tubes from bicycles are not comprised by the above regulations and therefore larger concentrations of the mentioned PAHs are permitted.

Tyres sold before 16 November 2005 and bicycle tyres can contain problematic substances in concentrations that are higher than in newer car tyres.

4.4 Rubber - Tubes (e.g. from bicycles, cars and tractors)

The survey showed that tubes from e.g. bicycles, cars and tractors are separated by carving, cutting, hammering or sawing and they are joined together with other materials by means of e.g. tape or glue. In addition, the produced products were used as toys, clothes (sandals and handbags) and jewellery.

4.4.1 Literature study for problematic substances

Table 17 shows the problematic substances that were found in the literature study.

TABLE 17 POTENTIAL PROBLEMATIC SUBSTANCES IN RUBBER TUBES FOR TYRES.

Problematic substances	CAS no.	Remarks*
Tubes for tyres are made of butyl rubber. Rubber is usually vulcanised with organic sulphur compounds such as benzothiazole. If the tube is black, various types of PAHs are present (Nils Nilsson, personal communication 2014).		
Organic sulphur compounds, including benzothiazole	95-16-9 (Benzothiazole)	Acute Tox. 3, Eye Irrit. 2 , Acute Tox. 4 (Benzothiazole)
PAHs	-	A number of PAHs are classified as carcinogenic (Nilsson et al. 2005).

* The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classifications are in question. For self-classification, the health classification with most comments was used.

4.4.2 Selection of rubber tubes

There is a risk that PAH and organic sulphur compounds can be present in the material.

In addition, there is a risk of oral or longer dermal exposure as the material is used for toys, clothes and jewellery.

It was suggested to only select bicycle tubes for further analysis, as it is estimated that they are easiest to procure and handle by the child care centres compared to tubes from larger tyres.

4.4.3 Regulation

The following legal text relevant to rubber tubes was found:

- Directive of the European Parliament 2005/69/EF – Polycyclic hydrocarbons (PAHs).

Pursuant to the Directive of the European Parliament 2005/69/EU (European Parliament 2005b) it has since 16 November 2005 been forbidden to market and use oil-based plasticizers for rubber for the production of tyres or tyre parts if they contain:

- More than 1 mg/kg (0.0001 weight percent) Benzo[a]pyrene (BaP); or
- more than 10 mg/kg (0.001 weight percent) of all listed PAHs (Benzo[a]pyrene (BaP), Benzo[e]pyrene (BeP), Benzo[a]anthracene (BaA), Chrysene (CHR), Benzo[b]fluoranthene (BbFA), Benzo[j]fluoranthene (BjFA), Benzo[k]fluoranthene (BkFA) and Dibenzo[a,h]anthracene (DBAhA)).

In addition, tyres and treads for retreading made after 1 January 2010 must not be marketed if they contain oil-based plasticizers in amounts exceeding the stated limit values.

In this connection, tyres are for all ordinary motorized vehicles including tyres for cars, trailers, motorcycles, tractors and wagons. That means that tyres and tubes from bicycles are not comprised by the above rules and therefore larger concentrations of the mentioned PAHs are permitted.

Tyres sold before 16 November 2005 and bicycle tyres can contain problematic substances in concentrations that are higher than in newer car tyres.

4.5 Plastics – Disposable tableware (e.g. cups, cutlery and plates)

Disposable tableware is made of either polyethylene (PE), polyethylene terephthalate (PET) or polystyrene (PS) (www.forbrugerkemi.dk "Fakta om engangsservice", Jensen et al. 2000).

The survey showed that disposable tableware is heated and changes shape. In addition, the products that were made were used as everyday items.

4.5.1 Literature study for problematic substances

Disposable tableware comes into touch with food and therefore the product belongs within the legislation of food contact materials. That means that limit values have been determined for many of the substances that are liberated to the food, and through public control the Danish Veterinary and Food Administration assesses if the companies can document that the regulations have been observed.

There is a minimum risk of liberation of problematic substances when PE is heated.
PET melts at 250 °C and is irrelevant in this connection (Nils Nilsson, personal communication 2014).
When polystyrene is heated there is a risk of liberation of styrene, see Table 18.

TABLE 18 POTENTIAL PROBLEMATIC SUBSTANCES IN DISPOSABLE TABLEWARE MADE OF POLYSTYRENE.

Problematic substances	CAS no.	Remarks*
Disposable tableware belongs within the legislation of food contact materials and is made either of polyethylene (PE), polyethylene terephthalate (PET) or polystyrene (PS) (www.forbrugerkemi.dk "Facts about disposable tableware", Jensen et al. 2000). When PS is heated, styrene monomers can be liberated (Nils Nilsson, personal communication 2014)		
Styrene	100-42-5	Skin Irrit. 2, Eye Irrit. 2, Acute Tox. 4, Repr. 2, STOT RE 1 Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010).

* The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classifications are in question. For self-classification, the health classification with most comments was used.

4.5.2 Selection of disposable tableware

PET has a crystallite melting point of 250 ˚C, and notoriously there is a minimum risk of liberation of problematic substances when heating PE to crystallite (crystallite melting point at 120 ˚C), and therefore it was suggested to select disposable tableware made of PS.

When disposable tableware made of PS is heated there is a risk of development and inhalation of the monomer styrene and volatile oxidation products during heating in connection with processing.

In addition, there is a risk of dermal exposure as the material is used as an everyday item.

4.5.3 Regulation

The following legal texts that regulate food contact materials were found:

- Regulation of the European Parliament and Council (EU) no. 1935/2004 of 27 October 2004 on materials and articles which come into contact with foodstuffs and repealing Directive 80/590/EØF and 89/109/EØF.
- Regulation of the Commission (EU) no. 10/2011 of 14 January 2011 on plastic materials and articles which come into contact with foodstuffs.
- Executive Order no. 822 of 26 June 2013 on food contact materials.
- Regulation of the European Commission (EU) no. 2023/2006 of 22 December 2006 on good manufacturing practice for materials and articles intended to come into contact with food.

According to the regulation of the European Parliament and the Council (EU) no. 1935/2004 of 27 October 2004 materials and articles, including active and intelligent materials and items, must be made in accordance with sound production practice so that they under normal or predictable application conditions do not liberate components to food in amounts that can:

- endanger human health
- bring about an unacceptable change in the composition of the food; or
- bring about a deterioration in the food on the senses (organoleptic properties)

The first directive in the field entered into force in November 1976, and the ban on sale of food contact materials that do not live up to the above European regulations was implemented in Danish legislation for the first time on 1 February 1983.

Appendix 1 in the regulation of the European Commission (EU) no. 10/2011 on plastic materials and articles intended to come into contact with food describes the allowed migration values for

885 substances, including several phthalates (with limit values between 0.05 mg/kg – 60 mg/kg) and formaldehyde (15 mg substance per kg food).

Migration limit values for substances that are not mentioned in the above Appendix are determined to 60 mg/kg. In general, the components of plastic materials must not liberate more than 10 mg/dm^2 contact surface to food simulants. Plastic materials that come into contact with food for babies or infants have a migration limit of 60 mg/kg food.

The EU legislation entered into force on 1 May 2011.

In addition, food is regulated by the regulation of the European Commission (EU) no. 2023/2006 of 22 December 2006 on good manufacturing practice for materials and articles intended to come into contact with food. This EU legislation has been applicable since 1 August 2008.

Food contact materials (including disposable tableware) have been regulated since 1 February 1983, so even for very old disposable tableware the content and migration of problematic substances is expected to be low.

4.6 Plastics – Garden hoses

Garden hoses are often made of PVC as it is a rather inexpensive material, but hoses also exist in other materials, e.g. rubber.

The survey demonstrated that garden hoses can be separated by carving, cutting, hammering or sawing and they can be painted.

4.6.1 Literature study for problematic substances

Table 19 shows the problematic substances that were found in the literature study.

TABLE 19 POTENTIAL PROBLEMATIC SUBSTANCES IN GARDEN HOSES.

Problematic substances	CAS no.	Remarks*
An investigation in 2013 of 21 garden hoses showed that 14 out of 21 were made of PVC (www.healthystuff.org). The following problematic substances were also found:		
Antimony	7440-36-0	Found in 11 out of 21 hoses Self-classification: Acute Tox. 4
Lead > 100 ppm	7439-92-1	Found in 3 out of 21 hoses. The PVC manufacturers in the EU expect a complete substitution in 2015 (Hansen et al. 2014) Self-classification: Repr. 1A, STOT RE 1 Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the Norwegian priority list[3]
Bisphenol A	80-05-7	Found in water from 2 selected PVC garden hoses Skin Sens. 1, Eye Dam. 1, STOT SE 3, Repr. 2 Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the CoRAP list[1]

		Included in the Norwegian priority list[3].
Phthalates	-	Investigated in 4 selected PVC garden hoses Some are suspected of being hormone disrupting Several phthalates are suspected of being hormone disrupting Several are on the Candidate List[2] Several are included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010)
Tin stabilisers (found in 4 out of 14 PVC garden hoses)	-	List of registry of intentions[4] (ECHA 2014)

* The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classifications are in question. For self-classification, the health classification with most comments was used.
1 The EU CoRAP list (Community Rolling Action Plan) of substances that the member states investigate closer due to suspicion of health hazardous properties.
2 The EU SVHC Candidate List (substances of very high concern).
3 *Klima- og Forurensningsdirektorat* (Norwegian Environmental Agency). Norwegian priority list of hazardous substances to be substituted or substantially reduced.
4 ECHA's registration of the intention of member states to prepare an Annex XV or propose harmonized classification and marking.

4.6.2 Selection of garden hoses

There is a risk that plasticizers (e.g. phthalates) and heavy metals are present in the material. If the hose is made of rubber, then the chemicals that are present in the rubber can be liberated.

4.6.3 Regulation

The following legal texts relevant to garden hoses were found:

- Executive Order on Lead (No. 856 of 05/09/2009).
- REACH (Regulation no. 276/2010 on change of Regulation no. 1907/2006), Annex XVII - organic tin compounds.

Pursuant to the Executive Order on lead, the import and sale of products containing lead, including lead-containing garden hoses, has been prohibited as from 1 December 2000.

Garden hoses sold before 1 December 2000 can contain lead, and the ones containing lead might therefore constitute a greater health risk than newer garden hoses.

Pursuant to REACH (Regulation no. 276/2010 on change of Regulation no. 1907/2006), Annex XVII, trisubstituated organic tin compounds such as tributyltin compounds (TBT compounds) and triphenyltin compounds (TPT compounds) must not be used in articles after 1 July 2010 if the concentration in the article or part of it exceeds the equivalent of 0.1 weight percent tin.

In addition, dibutyltin compounds (DBT compounds) must not be used after 1 January 2012 in mixtures and articles sold for private use if the concentration in the mixture or the article or part of it exceeds the equivalent of 0.1 weight percent tin. There are some exceptions, e.g., sealants, paint and surface treatment, soft PVC profiles and outdoor drain pipes, gutters and fittings.

Garden hoses sold before 1 July 2010 can contain TBT and TPT compounds, whereas garden hoses from before 1 January 2012 can contain DBT compounds.

4.7 Plastics – Sleeping mats/foam mattresses

The survey showed that sleeping mats/foam mattresses are separated by e.g. carving, cutting, hammering or sawing and that they are joined together with other materials by means of e.g. tape or glue. In addition, it was found that the products were used as toys or jewellery.

4.7.1 Literature study for problematic substances

The literature study showed that foam mattresses for babies can contain problematic substances (Tønning et al. 2008). Table 20 lists the problematic substances that were found in toys and foam articles for children (Borling et al. 2006), as similar substances might be present in sleeping mats that also are made of foamed plastics.

Table 20 shows the problematic substances that were found in the literature study.

TABLE 20 POTENTIAL PROBLEMATIC SUBSTANCES IN SLEEPING MATS/FOAM MATTRESSES.

Problematic substances	CAS no.	Remarks*
The following problematic substances were found in new foam mattresses for babies (Tønning et al. 2008):		
2-Ethyl hexane acid	149-57-5	Repr. 2 Included in the CoRAP list[1]
2,4-Diisocyanat-1-methyl benzene	584-84-9	Skin Irrit. 2, Skin Sens. 1, Eye Irrit. 2, Acute Tox. 2, Resp. Sens. 1, STOT SE 3, Carc. 2 Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010)
Hexaethylenglycol dimethylether	1072-40-8	No data in the ECHA C&L list
Tetrapropylenglycol monomethyl ether	20324-34-9	No data in the ECHA C&L list
Toys and articles for children made of foamed plastics are typically made of Ethylen-vinylacetat (EVA) and Polyurethane (PUR) foam. Some problematic substances were found in toys and articles for children made of foam plastics (Borling et al. 2006):		
C10-C14 hydrocarbons (volatile organic compounds)	-	A number of PAHs are classified as carcinogenic (Nilsson et al. 2005).
Phthalates Dimethyl phthalate (DMP) Diisobutyl phthalate (DIBP) Di-n-butyl phthalate (DBP) Di-2-(ethylhexyl) phthalate (DEHP) Di-n-octyl-phthalate (DNOP) Diisodecyl phthalate (DIDP) Diisononyl phthalate	 131-11-3 84-69-5 84-74-2 117-81-7 117-84-0 26761-40-0 28553-12-0	The low molecular phthalates (DEHP, BBP, DBP and DIBP) are classified as harmful to reproduction (CLP). DEHP, DBP), BBP, DMEP and DIBP are included in the list of the Danish EPA of undesirable substances (Danish EPA 2010)

Problematic substances	CAS no.	Remarks*
Organotin compounds	-	Included in the Norwegian priority list[3] (Hansen et al. 2014)
Flexible PUR foam is made by means of toluene diisocyanates (TDI) and methylene difenyl diisocyanates (MDI) (Christensen et al. 2014).		
Toluene diisocyanates (TDI)	584-84-9 (2,4-TDI) 91-08-7 (2,6-TDI) 26471-62-5 (Mix of 2,4 TDI and 2,6 TDI)	Skin Irrit. 2, Skin Sens. 1, Eye Irrit. 2, Acute Tox. 2, Resp. Sens. 1, STOT SE 3, Carc. 2 Mix of 2,4 TDI and 2,6 TDI (CAS no. 26471-62-5) included in the CoRAP list[1]. TDI is included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010)
Methylene difenyl diisocyanater (MDI)	101-68-8 (4,4'-MDI) 26447-40-5 (unspecified mix of MDI)	Skin Irrit. 2, Skin Sens. 1, Eye Irrit. 2, Acute Tox. 4, Resp. Sens. 1, STOT SE 3, Carc. 2, STOT RE 2 4,4'-MDI is included in the CoRAP list[1]. MDI is included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010)

* The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classifications are in question. For self-classification, the health classification with most comments was used.
1 The EU CoRAP list (Community Rolling Action Plan) of substances that the member states investigate closer due to suspicion of health hazardous properties.
(2 Not mentioned in the table).
3 *Klima- og Forurensningsdirektorat* (Norwegian Environmental Agency). Norwegian priority list of hazardous substances to be substituted or substantially reduced.

4.7.2 Selection of sleeping mats and foam mattresses

There is limited possibility of presence of problematic substances such as plasticizers (e.g. phthalates), organic tin compounds or residue of monomers in the material (e.g. MDI and TDI). In addition, there is risk of oral or longer dermal exposure as the material is used for toys and jewellery.

4.7.3 Regulation

The following legal texts relevant to sleeping mats and foam mattresses were found:

- REACH (Regulation no. 552/2009 on the change of Regulation no. 1907/2006), Annex XVII - organic tin compounds.
- Partly REACH (Regulation no. 552/2009 on change of Regulation no. 1907/2006), Annex XVII – the phthalates DBP, DEHP, BBP, DINP, DIDP and DNOP that concern articles for infants and toys.

Persuant to REACH (Regulation no. 552/2009 on change of Regulation no. 1907/2006), Annex XVII, trisubstituated organic tin compounds such as tributyltin compounds (TBT compounds) and triphenyltin compounds (TPT compounds) must not be used in articles after 1 July 2010 if the concentration in the article or parts of it exceeds the equivalent of 0.1 weight percent tin. In addition, dibutyltin compounds (DBT compounds) must not be used after 1 January 2012 in mixtures or articles sold for private use if the concentration in the mixture or article or parts of it exceed the equivalent of 0.1 weight percent tin. There are some exceptions, e.g. sealants, paint and surface treatment, soft PVC profiles and outdoor drain pipes, gutters and fittings.

In addition, dioctyltin compounds (DOT compounds) must not be used after 1 January 2012 if the concentration in the mixture or the article or part of it exceeds the equivalent of 0.1 weight percent tin in the following articles sold for private use:

- Textiles intended to come into contact with the skin
- Gloves
- Shoes or parts of shoes intended to come into contact with the skin
- Wall lining and flooring
- Articles for infants
- Sanitary products for women
- Diapers
- Two component rubber curing product ready to use at room temperature

Sleeping mats and foam mattresses sold before 1 July 2010 can contain TBT and TPT compounds, whereas sleeping mats and foam mattresses sold before 1 January 2012 can contain DBT compounds and DOT compound. Therefore, sleeping mats and foam mattresses purchased after 1 January 2012 constitute a smaller health risk than older articles regarding organic tin compounds.

If a sleeping mat or foam mattress has been marketed as an article for infants, then dibutyl phthalate (DBP), bis(2-ethylhexyl) phthalate (DEHP) and butylbenzyl phthalate (BBP) must according to REACH (Regulation no. 552/2009 on change of Regulation no. 1907/2006), Annex XVII, not be used as material or in mixtures in concentrations exceeding 0.1 weight percent of the softened material in toys or articles for infants.

Di-isononyl-phthalat (DINP), di-isodecyl-phthalat (DIDP) and di-n-octylphthalat (DNOP) must not be used in concentrations exceeding 0.1 weight percent of the softened material in toys or articles for infants, which children can put in the mouth.

In this connection, articles for infants comprise all products that are intended to make it easier for children to sleep or relax, products used for children's hygiene or products that can be used to feed children or that children can suck.

The EU legislation came into force 16 January 2007 (the European Parliament 2005a).

After the above-mentioned date, sleeping mats/foam mattresses that are marketed as articles for infants may not contain the phthalates DBP, DEHP or BBP or DINP, DIDP or DNOP (if the sleeping mat or the foam mattress can be put in the mouth). Older sleeping mats/foam mattresses that are marketed as articles for infants, and all other sleeping mats/foam mattresses irrespective of age might contain the mentioned phthalates and therefore they constitute a greater health risk than newer sleeping mats/foam mattresses for infants.

4.8 Plastic material - LPs

LPs are made of PVC. The survey disclosed that LPs are heated and change shape. In addition, the survey showed that the products that were made were used as everyday items for food.

4.8.1 Literature study for problematic substances

Table 21 shows the problematic substances that were found in the literature study.

TABLE 21 POTENTIAL PROBLEMATIC SUBSTANCES IN LPs.

Problematic substances	CAS no.	Remarks*
LPs can contain lead or cadmium that previously has been used as stabiliser in PVC. In addition, PAH may appear. Hydrogen chloride gases can be liberated during heating. (Nils Nilsson, personal communication 2014).		
Lead	7439-92-1	The PVC manufacturers in the EU expect a complete substitution in 2015 (Hansen et al. 2014) Self-classification: Repr. 1A, STOT RE 1 Included in the list of the Danish EPA of undesirable substances (Danish EPA 2010) Included in the Norwegian priority list[3]
Cadmium	7440-43-9	Acute Tox. 2, Muta. 2, Carc. 1B, Repr. 2, STOT RE 1 Included in the list of the Danish EPA of undesirable substances (Danish EPA 2010) Included in the Candidate List[2]
PAH	-	A number of PAHs are classified as carcinogenic (Nilsson et al. 2005).
Hydrogen chloride	7647-01-0	Skin Corr. 1B, STOT SE 3

* The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classifications are in question. For self-classification, the health classification with most comments was used.
(1 Not mentioned in the table)
2 The EU SVHC Candidate List (substances of very high concern)

4.8.2 Selection of LPs

There is a risk of development and inhalation of hydrochloric acid and aldehydes, PAH, hydrogen chloride and other volatile oxidation products during heating in connection with processing. In addition, there is risk of dermal or oral exposure as the material is used to make everyday items for food.

4.8.3 Regulation

The following legal texts relevant to LPs were found:

- Executive Order on Lead (No. 856 of 05/09/2009)
- REACH (Regulation No. 1907/2006), Annex XVII – Cadmium
- Executive Order on Cadmium (No. 858 of 05/09/2009)

Pursuant to the Executive Order on lead, the import and sale of products containing lead, including lead-containing LPs, has been prohibited as from 1 December 2000.

LPs sold before 1 December 2000 can contain lead and therefore they constitute a greater health risk than newer LPs.

Pursuant to the Executive Order on cadmium, the import, sale and production of cadmium-containing products with more than 75 ppm in the homogeneous single parts of the product, has been prohibited as from 1 January 1993.

Pursuant to REACH (Regulation no. 1907/2006), Annex XVII, cadmium must not be used as insoluble colorant in a wide range of plastic types, including PVC. In addition, the use of cadmium as plastic stabilizer in LPs is prohibited. The EU legislation entered into force on 1 June 2007.

LPs sold after 1 June 2007 must not contain cadmium stabilisers irrespective of concentration. LPs sold in Denmark after 1 January 1993 and before 1 June 2007 must max. contain 75 ppm in the homogeneous single parts of the product, whereas LPs sold before 1993 can contain larger concentrations of cadmium and therefore they constitute a greater health risk than newer LPs.

4.9 Wood – Lacquered wood

The category of lacquered wood, e.g., comprises wood from furniture, wooden toys and fences.

The survey showed that lacquered wood is heated for instance with a soldering iron.

4.9.1 Literature study for problematic substances

Lacquered wood has typically been treated with nitrocellulose lacquer that contains app. 20% cellulose (Ferdinand et al. 2003) and 75% volatile organic compounds (butyl acetate, ethanol, 2-propanol and aliphatic hydrocarbons) (Danish EPA 1999).

Table 22 shows the problematic substances found in the literature survey.

TABLE 22 POTENTIAL PROBLEMATIC SUBSTANCES IN LACQUERED WOOD.

Problematic substances	CAS no.	Remarks*
Lacquered wood can contain residue of the monomers and catalysts of the lacquer that can be problematic. When heating with a soldering iron, a number of break-down products and transformation products can develop and they are of unknown nature. Development depends on the type of lacquer, temperature and time (Nils Nilsson, Personal communication 2014)		
Residue of monomers and catalysts	-	-
In the RAPEX database, CMR substances were found in wooden toys with painted/treated surfaces, including lacquered surfaces (RAPEX 2014):		
Formaldehyde	50-00-0	Expected to have evaporated in used products Acute Tox. 3, Skin Corr. 1B, Skin Sens. 1, Acute Tox. 3, Muta. 2, Carc. 1B Included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010) Included in the CoRAP list[1]
Lead	7439-92-1	Self-classification: Repr. 1A, STOT RE 1 Included in the list of the Danish EPA of undesirable substances (Danish EPA 2010) Included in the Norwegian priority list[3]

Problematic substances	CAS no.	Remarks*
Chromium	7440-47-3	Self-classification: Skin Sens. 1, Resp. Sens. 1
O-toluidine	95-53-4	Acute Tox. 3, Eye Irrit. 2, Carc. 1B Included in the Candidate List[2]

*The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classifications are in question. For self-classification, the health classification with most comments was used.
1 The EU CoRAP list (Community Rolling Action Plan) of substances that the member states investigate closer due to suspicion of health hazardous properties.
2 The EU SVHC Candidate List (substances of very high concern).
3 *Klima- og Forurensningsdirektorat* (Norwegian Environmental Agency). Norwegian priority list of hazardous substances to be substituted or substantially reduced.

4.9.2 Selection of lacquered wood

There is a risk of presence of residue of monomers and catalysts as well as heavy metals in the lacquer on the material. In addition, there is a risk of development and inhalation of aromatic hydrocarbons and other volatile oxidation products when heating in connection with processing.

4.9.3 Regulation

The following legal texts relevant to lacquered wood were found:

- Executive Order on Lead (No. 856 of 05/09/2009).
- Partly the Executive Order on the limitation of formaldehyde in chip boards, plywood boards and similar boards that are used for furniture, equipment and the like (No. 289 of 22/06/1983).

Pursuant to the Executive Order on lead, the import and sale of products containing lead, including lead-containing lacquered wood, has been prohibited as from 1 December 2000. Lacquered wood, sold before 1 December 2000, can contain lead and therefore constitutes a greater health risk than newer lacquered wood.

Pursuant to "the Executive Order on the limitation of formaldehyde in chip boards, plywood boards and similar boards that are used for furniture, equipment and the like", chips boards, plywood boards and similar boards may only be used in furniture, equipment and the like if the equilibrium concentration of formaldehyde does not exceed 0.15 mg/m^3 air, or if the content of free formaldehyde does not exceed 25 mg/100 g dry matter of the board.

Pursuant to "the Executive Order on the limitation of formaldehyde in chip boards, plywood boards and similar boards that are used for furniture, equipment and the like", chips boards, plywood boards and similar boards, in which glue that liberates formaldehyde forms part, may only be used in furniture, equipment and the like, if they during testing in a climate chamber max. liberate so much formaldehyde that the equilibrium concentration does not exceed 0.15 mg/m^3 air or if the content of free formaldehyde does not exceed 25 mg/100 g dry matter of the board.

All decisions of the Executive Order entered into force on 1 July 1984.

Due to the low boiling point of formaldehyde it is expected that formaldehyde has evaporated from used wood products and therefore they do not constitute a risk for children when they use the wood for creative activities and make new products irrespective of the age of the wood.

4.10 Wood – Pressure-treated wood

The category of pressure-treated wood, e.g., comprises terraces, fences and other pressure-treated wood that is intended for outdoor use.

The survey showed that pressure-treated wood is heated with for instance a soldering iron and separated by carving, cutting, hammering or sawing. The wood is joined together with other material by means of tape, nails or a glue gun. It was also found that the new products are used as everyday items and toys.

4.10.1 Literature study for problematic substances

Table 23 shows the problematic substances that were found in the literature study.

TABLE 23 POTENTIAL PROBLEMATIC SUBSTANCES IN PRESSURE-TREATED WOOD.

Problematic substances	CAS no.	Remarks*
On the Danish homepage called *Forbrugerkemi.dk* (Forbrugerkemi.dk; Facts on impregnation of wood) the following problematic substances were found:		
Fungicides	-	-
On the homepage of the Danish EPA (www.mst.dk; Pressure-treated wood and natural wood and Creosote) the following problematic substances were found:		
Arsenic	7784-42-1	Acute Tox. 2, STOT RE 2
Chromium	7440-47-3	Self-classification: Skin Sens. 1, Resp. Sens. 1
Creosote A mixture of creosote, creosote oil, coal tar, naphthalene oil, acenaphtene oil, anthracene oil and tar acid	-	Creosote i.a. contains benzo-a-pyrene, which is carcinogenic. In case of contact with creosote allergic contact dermatitis may arise (www.mst.dk; Creosote). Creosote compounds with carcinogenic ”impurities” are included in the list of the Danish EPA of undesirable substances (Danish EPA, 2010).

* The classification of substances took place according to the ECHA C&L list. Where nothing else is stated, harmonized classifications are in question. For self-classification, the health classification with most comments was used.

4.10.2 Selection of pressure-treated wood

There is a risk that preservatives and heavy metals (e.g., arsenic and chromium) are present in the material. In addition, there is a risk of development and inhalation of aromatic hydrocarbons and other volatile oxidizing products when the product is heated during processing.
Finally, there is a risk of oral or dermal exposure as it is used for everyday items and toys.

4.10.3 Regulation

The following legal texts relevant to pressure-treated wood were found:

- REACH (Regulation no. 552/2009 on change of Regulation no. 1907/2006), Annex XVII – Arsenic compounds.
- REACH (Regulation no. 1907/2006), Annex XVII – creosote.
- Executive Order regarding the restrictions on sale and use of creosote (No. 665 of 04/07/1996).

Pursuant to REACH (Regulation no. 552/2009 on change of Regulation No. 1907/2006), Annex XVII, arsenic compounds must not be sold or used for wood preservation. However, in some cases arsenic may be sold for commercial or industrial use.

The above legislation entered into force the first time on 6 January 2003 (European Commission 2003b). Wood that has been treated with arsenic and used before 30 September 2007 may remain on the place of use and be used for the entire lifetime of the product (REACH Regulation no. 552/2009 on change of Regulation No. 1907/2006).

Pressure-treated wood sold before 6 January 2003 can contain arsenic and therefore it represents a greater health risk than newer pressure-treated wood.

Creosote means creosote, creosote oil, coal tar, naphthalene oil, acenaphtene oil, anthracene oil and tar acids.

Pursuant to the "Executive Order regarding the restrictions on sale and use of creosote" it has since 20 July 1996 been forbidden to import or sell chemical substances containing creosote unless it is used for wood preservation and contains concentrations of or less than 0.005 mass percent benzo-a-pyrene and 3 mass percent water extractable tar acid. In addition, it has since 20 July 1996 been forbidden to import and sell creosote treated products to private persons, including creosote treated wood.

Pursuant to REACH (Regulation no. 1907/2006), Annex XVII, the injunction does not apply to wood treated with creosote before 31 December 2002, and that previously has been used and marketed as used wood. However, creosote can still be marketed for and used commercially and industrially for wood preservation.

The EU legislation became effective as on 26 October 2001 (European Commission 2001).

Pressure-treated wood sold to private persons before 20 July 1996 can contain creosote and therefore represents a greater health risk than newer pressure-treated wood. Please note that it is still permitted to sell used wood treated with creosote and to sell creosote for wood preservation for commercial and industrial use.

5. Chemical analyses

5.1 Background

The literature study identified a number of substances that potentially might be present in used products and materials, but that does not mean that the substances also are present in the specific products that were chosen for analysis. A number of volatile substances were identified, e.g. monomers and solvents that true enough are present in new products, but they are assumed to have evaporated in the user phase and therefore they will not be present when the product is reused. In the literature study, substances were not necessarily used to make the products selected for analyses. Finally, chemical changes can take place in the preparation and user phase. On the other hand, the products might during transportation or during the user phase be contaminated with substances that do not form part of the production of the product, for instance from preserving substances such as naphthalene and dimethylfumarate, or plasticizers that migrate from one product to another.

Screenings were carried out based on gas chromatography with mass selective detection (GC/MS) or X-ray. It is possible that not all problematic substances will be detected by the screenings. Not all substances can be detected through the methods applied for the screenings, as the analyses for these substances require a specific analysis method.

Chapter 5.1.1 describes which potential problematic substance groups might be present in the selected products, the function of the substances in the products and to which degree they can be detected either by GC/MS or X-ray analyses.

The analysis programme is described in chapter 5.2.

5.1.1 Potential problematic substance groups and their function

Products consisting of polymeric materials (e.g. rubber, plastic or wood) or so-called compound products (e.g. electronics), can to varying degrees contain problematic substances as listed in the table below (Nils Nilsson, personal communication 2014).

TABLE 24 PROBLEMATIC SUBSTANCE GROUPS THAT CAN APPEAR IN POLYMERIC MATERIALS AND COMPOUND PRODUCTS.

Problematic substance groups
Anti-microbial compounds
Plasticizers
Colorants containing heavy metals or other problematic substances
Flame-retardants

Problematic substance groups
Monomers, hardeners and catalysts
Foaming agents
Solvents
Heavy metals
UV stabilisers, antioxidants and other stabilisers

Anti-microbial compounds are typically used in products with plasticizers or in materials with organic substances that serve as substrate for microbial growth, e.g. in soft PVC, polyurethane, rubber or wood. Organotin compounds, chromium and arsenic are for instance used. The mentioned anti-microbial compounds will not be detected by GS/MS screening, but the presence of tin, chromium and arsenic can be determined through X-ray analysis or through additional analyses by ICP/MS.

Plasticizers are mainly used to soften PVC, but in a few cases they are also used in rubber, polyurethane and in glue. Plasticizers will be detected by a GC/MS analysis.

A number of heavy metal-based colorants have been prohibited for a number of years. Therefore, the probability that this type of colorant will be present in plastic is very small, unless very old products are in question. On the other hand, something seems to indicate that this type of colorant still may be used in lacquers (Cramer et al. 2008). An X-ray screening can determine if these colorants are probable. The colorants are most often red or yellow and based on lead or cadmium.

Other heavy metal compounds in materials (e.g. soldering and surface treatments with nickel or chromium) can also be detected by X-ray screening.

Organic colorants are often based on metal complexes and will not migrate, but merely be liberated in the form of wearing particles (that also goes for the above-mentioned cadmium- and lead-based colorants). Azo colorants are used in certain types of plastic, e.g. acrylic plastic and polycarbonate. They cannot be detected by GC/MS screening.

Flame-retardants are typically used in insulation material and electronics. Halogenated flame-retardants (brominated- and chlorine-based) have a very low steam pressure at room temperature and are used in some parts of electronic and electrical devices where the local temperatures can become very high (e.g. in hair-dryers and parts of AV equipment), or where there are special requirements to fire safety.

Monomers, hardeners and catalysts comprise a very large group of very different chemical compounds. Some are very volatile, typically monomers, and others are non-volatile, for instance catalysts. Especially in rubber, the chemistry regarding hardeners and catalysts is very complicated. In connection with vulcanization a number of changes take place in the added chemical substances, and that creates break-down products or oxidation products. Some of them would be detected in a GC/MS screening, but not all of them (e.g. nitrosamines). An X-ray

screening of rubber can give information about the vulcanization system and sulphur-based additives as e.g. sulphur and zinc can be seen. When heating certain plastic substances, e.g. polystyrene and polyurethane, depolymerization can take place so free monomers are created (styrene and TDI/MDI).

In general, it is expected that very volatile, volatile and certain semi-volatile substances with a boiling point under app. 140 °C have evaporated or exist in used products in very low concentrations. That hypothesis can be verified by GC/MS screening.

Foam agents are typically used in cellular plastic, for instance flamingo (expanded polystyrene (EPS)), foamed polyurethane and foamed chloroprene. It must be expected that cellular plastic very rarely contains freon or HCF based gases as they for many years have been prohibited. The same goes for chlorinated blowing agents. C,C'-azodi(formamide) (ADCA) has been used a lot and must be expected to be present in foamed plastic if the substance has not been completely decomposed during foaming. The substance is very water-soluble and must be expected to migrate to aqueous solutions, e.g. saliva and sweat (Hansen et al. 2014). It might be possible to detect the volatile foam agents through a GC/MS screening. The same goes for ADCA, but the substance is expected to decompose in the gas chromatograph.

Solvents and certain monomers are volatile and as mentioned earlier, they are expected to be present in very small amounts if they at all are present in the used products. If present, they will be detected by GC/MS screenings. Therefore, it is possible to verify the above assumption.

Regarding UV stabilizers and antioxidants it is expected that UV stabilizers mainly are used in products for outdoor use whereas antioxidants are used for indoor as well as outdoor products. A chemical conversion can take place in both substance groups as a result of their function and therefore it can especially for older products be expected that a large part of the protective agents have been converted to other substances. It is uncertain to which degree these conversion products can be detected by GC/MS screenings.

5.2 The analysis programme

The literature study showed that electronics, rubber, treated wood and certain types of plastic can contain a number of problematic substances.

In addition, the literature and internet studies, through interviews with employees at the institutions and in the questionnaire study, demonstrated that various electronic devices and parts for devices, cords, bicycle tyres, bicycles tubes, garden hoses, sleeping mats and foam mattresses and pressure-treated wood can be separated by e.g. carving, cutting, hammering or sawing. In that way, inside parts are disclosed and/or particles are liberated and they might consist of or have been treated with problematic substances. That gives a risk of oral, dermal or inhalatory exposure when the materials are processed.

The survey also demonstrated that disposable tableware made of polystyrene, LPs and treated wood are heated, and therefore there is risk of exposure through the respiratory passages.

In addition, it was found that the new produced products end up as toys, jewellery, clothes, everyday items for food or non-food when the child care centres apply the used products and materials. They are all applications where dermal and/or oral exposure can appear.

In the light of the survey, 26 samples were selected for chemical analysis, see Table 25. Samples from the selected product groups were collected at a recycling centre and from private persons who contributed with relevant products.

The results of the survey cannot sufficiently clarify which substances are most relevant to analyse, and therefore screening analyses were initially carried out by gas chromatography (GC/MS) and by X-ray (XRD). The screening analyses by GC/MS were carried out to uncover a possible content of volatile and semi-volatile organic substances in the products. The screening analyses by X-ray were carried out to clarify the samples' content of elements, including content of heavy metals, and therefore the X-ray analysis can indicate if problematic inorganic substances or possibly organic metal compounds appear.

In the light of the results from the two screening analyses, a decision was made to carry out quantitative analyses for relevant substances. Subsequently, the results of the quantitative contents were compared with the exposure scenarios as a basis for the decision to carry out possible migration tests.

5.3 Screening analyses

25 screening analyses by GC/MS and 4 screening analyses by X-ray were carried out on a total of 26 samples. See the outline of samples and subsamples for the screening analyses in Table 25. The table also states the background for choice of product and analysis method.

In connection with the subsequent quantitative analyses for tin and lead in sample no. 1, 2, 6, 7, 15 and 16 (described in chapter 5.4.4) screening was also carried out for other constituents. Those screening results are reported in Table 55.

TABLE 25 SAMPLES AND SUBSAMPLES FOR SCREENING ANALYSES BY GC/MS AND X-RAY.

Sample no.	Product	Sample/subsample for GC/MS	Sample/subsample for X-ray (XRF)	Reason for choice of analysis method
1*	Garden hose 1, newest	Subsample of plastic material	-	Risk of presence of plasticizers (e.g. phthalates), and organic tin compounds
2*	Garden hose 2, oldest	Subsample of plastic material	-	Risk of presence of plasticizers (e.g. phthalates), and organic tin compounds
3	Lacquered wood 1, laminated	Subsample of layer with varnish	-	Risk of presence of monomer or catalyst residue in the varnish
4	Lacquered wood 2, solid wood, light	Subsample of layer with varnish	-	Risk of presence of monomer or catalyst residue in the varnish
5	Lacquered wood 3, solid wood, dark	Subsample of layer with varnish	-	Risk of presence of monomer or catalyst residue in the varnish
6*	LP 1	Subsample of material	-	Risk of presence of PAH
7*	LP 2	Subsample of material	-	Risk of presence of PAH
8	Disposable tableware, made of polystyrene (PS)	Subsample of plastic material	-	Risk of presence of styrene
9	Disposable tableware, cups made of polystyrene (PS)	Subsample of plastic material	-	Risk of presence of styrene

Sample no.	Product	Sample/subsample for GC/MS	Sample/subsample for X-ray (XRF)	Reason for choice of analysis method
10	Bicycle tube 1	Subsample of material (without print)	-	Risk of presence of PAH, amines or other rubber chemicals
11	Bicycle tube 2	Subsample of material (without print)	-	Risk of presence of PAH, amines or other rubber chemicals
12	Bicycle tyre 1	Subsample of material (without print)	-	Risk of presence of PAH, amines or other rubber chemicals
13	Bicycle tyre 2,	Subsample of material (without print)	-	Risk of presence of PAH, amines or other rubber chemicals
14	Cords 1, rubber cord, black	Subsample of outer shell of polymeric material/insulation	-	Risk of presence of PAH, amines or other rubber chemicals
15*	Cords 2, black cord from DVD	Subsample of outer shell of plastic material/ insulation	-	Risk of presence of plasticizers (e.g. phthalates)
16*	Cords 3, red cord with thick copper in centre	Subsample of outer shell of plastic material/ insulation	-	Risk of presence of plasticizers (e.g. phthalates)
17	Foam mattress 1, large, hard	Subsample of material	-	Risk of presence of plasticizers (e.g. phthalates), organic tin compounds or monomer residue in the material (e.g. MDI and TDI)
18	Foam mattress 2, little, soft	Subsample of material	-	Risk of presence of plasticizers (e.g. phthalates), organic tin compounds or monomer residue in the material (e.g. MDI and TDI)
19	Pressure-treated wood 1, dark	Subsample of material	-	Risk of presence of preservatives and heavy metals (e.g. arsenic and chromium)
20	Pressure-treated wood 2, green	Subsample of material	-	Risk of presence of preservatives and heavy metals (e.g. arsenic and chromium)
21	Electronics 1, large, green printed circuit board	-	Surface of soldering	Risk of presence of phosphorus and brominated flame-retardants

Sample no.	Product	Sample/subsample for GC/MS	Sample/subsample for X-ray (XRF)	Reason for choice of analysis method
22	Electronics 2, printed circuit board from DVD	Subsample of printed circuit board	-	Risk of presence of Bisphenol A
23	Electronics 3, printed circuit board from keyboard	Subsample of printed circuit board	-	Risk of presence of Bisphenol A
24	Electronics 4, printed circuit board from cell phone	Subsample of printed circuit board (without soldering)	Surface of printed circuit board	Risk of presence of Bisphenol A, heavy metals or phosphorus and brominated flame-retardants
25	Sleeping mat 1	Subsample of material	-	Risk of presence of plasticizers (e.g. phthalates), organic tin compounds or monomer residue in the material (e.g. MDI and TDI)
26	Sleeping mat 2	Subsample of material	-	Risk of presence of plasticizers (e.g. phthalates), organic tin compounds or monomer residue in the material (e.g. MDI and TDI)

- Not analysed

* Sample no. 1, 2, 6, 7, 15 and 16 were investigated by X-ray (XRF). Measurements were carried out on the surface of the material. The results are stated in Table 55.

As a starting point, 2 products from each product type were selected. More than 2 products were chosen among the following types: printed circuit board, cords and lacquered wood, as the material composition/material chemistry of these product types together with the found processing methods or applications indicate an increased risk of exposure.

GC/MS screenings were carried out on printed circuit boards and pressure-treated wood together with X-ray screenings as the products might contain problematic heavy metal-based or halogenated compounds.

5.3.1 Screening analyses by GC/MS

The 25 subsamples were investigated by GC/MS screening for content of volatile and semi-volatile organic substances. The analyses cover a substantial number of volatile and semi-volatile organic substances, but the method is not equally suited for all substances. Volatile aldehydes, including formaldehyde, could for instance not be detected by the method. In addition, it is not possible to detect all flame-retardants, including the phosphorus-based, by the screening analysis. GC/MS can indicate a content of isocyanates that might appear as residue monomers. As the analysis is uncertain, the content of isocyanates must be verified by a specific analysis method.

All substances were calculated against internal standards and therefore the results of the GC/MS screening must be considered as semi-quantitative.

5.3.1.1 Analysis method for screening by GC/MS for volatile and semi-volatile organic substances

A known sub-amount of between 0.5 gram and 10 gram was drawn from the products. Two subsamples were taken from each item, and for each subsample a representative sample was taken - except in connection with the electronic samples. In the electronic samples, only the organic parts were removed, meaning that metal parts such as the insides of cords and the soldering on printed circuit boards etc. did not form part of the subsamples for screening of organic substances.

The subsamples were extracted by ultrasound at room temperature with n-hexane and/or dichlormethane, and subsequently the solvent extracts were analysed by gas chromatography combined with mass selective detection (GC/MS). An internal standard of o-Terphenyl (1,2-diphenylbenzene) was used. The analyses were carried out as single determinations. The detected main components were identified by comparing the mass spectrum in question with mass spectra in the NIST library[7].

All substances were determined semi-quantitatively against the response factor of o-Terphenyl (1,2-diphenylbenzene).

The detection limits vary between 10 and 50 mg/kg depending on the matrix and the response of the substances.
All detected substances above the detection limit of the individual substances have been reported. In the case of several not identified substances, they are stated as the sum of not identified substances. The substances were reported according to increasing retention time.

The analysis is semi-quantitative.

5.3.1.2 Analysis results of screening analysis by GC/MS for volatile and semi-volatile organic substances

TABLE 26 SAMPLE 1: GARDEN HOSE 1, NEWEST.

Component	CAS no.	Results in mg/kg
Diiso butyl phthalate (DIBP)	84-69-5	2400
Not identified	-	110
Dibutyl phthalate (DBP)	84-74-2	6400
Dioctyl adipate	123-79-5	200
Di-iso-octyl phthalate	131-20-4	1700

TABLE 27 SAMPLE 2: GARDEN HOSE 2, OLDEST.

Component	CAS no.	Results in mg/kg
Diethyl phthalate	84-66-2	12
Diiso butyl phthalate (DIBP)	84-69-5	16
Dibutyl phthalate (DBP)	84-72-2	49
Diisononyl phthalate (DINP), isomers 1	-	29000
Diisononyl phthalate (DINP), isomers 2	-	19000

[7] National Institute of Standards and Technology (NIST), USA.

Sum of 6 not identified substances	-	530

TABLE 28 SAMPLE 3: LACQUERED WOOD 1, LAMINATED.

Component	CAS no.	Results in mg/kg
Volatile and semi-volatile organic substances	-	< 20

TABLE 29 SAMPLE 4: LACQUERED WOOD 2, SOLID WOOD, PALE.

Component	CAS no.	Results in mg/kg
Methylcyclohexanol (isomers)	-	280
Methylcyclohexylester, formic acid (isomers)	-	86
Bromomethylcyclohexan (isomers)	-	1000
4-Methyl-N-phenylbenzene sulphonamides	68-34-8	1500

TABLE 30 SAMPLE 5: LACQUERED WOOD 3, SOLID WOOD, DARK.

Component	CAS no.	Results in mg/kg
Volatile and semi-volatile organic substances	-	< 50

TABLE 31 SAMPLE 6: LP 1.

Component	CAS no.	Results in mg/kg
Volatile and semi-volatile organic substances	-	< 50

TABLE 32 SAMPLE 7: LP 2.

Component	CAS no.	Results in mg/kg
Volatile and semi-volatile organic substances	-	< 50

TABLE 33 SAMPLE 8: DISPOSABLE TABLEWARE, SPOONS MADE OF POLYSTYRENE (PS).

Component	CAS no.	Results in mg/kg
Sum of aliphatic hydrocarbons	-	220
Styrene	100-42-5	72
trans-1,1'-(1,2-Cyclobutanediyl)-bis-benzene	20071-09-4	37
Sum of 5 not identified substances	-	460

TABLE 34 SAMPLE 9: DISPOSABLE TABLEWARE, CUP MADE OF POLYSTYRENE (PS).

Component	CAS no.	Results in mg/kg
Sum of aliphatic hydrocarbons	-	510
Styrene	100-42-5	24
trans-1,1'-(1,2-Cyclobutanediyl)-bis-benzene	20071-09-4	39
Sum of 8 not identified substances	-	760

TABLE 35 SAMPLE 10: BICYCLE TUBE 1

Component	CAS no.	Results in mg/kg
Mineral oil*	-	73000

* Sum of hydrocarbons from C14-C44

TABLE 36 SAMPLE 11: BICYCLE TUBE 2.

Component	CAS no.	Results in mg/kg
Mineral oil*	-	59000

* Sum of hydrocarbons from C14-C44

TABLE 37 SAMPLE 12: BICYCLE TYRE 1.

Component	CAS no.	Results in mg/kg
Mineral oil*	-	64000

* Sum of hydrocarbons from C14-C44

TABLE 38 SAMPLE 13: BICYCLE TYRE 2.

Component	CAS no.	Results in mg/kg
Mineral oil*	-	45000

* Sum of hydrocarbons from C14-C44

For sample 10, 11, 12 and 13, possible aromatic hydrocarbons or other single components could not be detected individually in the applied screening method due to the high content of hydrocarbons in bicycle tubes and tyres. Therefore, it cannot be determined if the content of hydrocarbons comprises aromatic hydrocarbons or other single components.

TABLE 39 SAMPLE 14: CORDS 1, RUBBER CORD (BLACK).

Component	CAS no.	Results in mg/kg
1,1,2,2-tetrachloroethane	79-34-5	10
α,α'-Dihydroxy-m-diisopropyl benzene	1999-85-5	130
1-[4-(2-Hydroxypropane-2-yl) phenyl]-ethanone	54549-72-3	220
α,α,α',α'-Tetramethyl-1,4-benzene dimethanol	2948-46-1	58
1-[4-(2-Hydroxypropane-2-yl) phenyl]-	54549-72-3	140

ethanone		
Sum of not identified substances	-	88

TABLE 40 SAMPLE 15: CORDS 2, BLACK CORD FROM DVD.

Component	CAS no.	Results in mg/kg
3-Methylenheptane	1632-16-2	450
2-Ethyl-1-hexanol	104-76-7	670
Diethyl phthalate	84-66-2	710
Sum of 2 not identified substances	-	2400
Diisononyl phthalate (DINP), isomers 1	-	39000
Diisodecyl phthalate	89-16-7	32000
Diisononyl phthalate (DINP), isomers 2	-	5500
Tris(2-ethylhexyl)-trimellitate	3319-31-1	47000

TABLE 41 SAMPLE 16: CORDS 3, INSULATION OF RED CORD WITH THICK INNER COPPER CORD.

Component	CAS no.	Results in mg/kg
Sum of 5 siloxanes	-	7100
Di-(2-ethylhexyl)-phthalate (DEHP)	117-81-7	370000

TABLE 42 SAMPLE 17: FOAM MATTRESS 1, LARGE, HARD.

Component	CAS no.	Results in mg/kg
3,5-Di-tert-butyl-4-hydroxybenzaldehyde	1620-98-0	34
Diiso butyl phthalate (DIBP)	84-69-5	140
Dibutyl phthalate (DBP)	84-74-2	110

TABLE 43 SAMPLE 18: FOAM MATTRES 2, LITTLE, SOFT.

Component	CAS no.	Results in mg/kg
2,4-Toluenediisocyanate (2,4-TDI)	584-84-9	310*
Diiso butyl phthalate (DIBP)	84-69-5	1400
Not identified	-	100
Di-(2-ethylhexyl) phthalate (DEHP)	117-81-7	680

*The result should be considered as an indication of content of 2,4-TDI. See the result of the specific analysis in chapter 5.4.3.

TABLE 44 SAMPLE 19: PRESSURE-TREATED WOOD 1, DARK.

Component	CAS no.	Results in mg/kg
Sum of 2 terpenes	-	60
N,N-Dimethyl-1-dodecanamine	112-18-5	27
N,N-Dimethyl-1-tetradecanamine	112-75-4	15
Sum of 2 not identified substances	-	38
2,2'-Dimethyl-6,6'-dinitro-1,1'-biphenyl	55153-02-1	90

TABLE 45 SAMPLE 20: PRESSURE-TREATED WOOD 2, GREEN.

Component	CAS no.	Results in mg/kg
Volatile and semi-volatile organic substances	-	< 30

TABLE 46 SAMPLE 22: ELEKTRONICS 2, PRINTED CIRCUIT BOARD FROM DVD.

Component	CAS no.	Results in mg/kg
Volatile and semi-volatile organic substances	-	< 50

TABLE 47 SAMPLE 23: ELEKTRONICS 3, PRINTED CIRCUIT BOARD FROM PC KEYBOARD.

Component	CAS no.	Results in mg/kg
Isomeric nonylphenol	-	670
Triphenyl phosphate	115-86-6	6500
Methylphenyl diphenyl ester phosphoric acid (isomers 1)	-	7700
Methylphenyl diphenyl ester phosphoric acid (isomers 2)	-	4500
bis-(Methylphenyl) phenyl ester (isomers 1) phosphoric acid	-	3980
bis-(Methylphenyl) phenyl ester (isomers 2) phosphoric acid	-	3380
bis-(Methylphenyl) phenyl ester (isomers 3) phosphoric acid	-	910
tris-(Methylphenyl) ester (isomers 1) phosphoric acid	-	1000
tris-(Methylphenyl) ester (isomers 2) phosphoric acid	-	940

TABLE 48 SAMPLE 24: ELEKTRONICS 4, PRINTER CIRCUIT BOARD FROM CELL PHONE.

Component	CAS no.	Results in mg/kg
Volatile and semi-volatile organic substances	-	< 20

TABLE 49 SAMPLE 25: SLEEPING MAT 1.

Component	CAS no.	Results in mg/kg
Volatile and semi-volatile organic substances	-	< 20

TABLE 50 SAMPLE 26: SLEEPING MAT 2.

Component	CAS no.	Results in mg/kg
Tri(2-ethylhexyl)-trimellitate	3319-31-1	1500

The screening detected a number of substances that could not be identified, as the substances do not appear in the NIST library. Therefore, no health or environmental assessment of these substances could be carried out.

The results of the screening analysis by GC/MS formed the basis of the choice of the quantitative specific analyses for organic substances. See the outline of subsamples for quantitative analyses under chapter 5.4.

5.3.2 Screening analyses by X-ray

4 subsamples were selected for screening analyses by X-ray (XRD). The screening analysis by X-ray detected all elements with an atomic number larger than 8. Therefore, the X-ray analysis can clarify if the samples contain heavy metals and in that way indicate if critical inorganic substances or organic metal compounds appear.

5.3.2.1 Analysis method for screening analyses by X-ray

Samples 19 and 20 were analysed for content of elements by wavelength dispersive (WD) X-ray analysis; Philips PW2400/UNIQUANT ver. 5.49. All detected elements above the detection limit of 0.005 w/w%, corresponding to 50 mg/kg, were reported quantitatively.

The analysis uncertainty is estimated to 5-15% (RSD).

Samples 21 and 24 are not homogeneous and do not have a level surface and therefore the results are stated as semi-quantitative. The determined areas on the items were investigated and the content of the elements was stated as detected or not detected above the detection limit estimated to 0.01 w/w%, corresponding to 100 mg/kg.

Sample 24 (the printed circuit board itself without soldering) was analysed for content of bromine and phosphorus, which can indicate content of flame-retardants by energy dispersive microprobe X-ray florescence (Micro ECXRF).

5.3.2.2 Analysis results for screening analysis by X-ray

TABLE 51 ANALYSIS RESULTS FOR SCREENING ANALYSES BY X-RAY IN W/W%.

Unit: w/w% Component	Sample 19 Pressure-treated wood 1, dark	Sample 20 Pressure-treated wood 1, green	Sample 21 Electronics 1, soldering on green printed circuit board	Sample 24 Electronics 4, Printed circuit board from cell phone (without soldering)
Aluminium (Al)	0.32	0.019	< 0.01	*
Silicon (Si)	1.1	0.035	< 0.01	*
Chlorine (Cl)	-	-	< 0.01	*
Sulphur (S)	0.038	0.011	< 0.01	*
Calcium (Ca)	0.10	0.074	< 0.01	*
Titanium (Ti)	0.0083	-	< 0.01	*
Manganese (Mn)	0.0029	0.0067	< 0.01	*
Iron (Fe)	0.028	-	< 0.01	*
Copper (Cu)	1.5	0.19	< 0.01	*
Strontium (Sr)	< 0.005	< 0.005	< 0.01	*
Tin (Sn)	< 0.005	< 0.005	Detected	*
Antimony (Sb)	< 0.005	< 0.005	< 0.01	*
Cadmium (Cd)	< 0.005	< 0.005	< 0.01	*
Lead (Pb)	< 0.005	< 0.005	< 0.01	*
Nickel (Ni)	< 0.005	< 0.005	Detected	*
Bromine (Br)	< 0.005	< 0.005	< 0.01	< 0.01
Phosphorus (P)	< 0.005	< 0.005	< 0.01	Detected

< : Means less than the stated detection limit.

* The printed circuit board from sample 24 was only investigated for phosphorus and bromine, which might indicate content of brominated or phosphorus based flame-retardants. See results of additional analyses of sample nos. 1, 2, 6, 7, 15 and 16 by X-ray in Table 54 under the quantitative analyses.

As expected, a high content of copper was detected in the samples of pressure-treated wood and high contents of tin and nickel were detected in the surface of the soldering on the printed circuit board.

Bromine was not detected in the printed circuit board from the cell phone (sample 24), and therefore no brominated flame-retardants were used in the investigated printed circuit board. On the other hand, a very low concentration of phosphorus was detected and that might originate from phosphorus-based flame-retardants; however, that has not been verified. The result of the GC/MS screening did not detect a content of phosphorus-based flame-retardants in sample 24, but that does not necessarily mean that the printed circuit board does not contain phosphorus-based flame-retardants, as not all of them can be detected by GC/MS screening.

5.4 Quantitative analyses and migration test on selected products

Quantitative analyses for selected substances were carried out on the basis of the results from the screening analyses by GC/MS and the X-ray analyses.

As previously described, the screening method by GC/MS covers a very large number of volatile and semi-volatile organic substances, but the method is not suited for all organic substances. For instance, the indication of isocyanates requires verification with a specific analysis method.

Based on the screening results by GC/MS, these follow-up analyses were selected:

- Polyaromatic hydrocarbons (PAH) in bicycle tubes and tyres. A substantial content of hydrocarbons from C_{14}-C_{44} was detected in the samples. The screening analysis could not clarify if there was a content of PAH among the hydrocarbons, precisely because of the high content of hydrocarbons.

And the following migration test:

- Migration of DEHP from cords. Due to a high content of DEHP detected during the screening it is relevant to investigate for migration of DEHP.

In addition, the following isocyanates that are not suited for determination by the GC/MS screening analysis were selected for relevant products:

- Selected isocyanates: 2,4- and 2,6-TDI and 4,4'-Diphenylmethanediisocyanate (MDI), as they can appear as residue monomers in foam.

Based on the survey, products were selected for quantitative analyses by X-ray with focus on tin and lead:

- Tin, which can indicate a content of organic tin compounds
- Screenings by X-ray with focus on lead, which can be used as stabilizer.

See the outline of the specific analyses of the selected products in Table 52.

TABLE 52 SAMPLES AND SUBSAMPLES FOR QUANTITATIVE DETERMINATION OF SPECIFIC SUBSTANCES.

Substance	Samples
Polyaromatic hydrocarbons (PAH)	Sample 10: Bicycle tube 1 Sample 11: Bicycle tube 2 Sample 12: Bicycle tyre 1 Sample 13: Bicycle tyre 2
Isocyanates	Sample 18: Foam mattress 2
Tin (possibly organic tin)	Sample 25: Sleeping mat 1 Sample 26: Sleeping mat 2
X-ray with focus on lead	Sample 1: Garden hose 1 Sample 2: Garden hose 2 Sample 6: LP 1 Sample 7: LP 2 Sample 15: Cord 2 Sample 16: Cord 3 (red)
Migration test for DEHP	Sample 16: Cord 3 (red)

5.4.1 Polyaromatic hydrocarbons (PAH)

Quantitative analyses were carried out with focus on the 8 regulated PAHs according to REACH, Annex XVII.

5.4.1.1 Analysis method for quantitative analyses for PAH by GC/MS

Subsamples of the selected materials (subsamples as for the screenings) were carefully weighed (app. 1 g) and extracted with solvent of dichloromethane added deuterium marked internal standards of naphthalene-d_8 and phenanthrene-d_{10} by ultrasound for 1 hour at room temperature. The extract was analysed by capillary gas chromatography with mass spectrometric detection (GC/MS).
Quantification was carried out against external standards of all of the listed substances (the 8 PAHs, regulated in REACH).

Two independent control samples were prepared in the same way as the calibration standards. Detection limit: 0.5 mg/kg.

5.4.1.2 Analysis results for quantitative analyses for PAH by GC/MS

TABLE 53 ANALYSIS RESULTS FOR QUANTITATIVE ANALYSIS FOR PAH.

Unit: mg/kg		Sample 10	Sample 11	Sample 12	Sample 13
Component	CAS no.	Bicycle tube 1	Bicycle tube 2	Bicycle tyre 1	Bicycle tyre 2
Benzo[a]pyrene	50-32-8	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[e]pyrene	192-97-2	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[a]anthracene	56-55-3	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	218-01-9	< 0.5	< 0.5	< 0.5	< 0.5
Benz[b]fluoranthen	205-82-3	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[j]fluoranthen	205-82-3	< 0.5	< 0.5	< 0.5	< 0.5
Benzo[k]fluoranthen	207-08-9	< 0.5	< 0.5	< 0.5	< 0.5
Dibenzo[a,h]anthracene	53-70-3	< 0.5	< 0.5	< 0.5	< 0.5

< : Means less than the detection limit

No content was detected of the 8 PAHs that are regulated in REACH.

The method included all EPA PAH[8], but none of them were detected above the detection limit of 0.5 mg/kg.

5.4.2 Isocyanates

One single sample of foam was selected for quantitative analysis of isocyanates, as it is well-known that foam can contain residue of monomer isocyanates.

5.4.2.1 Analysis method for isocyanates by HPLC

Sub-samples with a known weight were extracted with dichloromethane added internal standard with subsequent derivatisation. The analysis was carried out by HPLC with fluorescence detector

[8] PAHs comprised by the analysis: Naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benz(b,j,k)fluoranthenes, benz(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(ghi)perylene.

for 2,4- and 2,6-toluenediisocyanate (2,4- and 2,6-TDI), CAS no. 584-84-9 and 91-08-7 as well as 4,4'-diphenylmethandiisocyanate, (MDI), CAS no. 101-68-8.

True triple determinations were carried out. The average of the triple determinations is stated in Table 54.
Detection limit: 0.01 mg/kg
Analysis uncertainty: 15%RSD

5.4.3 Analysis results for isocyanates by HPLC

TABLE 54 SAMPLE 18: FOAM MATTRESS 2, RESULTS FOR ISOCYANATES.

Component	CAS no.	Results in mg/kg
2,4-Toluenediisocyanate (2,4-TDI)	584-84-9	0.01
2,6-Toluenediisocyanate (2,6-TDI)	91-08-7	0.02
4,4'-Diphenylmethanediisocyanate, (MDI)	101-68-8	0.06

A content close to the detection limit of the method of 2,4- and 2,6-TDI and MDI in the foam mattress was detected.

The screening analyses by GC/MS showed a content of isocyanates 2,4-TDI in foam mattress no. 2 in a concentration of 310 mg/kg. It was not possible to recover that content by the specific analysis for TDI. The results of the specific analysis clearly show that the GC/MS method cannot be used to determine isocyanates.

5.4.4 Elements by X-ray

6 samples were selected for quantitative determination of tin and lead. As the analysis by X-ray is a screening, all detected elements were reported. The same analysis methods were used as for the initial screening analyses by X-ray. See the results in Table 51.

5.4.4.1 Analysis method for elements by X-ray

The samples were analysed for content of elements by wavelength dispersive (WD) X-ray analysis; Philips PW2400/UNIQUANT ver. 5.49.
All elements detected above the detection limit of 0.002 – 0.005 w/w%, corresponding to 20-50 mg/kg, were reported quantitatively.

The analysis uncertainty is estimated to 10-25% (RSD).

5.4.4.2 Analysis results for tin and lead by X-ray

Tin was not detected above 50 mg/kg in the two sleeping mats, sample 25 (sleeping mat 1) and sample 26 (sleeping mat 2), and therefore additional analyses for organic tin compounds were not carried out.

See the results below for the additional analyses by X-ray with focus on content of lead.

TABLE 55 ANALYSIS RESULTS FOR X-RAY IN W/W%.

Unit: w/w%	Sample 1	Sample 2	Sample 6	Sample 7	Sample 15	Sample 16
Component	Garden hose 1	Garden hose 2	LP 1	LP 2	Cord 2	Cord 3
Chlorine (Cl)	37	29	40	38	13	9,0
Sulphur (S)	0.062	0.078	0.006	< 0.005	0.008	0.034
Calcium (Ca)	0.087	0.11	0.008	0.009	4.1	2.8
Iron (Fe)	0.002	0.018	< 0.002	< 0.002	0.004	0.003
Strontium (Sr)	0.022	0.003	< 0.002	< 0.002	< 0.002	0.011
Tin (Sn)	0.063	< 0.002	< 0.002	< 0.002	0.007	< 0.002
Antimony (Sb)	< 0.002	< 0.002	< 0.002	< 0.002	0.57	< 0.002
Cadmium (Cd)	< 0.002	< 0.002	0.019	0.018	< 0.002	< 0.002
Lead (Pb)	< 0.002	0.068	0.20	0.20	< 0.002	0.21

< : Means less than the stated detection limit.

Results of the initial screening investigations by X-ray for sample 19, 20, 21 and 24 appear in Table 51.

A content of lead was detected in one garden hose (sample 2), the two LPs (sample 6 and 7) and in the red cord (sample 16). The highest content was found in the two LPs and in cord no. 3, where 0.20 and 0.21 w/w%, respectively, were detected, corresponding to 2000 and 2100 mg/kg, respectively. Of other heavy metals, tin was found in two of the samples and the highest content appeared in garden hose 1 with 0.063 w/w%, corresponding to 630 mg/kg. In addition, a content of cadmium was detected in the two LPs of 0.019 and 0.018 w/w%, respectively, corresponding to 190 and 180 mg/kg, respectively.

5.5 Migration test

The semi-quantitative GC/MS screening analysis showed a high content of di-(2-ethylhexyl)-phthalate (DEHP) of 370000 mg/kg, corresponding to 37%, in sample 16 (cord 3, electronics), and therefore that sample was selected for migration test. Artificial sweat was chosen for migration test of the cord as it, if desired, can be shaped as a bracelet and in that way get into contact with skin.

5.5.1 Method for migration test

The migration liquid of artificial sweat was made according to ISO 105-E04 as for Oeko-Tex, where the simulator consists of 1-histidin-monohydrochlorid-1-hydrat, sodium chloride, sodium dihydrogen-phosphate and sodium hydroxide for adjustment of pH to 5.5. The artificial sweat was heated to 37 °C to imitate body temperature. The sample amount compared to the migration liquid is 2.5 gram for 50 ml simulant.

A subsample with known weight and surface area was drawn from the cord, and the relation between the insulation mass on the cord and the cord with metal was determined. The subsample was placed in a known amount of the heated simulant in a temperature driven incubator at 37 °C and with static contact to the simulant for 3 hours.

After 3 hours of migration to the artificial sweat at 37 °C, the subsamples were removed from the migration liquid, and the migration liquid was at once extracted with dichloromethane and stored in a fridge until analysis of the specific substances.

The migration test was carried out as analysis in true duplicate.

5.5.2 Analysis method for DEHP in migration liquid

A known sub-amount of migration liquid was weighed. Extraction took place with dichloromethane and subsequently analysis was carried out by gas chromatography combined with mass selective detection (GC/MS). Internal standards of deuterium marked DEHP- D_4 were applied. DEHP was quantified against external calibration standard.

The detection limit was determined to 0.05 mg/kg. The analysis uncertainty was estimated to 55% (RSD) on the basis of the results of the analyses in duplicate.

5.5.3 Analysis results for DEHP in migration liquid

TABLE 56 SAMPLE 16: CORD 3. RESULTS OF MIGRATION TEST FOR ARTIFICIAL SWEAT (THE RESULTS ARE THE MIGRATION AFTER 3 HOURS).

Component	CAS no.	mg/kg cord	mg/m² cord
Di-(2-ethylhexyl)-phthalate (DEHP)	117-81-7	0.23	0.50

The result of the migration test shows that only a small amount of DEHP migrates to the migration liquid in the course of 3 hours. That is in agreement with previous investigations, which also show that DEHP momentarily does not migrate to aqueous simulants.

5.6 Summary of the chemical analyses

5.6.1 Summary of screening analyses

The results of the screening analysis of the 25 samples by GC/MS for volatile and semi-volatile organic substances vary among the different types of products. That was as expected, as the selected types of used products are very different. The results also vary within the same product categories. The disposable tableware, bicycle tyres, bicycle tubes and the LPs show homogeneous results, whereas the results vary e.g. for the different types of lacquer for wood, electronics/cords, foam mattresses, pressure-treated wood and sleeping mats. Phthalates were detected in both samples of the garden hoses, but the levels and the substances themselves are different.

In some of the samples very few volatile or semi-volatile substances were detected, and in other samples up to 10 different components were detected. The screening analysis detected phthalates in a number of the samples, and one single sample with the highest content was selected for migration test for DEHP.

The screening by GC/MS detected a number of substances that could not be identified, as the substances do not appear in the NIST library. Therefore, no health or environmental assessment can be carried out on these substances.

The screening analysis by X-ray of the 4 samples as expected disclosed a content of copper in the samples of pressure-treated wood, and also as expected tin and nickel were disclosed in the soldering on the printed circuit board. Bromine was not detected in the printed circuit board from the cell phone, and therefore no brominated flame-retardants were used in the investigated printed circuit board. On the other hand, phosphorus was detected in a very low concentration and it might originate from phosphorus-based flame-retardants; however, that has not been verified by specific analysis.

5.6.2 Summary of the quantitative analyses

The 4 samples of bicycle tubes and tyres showed a high content of hydrocarbons in the screening analysis by GC/MS. Due to the high content of hydrocarbons it was not possible during the screening to determine if there could be a content of PAH in the total amount of hydrocarbons. Quantitative analyses were carried out with focus on the 8 regulated PAHs according to REACH, Annex XVII, but they could not be detected in a content exceeding the detection limit of the method.

Quantitative analyses were carried out for isocyanates as they were not detected in the screening analysis by GC/MS. One single sample of foam was selected for quantitative analysis for isocyanates, as it is well known that foam can contain residue of monomer isocyanates.
A content of 2,4- and 2,6-TDI and MDI close to the detection limit of the method was detected in the foam mattress. The screening analyses by GC/MS showed a content of isocyanate 2,4-TDI in foam mattress no. 2 in a concentration of 310 mg/kg. It has not been possible to recover that content by the specific analysis for TDI. The results of the specific analysis illustrated the uncertainty by GC/MS concerning determination of isocyanates.

The quantitative X-ray analyses with focus on lead detected a content of lead in one of the garden hoses, the two LPs and in the red cord. The highest content was found in the two LPs and in the red cord.

Other heavy metals were found, and tin was detected in two of the samples; the highest content appeared in one of the garden hoses. In addition, cadmium was detected in the two LPs amounting to 0.019 and 0.018 w/w%, respectively, corresponding to 190 and 180 mg/kg, respectively.

5.6.3 Summary of migration test

The migration test for artificial sweat only detected a rather low content of DEHP in spite of the high content of DEHP in the sample.

6. Exposure assessment

6.1 Introduction

When applying used products in creative contexts in day care centres, children and adults may be unintended exposed to chemicals from the materials. During processing of the materials, for example by heating, vapours containing volatile chemical substances may be emitted and subsequently inhaled. When processing with the hands, ingredients from eg plasticisers from the plastic products may to some extent migrate the materials to the skin. By other processing, eg sawing, particles may be released into the air, which may subsequently be inhaled, and particles may be deposited on the skin of the fingers, which are subsequently put in the mouth.

Also, the design of the end-products and the use of these may lead to a potetial for exposure to chemical substances, eg pendants for necklaces and other jewelry may lead to oral exposure to substances due to children's behaviour of putting the pendants in the mouth.

Depending on the materials, ingredients and the creative processing, the exposure from the used products may therefore occur in connection with skin contact (dermal exposure), if swallowed (oral exposure, through inhalation of vapours or particles in the air (inhalation exposure), or a combination thereof.

In some cases, the manufacturing and the processing processes may result in a higher exposure than the use of the finished product, for example heating of the plastic during the manufacturing of a decorative item. In other cases, the actual use of the manufactured product may cause the highest exposure potential, such as a necklace made of keyboard buttons, which the child sucks when carrying the necklace.

This section describes how to calculate the exposure via the three routes of exposure: skin contact, ingestion and inhalation. The starting point is the models and calculation tools listed in the European Chemicals Agency (ECHA) guidance for estimating consumer exposure (ECHA, 2012). The section specifies the algorithms to be used for the calculations, and describes the various parameters included in the algorithms. Some parameters are dependent on the used product (eg the amount of material being worked with, and the concentration of an ingredient in the material), while other parameters depend on the conditions and processes involved in the processing and use. The latter parameters may often be estimated/ assumed based on information on the specific activity (eg information concerning the processing method and the duration of the activity (or part of the activities)).

This chapter also includes a section that specifies a number of important anatomical and physiological parameters used in the algorithms, focusing on the age groups most relevant to the specific activity. This includes a number of predefined values parameters, such as skin area of body parts and the volume of inhaled air per day for different age groups.

The models and default values, together with the actual measurements (if any), will be used to calculate/ estimate the exposure of children to specific substances in selected products used for creative purposes in day care centres.

6.2 Models for estimation of exposure to chemical substances in products and articles

Overall, exposure to a chemical substance contained in an article may be described as follows:

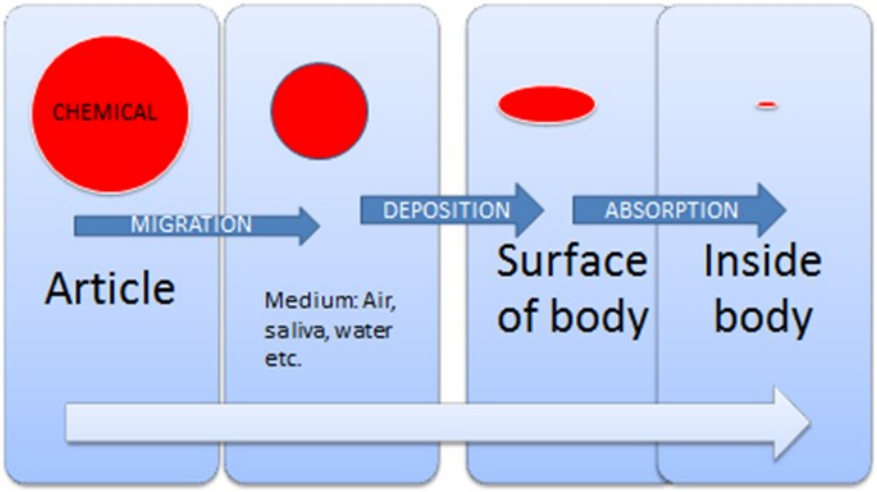


FIGURE 2 ILLUSTRATION OF EXPOSURE TO A SUBSTANCE IN AN ARTICLE AND SUBSEQUENT ABSORPTION IN THE ORGANISM (DANISH EPA, 2014).

The exposure calculations initially calculate the external exposure, ie the quantity of a substance to which the body is externally exposed. In Figure 5, this corresponds to the events in the first three boxes. For calculation of the the internal exposure to the organism the degree of absorption into the body has to be considered.

There are several different models to estimate exposure to chemicals from different products. Some models are more advanced than others and some models refer to the exposure of a consumer and some to the exposure of a professional worker. These models from ECHA's guidelines are so-called Tier 1 models, ie they are relatively simple to use, employing a series of predetermined parameters for exposure estimation (ECHA, 2012). These models are designed to provide a conservative estimate (ie have a tendency to overestimate) relative to the actual exposure. However, a more precise estimation expoosure estimation would require additional and more precise data for description of the exposure situtation. The models are thus suitable for an initial estimation of exposure, and also for identifying problematic processes and exposure situtations for a given use of a material. If the subsequent risk assessment based on a tier 1 exposuer assesment does not indicate a risk, it would not be necessary to carry out further and more precise and costly exposure estimations. More precise calculations may, however, be necessary if the model gives a result that indicate a risk. Then further investigations have to be carried out as to whether more detailed and accurate estimates for the individual parameters allow a less conservative exposure estimate, on which to base the risk assessment. ECHA's models for exposure estimations have been developed in relation to the specific exposure routes to be assessed, ie inhalation, dermal or oral contact. The individual models are described below.

6.2.1 Estimation of exposure via inhalation

Exposure via inhalation is estimated from the ECHA model based on the concentration of a substance in the air expressed in mg/m^3. The method is applicable to all substances, whether or not the chemical substance in the air occurs as gas/vapours or airborne particles. The model requires input in terms of amount of product [g] and concentration of the substance in the product [mg/gprod]. In addition, it uses a number of parameters that can be estimated in relation

to the specific conditions listed in the tables in the ECHA guideline document. Parameters of the model (Table 57) and the algorithms are shown below:

The air concentration of the substance in the room, C_{inh} [mg/m³] by the use of a specific quantity of a product Q_{prod}:

$$Cinh\ \left[\frac{mg}{m3}\right] = \frac{Q\ prod\ [g] * Fc\ prod\ \left[\frac{mg}{g}\right]}{V\ room[m3]} \qquad (1)$$

C_{inh}, the air concentration in the room (ie mg substance/m³ in the inhaled air), stated in air, is especially important to estimate whether the chemical can cause local effects in the respiratory system (eg irritation and respiratory problems), as this type of effects are often concentration-dependent.

If the substance may cause harmful effects by absorption into the bloodstream, e.g. damage to the liver or kidneys, it is often the total inhaled amount that is crucial. In such cases, the inhaled amount of substance per day per kg body weight may be calculated, D_{inh} [mg/kg bw/d]:

$$Dinh\ \left[\frac{mg}{kg\ d}\right] = \frac{Cinh\ \left[\frac{mg}{m3}\right] * IH\ air\ \left[\frac{m3}{h}\right] * T\ [h\ ] * n[/d\ ]}{bw\ [kg]} \qquad (2)$$

TABLE 57 PARAMETERS FOR ESTIMATION OF EXPOSURE TO A SUBSTANCE IN A PRODUCT BY INHALATION (ECHA, 2012).

Parameters	Description	Units
Qprod	Used amount of product	[g]
Fcprod	Proportion of a substance in the product	[mg/g prod]
Vroom	Room size (default value 20 m³)	[m³]
IHair	Volume of inhaled air per person	[m³/h]
T	Duration	[h]
BW	Body weight	[kg]
n	Application rate per day	[/d]
Cinh	Air concentration of the substance in the room	[mg/m³]
Dinh	Inhaled amount of substance per day per kg body weight	[mg/kg bw d]

As shown in Table 57, the material specific parameters Q_{prod} and Fc_{prod} are included, whichin this project will be determined, possibly measured, in relation to each selected product, while the parameters V_{room}; T and n will be determined based on specific details of operation. The parameters for IH_{air} and the bodyweight will set for the subjects' age group and based on the international default values for this (tables for these parameters are included later in this section).

6.2.1 Estimation of dermal exposure

Dermal exposure can be caused by direct skin contact with the product, eg if the substance is contained in a chemical mixture of other substances, such as a substance in a cream applied to the skin, or dermal exposure may occur as a substance is released (migrates) from a consumer article, which is in contact with the skin. In relation to day care centres' use of used products, it is assumed that dermal exposure to substances is typically a result of migration of substances from used articles.

Dermal exposure can be estimated as amount of substance per surface [mg/cm²], which is especially important if a substance is an irritant or an allergen, as the amount per skin surface is essential for inducing these effects:

$$Lder\ \left[\frac{mg}{cm2}\right] = \frac{Q\ prod\ [g] * Fc\ prod\left[\frac{mg}{g}\right]}{Ader[cm2]} \qquad (3)$$

L_{der} is the skin exposure expressed as mg substance/cm² skin.

In this project, the chemical substance will often be more or less bound in the used product, and skin exposure will depend on the extent and rate of the substance's release (migration) from the used product. Having knowledge regarding the migration rate and the size of the contact area, and the contact duration, the surface exposure can be calculated:

$$Lder\ \left[\frac{mg}{cm2}\right] = \frac{Q\ prod\ [g] * Fc\ prod\left[\frac{mg}{g}\right] * Fcmigr\left[\frac{g}{g*h}\right] * Fcontact * Tcontact\ [h]}{Ader[cm2]} \qquad (4)$$

For substances that may be absorbed through the skin and causing effects on internal organs, it is the total amount of the substance available for the absorption that is interesting, and the exposure (or dose) is therefore set according to body weight, Dder [mg/kg bw/d]:

$$Dder\ \left[\frac{mg}{kg\ d}\right] = \frac{Lder\left[\frac{mg}{cm2}\right] * Ader[cm2] * n\ \ [/d\ ]}{BW\ [kg} \qquad (5)$$

TABLE 58 PARAMETERS FOR ESTIMATION OF DERMAL EXPOSURE TO A SUBSTANCE IN A PRODUCT (ECHA, 2012).

Parameters	Description	Units
Qprod	Used amount of product	[g]
Fcprod	Proportion of a substance in the product	[mg/g prod]
Fcmigr	Migration of a substance per hour	[(g/g prod)/h)]
Fcontact	The percentage of the product surface area in contact with the skin (default value = 1)	[-]
Tcontact	Contact time	[h]
Ader	Dermally exposed area	[cm²]
BW	Body weight	[kg]
n	Application rate per day	[- /d]
Lder	Expected amount of substance migrated from the product to the skin	[mg/cm²]
Dder	Dermal dose per day per kg body weight	[mg/kg /d]

Thus, the models require information about a number of parameters that are either estimated on the basis of the individual case or retrieved from tables: the amount of material and concentration of the substance therein, the area of the product in contact with skin [cm²], contact time [h], exposed skin area [cm²], body weight of the consumer [kg] and frequency of use per day [/d]. A particularly important parameter associated with exposure from articles is as mentioned the migration parameter [(mg substance/g_{prod})/t)].

6.2.2 Estimation of oral exposure

Oral exposure is expressed as mg/kg body weight, and ECHA distinguishes between two different scenarios for the calculation: Either the exposure can occur by ingestion of the product or small parts thereof or as result of sucking the product, where a gradual migration of a substance from a product may take place. The last scenario would typically be from products by the consumer in a different way than the one intended, for example by putting the top of a pen in the mouth, or when a child plays with a pendant to a necklace by putting it in the mouth and sucking on it.

When processing and using used products for creative purposes, the oral exposure may arise as result of:

- migration to saliva, if parts of the used products come in the mouth (sucking)
- swallowing of small parts from the used products
- transfer from skin (usually fingers) to mouth by sucking on fingers or fabric
- migration of substances to food in contact with the used products
- inhalation of particles that are deposited in the upper respiratory system and then swallowed with the saliva

In the latter case, the exposure can be calculated as described under inhalation.

In general, the following formula is used for the oral exposure where part of a product is swallowed:

$$Doral\ \left[\frac{mg}{kg\ d}\right] = \frac{Q\ prod\ [g] * Fc\ prod\ \left[\frac{mg}{g}\right] * n\ [/d\ ]}{BW\ [kg\ ]} \qquad (6)$$

TABLE 59 explains the individual parameters and indicates the units.

ECHA indicates that the model for exposure as a result of swallowing can be used for initial screening of oral exposure, assuming that 100% of the chemical substance in the swallowed or mouthed product is released and available for absorption in the organism.

If the migration rate from the substance mouthed or swallowed is known, the amount of substance available for absorption can be calculated. The ECHA guidelines do not indicate a specific algorithm that takes into account the rate of migration, but in EU's previous guidance for risk assessment, the following formula for calculation was given (European Commission, 2003a):

$$Doral\ \left[\frac{mg}{kg\ d}\right] = \frac{A\ oral\ [cm2] * Fcmigr\ \left[\frac{mg}{cm2 * h}\right] * Tcontakt\ [h] * n\ [/d\ ]}{BW\ [kg\ ]} \qquad (7)$$

The parameters are described in Table 59.

TABLE 59 PARAMETERS FOR ESTIMATION OF ORAL EXPOSURE TO A SUBSTANCE IN A PRODUCT (EUROPEAN COMMISSION, 2003a).

Parameters	Description	Units
Qprod	Used amount of product	[g]
Aoral	Surface area of the object	[cm²]
Fcprod	Proportion of substance in the product	[mg/g prod]
Fcmigr	Fraction of substance that migrates per time unit	[mg/cm²/h]
Tcontact	Contact time	[t]

Parameters	Description	Units
BW	Body weight	[kg]
N	Application rate per day	[/d]
Doral	Amount of ingested substance available for absorption	[mg/kg bw/d]

6.2.3 Values for human parameters used for exposure calculations

The tables above list a number of relevant parameters for the use of the calculations. The situation-specific parameters depend on the particular processing of the substance, the particular use and the concentration of the substance in a given product. There are a number of additional parameters: Body weight, skin area and volume of inhaled air per time unit that are related to the exposed person. Values for these non-chemical parameters can e.g. be found in the Nordic Council of Ministers' publication "Existing Default Values and Recommendations for Exposure Assessment - A Nordic Exposure Group Project 2011" (NCM, 2012). The publication compiles gender and age-specific values, which are used for exposure assessment by leading organisations (ECHA, US-EPA and WHO). The Nordic report compares the values and provides an expert assessment regarding choice of the values to be used when estimating exposure.

The tables below include values for children from the age of 1 year up to young adults 21 years as the age group from 16 to 21 years typically may work as assistants in day care centres.

6.2.3.1 Body weight

Nordic Council of Ministers' publication recommends the use of US data (US-EPA) for estimating body weights of children, as these are based on the most recent data. The Council of Ministers commented that Americans typically weigh more than Europeans, but the trend towards increasing weight among Europeans makes the data suitable for Europeans as well. Table 60 shows the figures for children from 1 year of age and older.

TABLE 60 TABLE VALUES FOR ESTIMATION OF CHILDREN'S WEIGHTS BASED ON US-EPA'S FIGURES.

Age group	Average [kg]	5. percentile	95. percentile
1-<2 years	11.4	8.9	14.0
2-<3 years	13.8	10.9	17.1
3-<6 years	18.6	13.5	26.2
6-<11 years	31.8	19.7	52.5
11-<16 years	56.8	34.0	88.8
16-<21 years	71.6	48.2	108.0

Table values of physiological parameters are often presented as average values, while in other cases percentile values (eg 5 and 95 percentiles) are also given. As a general rule (but not always), the average values in the exposure calculations are used, eg for body weight and skin area, because calculations could otherwise become unrealistic. For example, it would be unrealistic even in a worst-case approach to use a low 5-percentile body weight in combination with a worst case high 95-percentile skin surface in relation to skin contact, because it is not realistic for a small and lightweight person to have a skin area larger than average.

The publication of Nordic Council of Ministers recommends to use the European values for adult body weight, see Table 61.

TABLE 61 TABLE VALUES FOR ESTIMATION OF ADULT WEIGHT.

Gender	Body weight [kg]
Male	70
Female	60
Male and female, total	70

6.2.3.2 Skin area

Nordic Council of Ministers' publication recommends using US EPA's figures for skin area, as these figures are based on more recent studies than the European figures. The Council of Ministers further comments that while Americans generally weigh more than Europeans do, and thus have a larger skin area, there is an increased trend towards higher weight in Europe. Therefore, the US estimates for body surface areas are considered representative for European consumers as well.

Table 62 indicates the US EPA's estimates of the surface area of the body parts as listed in the Council of Ministers' publication (NCM, 2012).

TABLE 62 US-EPA's AVERAGE VALUES FOR THE SURFACE AREA OF BODY PARTS FOR SELECTED AGE GROUPS.

Age [years]	Head [m²]	Torso [m²]	Arms [m²]	Hands [m²]
1-<2	0.087	0.188	0.069	0.030
2-<3	0.051	0.250	0.088	0.028
3-<6	0.061	0.313	0.106	0.037
6-<11	0.066	0.428	0.151	0.051
11-<16	0.073	0.630	0.227	0.072
16-<21	0.075	0.759	0.269	0.083
Adult males				
≥ 21	0.136	0.827	0.314	0.107
Adult females				
≥ 21	0.114	0.654	0.237	0.089

6.2.3.3 Volume of inhaled air

For estimation of the volume of inhaled air, the Nordic Council of Ministers again recommends to use US-EPA values for children and adults. The US-EPA indicates both values per day [m³/d] and for shorter time [m³/min] at varying physical activity. In terms of creative work this is assumed to equal light physical activity, see Table 63.

TABLE 63. AVERAGE VALUES (US-EPA-VALUES) FOR INHALED AIR PER DAY AND PER MINUTE DURING LIGHT PHYSICAL ACTIVITY (NCM, 2012).

Age [years]	Volume of inhaled air Average [m^3/day]	Volume of inhaled air Light activity, average [m^3/minute]
1-<2	8.0	0.021
2-<3	8.9	0.021
3-<6	10.1	0.011
6-<11	12.0	0.011
11-<16	15.2	0.013
16-<21	16.3	0.012
Adults		
21-<31	15.7	0.011
31-<41	16.0	0.011
41-<51	16.0	0.012
51-<61	15.7	0.012

7. Specific exposure scenarios

Based on the screening analyses, it was decided to carry out risk assessments for the following used products and ingredients:

- DEHP in cords.
- TDI in foam materials.
- Triaryl phosphates in printed circuit boards.
- PAH's in bike tires and bike tubes.

These choices were made partly due to high contents in the screening analyses (especially for DEHP and the triaryl phosphates), and partly due to the toxicological profiles of the chemical substances: PAHs - carcinogenic; DEHP - endocrine disrupters, developmental effects; TDI - respiratory sensitizer, carcinogenic; triaryl phosphates - causing organ damage.

It was decided that the risk assessment of DEHP from cords should be based on the results of the migration test in artificial sweat.

For TDI in foam materials the exposure scenario should be based on the quantitative analyses of TDI in the foam materials, as it due to TDI's reactivity would be very difficult and also costly to measure the amount of migrated TDI in artificial sweat liquid.

For aryl phosphates in printed circuit boards the exposure scenario should be based on the measured content of the print circuit boards.

For PAHs in bike tires and bike tubes, it was not deemed necessary to describe a more detailed exposure scenario, since the measured PAH content may be directly compared to the general requirement for PAH content in toys (maximum limits of 0.5 mg/ kg for individual PAHs (EC no. 10/2011).

With respect to the measured levels of cadmium these are considered so low that they do not represent a risk, even if the measured content is slightly above the limit value (75 mg/kg) for the allowed cadmium content in connection with surface treatment, as a pigment and as a stabiliser. This limit value is set considering the environment, and therefore cannot as for PAH be used as an indication of human. Therefore, we the content of cadmium in the products is not assessed furhter.

The following describes the exposure scenarios in relation to DEHP in cords, TDI in foam materials and triaryl phosphates in the circuit boards in connection with day care centres' recuse of these materials for creative purposes.

7.1 Reuse of cords containing DEHP

Cords can be reused for making jewelry. Children (6-11 year-old) can produce bracelets and necklaces from colourful cords that are cut to size and supplied with pendants of various kinds. Children using the jewelery will typically have skin contact, but it is also conceivable that they put the jewelry in the mouth. Cords may contain phthalates such as DEHP, which is added to soften PVC, but some phthalates are suspected of having endocrine disrupting effects. Some phthalates are banned in toys and childcare articles.

The exposure calculation is based on a worst-case scenario, which may be refined to a more realistic scenario, if a risk is identified for the worst-case sceanrio.

In the making of jewelry from cords, children are believed to be exposed via the skin on the hands, and during subsequent use, they will be exposed both via the skin and orally. It is therefore considered relevant to estimate the dermal exposure during manufacture and use of the jewelry, and oral exposure from the jewelry during use (when the children suck on jewelry).
During handling of the product, it is assumed that 1 meter cord is used for the making of the jewelry, that the children work a maximum of 3 hours with the cord, that both hands are used, and that only the palms are in contact with the cord, ie the contact area corresponds to about half of the skin area of the hands. In addition, it is assumed that children's hands and fingers come into contact with the mouth. The extent of sucking the fingers and hands of children of 6.5 years is estimated to comprise sucking of 45 cm²/hour (RIVM, 2007).

It is assumed that the jewelry is worn about 8 hours a day, and that the jewelery is in contact with the skin during this time. As children can suck on jewelry and pendants, this route is also included. Values for the time children typically suck on a piece of jewelry and the area of the jewelry surfaces are taken from ECHA's Risk Assessment Committee (RAC) that in 2011 assessed the exposure to lead from jewelry (RAC, 2011). In the report, RAC discussed oral exposure due to sucking on the jewelry ("mouthing"). Based on the report, it is assumed that children suck on 10 cm² of the jewelry surface and typically for an hour during use of the jewelry (RAC, 2011).

7.1.1 Algorithm for estimating dermal exposure

Section 6 states the algorithm (formula no. 4) for calculating the dermal exposure (amount of substance on a skin area) as:

$$Lder\ \left[\frac{mg}{cm2}\right] = \frac{Q\ prod\ [g] * Fc\ prod\left[\frac{mg}{g}\right] * Fcmigr\left[\frac{g}{g*h}\right] * Fcontact * Tcontact\ [h]}{Ader[cm2]} \quad (8)$$

Where

Qprod = amount of product [g],
Fcprod = concentration of the substance in the product,
Fcmigr = migration rate of the substance in the product [(mg/g product)/hour],
Fcontact = percentage of the product area in contact with the skin (default value = 1),
Tcontact = contact duration
Ader = exposed skin area

The Dermal load (L_{der}) expresses the amount of substance per cm2 for a certain time. For DEHP, the migration rate has been measured in the unit "mg/cm² per hour", and thus, the formula can be reduced to:

$$Lder\ \left[\frac{mg}{cm2\ skin}\right] = DEHP\ migration\ measured\ \left[\frac{\frac{mg}{cm2\ product}}{hour}\right] * 1 * contact\ time\ [hour] \quad (9)$$

The dermal exposure (expressed as mg substance per kg body weight) can be calculated from the dermal exposure (mg/cm²), and the exposed skin area and body weight:

$$Dder\left[\frac{mg}{kg\ bw}\right] = \frac{Lder\left[\frac{mg}{cm2\ skin}\right] * A\ der\ [cm2]}{body\ weight[kg]} \quad (10)$$

7.1.2 Algorithm for estimating oral exposure

Exposure to the substance by sucking the hands and fingers can be calculated from the RIVM (2007) estimates of the sucking frequency and sucking area of the hands and fingers in the various age groups [cm²/hour], time/duration of the activity, concentration of the substance per skin area [mg/cm²] and body weight [kg]:

$$Doral[\frac{mg}{kg\ bw}] = \frac{sucking\ area\ of\ skin\ [\frac{cm2}{hour}] * hours * amount\ of\ substance\ on\ skin\ [\frac{mg}{cm2}]}{body\ weight\ [kg]} \qquad (11)$$

7.1.3 Content and migration of suspect substances (DEHP)

In sample no. 16 (cord no. 3), a DEHP content of 37% was found. The migration analysis of the cord to artificial sweat showed a migration of DEHP of 50 ng/cm2/3 hours.

The low migration measured, despite the high DEHP content in the cord, is likely to be due to DEHP's very poor water solubility. On the other hand, DEHP is - due to its high fat solubility - known to migrate to fatty matrices, as example DEHP can migrate from food packaging material to fatty foods.

7.1.4 Estimate of exposure to DEHP during jewelry making

The scenario includes the following parameters:
Age group of the children: 6-11 years.

- Body weight [kg]: 31.8 kg as the average weight of the age group (NCM, 2012).
- Area [cm²] of cord from which migration may occurs.
  Surface area of one meter of cord with a diamiter of 3 mm:
  2 *π*radius*length = 2*π*0.15 cm*100 cm = 94 cm².
- Exposed skin area: the area of the hand palms of children in the age group 6-11 years is 255 cm², as the total area of the hand is 510 cm² (0.5*510 cm² = 255 cm²) (NCM, 2012).
- Migration rate of DEHP ng/cm²/hour: 50 ng/cm²/3 hours.
- Contact time: working time of 3 hours (worst-case scenario).
- Sucking of fingers and hands, children 6.5 years: 45 cm²/hour (RIVM, 2007).

It is assumed that the migration is constant from the total cord area to the skind during the three hours in which dermal contact is assumed.

Please note that the cord surface area is smaller than the area of the hand palms, and the migration from the cord area (94 cm²) is assumed distributed evenly on the area of the palms of the hands (255 cm²).

7.1.4.1 Dermal exposure, manufacturing

From the above formulas 9 and 10, the dermal exposure can be calculated as:

$$Dder[\frac{ng}{kg\ bw}] = \frac{migration\left[\frac{ng}{cm2\ x\ h}\right] * product\ surface\ area\ [cm2] * T}{body\ weight[kg]} \qquad (12)$$

$$Dder[\frac{ng}{kg\ bw}] = \frac{50\left[\frac{ng}{cm2\ x\ 3\ hours}\right] * 94[cm2] * 3\ hours}{31{,}8[kg]}$$

$$Dder\left[\frac{ng}{kg\ bw}\right] = 148\frac{ng}{kg\ bw}$$

7.1.4.2 Oral exposure, manufacturing

An estimate of oral exposure to DEHP in the manufacture of the jewelry can be calculated using the following formula, which takes into account - the amount of migration per kg body weight – the distribution of the migrated amount on the skin area of the palms, - and the fraction of the exposed skin area being sucked:

$$Doral[\frac{ng}{kg\ bw}] = \frac{migr\left[\frac{ng}{cm2\ x\ h}\right]*T*prod\ surface\ area\ [cm2]}{body\ weight\ [kg]} * \frac{prod\ surface\ area\ [cm2]}{Ader[cm2]} * \frac{skin\ area\ sucked\ [cm2]}{Ader[cm2]}$$

$$Doral[\frac{ng}{kg\ bw}] = \frac{50\left[\frac{ng}{cm2x\ 3h}\right]*3h*94\ [cm2]}{31.8\ [kg]} * \frac{94\ [cm2]}{255\ [cm2]} * \frac{135\ [cm2]}{255\ [cm2]} \qquad (13)$$

$$Doral\left[\frac{ng}{kg\ bw}\right] = 29\ ng\ \frac{DEHP}{kg\ bw}$$

Where the sucked skin area during 3 hours is calculated to 135 cm², as RIVM (2007) estimates that 45 cm² is sucked per hour.

7.1.5 Exposure scenario for use of a necklace made of cord

This scenario should estimate the exposure to DEHP when using a necklace made of the cord. The necklace contains cord as necklace with a length of 50 cm and a flat circular pendant rolled on the cord with a surface area of 5 cm². It is relevant to assess the dermal exposure to DEHP in connection with contact to the skin and the oral exposure when the child is sucking the pendant. The figures for the use of an estimate of the oral exposure are from RAC (2011) as described in Section 9.1.

It is assumed that 50 cm of the cord and the pendant are in contact with skin during use, and that half of the total surface area of the jewelry corresponds to the area with skin contact.

- Age group: 6-11 years.
- Area of necklace with skin contact: 50 cm cord, diameter 3 mm: 2*π*0.15 cm* 50 cm = 47 cm². 50% of this area (cord area in contact with the body) is assumed to have contact with the skin, corresponding to 23.5 cm².

Furthermore, a pendant (eg flattened cord spiral) to the necklace with an area of 5 cm² is assumed.

- Skin area in contact with the jewelry: 23.5 cm² + 5 cm² pendant = 28.5 cm².
- Exposure time for skin contact: 8 hours.
- Area of the jewelry put into the mouth: 10 cm² (total area of front and back of the pendant) (RAC, 2011).
- Exposure time for oral exposure: 1 hour (RAC, 2011).
- Migration rate: 50 ng DEHP/cm²/3 hours.

7.1.5.1 Dermal exposure when using the jewelry

$$Dder\left[\frac{ng}{kg\ bw}\right] = \frac{migration\left[\frac{ng}{cm2\ h}\right]*A[cm2]*T}{body\ weight\ [kg]} \qquad (14)$$

$$Dder[\frac{ng}{kg\ lgv}] = \frac{50\left[\frac{ng}{cm2\ x\ 3\ hours}\right]*28{,}5\ [cm2]*8\ hours}{31{,}8\ \ [kg\ bw]}$$

$$Dder\left[\frac{ng}{kg\ bw}\right] = 119\ \frac{ng}{kg\ bw}$$

7.1.5.2 Oral exposure when using the jewelry

$$Doral[\frac{ng}{kg\ bw}] = \frac{migration\left[\frac{ng}{cm2\ x\ h}\right] * T * product\ area\ [cm2]}{body\ weight\ [kg]} \qquad (15)$$

$$Doral[\frac{ng}{kg\ bw}] = \frac{50\ \left[\frac{ng}{cm2\ x\ 3\ hours}\right] * 1\ hour\ * 10\ [cm2]}{31.8\ [kg]}$$

$$Doral\left[\frac{ng}{kg\ bw}\right] = 5.2\ \frac{ng}{kg\ bw}$$

7.2 Reuse of foam material containing TDI

2,4-TDI is a reactive substance that is used in the manufacture of polyurethane foams and other elastomers. In foam materials, such as mattress filling, the substance is incorporated as a part of polyurethane polymer. From here it may be released to the environment in case of presence of unreacted monomers of TDI or if the polymer degrades over time.

Foam material from mattresses may e.g. be reused for upholstery in costumes. One scenario could be preparing a superhero costume, where the foam material is cut and used as a filler in a sweat shirt, and the child subsequently plays wearing the this shirt/costume. It is assumed that the worst-case sceanario is by wearing the costume, as large skin suface area (torso, arms and hands) will have close contact to the skin during longer time, compared to the manufacturing process where only the hands will be exposued for a shorter duration.

In a study in which the release by evapotation of TDI from a polyurethane mattress during an 8-hour period, evaporation of TDI could not be detected (Arnold et al., 2012).

Based on the analysis results of Arnold et al. (2012), it is assumed that exposure via inhalation of evaporated monomers does not pose a risk in the reuse of the foam material for costumes.

Inhalation of evaporated TDI is considerede negligible as in a study by Arnold et al. (2012) no such evaporation could be measured from a polyurehtane foam matress. Also, inhalation of airborne polyurethane dust with a potential content of residul TDI monomer is considered to pose a very low and negligible exposure.

7.2.1 Algorithm for estimating dermal exposure from quantitative analysis of content

The quantitative analytical data on the content of TDI in the foam material can be used for estimating the exposure by direct skin contact during wearing the costume using the formulas 3 and 5 given in Section 6.2.2:.

$$Lder\ [\frac{mg}{cm2}] = \frac{Qprod * Fcprod}{Ader[cm2]} \qquad (16)$$

The dermal exposure expressed as mg substance per kg body weight can then be calculated from the dermal load per cm² the exposure area and the body weight:

$$Dder[\frac{mg}{kg\ bw}] = \frac{Lder\left[\frac{mg}{cm2}\right] * Ader[cm2]}{body\ weight\ [kg]} \qquad (17)$$

By the use of these algorithms it is assumed that that 100% of the TDI content may migrate, which of course is a very conservative 1 tier exposure assumption.

7.2.2 Algorithm for estimating dermal exposure to TDI using migration rate data

The dermal load (Lder) expresses the amount of substance that migrates to a skin area unit for a certain period.

$$Lder\ \left[\frac{mg}{cm2}\right] = measured\ \left[\frac{\frac{mg}{cm2\ product}}{hour}\right] * T, contact\ time[hour] \qquad (18)$$

The dermal exposure (expressed as mg substance per kg body weight) can be calculated from the dermal exposure (mg/cm²), and the exposed skin area and the body weight:

$$Dder[\frac{mg}{kg\ bw}] = \frac{Lder\left[\frac{mg}{cm2\ Skin}\right] * Ader[cm2]}{body\ weight\ [kg]} \qquad (19)$$

The migration rate of 2,4-TDI from foam mattresses was measured by Vangronsveld et al. (2012) using migration cells, in which a slice of foam material was covered with a filter paper impregnated with 1- (2-methoxyphenyl)-piperazine for capturing migrated TDI. Although the foam material had a quantitative content of TDI (240-2800 ng/g foam measured in extractions using toluene), TDI could not be detected on the migration filter paper after 8 to 24 hours of contact time. The detection limit was 0.16 ng/cm². Based on this study, Arnold et al. (2012) assumed that half of the detection limit, ie 0.08 ng/cm², could be used as an upper estimate for the migration frm the foam.

7.2.3 Algorithm for estimating oral exposure

Exposure to the substance by sucking the hands and fingers can be calculated from the RIVM (2007) estimates of the sucking frequency and sucking area of the hands and fingers in the various age groups [cm²/hour], time/duration of the activity, concentration of the substance per skin area [mg/cm²] and body weight [kg]:

$$Doral\ \left[\frac{mg}{kg\ bw}\right] = \frac{sucking\ area\ \left[\frac{cm2}{hour}\right] * hours * amount\ of\ substance\ on\ skin\ [\frac{mg}{cm2}]}{body\ weight\ [kg]} \qquad (20)$$

The exposure is expressed in mg substance/kg body weight.

Furthermore, there may be oral exposure by release of particles/dust from the foam material. These particles can get in the mouth partly through the fingers or they may be inhaled and deposited in the throat/upper respiratory tract and swallowed.

7.2.4 Content and migration of 2,4 and 2,6 TDI

In the present study, found TDI was found in sample no. 18 (foam mattress no. 2) in a total concentration of 0.03 mg/kg (0.01 mg/kg of 2,4-TDI and 0.02 mg/kg of 2,6-TDI, respectively). An absolute worst-case exposure can be estimated from this, if 100% of this content is assumed to migrate.

7.2.5 Exposure scenario when playing with the foam costume

The foam material is assumed to be used as filling in costumes for children of kindergarten age, ie 3-6 year olds. It is assumed that the filling is primarily used in the top part of a costume, where the exposed area is the total of the naked torso area and the arms. It is a worst-case scenario, as some children are likely to have underwear or T-shirt under the costume. However, the children will be warm during play wearing a foam-filled costume and might therefore take off as much clothing as possible. Thus, it is assumed that the contact area is the entire torso and arms and hands, and that the children get sweaty while playing. Typically, such a situation will increase the

skin permeability of the chemical substances. Furthermore, it is assumed that children are wearing the costumes for 4 hours. The foam material surface area is assumed to be almost similar to that of the average surface area of the torso of children in the age group 3-6 years. It is also assumed that the children are exposed to TDI both via the skin and by sucking the fingers as it is assumed that they also have hand contact with the material while playing.

The scenario for the use of costumes filled with reused foam is based on the following parameters:

- Age of the child: 3-6 years.
- Body weight, BW: 18.6 kg, average for 3-6 years old (NCM, 2012).
- Sucking of fingers and hands, children 6.5 years 45 cm²/hour (RIVM, 2007).
- Area of foam material from which migration may occur (A_{prod}) = surface area of the torso, arms and hands: 0.63 m² (NCM, 2012).
- Exposed skin area: Area of the torso, arms and hands 0.63 m² (NCM, 2012).
- Total quantitative content of TDI in foam mattress: 0.03 mg/kg foam mattress.
- Estimated weight of foam filling in costumes: 0.5 kg.
- Migration rate ng TDI/cm² per 24 hours: 0.08 ng TDI/cm²/24 hours (estimated according to Arnold et al., 2012).
- T (hours per day): 4 hours.

7.2.5.1 Estimation of dermal exposure when using costumes, using measured quantitative content

It is assumed that 0.5 kg foam mattress is used for a costume with a contact area of 0.63 m².

Since 100% TDI is assumed to be available, the exposure per cm² skin can be calculated from formula 11:

$$L, der\left[\frac{mg}{cm2}\right] = \frac{0.5\ kg\ foam\ mattress * \left[\frac{0{,}03\ mg\ TDI}{kg\ foam\ mattress}\right]}{6300\text{cm2}}$$

$$L, der = 2.4\ \left[\frac{ng}{cm2}\right]$$

The dermal exposure per kg body weight is calculated to be:

$$Dder[\frac{mg}{kg\ bw}] = \frac{Lder[mg] * Ader}{body\ weight[kg]} \qquad (21)$$

$$Dder\ [\frac{ng}{kg\ bw}] = \frac{2.4\ \left[\frac{ng}{cm2\ skin}\right] * 6300\ cm2}{18.6[kg]}$$

$$Dder\left[\frac{ng}{kg\ bw}\right] = 813\ \frac{ng\ TDI}{kg\ bw}$$

7.2.5.2 Estimation of dermal exposure from costumes, using stated migration rate

$$Lder\left[\frac{mg}{cm2}\right] = migration\ \left[\frac{\frac{mg}{cm2\ produkt}}{hour}\right] * T, contact\ time \qquad (22)$$

$$L, der[\frac{ng}{cm2}] = \frac{\frac{0{,}08ng}{cm2\ product}}{24\ hours} * 4\ hours$$

$$L, der\left[\frac{ng}{cm2}\right] = 0.013\ \frac{ng}{cm2}$$

The dermal exposure per kg body weight is then calculated:

$$Dder\left[\frac{ng}{kg\ bw}\right] = \frac{Lder\left[\frac{ng}{cm2}\right] * Ader}{body\ weight\ [kg]} \quad (23)$$

$$Dder\left[\frac{ng}{kg\ bw}\right] = \frac{Lder\left[\frac{0.013\ ng}{cm2\ n}\right] * 6300cm2}{18.6[kg]}$$

$$Dder\ \left[\frac{ng}{kg\ bw}\right] = 4.5\ \frac{ng\ TDI}{kg\ bw}$$

It should be noted that the migration of 0.08 ng/cm² was estimated by the authors, as they could not actually measure any migration of TDI at a detection limit of 0.16 ng/cm², so therefore the calculated exposure of 4.5 ng TDI/kg bw is a theoretical value based on a migration corresponding to 50% of the detection limit for TDI. By measuring for migration, a foam material was used containing TDI in the range of 240-2800 ng TDI/g foam. Thus, the concentrations of TDI in the foam as described by Arnold et al. (2012) and Vangronsveld et al. (2012) are significantly higher than the content of TDI, as measured in our study (30 ng TDI/g foam).

7.2.5.3 Estimation of oral exposure for TDI during play with costumes

Estimate of oral exposure to TDI by sucking the fingers and hands, based on the results of the quantitative analyses of the TDI content in the foam mattress:

$$Doral = \frac{sucking\ area\ \left[\frac{cm2}{hour}\right] * T * amount\ of\ substance\ on\ skin\ \left[\frac{mg}{cm2}\right]}{body\ weight\ [kg]} \quad (24)$$

$$Doral = \frac{45\ \left[\frac{cm2}{hour}\right] * 4\ hours * 2.4\ \left[\frac{ng\ TDI}{cm2}\right]}{18{,}6\ [kg]} = 23\ ng\ TDI/kg\ bw$$

In addition to oral exposure via mifration to the skin surface, children may be exposed via oral exposure of dust/particles from the used product. Assuming that the children through their play ingest 100 mg dust (NCM, 2012) and particles from the foam mattress (via fingers or via inhalation and deposition in the throat and upper respiratory tract), this will lead to extra oral exposure of:

100 mg x 0.03 ng TDI/mg = 3 ng TDI or 0.16 ng TDI/kg bw

That is a relatively limited additional contribution relative to the calculated oral exposure via migration to the skin and sucking of fingers.

7.3 Reuse of printed circuit boards containing triaryl phosphates

In case of possible reuse of printed circuit boards from electronic waste, a worst-case exposure scenario is considered, in which a 6-7 year old child uses a circuit board to build a robot or a car and plays with the robot/electronic car.

The exposure will be based on quantitative chemcial analyses carried out with respect to the content of aryl phosphates (flame retardants) in the circuit board and will be considered in relation to dermal and oral exposure associated with playing with the toy.

7.3.1 Content and migration of triaryl phosphates

In sample no. 23, triaryl phosphates were found in a printed circuit board at a total level of 28,910 mg/kg, that was distibuted on the following substances:

Triphenyl phosphate	6,500 mg/kg
Methylphenyl diphenyl phosphates	12,200 mg/kg

bis-(Methylphenyl) phenyl phosphates	8,270 mg/kg
tri-(Methylphenyl) phosphates	1,940 mg/kg

7.3.2 Exposure scenario associated with processing/play with the printed circuit board

As a scenario, a 6-7 year old child is assumed to play 3 hours a day with the toys and have hand contact with 50 cm² of printed circuit board. It is also assumed that fingers/hands are in contact with the mouth and partly mouthed:

Age of the child: 6-7 years
BW: Body weight of the child 20.6 kg for 6-7 years old (NCM, 2012)
Ader: Hand area: 115 cm² (inside of a hand) (NCM, 2012; RIVM, 2007)
EA: Exposure area. The contact area of circuit board with the hand: 50 cm² (the circuit board is assumed to be approx. 7 x 7 cm)
$T_{contact}$: Play time per day, 3 hours (assumed)
S: Sucking of hand/fingers: 45 cm²/hour (value for children of 6.5 years) (RIVM, 2007)
Fc_{migr}: Migration rate (mg/cm²/h) = not measured

7.3.2.1 Calculation of dermal exposure

$$Dder\left[\frac{mg}{kg\ bw}\right] = \frac{Lder\left[\frac{mg}{cm2}\right] * Ader[cm2]}{body\ weight\ [kg]} \qquad (25)$$

As Lder $\left[\frac{ng}{m2}\right]$ can be set equal to $Fc_{migr}\left[\frac{\frac{mg}{cm2\ product}}{hour}\right]$ x $T_{contact}$ $[hours]$, the formula can be rewritten:

$$Dder\left[\frac{mg}{kg\ bw}\right] = \frac{\text{Fcmigr}\left[\frac{\frac{mg}{cm2\ product}}{hour}\right] * \text{Tcontact}\ [hours] * Ader[cm2]}{body\ weight\ [kg]} \qquad (26)$$

$$Dder\left[\frac{mg}{kg\ bw}\right] = \frac{\text{Fcmigr}\left[\frac{\frac{mg}{cm2\ product}}{hour}\right] * 3\ \text{hours} * 50[cm2]}{20.6\ [kg]}$$

$$Dder\left[\frac{mg}{kg\ bw}\right] = \frac{\text{Fcmigr}\left[\frac{\frac{mg}{cm2\ product}}{hour}\right] * 3\ [hours] * 50[cm2]}{20.6\ [kg]}$$

$$Dder\left[\frac{mg}{kg\ bw}\right] = \frac{\text{Fcmigr}\left[\frac{\frac{mg}{cm2\ product}}{hour}\right] * [hours] * [cm2]}{[kg]} * 7.3 \qquad (27)$$

For risk assessment of the scenario, the dermal exposure is set to the tolerable daily exposure to triaryl phosphates (calculated in the following section), after which the tolerable migration Fcmigr can be calculated, and thus be compared with the percentage of the content of aryl phosphates that may migrate from the circuit board without exceeding the tolerable daily exposure.

7.3.2.2 Calculation of oral exposure

Above the amount of triaryl phosphate deposited on the inside of the hand area (115 cm²) is calculated. When it is further assumed that only 45 cm² of the hand area is currently sucked, the oral exposure will be 45 cm²/115 cm² lower than the dermal exposure.

I.e.

$$Doral\left[\frac{mg}{kg\ bw}\right] = \text{D}der\left[\frac{mg}{kg\ bw}\right]\ x\ 45/115$$

7.4 Reuse of bike tubes and tires containing PAHs

For possible content of PAHs in bike tubes and tires, it was decided in the project not to describe exposure scenarios for these products. The evaluation should instead be based in the content of PAH and whether this content exceeds the current maximum limit for PAHs as stated in the European Commission's limits on use of plastic and rubber articles intended for children (European Commission, 2013).

7.4.1 PAH content in bicycle tires and tubes

The content of the PAH substances benzo[a]pyrene, benzo[e]pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoroanthene, benzo[k]fluoroanthene, benzo[j]fluoroanthene, and dibenzo[a,h]anthracene has been measured in 2 bike tubes and 2 bike tires (samples 10-13). For all these substances the contents were elow the analytical detection limit of 0.5 mg/kg for the individual PAH substances.

7.5 Reuse of LP records, cords and garden hoses containing lead

In relation to the content of lead in LP records, cords and garden hoses, it was decided not to describe further exposure scenarios for these products. The evalaution should instead be based on whether the analysed content of lead exceeds the limit for lead of 500 mg/kg, as specified in the future European regulation of lead in articles, which under normal or reasonably foreseeable conditions of use can be mouthed by children (Commission Regulation (EU) 2015/628 of 22 April 2015).

8. Health assessment, ingredients

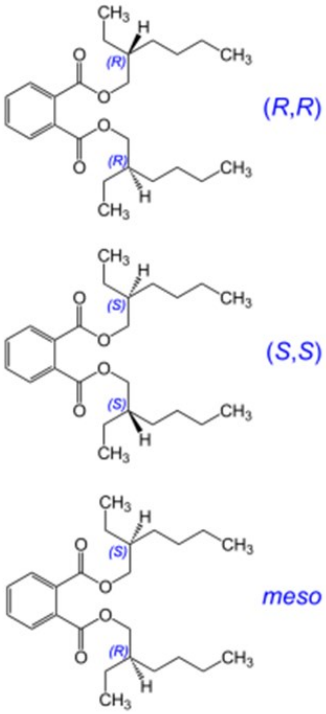
The following describes the adverse health effects of the selected ingredients DEHP, TDI and triaryl phosphates. For the most critical effects of the substances (i.e. the harmful effects that occur at the lowest exposure) a DNEL (derived no-effect level, corresponding to a tolerable daily exposure) is given/calculated for the relevant routes of exposure.

The calculations of DNEL values is based on the guidelines set out in the REACH R8 guidance published by the European Chemicals Agency (ECHA, 2012). The DNEL value is an expression of the external exposure considered not to cause any risk. In cases where a DNEL value is extrapolated from one route of exposure to another (e.g. from oral to dermal exposure), it may be necessary to adjust the DNEL value (specified number of mg/kg bw/d) considering differenct absroption rates for the exposure routes. Where there are no data on the extent of absorption, the dermal absorption, for cautious reasons, is set to equal the oral absorption when calculating a dermal DNEL value based on oral data.

8.1 DEHP

8.1.1 Identity

Name:	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester (DEHP)
CAS Number:	117-81-7
IUPAC Name:	Bis(2-ethylhexyl) phthalate
EC Number:	204-211-0
Molecular formla:	$C_{24}H_{38}O_4$
Molecular weight:	390,6 g/mol
Melting point:	−50 C (−58 F; 223 K) at 760 mm Hg
Boiling point:	385 C (725 F; 658 K) at 760 mm Hg
Log K_{ow} (octanol/water):	7.5
Molecular structure:	There are three isomers of DEHP:



8.1.2 Substance use

DEHP is an effective plasticiser used to soften PVC. Soft PVC occurs in many types of quite common products thant can be found in a typical household. For example, PVC for insulation on cords, shower curtains, vinyl flooring, carpets, toys, electronic equipment, suitcases, tablecloths and various swimming equipment (water wings, swim rings, air mattresses and the like). The polymer blend is added to DEHP during production, but the substance is not chemically bound to the plastic. Therefore, DEHP can be released relatively easily from the plastic material to the surroundings.

8.1.3 Classification and limit values

DEHP has an EU harmonised classification as toxic to reproduction: Repr. 1B; H360-FD (May damage fertility or the unborn child).

Furthermore, the European Food Safety Authority, EFSA, has set a tolerable daily intake of 0.05 mg/kg bw/d for DEHP.

The Risk Assessment Committee under the European Chemicals Agency has also concluded 0.05 mg/kg bw /d as an oral DNEL value for DEHP.

8.1.4 Adverse health effects

The section below on the adverse health effects of DEHP is based on data and assessments in ECHA's evaluation of phthalates (ECHA, 2012).

Phthalates are generally rapidly absorbed from the gastrointestinal tract. The substances can also after inhalation be absorbed in the lungs, whereas the dermal absorption is limited.

It is estimated that rats absorb 60-70% of DEHP following oral exposure. Human studies indicate that adult humans absorb DEHP to the same degree as rats when exposed orally to DEHP. There are no data of sufficient quality for the determination of children's absorption of DEHP and therefore it is assumed that the substance is orally absorbed 100%.
ECHA uses the same percentages for the respiratory absorption of DEHP: 70% for adults and 100% of children. The dermal absorption is estimated to 5% for both children and adults.

8.1.4.1 Acute toxicity, irritation, sensitisation

DEHP has low acute toxic potentail, and there is no evidence that the substance causes irritation or sensitisation of eyes or skin. Therefore, the focus in the following is on the reproductive toxicity of DEHP.

8.1.4.2 Subchronic, chronic toxicity

Studies of the effect of repeated doses of DEHP show, that besides the genitals, the liver and the kidneys are the organs most easily affected by DEHP. ECHA (2012) indicates NOAEL for liver and kidneys to 28.9 mg/kg bw/d, without specifying animal species or detailed specifications of the study.

8.1.4.3 Mutagenic and carcinogenic effects

DEHP is considered neither mutagenic nor carcinogenic.

8.1.4.4 Effects on fertility and fetal development

DEHP is classified as toxic to reproduction in Category 1B. The substance is understrong suspected of causing deformed genitals in boys already in the embryonic stage. Decreased sperm quality, low levels of male hormones, early puberty, including changes in breast development, are other critical effects of DEHP and other phthalates. The lowest effect level was found from a 3-generation reproduction study in which toxic effects in the testis of newborn rats were found at a dose level of 14 mg/kg/d. In this study a NOAEL level of 4.8 mg/kg bw/d was found.

Based on this NOAEL, ECHA (2012) estimates the oral DNEL value to be 0.05 mg/kg bw/day using a total uncertainty factor of 100.

As around 70% of the external concentration of DEHP is absorbed by oral exposure, ECHA (2012) estimated the $DNEL_{intern}$ for DEHP in the body to be 0.035 mg/kg bw/day.

8.1.5 Summary and tolerable exposure

DEHP is classified as toxic to reproduction (Repr. 1B), and the reproductive toxicity effects are considered the most critical toxic effects of DEHP. For these effects a NOAEL of 4.8 mg/kg bw /d was set, and from this an oral DNEL of 0.05 mg/kg bw/day has been calculated. Assuming about 70% absorption of DEHP by oral exposure, an internal tolerable dosis ($DNEL_{intern}$) of 0.035 mg/kg bw/d was calculated (ECHA, 2012).

Taking into account the dermal absorption fraction of 5%, the dermal DNEL can be calculated:

$DNEL_{dermal}$ = $DNEL_{intern}$ / dermal abs.
$DNEL_{dermal}$ = 0,035 mg/kg bw/d / 0,05 = 0,7 mg/kg bw/d

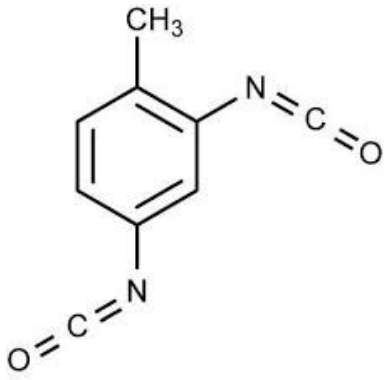
8.2 TDI

8.2.1 Identity

Toluene diisocyanate (TDI) includes three substances: 2,6-toluene diisocyanate (CAS-no. 91-08-7), 2,4-toluene diisocyanate (CAS-no. 584-84-9) and mixtures with 2,6-toluene diisocyanate and 2,4-toluene diisocyanate (CAS-no. 26471-62-5).

Molecular formula: $C_9H_6N_2O_2$

Molecular structure:



Molecular weight:	174.16 g/mol
Melting point:	20.5 °C at 760 mm Hg
Boiling point:	251 °C at 760 mm Hg
Log K_{ow} (octanol/water):	3.74

8.2.2 Substance function

The substance is an intermediate used in the manufacturing of polyurethane foams, elastomers and coatings. Technical toluene diisocyanate is a mixture of 2,4- and 2,6-isomers (80:20) (EPA, 2008).

8.2.3 Classification and limit values

TDI (all three CAS-numbers) has an identical EU harmonised classification for the following adverse health effects (ECHA, 2014):

Acute tox.2; H330 (Fatal if inhaled)
Skin Irrit.2; H315 (Causes skin irritation)
Skin Sens. 1; H317 (May cause an allergic skin reaction)
Eye Irrit. 2; H319 (Causes serious eye irritation)
Resp. Sens. 1; H334 (May cause allergy or asthma symptoms or breathing difficulties if inhaled) for conc. ≥ 0.1 %
STOT SE 3; H335 (May cause respiratory irritation)
Carc. 2; H351 (Suspected of causing cancer)

The occupational exposure limit in Denmark is 0.035 mg/m^3, corresponding to 0.005 ppm. The substance is marked 'K', which means that the substance is on the list of substances considered carcinogenic (Working Environment Authority, 2011).

8.2.4 Adverse health effects

As the classifications indicate, 2,6-toluene diisocyanate (CAS no. 91-08-7), 2,4-toluene diisocycanat (CAS no. 584-84-9) and mixtures of 2,6-toluene diisocyanate and 2,4-toluene diisocycanat (CAS no. 26471-62-5) have identical toxicological profiles.
There is general agreement that the substance is harmful and causes irritation and/or damage to both skin, eyes and respiratory system depending on the concentrations, which is reflected in the classification. The substance is suspected of being carcinogenic too. IARC indicates that TDI causes irritation and/or sensitisation of the respiratory system, even at low air concentrations. In humans exposed to TDI, chronic bronchitis, chronic pulmonary disease, and hypersensitivity have been observed (IARC, 1999).

8.2.4.1 Absorption (uptake) by oral, dermal exposure or inhalation

There are no data on the absorption of TDI in connection with oral or dermal exposure or during inhalation. However, it is assumed that there may be significant differences in the absorption for the various routes of exposure, as the substance is very reactive and therefore is short-lived. This will make the calculation of DNEL values for systemic effects very uncertain. TDI reacts with proteins in tissues and plasma. In the aqueous environment of the body, the substances hydrolyse to diamines, which in reaction with non-hydrolysed TDI may form uric acid polymers. In both animals and humans TDI is transformed primarily to toluene diamines and acetylated products hereof (IARC, 1999).

8.2.4.2 Acute toxicity, irritation, sensitisation

This section refers the toxicity of TDI as described in Arnold et al. (2012).

There is no generally accepted (validated) model that clarifies the process for respiratory sensitisation in humans. Apparently, there is a connection between dermal exposure and activation of the immune system, but whether there is a relationship between dermal exposure and sensitisation of the respiratory system is not sufficiently clarified. It is therefore uncertain whether dermal exposure to TDI can induce respiratory sensitisation in humans.

Arnold et al. (2012) estimated a human NOAEL for sensitisation of the respiratory system. As a starting point, the limit value in the working environment of 5 ppb (corresponding to 0.035 mg/m^3) was used, and then adjustments were made for differences in exposure duration between working environment and average daily exposure of consumers (5 days per week for a worker inhaling $10m^3$ air during 8 h exposure, and 7 days per week for a consumer inhaling $20m^3$ air per day). Then adjustment was made to consider especially sensitive individuals by dividing by a factor 2. This resulted in a tolerable exposure level of 0.9 ppb (6.4 $\mu g/m^3$) for respiratory sensitisation for the consumer.

Also a human NOAEL for the development of skin irritation in humans was determined by Arnold et al. (2011). In a human study 360 workers suffering from occupational related skin diseases were dermally exposed to 15 ml of a solution containing 1.5% or 2% of TDI (the concentration of 1.5% TDI corresponded to an exposure to 600 µg TDI/cm^2). The exposed area was 50 mm^2 which was covered by a patch (occlusion) that remained for 2 days. About 2% of the population showed signs of skin irritation at this exposure and thus, this was considered as a LOAEL (TDI 600 µg TDI/cm^2). An assessment factor of 3 was used and a NOAEL for skin irritation in humans of 200 µg TDI/cm^2 was estimated (Arnold et al.,2012).

A limit value for skin sensitisation is more difficult to define. Based on results from a Local Lymph Node Assay (LLNA) in mice, the EC3 value has been determined to 5000 ng TDI/cm^2 (Arnold et al., 2011). (EC3 is defined as the concentration of a substance that leads to a three times elevated proliferation of the lymphoid cells). It is considered that animals are more sensitive to dermal exposure to TDI than humans are, but the difference cannot be immediately explained. However, several authors have used this EC3 value to estimate the No Expected Sensitisation Induction Level (NESIL) for humans to 333 ng TDI/cm^2, using an uncertainty factor of 15 to compensate for the differences between mice and humans (Arnold et al., 2012).

Arnold et al. (2011) provides an overview of the critical toxicological effects and values from which the tolerable exposure is calculated:

TABLE 64 DNEL-VALUES FOR EXPOSURE TO TDI (Arnold et al., 2011)

Effect	Parameter, value	Uncertainty factor	Tolerable TDI exposure (DNEL)
Skin irritation	Human LOAEL 600 µg/cm²	3	200 µg/cm²
Skin sensitisation	Mouse EC3, NOEL 5 µg/cm²	15	0.33 µg/cm²
Respiratory sensitisation	Human NOAEL 12.8 µg/m³	2	6.4 µg/m³
Effect on lung function	Human NOAEL 2000 ng/m³	30	70 ng/m³

8.2.4.3 Mutagenic and carcinogenic effects

There is not sufficient evidence for the carcinogenicity of TDI in humans but there is sufficient evidence for the carcinogenicity of TDI in experimental animals. On this background, WHO's International Agency on Research on Cancer, IARC, has concluded that TDI is possibly carcinogenic to humans (IARC Group 2B). The carcinogenic effect was observed in animal studies using rats and mice in which dosing by gavage caused cancer in hypodermis, liver, breast and pancreas. The carcinogenic effects were found at the lowest dosage level tested of 30 mg/kg/day, which also showed increased mortality. In connection with inhalation tests local tissue damage of the respiratory system but no carcinogenic effects was found (IARC 1986).

8.2.5 Summary and tolerable exposure

As TDI is an extremely reactive substance reacting with proteins, tissues and plasma, absorption in connection with inhalation as well as oral and dermal exposure are considered very limited. The harmful effects of TDI are primarily associated with the direct contact with the substance on skin and mucous membranes.

Adverse effects of TDI have mainly been observed in the working environment where workers generally are exposed to the substance for several hours daily. Based on experience in the working environment, a limit value for the concentration of TDI in the air has been established at 5 ppb (corresponding to 0.035 mg/m³), which is considered an acceptable level of exposure below which no sensitisation or irritation of the respiratory system is observed. In the literature (Arnold et al. 2011), an estimated NOAEL of 0.2 mg TDI/cm² has been set while NOEL for skin sensitisation was estimated to 5 µg/cm².

It is based on the available data not possible to set a lower limit for the harmful effects in connection with oral exposure, as the lowest dose level tested of 30 mg/kg/day has led to serious effects such as increased mortality and carcinogenic effect. Thus, any potential for oral exposure must be assessed on a qualitative/semi-quantitative basis.

In connection with risk assessment, the lowest values from Table 64 are used as DNEL values in this project:

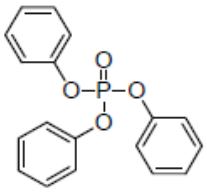
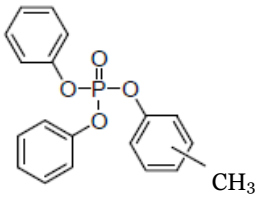
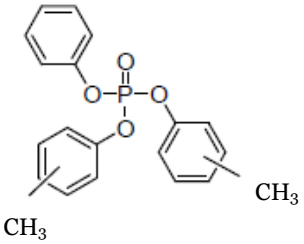
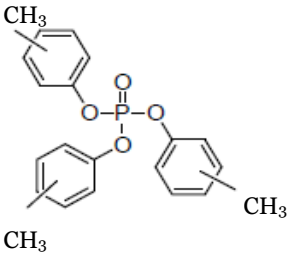
DNEL, inhalation:
DNEL (respiratory sensitisation, induction) = 6.4 µg TDI/m³
DNEL (effect on lung function) = 0.07 µg TDI/m³

DNEL, dermal exposure:
DNEL (skin irritation) = 200 µg TDI/cm²
DNEL (skin sensitisation) = 0.33 µg TDI/cm²

8.3 Aryl phosphates

8.3.1 Identity

TABLE 65 IDENTITY OF ARYL PHOSPHATES (US EPA, 2013).

Name	CAS-no.	Gross formula	Structure
Triphenyl phosphate	115-86-6	$C_{18}H_{15}O_4P$	
Diphenylcresyl phosphate Cresyldiphenyl phosphate or Methylphenyldiphenyl phosphate	26444-49-5	$C_{19}H_{17}O_4P$	
Bis(methylphenyl)phenyl phosphate	26446-73-1	$C_{20}H_{19}O_4P$	
Tri-(methylphenyl)-phosphate or Tricresyl phosphate	1330-78-5	$C_{21}H_{21}O_4P$	

As representative of the physico-chemical data, data for diphenylcresyl phosphate (CAS no. 26444-49-5) can be highlighted (OECD SIDS, 1998):

Melting point:	< -10 °C
Boiling point:	245 °C at 0.53 kPa
Vapour pressure:	< 1.2 x 10^{-4} Pa at 25 °C
Log Kow (octanol/water):	3.7
Water solubility:	2.4 mg/L

8.3.2 Substance use

Triaryl phosphates are used as flame retardants in e.g. PVC plastic, where the substances are mixed into the plastic material, i.e. the substances are embedded and not chemically bound in the material.

In sample 23, a printed circuit board (plastic type not specified) was found to contain triaryl phosphates in a total amount of 28,910 mg/kg, as follows:

Triphenyl phosphate	6,500 mg/kg
Methylphenyl diphenyl phosphates	12,200 mg/kg
bis-(Methylphenyl) phenyl phosphates	8,270 mg/kg
tri-(Methylphenyl) phosphates	1,940 mg/kg

8.3.3 Classification and limit values

None of the listed aryl phosphates are subjected to a harmonised EU classification, cf. Regulation 272/2008 (CLP). However, the following classifications for harmful effects are used in the EU, and notified to the European Chemicals Agency:

Triphenyl phosphate

Two out of 25 notifications use a classification for eye irritation (Eye Iritt. 2). In the registeratkion under REACH no classification for adverse health effects is stated.
UK has proposed further evaluation of the substance (REACH substance evaluation) due to suspected endocrine-disrupting effects.

Diphenylcresyl phosphate

Five out of 15 notifications use classification either for acute toxic effects as harmful if swallowed or in contact with skin (Acut tox 4), or to cause organ damage by single exposure (STOT SE2).
The substance is *not registered* under REACH.

Dicresylphenyl phosphate

One out of 7 notifications uses classification for acute toxic effects as harmful if swallowed or in contact with skin (Acut tox 4), fatal if inhaled (Acut tox 2), for mutagenic effect (Muta 1B) and for skin sensitising effect (Skin sens 1).
The substance is *not registered* under REACH.

Tricresyl phosphate

Of 35 notifications, 26 use classification either for: skin sensitisation (Skin sens 1), harmful if swallowed or in conctact with skin (Acut tox 4), eye irritation (Eye Iritt. 2), organ damage (nervous system), by repeated or single exposure (STOT RE1 or STOT RE2 or STOT SE 1), and damage to reproduction (Repr 2).
The substance is registered under REACH, where classification for adverse health effects is given as Repr 2 with possible effect on fertility after ingestion (impairment of concentration of sperm cells).

The Netherlands has proposed a more detailed evaluation of the substance (REACH substance evaluation) due to suspicion that it may be a PBT substance.

8.3.4 Adverse health effects

The following review is based on data from a comprehensive review regarding flame retardants (ARCADIS, 2011) and an OECD SIDS document on diphenylcresyl phosphate and data from the REACH registration of the substances (for triphenyl phosphate and tricresyl phosphate).

8.3.4.1 Absorption by oral, dermal exposure or inhalation

ARCADIS (2011) has found most data on tricresyl phosphate. It is inidcated that the substance is absorbed by skin contact and the absorption is higher in humans than in e.g. dogs and cats. The toxicity even at low oral doses of tricresyl phosphate and diphenylcresyl phosphate in animal studies suggests a relatively high oral absorption rate.

The most toxic isomer, tri-*ortho*-cresyl phosphate has been extensively studied, and it is stated that the substance is easily absorbed by ingestion and in contact with skin (REACH registration 2014a). After absorption, tricresyl phosphate is to a great extent distributed to body organs.

Although data is lacking for the other aryl phosphates, corresponding properties are assumed in terms of absorption and distribution in the body, as these properties will be significantly comparable for this group of substances because of their similar chemical structure and physico-chemical properties.

With regard to inhalation and oral and dermal exposure, there are no specific values for absorption rates. In the subsequent risk assessment of dermal and oral exposure, a conservative assumption is, that the substances are absorpted to the same extent by the dermal route as from the oral route of exposure.

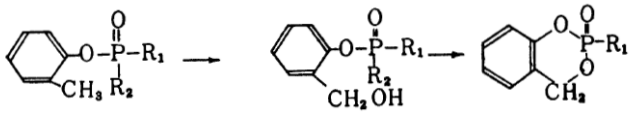
8.3.4.2 Metabolism and excretion

Data on tri-*ortho*-cresyl phosphate have shown that this aryl phosphate can hydrolyse into one or more cresyl groups and/or be oxidised in methyl groups to form mono and dihydroxy methyl groups, and subsequently form aldehyde and carboxylic acid groups.

The substance and its metabolites are excreted through urine and feces, and half-lives in the body for the substances are stated to be from 1 to 14 days.

Similar metabolism can be assumed for the other aryl phosphates, with the exception of triphenyl phosphate, which does not include methyl groups that can be oxidised. The REACH registration of triphenyl phosphate states that the substance in an *in vitro* system can be converted to diphenyl phosphate.

Especially for the *ortho*-cresyl isomers, it applies that these may be converted to the cyclic compound saligenin-phosphate, which is a very potent neurotoxic substance (ARCADIS, 2011):



In The REACH registration of tricresyl phosphate, it is stated that the commercial quality is purified for *ortho*-cresyl isomers to prevent formation of the neurotoxic metabolites, and therefore the registered substance has only a very low content of this isomer (0.07%).

8.3.4.3 Acute toxicity

The mentioned aryl phosphates have low acute toxicity by oral and dermal routes and LD50 values above 2000 mg/kg have been found in experimental animals.
The exception is the tri-*ortho*-cresyl phosphate isomer, for which an oral LD50 value of 100-200 mg/kg and a dermal LD50 value of 1500 mg/kg has been found.

8.3.4.4 Irritation

ARCADIS (2011) indicates that none of the aryl phosphates are skin irritants, while a slight degree of eye irritation is indicated from animal studies. This is consistent with the data in the REACH registrations.

8.3.4.5 Sensitisation

ARCADIS (2011) indicates that tricresyl phosphate based on human data is found to be a skin sensitiser, while for triphenyl phosphate a only few human cases have been seen that could not be supported in connection with animal studies. The REACH registration of tricresyl phosphate indicates that a LLNA test in mice showed positive results for the induction of allergy, but still considered the experiment as non-conclusive because of lack of clear dose-response relationship. The REACH registration for triphenyl phosphate refers to a negative result in a guinea pig maximasation test (GPMT).

8.3.4.6 Effects of prolonged / repeated exposure

Triphenyl phosphate
ARCADIS (2011) indicates an oral NOAEL of 70 mg/kg bw/d and an oral LOAEL of 370 mg/kg bw/day from a 35-day rat study, in which a liver weight was increase was observed at the highest dose level. For dermal exposure in connection with the daily dosing of rabbits for 15 days, inhibition of the activity of acetylcholine esterase at 1000 mg/kg bw/d was seen, while this was not the case at 100 mg/kg bw/day.

The REACH registration for triphenyl phosphate refers to a 28-day study with oral dosing of rats that received the substance through the feed in concentrations of 0, 250, 1000 or 4000 ppm (equivalent to 23, 104 or 508 mg/kg bw/d for male rats and 39, 161 or 701 mg/kg bw/d in female rats). Liver effects in both female and male rats were found. Male rats were the most sensitive with a LOAEL and a NOAEL of 104 and 23 mg/kg bw/day, respectively.
Based on this NOEL value, a DNEL value of 0.04 mg/kg bw/d for consumers was estimated, as the NOAEL was divided by a total assessment factor of 600.

Diphenylcresyl phosphate
With regard to oral exposure ARCADIS (2011) indicates a NOAEL of 12 mg/kg bw/d for diphenylcresyl phosphate, as damage on adrenals, kidneys, liver, testes, spleen and ovaries were observed at higher dose levels (studies were not specified). From the OECD SIDS (1998) document, this can be verified, by a reproduction study in which rats were orally dosed with 0, 12, 60 and 300 mg/kg/d from 14 days before mating to three days into the lactation period. LOAEL and NOAEL for the adult animals in terms of the above-mentioned effects were 60 and 12 mg/kg bw/day, respectively.

For dermal dosing ARCADIS (2011) indicates a NOAEL of 120 mg/kg bw/d for diphenylcresyl phosphate, as guinea pigs dosed daily during 73 days developed damage in the adrenal cortex and paralysis in the rear body at higher dermal doses(480 mg/kg/d and higher).

Tricresyl phosphate
ARCADIS (2011) indicates that *ortho*-tricresyl phosphate is a well-known neurotoxic substance. In an oral 90 days study using mice, a LOAEL of 100 and a NOEAL of 50 mg/kg bw/day was found for tricresyl phosphate (content of *ortho* isomer not specified) in relation to damage to the

ischiatic nerve. A two-year study in mice, however, found a LOAEL of 7 mg/kg bw/d for effects on the adrenal cortex.

The REACH registration describes this study in more detail. Mice were orally administered 0, 60, 125 or 250 ppm tricresyl phosphate (corresponding to 0, 7, 13 or 27 mg/kg bw/day for male mice and 0, 8, 18 or 37 mg/kg bw/d for female mice). At the highest dose level, paralysis of the hind parts of the female mice occurred. In all mice - even at the lowest concentration in the feed - pigmentation of the cells in the adrenal cortex was seen. Based on a LOAEL value of 7 mg/kg/d, the REACH registration set a DNEL of 0.05 mg/kg/d for consumers using a total assessment factor of 140. A DNEL for dermal exposure was calculated to be 1.25 mg/kg bw/d based on the oral DNEL and adjusted for the difference in oral absorption (set at 50%) and dermal absorption (set at 2%) of the substance (i.e. a total correction factor of 25).

8.3.4.7 Mutagenic and carcinogenic effects

ARCADIS (2011) indicates that triphenyl phosphate has not shown genotoxic effects in *in vitro* mutagenicity tests, but also that there are no studies of carcinogenic effects.
For diphenylcresyl phosphate, there were mainly lack of genotoxic effects in *in vitro* studies, but one study caused chromosomal damage in lung cells of hamsters.
For tricresyl phosphate, only negative *in vitro* mutagenicity tests are stated. Carcinogenicity studies indicate lack for carcinogenic properties of the substance.

The REACH registrations on triphenyl phosphate and tricresyl phosphate conclude accordingly that the substances are not mutagenic.

8.3.4.8 Effects on fertility and fetal development

For triphenyl phosphate, ARCADIS (2011) refers to an oral reproduction study in rats, where the animals were giving feed containing 1% triphenyl phosphate (corresponding to 690 mg/kg bw/d) for 91 days before mating and throughout gestation. There were no adverse effects associated with fertility and fetal development in the study. This is consistent with the conclusions of the REACH registration.

UK has proposed to make a REACH substance evaluation on the substance as it was indicated that the substance may be suspected of endocrine disrupting properties on the basis of an assessment with a screening tool (undefined) (UK, 2013).

ARCADIS (2011) states that diphenylcresyl phosphate caused reduced sperm production and decreased fertility at a dose level (300 mg/kg/d), which also led to other harmful effects in the animals (species not specified).

OECD SIDS (1998) reported an oral reproduction study in which rats were dosed with 0, 12, 60 and 300 mg/kg bw/d diphenylcresyl phosphate from 14 days before mating to three days into the lactation period. At 300 mg/kg bw/d effects on fertility and effects on the ovaries and testes were observed while this was not found at 60 mg/kg bw/day.

Regarding tricresyl phosphate, adverse effects were seen on testes and reduced sperm quality in mice dosed with feed containing 0.1% and 0.05% tricresyl phosphate.
No effects were found on the fetus in this and other animal experimental studies (ARCADIS, 2011).

The REACH registration on tricresyl phosphate further contains a one-generation reproduction study in rats, which caused reduced sperm count at exposure levels of 200 and 400 mg/kg bw/day. Fertility was seriously impaired at 400 mg/kg bw/d, while fetal development was not affected. Furthermore, the REACH registration reports a 90-day oral study in mice in which

influence on the ovaries was found in female mice down to and including the lowest dose level of 50 mg/kg bw/day.

8.3.5 Summary and tolerable exposure

The following conclusions are based on the studies above, in which the content of *ortho*-tricresyl phosphate may be considered negligible. It can be noticed that tricresyl phosphate is to be considered as the most toxic of the aryl phosphates.

Data indicate that dermal exposure to a mixture of the above aryl phosphates should be considered as having a skin sensitising potential. This has especially been shown for tricresyl phosphate.

Furthermore, exposure to tricresyl phosphate and diphenylcresyl phosphate may be able to affect fertility by affecting testes and ovaries (effects on ovaries observed down to and including a dose level of 50 mg/kg bw/d tricresyl phosphate).
Effects of the substances on other target organs seem, however, to be the most critical (occurs at the lowest exposure levels), based on the following findings:
NOAEL of 23 mg/kg/d for *triphenyl phosphate* for liver effects i en oral 28-days study in rats.
NOAEL of 12 mg/kg/d for *diphenylcresyl phosphate* for effects on adrenal glands, liver, kidneys and spleen after approx. 40 days of oral dosing to rats.
LOAEL of 7 mg/kg/d for *tricresyl phosphate* for effects on the adrenal glands in a chronic study in mice.

Using the ECHA (2012) guidance for calculating DNEL values, the above NOAEL and LOAEL values are used as a starting point for the calculation of DNEL values for the substances.

Triphenyl phosphate

$DNEL_{oral}$ = N(L)OAEL/ AF(I) x AF(II) x AF(III) x …

$DNEL_{oral}$ = 23 mg/kg/d / 10 x 10 x 6 = 0.04 mg/kg/d

As
AF(I)-interspecies assessment factor for extrapolation from rats to humans is set to 10
AF(II)-intraspecies assessment factor (variation in sensitivity among humans) is set to 10
AF(III)- assessment factor is set to 6 to compensate for the duration of the animal study (i.e. extrapolation from a 28 days study to chronic exposure).

Since there are no specific data to illustrate differences in the absorption of the substances in connection with the different routes of exposure, the same degree of absorption for dermal exposure as for oral exposure is assumed as a precautionary measure, i.e.:

$DNEL_{dermal}$ = 0.04 mg/kg/d

Diphenylcresyl phosphate

$DNEL_{oral}$ = N(L)OAEL/ AF(I) x AF(II) x AF(III) x …

$DNEL_{oral}$ = 12 mg/kg/d / 10 x 10 x 6 = 0.02 mg/kg/d

As
AF(I)-interspecies assessment factor for extrapolation from rats to humans is set to 10
AF(II)-intraspecies assessment factor (variation in sensitivity among humans) is set to 10

AF(III)- assessment factor is set to 6 to compensate for the duration of the animal study (i.e. extrapolation from a 40 days study to chronic exposure).

Since there are no specific data to illustrate differences in the absorption of the substances in connection with the different routes of exposure, the same degree of absorption for dermal exposure as for oral exposure is assumed as a precautionary measure, i.e.:

$DNEL_{dermal}$ = 0.02 mg/kg/d

Tricresyl phosphate

$DNEL_{oral}$ = N(L)OAEL/ AF(I) x AF(II) x AF(III) x ...

$DNEL_{oral}$ = 7 mg/kg/d / 17.5 x 10 x 3 = 0.013 mg/kg/d

As
AF(I)-interspecies assessment factor for extrapolation from mice to humans is set to 17.5
AF(II)-intraspecies assessment factor (variation in sensitivity among humans) is set to 10
AF(III)- assessment factor is set to 3 for extrapolation from a LOAEL level and not a NOAEL level. The factor is limited to a value of 3 as the effect (pigmentation in the adrenal cortex) was significantly reduced at 7 mg/kg bw/d compared to dosing at 13 and 27 mg/kg/d.

Since there are no specific data to illustrate differences in the absorption of the substances in connection with the different routes of exposure, the same degree of absorption for dermal exposure as for oral exposure is assumed as a precautionary measure, i.e.:

$DNEL_{dermal}$ = 0.013 mg/kg/d

Dicresylphenyl phosphate

There are no suitable data for this substance. However, it can be seen that the toxicity of the aryl phosphates is increasing with increasing number of cresyl groups included in the molecule. As a precautionary measure, the same DNEL values for dicresyl phosphate as for tricresyl phosphate are used: i.e. a $DNEL_{oral}$ and a $DNEL_{dermal}$ of 0.013 mg/kg/d.

8.4 PAH

PAH substances are very potent carcinogens, but a more detailed description of the harmful effects of the PAH substances will not be made, as the risk assessment in the next section is not based on derived tolerable exposure levels. Instead, the risk assessment will be based on whether the measured PAH content in reused materials (bike tubes and bike tires) meets the current maximum limits for PAHs for protection against the carcinogenic effects listed in the European Commission's limits on use of plastic and rubber articles intended for children (European Commission, 2013).

8.5 Reuse of LP records, cords and garden hoses containing lead

Lead is a neurotoxic substance that can affect children's learning capacity. There is no further description of the adverse health effects of lead, as the risk assessment will be based on whether the measured content of lead in reused materials (LPs, cords and garden hoses) comply with the limit for lead of 500 mg/kg. This lead content is the limit given in the future European regulation of lead in those types of articles that under normal or reasonably foreseeable conditions of use can be mouthed by children (Commission Regulation (EU) 2015/628 of 22 April 2015). In this

regulation, the lead limit value is determined based on understanding of the correlation between content and migration of lead in different materials. From this, a safe limit for the content is set, taking into account that the products must not pose a risk to children. The future regulation, however, also specifies that the content limit does not apply if it can be documented that the lead migrtation does not exceed 0.05 µg/cm² per hour. However, in the present study, the migration of lead is not investigated and the lead content is therefore compared with the limit value of 500 mg/kg for the lead content.

9. Risk assessment

This chapter compares exposure estimates for each scenario (Chapter 7) with the DNEL values specified in the health assessments (Section 8). The risk assessment is carried out by comparing the exposure to the DNEL value by calculating the so-called risk characterisation ratio, RCR:

RCR= exposure/ DNEL

If RCR> 1, it is generally interpreted as unacceptable, as the exposure is higher than the DNEL value; i.e. there is a calculated risk. However, it should be noticed that the RCR values should always be assessed in connection with the uncertainties and assumptions that have been made partly by the exposure assessment and partly by the health assessment. This is particularly relevant when the RCR values are close to 1. In such cases it will often be necessary to review the assessment in more detail and try to obtain more data and thus make more accurate assumptions. If the RCR values are very high or very low, the risk assessment is generally considered more robust, as the result is then more obvious (and not so much influenced by uncertainties) whether there is a risk or not.

9.1 DEHP in cords

9.1.1 Dermal exposure

The dermal exposure is assumed to occur during processing and use of the jewelry.
The exposure estimationis based on the measured value for the migration of DEHP (50 ng/cm² product/3 hours) from the cord (containing 37% DEHP) to a medium consisting of artificial sweat. As DEHP is not chemically bound in the cord the very low migration that has been measured is most probably due to the very low water solubility of the substance.
From ECHA (2012), the oral DNEL of 0.05 mg/kg bw/day is converted assuming an oral absorption of 70% to a dermal DNEL of 0.7 mg/kg bw/day based on the assumption that 5% of DEHP on the skin is absorbed in the body.

9.1.1.1 Cord processing

As the dermal exposure by processing of a piece of jewelry is calculated to 148 ng DEHP/kg bw/day, the risk characterisation ratio RCR can be calculated:

RCR = actual exposure/ DNEL
RCR = 0.148 µg DEHP/kg bw/day / 700 µg/kg bw/day = 0.00021

9.1.1.2 Use of jewelry made of cord

As the dermal exposure by processing a piece of jewelry is calculated to 119 ng DEHP/kg bw/day, the risk characterisation ratio RCR can be calculated:

RCR = actual exposure/ DNEL
RCR = 0.119 µg DEHP/kg bw/day / 700 µg/kg bw/day = 0.00017

9.1.2 Oral exposure

The oral exposure occurs both during processing of the cord, where it is assumed that children follow the normal "sucking pattern" for children in the age group, and during use of the jewelry, where children may suck on a jewelry pendant during play.

From ECHA (2012), the oral DNEL is calculated to 0.05 mg/kg bw/day.

9.1.2.1 Cord processing

Oral exposure = 29 ng DEHP/kg bw/3 hours
As the activity is ongoing for 3 hours per day, the dose can be expressed as 0.029 µg DEHP/kg bw/day.

RCR = actual exposure/ DNEL
RCR = 0.029 µg DEHP/kg bw/day / 50 µg/kg bw/day = 0.0006

9.1.2.2 Use of jewelry made of cord

Oral exposure = 5.2 ng DEHP/kg bw/hour
As the oral exposure is assumed to last 1 hour per day, the exposure is 0.0052 µg DEHP/kg bw/day.

RCR = actual exposure/ DNEL
RCR = 0.0052 µg DEHP/kg bw/day / 50 µg/kg bw/day = 0.0001

9.1.3 Assessment of the risk calculations

All calculations show an RCR ≤ 0.0006, i.e. all RCR values and any combined oral and dermal RCR values (i.e. simultaneous oral and dermal exposure) are well below 1, so it is assessed that there is no risk in connection with any DEHP exposure from this product.

As the cord with a content of 37% DEHP must be considered a worst-case estimate, the stated reuse of cords gives no immediate cause for concern for additional DEHP exposure.

As can be seen, the very low RCR values are obtained because of the low measured migration of DEHP from the cord. As the DEHP is soluble in fat, it is possible that the migration to fatty hands (eg remnants of cream/hand lotion) will be higher, but it is assessed unlikely that this will have so much influence that the RCR values will approach 1.

9.2 TDI in foam material

9.2.1 Dermal exposure

The dermal exposure in relation to costume wearing is estimated partly from the measured total content of TDI (0.03 mg TDI/kg in a foam mattress) and partly from the migration rate as stated in the literature (0.08 ng/m² foam/hour).

From the study by Arnold et al (2012), the following DNEL values are considered relevant for TDI:

DNEL, skin sensitisation: 0.33 µg/cm²

DNEL, skin irritation: 200 µg/cm²

9.2.1.1 Dermal exposure based on quantitative TDI content

Calculation of RCR from **quantitative** measuring of TDI content in the foam mattress (0.03 mg TDI/kg foam mattress):

Lder = 0.0024 µg TDI/cm² skin

$$\textbf{RCR}skin\ sensitisation = \frac{0.0024\ \mu g \frac{TDI}{cm2}}{0.33\ \mu g \frac{TDI}{cm2} Skin} = 0.007$$

$$\textbf{RCR}skin\ irritation\ = \frac{0.0024\ \mu g \frac{TDI}{cm2}}{200\ \mu g \frac{TDI}{cm2} Skin} = 0.00001$$

It appears that even if all TDI in the foam material should migrate (a very conservative assumption), the RCR value will be extremely low. Therefore, it is assessed that the scenario does not pose a risk for development of skin irritation or skin sensitisation.

9.2.1.2 Calculation of RCR based on the migration rate of TDI

Calculation of RCR based on the estimated migration of TDI from foam mattresses (0.08 ng TDI/m² foam/hour):

Lder =0.013 ng TDI/cm² skin,

$$\textbf{RCR}\boldsymbol{skin\ sensitisation} = \frac{0.013ng \frac{TDI}{cm2}}{330\ ng \frac{TDI}{cm2} Skin} = 0.00004$$

$$\textbf{RCR}\boldsymbol{skin\ irritation}\ = \frac{0.013ng \frac{TDI}{cm2}}{200000\ ng \frac{TDI}{cm2} Skin} = 6{,}5\ x\ 10^{-8}$$

As RCR for both skin sensitisation and skin irritation is far below 1, the use of the foam material in costumes does not pose a risk of sensitisation or irritation of the skin.

9.2.1.3 Oral exposure

An oral exposure of 23 ng TDI/kg bw was calculated from the amount of TDI that could migrate to children's hands if all the content in the foam material migrated during play with costumes. The oral exposure is a follow of children's hand to mouth contact.

The lowest oral dose tested in animals is 30 mg/kg bw/d, where increased incidence of cancer together with an increase of mortality. The animal experimental data do not allow any possibility to assess the dose-response relationship further, and therefore a more precise risk assessment regarding oral exposure cannot be made.

9.2.2 Assessment of the risk calculations

Overall, the above scenario is assessed not to pose a risk of inducing skin irritation or skin allergy.

It is not possible to make a more precise assessment of any oral exposure to TDI due to lack of data on dose-response for carcinogenic effects by oral exposure.

It should be noted that it is difficult to assess whether the content of TDI in the foam material, which in this project is measured to 30 ng TDI/g foam, is representative of foam materials in general. However, the content is significantly lower than the foam material examined for TDI migration and risk assessed by Arnold et al (2012) and Vangronveld et al (2012), where the content ranged from 240 to 2800 ng TDI/g foam.

The risk assessment by Arnold et al (2012) and results described herein are briefly described in the following. Based on the results presented, it is estimated that an accurate exposure assessment cannot be made from a measurement of the concentration of TDI in a sample of a foam mattress. The fact that the substance is found in the mattress does not mean that it is freely available for exposure, and that it will react with the skin and the respiratory system. This is supported by the fact that the migration tests could not detect any emission of TDI into the air or migration of TDI to the foam surface. However, it can also be concluded that a precise exposure assessment based

on migration data will only be needed if a worst-case risk assessment based on the content of TDI shows concern.

Based on data from the literature (see below) and on the present assessment, there is no reason to discourage the reuse of foam material, as the potential for TDI exposure seems to be minimal. The assessment is supported as the potential for exposure is only considered to occur once in a while and with at limited duration.

Risk assessment by Arnold et al. (2012)
This study estimated human exposure to TDI by 8 hours daily stay on a foam mattress made of polyurethane foam of a quality with relatively high levels of TDI monomers. The authors considered inhalation and skin contact as the major routes of exposure to TDI by the use of a foam mattress, and therefore make an exposure assessment for these exposure routes. The authors attempted to measure the *evaporation* of TDI from the foam mattress, as well as the *migration* of TDI to the surface but could not detect any TDI with the availbe analytical methods. To obtain an exposure estimate, they assumed that half the detection limit of TDI is emitted to the air, i.e. 25 ng TDI/m^2. From this emission from a foam mattress, a concentration in a room was calculated to 2.2 ng TDI/m^3 and the daily average exposure of a person in the room was calculated to 0.44 ng /m^3. Similarly, a surface concentration of 0.08 ng TDI/cm^2 was assumed on the matress suface (a value half the analytical detection limit) and thus this surface concentration was considered also to represent the dermal load when using the matress.

Based on these assumptions, a Margin of Safety (MOS) for each hazard end-point was calculated for TDI for 8 hours stay on the foam mattress.

For development of skin irritation, a MOS of 3,000,000 (tolerable exposure level estimated to 0.2 mg/cm^2) was found, and for development of skin sensitisation a MOS of 4,000 was calculated (tolerable exposure level 333 ng/cm^2), while a MOS for respiratory sensitisation was calculated to 15,000 (tolerable exposure level of 6400 ng/m^3).
Based on this, Arnold et al. (2011) concluded that 8 hours of sleep on a foam mattress does not constitute a risk for the development of either skin irritation, skin sensitisation or respiratory sensitisation.
Thus, based on the available literature, there is no immediate indication that the polyurethane foam mattresses constitute a risk for development of sensitisation or irritation of the respiratory system or the skin.

9.3 Aryl phosphates in printed circuit boards

In sample 23, triaryl phosphates were found in a printed circuit board in a total amount of 28,910 mg/kg, as follows:

triphenyl phosphate	6,500 mg/kg
methylphenyl diphenyl phosphates	12,200 mg/kg
bis-(methylphenyl) phenyl phosphates	8,270 mg/kg
tri-(methylphenyl) phosphates	1,940 mg/kg

9.3.1 Exposure scenario associated with processing / play with printed circuit boards

An RCR value cannot be calculated in this scenario, as there is no available migration data from which to calculate exposure. Instead, a so-called reverse risk assessment is made, calculating how much of the measured content in the printed circuit board is allowed to migrate for the RCR value to be equal to 1.

As a scenario, a 6-7 year old child is assumed playing 3 hours a day with the toy and have hand contact with 50 cm² of a printed circuit board. It is also assumed that fingers/hand come into contact with the mouth and are partly mouthed:

Age of the child: 6-7 years
BW: Body weight of the child: 20.6 kg (NCM, 2011)
Ader: Hand area: 115 cm² (inside of a hand) (NME, 2011; RIVM, 2007)
EA: Exposure Area. Contact area of the circuit board with the hand: 50 cm² (ie a printed circuit board of approximately 7 x 7 cm is assumed)
$Tc_{contact}$: Play time per day, 3 hours (assumed)
S: Sucking of hand/fingers: 45 cm²/hour (RIVM 2007-value for children of 6,5 years)
Fc_{migr}: Migration rate (mg/cm²/ h). Not measured

9.3.1.1 Calculation of dermal exposure

Triphenyl phosphate (DNEL = 0.04 mg/kg/d):
As a starting point, formula 27 in Section 7.3.2.1 is used:

$$Dder\ \left[\frac{mg}{kg\ bw}\right] = \frac{\text{Fcmigr}\ \left[\frac{\frac{mg}{cm2\ product}}{hour}\right] * [hours]*[cm2]}{[kg]} * 7.3 \qquad (27)$$

From this, Fmigr can be calculated:

$$\text{Fcmigr}\ \left[\frac{\frac{mg}{cm2\ product}}{hour}\right] = \frac{Dder\ \left[\frac{mg}{kg\ bw}\right] * [kg]}{[hours]*[cm2]*7.3]} \qquad (21)$$

$$\text{Fcmigr}\ \left[\frac{\frac{mg}{cm2\ produkt}}{hour}\right] = \frac{0{,}04\ \left[\frac{mg}{kg\ lgv}\right] * [kg]}{[hour]*[cm2]*7{,}3]}$$

$$\text{Fcmigr}\ \left[\frac{\frac{mg}{cm2\ product}}{hour}\right] = 0.0055\ \frac{\frac{mg}{cm2\ product}}{hour}\ \ or\ \ 5.5\ \frac{\frac{\mu g}{cm2\ product}}{hour}$$

Diphenylcresyl phosphate (DNEL= 0.02 mg/kg/d):
Similarly, for diphenylcresyl phosphate can be calculated:

$$\text{Fcmigr}\ \left[\frac{\frac{mg}{cm2\ product}}{hour}\right] = 0.0027\ \frac{\frac{mg}{cm2\ product}}{hour}\ \ or\ \ 2.7\ \frac{\frac{\mu g}{cm2\ product}}{hour}$$

Tricresyl phosphate + dicresylphenyl phosphate (DNEL= 0.013 mg/kg/d):
Similarly, for tricresyl phosphate + dicresylphenyl phosphate can be calculated:

$$\text{Fcmigr}\ \left[\frac{\frac{mg}{cm2\ product}}{hour}\right] = 0.0018\ \frac{\frac{mg}{cm2\ product}}{hour}\ \ or\ \ 1.8\ \frac{\frac{\mu g}{cm2\ product}}{hour}$$

9.3.1.2 Calculation of oral exposure

As mentioned in Section 7.3.2.2, the oral exposure is relatively lower as only 45 cm² of the 115 exposed cm² skin per hour is sucked, ie the exposure is a factor 45/115 lower. In order to obtain the corresponding oral exposure, the migration, therefore, must be proportionally higher by a factor of 115/45 = 2.6, in order for the oral DNEL value to be exceeded.

It thus requires lower migration to exceed the dermal DNEL value compared to the oral DNEL value, so based on the dermal migration value, the percentage of the content of the printed circuit board allowed to migrate can be calculated.

9.3.2 The permitted migration compared to the content in the printed circuit board

By analysis of the circuit boards, the following content was found:

Triphenyl phosphate	6.5 mg/g
Diphenylcresyl phosphates	12.2 mg/g
Dicresylphenyl phosphates	8.27 mg/g
Tricresyl phosphates	1.94 mg/g

As 1 cm^2 circuit board weighs 0.3 g, this concentration can be converted to amount per surface by multiplying by 0.3 g/cm^2:

Triphenyl phosphate	2.0 mg/cm^2
Diphenylcresyl phosphates	3.7 mg/cm^2
*Dicresylphenyl phosphates	2.5 mg/cm^2
*Tri-(methylphenyl) phosphates	0.6 mg/cm^2

* The content of dicresylphenyl phosphates + tricresyl phosphates = 3.1 mg/cm^2

By using the tolerable migration limit for each aryl phosphate, the percentage of the content of the printed circuit board, allowed to migrate from the circuit board per hour before the DNEL values are exceeded, can be calculated:

Triphenyl phosphate	5.5 $\mu g/cm^2/h$ x 100/ 2.000 $\mu g/cm^2$ = 0.28 %
Diphenylcresyl phosphates	2.7 $\mu g/cm^2/h$ x100/3.700 $\mu g/cm^2$ = 0.07 %
Dicresylphenyl phosphates + Tricresyl phosphates:	1.8 $\mu g/cm^2/h$ x 100/3.100 $\mu g/cm^2$ = 0.06 %

9.3.3 Assessment of the risk calculations

As can be seen, the migration of dicresylphenyl and tricresyl phosphates will be the most critical, because for these aryl phosphates only the lowest migration of 0.06% per hour is allowed.

It is difficult to assess whether a migration of this size would be possible. This would require further follow-up analyses in the form of migration analyses.
Finally, it is unknown whether the content of triaryl phosphate in the present circuit board is representative of printed circuit boards in general.

9.4 PAHs in bike tires and tubes

9.4.1 Risk assessment

The risk assessment of PAH content in bike tires and bike tubes is carried out based on the concentration limits specified in the EU Commission's limits on use of plastic and rubber articles intended for children. These articles are covered by an upper content limit for each of the PAH substances benzo[a]pyrene, benzo[e]pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoroanthene, benzo[k]fluoroanthene, benzo[j]fluoroanthene and dibenzo[a, h]anthracene of 0.5 mg/kg (European Commission, 2013).

The contents of these PAH substances have been measured in two bike tubes and two bike tires (samples 10-13). Each of the PAH substances in all samples had a content below 0.5 mg/kg. On that basis, it is not considered critical to use these bike tires and tubes.

It must be emphasised that the conclusion solely relates to the four actual products, and that the analyses cannot be considered representative of bike tires and bike tubes in general. It cannot be excluded that some bike tires and tubes will contain higher concentrations of the PAH substances, and thus be inappropriate to use in day care centres.

9.5 Lead in cords, LP records and garden hoses

9.5.1 Risk assessment

Garden hose no. 2, LP records nos. 1 and 2 and cord no. 3 all contain lead in a higher concentration than the limit value of 500 mg/kg, as indicated in the future European regulation of lead in articles, which under normal or reasonably foreseeable conditions of use can be mouthed by children (Commission Regulation (EU) 2015/628 of 22 April 2015).

The cord contains 2100 mg lead/kg, the LP records 2000 mg lead/kg and the garden hose 650 mg lead/kg. This means that if these materials are reused for articles, which under normal or reasonably foreseeable conditions of use can be mouthed by children, it is possible that they might pose a risk.

According to the survey, the cord is used for jewelry and toys, where it is expected that it could be mouthed by children. The LP records are used for the storage of fruit - it is possible that the lead will be released to the food stored in the bowl, but it is not known to what extent this occurs. The garden hose is split manually and painted.

Thus, it is possible, especially for the cord, that the reuse may pose a risk to children when the produced items are mouthed.

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- http://www.genbrugblirguld.blogspot.dk/p/galleri.html
- http://oplevelsermedaffald.dk/?tag=genbrug
- http://www.tinadalboge.dk/blogindlaeg/kreative-ideer
- http://www.1000ideer.dk/soegning.asp?AjrSrchScp=1&AjrSrchInpt=genbrug
- http://www.kinderart.com/recycle/
- http://laughingkidslearn.com/2013/09/share-it-saturday-10-activities-using-recycled-materials.html/

PINTEREST (Non-exhaustive list)

- http://www.pinterest.com/tinadalboge/kreative-id%C3%A9er-til-b%C3%B8rn-diy-children/
- http://www.pinterest.com/thesugaraunts/trash-turned-kids-crafts-kids-crafts-made-from-rec/
- http://www.pinterest.com/susanmomof5/kids-crafts-recycled-materials/

Facebook pages/groups

- https://www.facebook.com/kendinyapsana?fref=ts
- https://www.facebook.com/groups/221630331320077/
- https://www.facebook.com/groups/1439992656215906/

Survey – questionnaire study

ReMida, centre for creative recycling, homepage: http://www.remida.dk

The Danish Reggio Emilia Network, homepage: http://www.reggioemilia.dk

Literature study regarding problematic substances

Chemistry.about.com, amerikansk online service that provides expert articles and questions/answers within chemistry:
http://chemistry.about.com/

ECHA C&L list:
http://echa.europa.eu/da/information-on-chemicals/cl-inventory-database

ECHA CORAP list:
http://echa.europa.eu/da/information-on-chemicals/evaluation/community-rolling-action-plan/corap-list-of-substances

ECHA Candidate List of very problematic substances (substances with very high concern - SVHC) for approval:
http://echa.europa.eu/da/candidate-list-table

ECHAs registry of intentions (registration of the intention of member countries to forward an Annex XV file or propose harmonized classification and marking):
http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/registry-of-intentions

Forbrugerkemi.dk, managed by the Danish *Informationscenter for Miljø & Sundhed*:
http://www.forbrugerkemi.dk/kemi-i-din-hverdag/hjemmet/gor-det-selv/traearbejde/impraegnering-af-trae/fakta-om-impraegnering-af-trae

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HealthyStuff.org operated by "Ecology Center", an American not-for-profit environmental organisation:
www.healthystuff.org

Priority list of the Norwegian *Klima- og Forurensningsdirektorat*
http://www.miljostatus.no/prioritetslisten

The Danish Environmental Protection Agency:
http://mst.dk/groenne-tips/hjemmet/trykimpraegneret-trae-og-naturligt-trae/

http://mst.dk/virksomhed-myndighed/kemikalier/regulering-og-regler/faktaark-om-kemikaliereglerne/creosot/

The Danish Plastics Federation:
http://www.plast.dk/Fakta/Fakta-om-PVC-og-ftalater/Ftalatater-goer-PVC-bloed/

Appendix 1 Material list

Tekst i citationstegn, er oplysninger, som respondenterne har noteret i fritekstfelter i spørgeskemaundersøgelsen.

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
Brugsgenstand	”Brugt legetøj, perler mm er ofte ret populært.”				Spørgeskemaundersøgelse
	"Vi køber brugte møbler hos genbrug"		Brugsgenstand	"Vi omsætter det ikke. Bruger det blot som det er."	Spørgeskemaundersøgelse
	”Vi køber nogen gange brugt legetøj på en genbrugsstation ca. 2 - 4 gange årligt”				Spørgeskemaundersøgelse
	Blandede brugsgenstande f.eks. briller, sko og vaser	Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst	Telefoninterviews
		Male/dekorere	Pyntegenstand		Litteratur- og internetstudie (Johanson og Lauridsen 2005)
	Gammelt legetøj	Lime/fæstne	Pyntegenstand/legetøj/smykke	Robotter, Legetøjshuse Små tøjdyr Smykker	Telefoninterviews
	Paraply	Lime/fæstne	Pyntegenstand/legetøj/smykke	Robotter, Legetøjshuse Små tøjdyr Smykker	Telefoninterviews
Elektronik	"Telefoner anvendes til leg som telefoner"	-	Legetøj		Spørgeskemaundersøgelse
	"Vi anvender primært elektronik til at børnene leger	-	Legetøj		Spørgeskemaundersøgelse

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
	med tastatur mv uden at ændre elektronikken mere end at fjerne farlige genstande på det."				
Elektronik (fortsat)	"Vi har i et projekt der strakte sig over et par uger brugt nogle få ledninger. Det er 2 år siden."			Det givne produkt har været udstillet og som sådan ikke 'brugt' af nogen til andet end at kikke på	
	Computerdele f.eks. harddiske, tastaturer, skærm og printplader	Klippe/skære/save Lime/fæstne	Pyntegenstand/legetøj	Robotter Dyr og mennesker Sjove maskinger	Telefoninterviews
		Skille ad/slå i stykker, Klippe/skære/save	Legetøj (f.eks. robot, dukke eller bil)		Spørgeskemaundersøgelse
		Skille ad/slå i stykker	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst	Telefoninterviews
		Skille ad/slå i stykker	Smykke		Litteratur- og internetstudie
		Skille ad/slå i stykker Lime/fæstne	Dekorationsmateriale		Litteratur- og internetstudie
	Elektroniske apparater f.eks. vægur, lommeregner, telefoner og musikafspiller	Klippe/skære/save Lime/fæstne	Pyntegenstand	Julepynt	Telefoninterviews
		Skille ad/slå i stykker, Klippe/skære/save	Legetøj (f.eks. robot, dukke eller bil)		Spørgeskemaundersøgelse
		Skille ad/slå i stykker, Klippe/skære/save	Legetøj (f.eks. robot, dukke eller bil)		Spørgeskemaundersøgelse

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
	Elpære	Skille ad/slå i stykker	Pyntegenstand/legetøj		Litteratur- og internetstudie (Dalbøge 2008)
	Fordelerboks, indmad fra forlængerledning - elektronikdelen	Lime/fæstne	Pyntegenstand/legetøj	Figurer	Litteratur- og internetstudie
	Ledninger	Klippe/skære/save Lime/fæstne	Pyntegenstand	Julepynt	Telefoninterviews
Elektronik (fortsat)	Ledninger (fortsat)	Klippe/skære/save Lime/fæstne	Brugsgenstand/smykke	Smykker (broderi, armbånd, halskæde), Redesign af gamle møbler	Telefoninterviews
		Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde)		Spørgeskemaundersøgelse
		Formes/flettes/foldes/ fyldes Lime/fæstne	Dekorationsmateriale/pyntegenstand	Figurer	Litteratur- og internetstudie (Dalbøge 2008)
	Lyskæder	Skille ad/slå i stykker Lime/fæstne	Dekorationsmateriale		Litteratur- og internetstudie
Glas	Glas	Lime/fæstne	Pyntegenstand/brugsgenstand	Perler på et syltetøjsglas, Fantasidyr, Modelby Potter til såning, Små lygter af husholdningsglas	Telefoninterviews
	Glas fra fødevarer	Male/dekorere	Brugsgenstand/opbevaring	Opbevaringsglas,	Litteratur- og internetstudie

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
				hvor plastdyr limes på låg, som males	(Buusmann 2005)
Gummi	"Vi har et enkelt bildæk stående som vi har brugt til at male med ved et projekt for år tilbage. Det leger børnene ofte med i pauserne."		Brugsgenstand/legetøj	"Som sagt, har vi kun brugt dækket, til at male med, ved at smøre maling på det, og rulle det hen over træplader og således brugt det som en slags pensel."	Spørgeskemaundersøgelse
	"Traktordæk til gynger og bildæk til at stable m.m."		Brugsgenstand/legetøj		Spørgeskemaundersøgelse
	Dæk f.eks. fra cykler, biler, traktorer	Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner)		Spørgeskemaundersøgelse
Gummi (fortsat)	Dæk f.eks. fra cykler, biler, traktorer (fortsat)	Klippe/skære/save Sy sammen	Beklædning	Sandaler	Litteratur- og internetstudie (Larsen 2009)
	Gummislanger f.eks. fra cykler, bil og traktor		Brugsgenstand/smykke	Smykker (broderi, armbånd, halskæde) Redesign af gamle møbler	Telefoninterviews
		Rengøre Klippe/skære/save Sy sammen Lime/fæstne	Brugsgenstand/smykke/Beklædning	Accessories (broche, tasker osv.)	Indledende interviews
		Klippe/skære/save Lime/fæstne	Brugsgenstand/legetøj	Punge Slangebøsser	Litteratur- og internetstudie (Larsen 2009)

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
		Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne)	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner)		Spørgeskemaundersøgelse
Kork	Korkpropper	Lime/fæstne	Brugsgenstand	Opslagstavle	Litteratur- og internetstudie
		Klippe/skære/save Lime/fæstne	Pyntegenstand/legetøj	Dyr og mennesker Legetøjshuse og byer Robotter	Telefoninterviews
Metal	"Kapsler fra øl og sodavand manuel opdeling til musikinstrumenter"		Legetøj		Spørgeskemaundersøgelse
	"Kapsler limes på...."		Dekorationsmateriale		Spørgeskemaundersøgelse
	”Metal”		Pyntegenstand	"Altid kunstprodukter - processen er det væsentlige. Mange holder knapt til børnene kommer hjem på skolen, men det er heller ikke det afgørende"	Spørgeskemaundersøgelse
Metal (fortsat)	"Nye låg (Overskudsmaterialer) der limes f.eks. papirmosaik på billeder glimmer"	Male/dekorere, Lime/fæstne)	Pyntegenstand	"Låg bliver til pyntegenstande"	Spørgeskemaundersøgelse
	”Produkterne anvendes ikke som legetøj, men i processer, hvor fernisering og udstilling		Pyntegenstand		Spørgeskemaundersøgelse

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
	kommer ind i billedet"				
	Chokoladedåser	Klippe/skære/save Lime/fæstne	Pyntegenstand/smykke	Dyr og mennesker Sjove maskiner Papmache	Telefoninterviews
	Dåseåbner på sodavandsdåse	Sy sammen Lime/fæstne	Dekorationsmateriale	Dekoration	Litteratur- og internetstudie
	Dåser til drikkevarer f.eks. øl og sodavand	Klippe/skære/save	Pyntegenstand/brugsgenstand	Lysestager	Litteratur- og internetstudie (Buusmann 2005)
		Klippe/skære/save	Pyntegenstand/brugsgenstand	Vaser	Litteratur- og internetstudie (Buusmann 2005)
		Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner)		Spørgeskemaundersøgelse
		Klippe/skære/save Slibe Lodde/svejse	Brugsgenstand/legetøj/smykke	Lampe af konservesdåser 'dåse-legetøj'	Telefoninterviews
		Klippe/skære/save Lime/fæstne	Pyntegenstand/ legetøj	Kunst Dyr og mennesker Sjove maskiner Papmache	Telefoninterviews
	Emballage fra rengøringsartikler (metal)	Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst	Telefoninterviews
	Grydesvamp (metal)	Forme/flette/folde/fylde Male/dekorere	Pyntegenstand/legetøj	Dekoration, f.eks. hjerter, sæler	Litteratur- og internetstudie (Dalbøge 2008)
Metal	Kapsler	Banke fladt/lave hul	Dekorationsmateriale/legetøj/brugsgen	Instrumenter	Litteratur- og internetstudie

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
(fortsat)			stand	Dekoration Dørmåtte	(Larsen 2009)
	Konservesdåser fra fødevarer f.eks. fra flåede tomater, ananas, makrel	Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner) Brugsgenstand til fødevarer		Spørgeskemaundersøgelse
		Banke fladt/lave hul	Pyntegenstand/brugsgenstand	Lysestager	Litteratur- og internetstudie (Larsen 2009)
		Male/dekorere	Legetøj/brugsgenstand	Trommer Holder til blyanter	Litteratur- og internetstudie (Larsen 2009)
		Klippe/skære/save Slibe Lodde/svejse	Legetøj/brugsgenstand/smykke	Lampe af konservesdåser ”dåse-legetøj”	Telefoninterviews
	Metalgenstande f.eks. figurer, nøgler, dåseøl/sodavand	Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst	Telefoninterviews
		Klippe/skære/save Slibe Lodde/svejse	Brugsgenstand/smykke	Smykker (broderi, armbånd, halskæde) Redesign af gamle møbler	Telefoninterviews
	Byggevarer (søm, skruer, fjedre, møtrikker, spændeskiver, VVS-rør og rørsamlinger)	Lime/fæstne	Pyntegenstand/legetøj	Dekoration af figurer til f.eks. øjne, ben	Litteratur- og internetstudie (Dalbøge 2008)
		Lime/fæstne	Dekorationsmateriale/pyntegenstand/ brugsgenstand/	Perler på et syltetøjsglas, Fantasidyr, modelby Potter til såning	Telefoninterviews
		Skille ad/slå i stykker, Klippe/skære/save	Pyntegenstand (f.eks. kunst) Legetøj (f.eks. robot, dukke eller bil)		Spørgeskemaundersøgelse

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
		Male/dekorere, Lime/fæstne			
Metal (Fortsat)	Ståltråd (forskellige typer metal)	Forme/flette/folde/fylde	Dekorationsmateriale/pyntegenstand	Figurer	Litteratur- og internetstudie (Dalbøge 2008)
	Sølvpapir	Lime/fæstne Forme/flette/folde/fylde	Dekorationsmateriale	Dekoration af genstande, kugler/stænger	Litteratur- og internetstudie (Buusmann 2005)
Natur-materialer	"Pinde - sten - blade mm hvad vi finder i naturen hver måned"				Spørgeskemaundersøgelse
Papir og pap	"Mælkekartoner"				Spørgeskemaundersøgelse
	"Mælkekartoner og æggebakker"				Spørgeskemaundersøgelse
	"Vi har modtaget en masse gamle 2013-kalendere, som vi bruger bagsiden af som tegnepapir daglig. Vi har modtaget karton fra en fabrik."				Spørgeskemaundersøgelse
	”Æggebakker - toilet og køkkenruller til leg og pynt”		Pyntegenstand/legetøj		Spørgeskemaundersøgelse
	Aviser og tryksager (f.eks. aviser, blade og reklamer)	Bløde op i vand	Pyntegenstand	Skål/bæger	Litteratur- og internetstudie (Buusmann 2005)
		Lime/fæstne	Dekorationsmateriale/pyntegenstand/ brugsgenstand/	Hjemmelavet papir	Litteratur- og internetstudie (Larsen 2009)
		Forme/flette/folde/fylde	Brugsgenstand	Siddeunderlag Poser til madvarer	Litteratur- og internetstudie (Larsen 2009)
		Klippe/skære/save	Smykke	Perler	Litteratur- og internetstudie (Larsen 2009)

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
		Lime/fæstne	Dekorationsmateriale	Decoupage	Litteratur- og internetstudie
		Lime/fæstne	Pyntegenstand/brugsgenstand/smykke	Perler på et syltetøjsglas, Fantasidyr, modelby Potter til såning Robotter, Legtøjshuse Små tøjdyr smykker	Telefoninterviews
Papir og pap (fortsat)	Gamle landkort	Klippe/skære/save Lime/fæstne	Pyntegenstand/brugsgenstand/smykke	Dyr og mennesker Sjove maskiner Papmache	Telefoninterviews
	Kartoner fra f.eks. mælk, mejeriprodukter og juice	Klippe/skære/save Male/dekorere	Pyntegenstand	Fuglehuse Legetøjshuse	Litteratur- og internetstudie (Viqué og Carrillo 2005)
		Klippe/skære/save Lime/fæstne	Pyntegenstand/brugsgenstand/smykke	Dyr og mennesker Sjove maskiner Papmache Robotter, Legtøjshuse Små tøjdyr Smykker	Telefoninterviews
		Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst	Telefoninterviews
	Pap	Klippe/skære/save Lime/fæstne	Pyntegenstand	Julepynt	Telefoninterviews
		Lime/fæstne	Pyntegenstand/smykke	Robotter Legetøjshuse Små tøjdyr Smykker	Telefoninterviews

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
	Papir	Klippe/skære/save Lime/fæstne	Pyntegenstand/brugsgenstand/smykke	Kunst, Dyr og mennesker Sjove maskiner Papmache	Telefoninterviews
		Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst Collager Smykker	Telefoninterviews
	Papkasser	Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst Collager Smykker	Telefoninterviews
		Lime/fæstne	Pyntegenstand/brugsgenstand	Robotter, Legtøjshuse Små tøjdyr Smykker	Telefoninterviews
Papir og pap (fortsat)		Klippe/skære/save Lime/fæstne	Pyntegenstand/legetøj	Legetøjshuse og landskaber Robotter	Telefoninterviews
		Male/dekorere	Legetøj	Huse til små dukker/udstilling	Litteratur- og internetstudie
		Male/dekorere	Opbevaring	Æsker	Litteratur- og internetstudie
	Paprør, f.eks. toiletruller	Male/dekorere	Brugsgenstand	Holder til blyanter	Litteratur- og internetstudie (Buusmann 2005)
		Forme/flette/folde/fylde	Legetøj	Risrasler (instrument)	Litteratur- og internetstudie (Larsen 2009)
		Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst Collager Smykker	Telefoninterviews

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
	Paptallerken	Male/dekorere	Pyntegenstand/legetøj	Kurv	Litteratur- og internetstudie (Buusmann 2005)
		Male/dekorere	Pyntegenstand/legetøj	Ur til at lære klokken	Litteratur- og internetstudie
		Male/dekorere	Pyntegenstand/legetøj	Tromme	Litteratur- og internetstudie (Buusmann 2005)
	Tefiltre/kaffefiltre	Male/dekorere	Pyntegenstand	Vaser på vandglas, så det ligner en vase Figurer	Litteratur- og internetstudie (Dalbøge 2008)
	Æggebakker	Blødes op i vand	Dekorationsmateriale/pyntegenstand/ brugsgenstand/	Hjemmelavet papir	Litteratur- og internetstudie (Larsen 2009)
		Lime/fæstne	Pyntegenstand/brugsgenstand	Fantasidyr Modelby Potter til såning	Telefoninterviews
		Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst Collager Smykker	Telefoninterviews
Plast	"Børnespil børn og voksne"		Brugsgenstand (f.eks. bordskåner)		Spørgeskemaundersøgelse
	”Maddag”			Bemærkningen er ikke uddybet i spørgeskemaunders øgelsen	Spørgeskemaundersøgelse
	"Mælkelåg, f.eks. bogstavspil"		Legetøj		Spørgeskemaundersøgelse
	”Plast - Vi bruger plastproduktet som trykstok. Dvs. det omdannes ikke direkte til et nyt produkt, men bruges		Brugsgenstand (f.eks. bordskåner)		Spørgeskemaundersøgelse

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
	som redskab i den kreative proces."				
	"Plastik mælkelåg knapper Plastposer mv. Højst en gang om året og som regel med ny skoleklasse hvert år. Så det er ikke de samme børn der bruger produkterne"				Spørgeskemaundersøgelse
	"Vi bruger brugte plastikbøtter til at dosere maling, lim, vand eller andre flydende ting. Vi prikker hul i plastikbøtter og lader malingen dryppe ud og ned på papiret."		Brugsgenstand		Spørgeskemaundersøgelse
	"Vi har lavet halskæder af flamingofyld fra pakkepost"		Smykke		Spørgeskemaundersøgelse
	"Vi har sået karse i tom emballage til tomater"		Brugsgenstand til fødevarer		Spørgeskemaundersøgelse
	"Vi har til et projekt brugt flamingo og ved et andet projekt brugt plastik indkøbsposer som børnene klippede i ."				Spørgeskemaundersøgelse
Plast (fortsat)	Bobleplast	Lime/fæstne Sy sammen	Dekorationsmateriale	Lysestager	Litteratur- og internetstudie (Buusmann 2005)
		Sy sammen	Brugsgenstand	Pose til svømmetøj	Litteratur- og internetstudie (Buusmann 2005)

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
		Lime/fæstne Klippe/skære/save	Pyntegenstand/brugsgenstand/smykke	Dyr og mennesker Sjove maskiner Papmache	Telefoninterviews
	CD/DVD'er	Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner)		Spørgeskemaundersøgelse
		Klippe/skære/save Male/dekorere	Dekorationsmateriale/pyntegenstand/ legetøj		Litteratur- og internetstudie
	CD-cover	Male/dekorere	Pyntegenstand	Fødselsdagskort	Litteratur- og internetstudie (Buusmann 2005)
	Emballage f.eks. flasker, bøtter, rengøringsartikler og skønhedsprodukter	Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner) Brugsgenstand til fødevarer		Spørgeskemaundersøgelse
		Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand		Telefoninterviews
		Klippe/skære/save Male/dekorere	Brugsgenstand	Telefonholder Holder til blyant	Litteratur- og internetstudie
	Emballage fra fødevarer	Male/dekorere	Pyntegenstand/Legetøj	Sommerfugle/ blomster	Litteratur- og internetstudie (Dalbøge 2008)
	Engangsservice f.eks. bestik, kopper, tallerkener	Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner) Brugsgenstand til fødevarer		Spørgeskemaundersøgelse

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
Plast (Fortsat)	Engangsservice f.eks. bestik, kopper, tallerkener (fortsat)	Opvarme f.eks. i ovn	Pyntegenstand/Brugsgenstand	Lysestager Dekoration	Litteratur- og internetstudie
	Engangsvaskeklud	Klippe/skære/save Lime/fæstne	Dekorationsmateriale		Litteratur- og internetstudie (Dalbøge 2008)
		Klippe/skære/save	Dekorationsmateriale (udsmykning på kroppen)	Tatovering med sovsekulør	Litteratur- og internetstudie (Dalbøge 2008)
		Male/dekorere	Legetøj	Skabelon til maling	Litteratur- og internetstudie (Dalbøge 2008)
	Flamingo/polystyren f.eks. kasser, små kugler/fiduser fra pakkepost	Klippe/skære/save	Pyntegenstand/brugsgenstand/smykke	Dyr og mennesker Sjove maskiner Papmache Robotter, Legtøjshuse Små tøjdyr Smykker	Telefoninterviews
		Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner)		Spørgeskemaundersøgelse
		Male/dekorere	Dekorationsmateriale		Litteratur- og internetstudie
	Grydesvamp (farvede)	Klippe/skære/save Lime/fæstne	Dekorationsmateriale/legetøj	Dekoration Skilte legetøjshuse	Litteratur- og internetstudie (Dalbøge 2008)
	Haveslange	"Manuel opdeling og maling"			Spørgeskemaundersøgelse
	Indmad fra Toffifee	Klippe/skære/save Lime/fæstne	Dekorationsmateriale7pyntegenstand/ legetøj/	Skåle og små mennesker Skrotrobotter	Telefoninterviews
	Kasettebånd-/videobånd	Skille ad/slå i stykker	Pyntegenstand/legetøj	Dekoration	Litteratur- og internetstudie

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
		Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Legetøj (f.eks. robot, dukke eller bil)		Spørgeskemaundersøgelse
	Klatretov, brugt	Klippe/skære/save Opvarme f.eks. i ovn	Smykke	Armbånd/smykker	Litteratur- og internetstudie
Plast (fortsat)	LP-plader	Opvarme f.eks. i ovn	Brugsgenstand med fødevarekontakt	Frugtskål	Litteratur- og internetstudie
	Opskummet plast, f.eks. liggeunderlag, skummadras	Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner)		Spørgeskemaundersøgelse
		Klippe/skære/save	Beklædning	Slippers	Litteratur- og internetstudie (Larsen 2009)
		Klippe/skære/save Lime/fæstne	Legetøj	Våben til rollespil	Litteratur- og internetstudie
	Plastflasker fra f.eks. sodavand og juice	Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst	Telefoninterviews
		Male/dekorere	Pyntegenstand/legetøj	Bowlingspil, der laves om til pingviner	Litteratur- og internetstudie (Buusmann 2005)
	Plastikdunke	Klippe/skære/save Opvarmes i f.eks. ovn Male/dekorere	Brugsgenstand	Opbevarings-beholder	Litteratur- og internetstudie
	Plastiklommer	Sys sammen	Pyntegenstand	Dækkeserviet	Litteratur- og internetstudie (Buusmann 2005)
		Male/dekorere	Brugsgenstand	Penalhus	Litteratur- og internetstudie

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
	Plastmaterialer	Lime/fæstne	Pyntegenstand	Skraldekunst	Telefoninterviews
	Plexiglas/acryl	Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde Legetøj (f.eks. robot, dukke eller bil)		Spørgeskemaundersøgelse
		Opvarmes i ved punktsug	Brugsgenstand/smykke	Smykker (broderi, armbånd, halskæde) Redesign af gamle møbler	Telefoninterviews
Plast (fortsat)	Poser af plast f.eks. fra kaffe, chips, kattemad og slik, bæreposer, bobleplast, plastlommer	Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner) Brugsgenstand til fødevarer		Spørgeskemaundersøgelse
		Rengøre Forme/flette/folde/fylde Sy sammen	Brugsgenstand/legetøj	Tasker og punge	Litteratur- og internetstudie (Jørgensen 2013)
		Klippe/skære/save	Legetøj	Drage	Litteratur- og internetstudie (Larsen 2009)
	Slikpose	Opvarme f.eks. i ovn	Smykke	Vedhæng i halskæder	Litteratur- og internetstudie
	Sugerør	Klippe/skære/save Male/dekorere	Smykke	Perler; sugerør klippes op og beklædes med avis	Litteratur- og internetstudie (Larsen 2009)
		Klippe/skære/save Opvarmes i f.eks. ovn	Smykke	Perler; sugerør klippes op og skrumper til små perler i ovn	Litteratur- og internetstudie

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
Porcelæn og keramik	Porcelæn f.eks. tallerkener, fliser, spejle, kakler	Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand/brugsgenstand	Skulpturer (dyr) Relieffer/billedkunst Mosaik, Perler på et syltetøjsglas, Fantasidyr Modelby Potter til såning	Telefoninterviews
		Skille ad/slå i stykker Lime/fæstne	Dekorationsmateriale	Mosaik	Litteratur- og internetstudie (Johanson og Lauridsen 2005)
Tekstil	Gammelt tøj	Rengøre Klippe/skære/save Sys sammen Lime/fæstne	Brugsgenstand/smykke	Accessories (broche, tasker osv.) Beklædning	Telefoninterviews
Tekstil (fortsat)	Garn og snor	Lime/fæstne	Pyntegenstand/brugsgenstand/smykke	Robotter Legetøjshuse Små tøjdyr Smykker	Telefoninterviews
		Klippe/skære/save Lime/fæstne	Pyntegenstand	Julepynt	Telefoninterviews
	Karklude	Klippe/skære/save Lime/fæstne	Dekorationsmateriale	Dekoration	Litteratur- og internetstudie
		Sys sammen	Legetøj	Figurer/bamser	Litteratur- og internetstudie
	Stof, stof- og garnrester	Lime/fæstne	Pyntegenstand/brugsgenstand/smykke	Robotter Legetøjshuse Små tøjdyr Smykker Fantasidyr Modelby Potter til såning	Telefoninterviews

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
		Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst Collager Smykker	Telefoninterviews
		Klippe/skære/save Lime/fæstne	Pyntegenstand/brugsgenstand	Dyr og mennesker Sjove maskiner Papmache	Telefoninterviews
	Tekstil, f.eks. fra dukketøj, andet tøj og filt	Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst Julepynt	Telefoninterviews
	Vat	Male/dekorere Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Dekorationsmateriale	Dekoration	Litteratur- og internetstudie (Dalbøge 2008)
		Forme/flette/folde/fylde	Legetøj	Fyld	Litteratur- og internetstudie
	Vatpinde	Lime/fæstne Male/dekorere	Dekorationsmateriale	Dekoration	Litteratur- og internetstudie
Træ	Europaller	Klippe/skære/save Slibe Lime/fæstne	Brugsgenstand	Møbler	Telefoninterviews
	Ispinde	Lime/fæstne	Pyntegenstand/legetøj	Flyvemaskine	Litteratur- og internetstudie (Viqué og Carrillo 2005)
	Lakeret træ, f.eks. træ fra møbler, trælegetøj, hegn	Lime/fæstne, Male/dekorere	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde) Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand		Spørgeskemaundersøgelse
		Brænde med træbrænder	Pyntegenstand	Skilte	Litteratur- og internetstudie

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
	Rent træ (f.eks. ispinde, rent resttræ fra værksteder)	Skille ad/slå i stykker, Klippe/skære/save Opvarmning (f.eks. med brænderpen) Male/dekorere, Lime/fæstne	Pyntegenstand (f.eks. kunst) Smykke (f.eks. armbånd eller halskæde) Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner) Brugsgenstand til fødevarer		Spørgeskemaundersøgelse
	Trykimprægneret træ, grønt eller brunt, f.eks. fra terrasser og hegn	Skille ad/slå i stykker, Klippe/skære/save Male/dekorere, Lime/fæstne	Legetøj (f.eks. robot, dukke eller bil) Brugsgenstand (f.eks. bordskåner)		Spørgeskemaundersøgelse
		Brænde med træbrænder	Pyntegenstand	Skilte	Litteratur- og internetstudie
	Træstykker	Klippe/skære/save Lime/fæstne Tørre med f.eks. hårtørrer	Pyntegenstand	Skulpturer (dyr) Relieffer/billedkunst Collager Smykker	Telefoninterviews
		Lime/fæstne	Pyntegenstand/brugsgenstand	Fantasidyr Modelby Potter til såning	Telefoninterviews
Varierende materialer	Blandet emballage	Klippe/skære/save Lime/fæstne	Pyntegenstand/legetøj	Robotter	Telefoninterviews
	"Bildæk til at plante blomster i. Gamle skoleborde, som bliver lavet om til alm. borde."				Spørgeskemaundersøgelse
Varierende materialer (fortsat)	"Vi bruger alt, mælkekartoner, toiletruller, låg, emballage mv."				Spørgeskemaundersøgelse
	"Vi bruger materialer fra ReMida"				Spørgeskemaundersøgelse
	"Vi bruger toiletruller, køkkenruller, syltetøjsglas og trærester til at fremstille f.eks.				Spørgeskemaundersøgelse

Materialetype	Produkter	Forarbejdning	Anvendelse af produkt	Specifikke anvendelser	Oprindelse
	sværd"				
	"Det kan også være andet genbrugsmateriale. Jeg er selv præget af Regio Emilia tænkning og pædagogik, derfor er vi også medlem af ReMida og skal til at hente genbrugsmaterialer og etablere et ude-værksted, hvor vi vil arbejde med mange forskellige materialer."				Spørgeskemaundersøgelse
	"mælkekartoner og låg 4-6/år papkasser/emballage 4-6/år"				Spørgeskemaundersøgelse
	"Vi anvender mælkekartonner ca. 3 gange årligt. Plasticlåg fra mælkekartonner et par gange årligt."				Spørgeskemaundersøgelse

Appendix 2 Guide to interviews with specialists

1. Hvilken institution kommer du fra?
2. Hvilke brugte produkter anvendes (f.eks. elektronik, metal-genstande, plast, papir og pap, glas, brugsgenstande)?
3. Hvilke nye produkter fremstilles?
4. Hvordan anvendes de (Er det som smykke, pyntegenstande, legetøj, det der kommer i forbindelse med fødevarer)?
5. Hvordan foregår fremstillingsprocessen?
6. Hvor ofte bruges brugte produkter og materialer i dagligdagen/ undervisningen?
7. Hvor lang tid af gangen er børnene beskæftiget mht. fremstilling?
8. Hvor får du inspiration fra (bøger, internetsider, kolleger)?
9. Hvor længe har jeres institution anvendt materialer fra brugte produkter i kreativ sammenhæng?

Appendix 3 Questionnaire

Kortlægning af børns kreative brug af materialer fra brugte produkter

Teknologisk Institut udfører et projekt for Miljøstyrelsen om børneinstitutioners anvendelse af materialer fra brugte produkter. Projektet har til formål at undersøge, om børn og unge under 14 år bliver udsat for problematiske kemiske stoffer, når de fremstiller og anvender kreative ting af materialer fra brugte produkter. I forbindelse med dette projekt vil vi gerne have jeres hjælp til at belyse hvordan børn arbejder med brugte produkter i jeres organisation.

Dette spørgeskema kortlægger hvilke brugte produkter der anvendes, hvilke typer nye produkter der fremstilles, hvordan disse anvendes, og hvordan fremstillingen foregår.

Resultaterne fra spørgeskemaet vil danne grundlag for Teknologisk Instituts kortlægning og sundhedsvurdering af børn og unges brug af materialer fra brugte produkter.

Jeres input er meget afgørende for, at Teknologisk Institut og Miljøstyrelsen får et retvisende billede af, hvordan brugte materialer og produkter anvendes af børn.

Hvis I har spørgsmål er I meget velkomne til at kontakte os.

På vegne af projektgruppen ved Teknologisk Institut
Kathe Tønning og Kristine Vium (kvi@teknologisk.dk)

1. Hvilken type institution/organisation besvarer du på vegne af?

(Angiv kun ét svar)

- ❑ Vuggestue
- ❑ Børnehave
- ❑ Integreret børneinstitution
- ❑ SFO
- ❑ Fritidshjem
- ❑ Skole
- ❑ Billedkunst-/kunsthåndværksskoler for børn (unge <14 år)
- ❑ Uddannelsesinstitutioner for fagpersonaler
- ❑ Museum med kreativ workshopmulighed

2. Anvender jeres institution materialer fra brugte produkter i kreativ sammenhæng?

(Angiv kun ét svar)

❑ Ja

❑ Nej - Gå til 33

3. Hvor gamle er børnene, som arbejder kreativt med materialer fra brugte produkter i jeres institution (angiv gerne flere svar)?

1 år	2 år	3 år	4 år	5 år	6 år	7 år	8 år	9 år	10 år	11 år	12 år	13 år
❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

Andet (angiv børnenes alder)

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I de følgende spørgsmål vil vi gerne indsamle information om hvilke brugte materialer I anvender (har anvendt), hvor længe børnene arbejder med dem, hvor gamle materialerne er, om I foretager en frasortering af materialer, samt hvor I får inspiration fra.

4. Hvilke materialer fra brugte produkter anvender I og hvor ofte arbejder børnene med brugte produkter og materialer?

(Angiv kun et svar pr. spørgsmål)

	Anvendes ikke	Anvendes sjældent	Hvert andet år	1-3 gange om året	4-6 gange om året	I hver måned	I hver uge
Elektronik (f.eks. PC'er, telefoner, ledninger)	❑	❑	❑	❑	❑	❑	❑
Glas (f.eks. flasker, syltetøjsglas)	❑	❑	❑	❑	❑	❑	❑

Gummi (f.eks. dæk, cykelslanger)	❑	❑	❑	❑	❑	❑	❑
Metal (f.eks. dåser, kapsler, låg)	❑	❑	❑	❑	❑	❑	❑
Papir og pap (f.eks. aviser, blade, æsker, kasser)	❑	❑	❑	❑	❑	❑	❑
Plastmaterialer (f.eks. emballager, vinylplader)	❑	❑	❑	❑	❑	❑	❑
Porcelæn og keramik (tallerkener, kopper, potteskår, klinker)	❑	❑	❑	❑	❑	❑	❑
Tekstiler og garn (f.eks. gammelt tøj, garnrester)	❑	❑	❑	❑	❑	❑	❑
Træ (f.eks. Europaller, ispinde, rester fra træværksted)	❑	❑	❑	❑	❑	❑	❑

Andet (beskriv hvilke øvrige materialer og produkter I bruger og hvor ofte de anvendes?)

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5. Hvor længe arbejder børnene maksimalt med materialer fra brugte produkter?
Spring de materialer over, som I ikke anvender.
Angiv de maksimale antal timer (fra 0 og opad) i felterne om dagen, om ugen og om måneden.

	Om dagen	Om ugen	Om måneden
Elektronik (f.eks. PC'er, telefoner, ledninger)	_____	_____	_____
Glas (f.eks. flasker, syltetøjsglas)	_____	_____	_____
Gummi (f.eks. dæk, cykelslanger)	_____	_____	_____
Metal (f.eks. dåser, kapsler, låg)	_____	_____	_____
Papir og pap (f.eks. aviser, blade, æsker, kasser)	_____	_____	_____
Plastmaterialer (f.eks. emballager, vinylplader)	_____	_____	_____
Porcelæn og keramik (tallerkener, kopper, potteskår, klinker)	_____	_____	_____
Tekstiler og garn (f.eks. gammelt tøj, garnrester)	_____	_____	_____
Træ (f.eks. Europaller, ispinde, rester fra træværksted)	_____	_____	_____

Andet (beskriv hvilke øvrige materialer I anvender og hvor længe af gangen børnene maksimalt arbejder med materialerne)

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6. Hvor gamle er materialerne fra de brugte produkter, når børnene anvender dem i kreative sammenhænge (Angiv gerne flere svar)?
Spring de materialer over, som ikke anvendes hos jer

Elektronik (f.eks. PC'er, telefoner, ledninger)

0-3 måneder	3-12 måneder	1-3 år	3-5 år	Over 5 år	Ved ikke
❑	❑	❑	❑	❑	❑

Glas (f.eks. flasker, syltetøjsglas)

0-3 måneder	3-12 måneder	1-3 år	3-5 år	Over 5 år	Ved ikke
❑	❑	❑	❑	❑	❑

Gummi (f.eks. dæk, cykelslanger)

0-3 måneder	3-12 måneder	1-3 år	3-5 år	Over 5 år	Ved ikke
❑	❑	❑	❑	❑	❑

Metal (f.eks. dåser, kapsler, låg)

0-3 måneder	3-12 måneder	1-3 år	3-5 år	Over 5 år	Ved ikke
❑	❑	❑	❑	❑	❑

Papir og pap (f.eks. aviser, blade, æsker, kasser)

0-3 måneder	3-12 måneder	1-3 år	3-5 år	Over 5 år	Ved ikke
❑	❑	❑	❑	❑	❑

Plastmaterialer (f.eks. emballager, vinylplader)

0-3 måneder	3-12 måneder	1-3 år	3-5 år	Over 5 år	Ved ikke

❑ ❑ ❑ ❑ ❑ ❑

Porcelæn og keramik (tallerkener, kopper, potteskår, klinker)

0-3 måneder	3-12 måneder	1-3 år	3-5 år	Over 5 år	Ved ikke
❑	❑	❑	❑	❑	❑

Tekstiler og garn (f.eks. gammelt tøj, garnrester)

0-3 måneder	3-12 måneder	1-3 år	3-5 år	Over 5 år	Ved ikke
❑	❑	❑	❑	❑	❑

Træ (f.eks. Europaller, ispinde, rester fra træværksted)

0-3 måneder	3-12 måneder	1-3 år	3-5 år	Over 5 år	Ved ikke
❑	❑	❑	❑	❑	❑

Andet (beskriv hvilke andre materialer I anvender og alderen på det givne materiale)

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Andet (beskriv hvilke andre materialer I anvender og alderen på det givne materiale)

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7. Hvorfra modtager I brugte materialer (angiv gerne flere svar)?

- ❑ Privatpersoner (f.eks. forældre, lokalsamfund)
- ❑ Personale
- ❑ Privat virksomhed
- ❑ Kommunal virksomhed (f.eks. genbrugsstation)
- ❑ Loppemarked/genbrugsbutik
- ❑ Ved ikke

Andet (beskriv hvorfra)

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8. Foretager I en frasortering af de indkomne materialer, før børnene arbejder med dem (angiv gerne flere svar)?

- ❑ Nej
- ❑ Ja, skarpe og stikkende genstande sorteres fra
- ❑ Ja, uhygiejniske materialer sorteres fra
- ❑ Ja, materialer med tegn på ældning (mørnet, krakeleret eller lignende) sorteres fra

Ja, andet (beskriv hvordan)

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9. Hvor får I inspiration til at børnenes arbejde med brugte materialer (angiv gerne flere svar)?

- ❑ Kolleger
- ❑ Studerende
- ❑ Forældre
- ❑ Børn
- ❑ På internettet
- ❑ Via TV programmer
- ❑ I fritiden
- ❑ Ved ikke

Andet (beskriv)

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10. Har du uddybende kommentarer, der knytter sig til de nævnte materialer (brugt elektronik, glas, gummi, metal, papir og pap, plastmaterialer, porcelæn og keramik, tekstiler og garn, træ) eller andre former for brugte materialer?

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Specifikke brugte produkttyper

I de følgende spørgsmål vil vi gerne indsamle specifik information om hvordan 'nye' produkter fremstilles og bruges ud fra en specifik brugt produkt/materialetype.

Vi fokuserer her på udvalgte produkter, der knytter sig til grupperne elektronik, metal, plast, gummi og træ.

Indledningsvist spørges (ja/nej) om en given produkttype anvendes og hvis dette ikke er tilfældet (nej) springer undersøgelsen videre til næste specifikke produkttype.

11. Anvender I brugte ELEKTRONIK produkter?

(Angiv kun ét svar)

- ❑ Ja
- ❑ Nej - Gå til 15

12. ELEKTRONIK

Anvender I følgende brugte produkter til fremstillingen af 'nye' kreative produkter og hvordan behandles/forarbejdes de brugte produkter i fremstillingen (angiv gerne flere svar)?

PC udstyr (skærm, tastatur m.m.):

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Printplader og andet elektronisk "indmad"

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Telefoner

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Ledninger

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Små el-apparater (lommeregner, musikafspiller m.m.)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Andet (angiv andre produkter eller produkttyper og forarbejdningen af produkterne (manuel opdeling/opvarmning/anden forarbejdning))

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13. ELEKTRONIK

Hvilke 'nye' produkter bliver fremstillet af et givent brugt produkt (Angiv gerne flere svar)?

PC udstyr (printplader, tastatur m.m.)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Printplader og andet elektronisk "indmad"

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Telefoner

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Ledninger

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Små el-apparater (lommeregner, musikafspiller m.m.)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer

halskæde)

❑ ❑ ❑ ❑ ❑ ❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvilke produkter de fremstilles ud fra)

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14. ELEKTRONIK

Hvem bruger de 'nye' produkter som indeholder brugte elektronikprodukter?

(Angiv kun et svar pr. spørgsmål)

	Fremstilles ikke	Børn	Voksne	Både børn og voksne	Ved ikke
Pyntegenstand (f.eks. kunst)	❑	❑	❑	❑	❑
Smykke (f.eks. armbånd eller halskæde)	❑	❑	❑	❑	❑
Legetøj (f.eks. robot, dukke eller bil)	❑	❑	❑	❑	❑
Brugsgenstand (f.eks. bordskåner)	❑	❑	❑	❑	❑
Brugsgenstand til fødevarer	❑	❑	❑	❑	❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvem der bruger dem (børn/voksne))

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15. Bruger I brugte produkter af GUMMI?

(Angiv kun ét svar)

- ❑ Ja
- ❑ Nej - Gå til 19

16. GUMMI

Anvender I følgende brugte produkter til fremstillingen af 'nye' kreative produkter og hvordan behandles/forarbejdes de brugte produkter i fremstillingen (angiv gerne flere svar)?

Slanger (f.eks. fra cykel, biler)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Dæk (f.eks. fra cykler, biler, traktorer)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Andet (angiv andre produkter eller produkttyper og forarbejdningen af produkterne (manuel opdeling/opvarmning/anden forarbejdning))

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17. GUMMI

Hvilke 'nye' produkter bliver fremstillet af et givent brugt produkt (Angiv gerne flere svar)?

Slanger (f.eks. fra cykel, biler)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Dæk (f.eks. fra cykler, biler, traktorer)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvilke produkter de fremstilles ud fra)

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18. GUMMI

Hvem bruger de 'nye' produkter, der indeholder brugte gummiprodukter?

(Angiv kun et svar pr. spørgsmål)

	Fremstilles ikke	Børn	Voksne	Både børn og voksne	Ved ikke
Pyntegenstand (f.eks. kunst)	❑	❑	❑	❑	❑

Smykke (f.eks. armbånd eller halskæde)	❑	❑	❑	❑	❑
Legetøj (f.eks. robot, dukke eller bil)	❑	❑	❑	❑	❑
Brugsgenstand (f.eks. bordskåner)	❑	❑	❑	❑	❑
Brugsgenstand til fødevarer	❑	❑	❑	❑	❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvem der bruger dem (børn/voksne))

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19. Bruger I brugte produkter af METAL?

(Angiv kun ét svar)

❑ Ja

❑ Nej - Gå til 23

20. METAL

Anvender I følgende brugte produkter til fremstillingen af 'nye' kreative produkter og hvordan behandles/forarbejdes de brugte produkter i fremstillingen (angiv gerne flere svar)?

Dåser til drikkevarer (f.eks. øl, sodavand)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, slibe, høvle)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Konserves dåser (f.eks. fra flåede tomater, ananas, makrel)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, slibe, høvle)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

VVS rør og rørsamlinger

Anvender ikke produktet	Manuel opdeling (skære, klippe, hamre, slibe, høvle)	Opvarmning	Anden forarbejdning (male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Andet (angiv andre produkter eller produkttyper og forarbejdningen af produkterne (manuel opdeling/opvarmning/anden forarbejdning))

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21. METAL

Hvilke 'nye' produkter bliver fremstillet af et givent brugt produkt (Angiv gerne flere svar)?

Dåser til drikkevarer (f.eks. øl, sodavand)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Konserves dåser (f.eks. fra flåede tomater, ananas, makrel)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

VVS rør og rørsamlinger

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvilke produkter de fremstilles ud fra)

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22. METAL

Hvem bruger de 'nye' produkter, der indeholder brugte metalprodukter?

(Angiv kun et svar pr. spørgsmål)

	Fremstilles ikke	Børn	Voksne	Både børn og voksne	Ved ikke
Pyntegenstand (f.eks. kunst)	❑	❑	❑	❑	❑
Smykke (f.eks. armbånd eller halskæde)	❑	❑	❑	❑	❑

Legetøj (f.eks. robot, dukke eller bil)	❑	❑	❑	❑	❑
Brugsgenstand (f.eks. bordskåner)	❑	❑	❑	❑	❑
Brugsgenstand til fødevarer	❑	❑	❑	❑	❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvem der bruger dem (børn/voksne))

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23. Anvender I brugte PLAST produkter?

(Angiv kun ét svar)

❑ Ja

❑ Nej - Gå til 27

24. PLAST

Anvender I følgende brugte produkter til fremstillingen af 'nye' kreative produkter og hvordan behandles/forarbejdes de brugte produkter i fremstillingen (angiv gerne flere svar)?

Emballage plast (f.eks. flasker, bøtter)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Poser af plast (f.eks. fra kaffe og slik, bobleplast, plastlommer)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

CD/DVD'er

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Kassette-/Videobånd

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Plexiglas

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Engangsservice (f.eks. bestik, kopper, tallerkener)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Opskummet plast (f.eks. liggeunderlag, skummadras)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Flamingo/Polystyren (f.eks. kasser, små kugler)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, save)	Opvarmning	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Andet (angiv andre produkter eller produkttyper og forarbejdningen af produkterne (manuel opdeling/opvarmning/anden forarbejdning))

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25. PLAST

Hvilke 'nye' produkter bliver fremstillet af et givent brugt produkt (Angiv gerne flere svar)?

Emballage plast (f.eks. flasker, bøtter)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Poser af plast (f.eks. fra kaffe og slik, bobleplast, plastlommer)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

CD/DVD'er

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Kassette-/Videobånd

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Plexiglas

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Engangsservice (f.eks. bestik, kopper, tallerkener)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Opskummet plast (f.eks. liggeunderlag, skummadras)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Flamingo/Polystyren (f.eks. kasser, små kugler)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvilke produkter de fremstilles ud fra)

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26. PLAST

Hvem bruger de 'nye' produkter, der indeholder brugte plastprodukter?

(Angiv kun et svar pr. spørgsmål)

	Fremstilles ikke	Børn	Voksne	Både børn og voksne	Ved ikke
Pyntegenstand (f.eks. kunst)	❑	❑	❑	❑	❑
Smykke (f.eks. armbånd eller halskæde)	❑	❑	❑	❑	❑
Legetøj (f.eks. robot, dukke eller bil)	❑	❑	❑	❑	❑
Brugsgenstand (f.eks. bordskåner)	❑	❑	❑	❑	❑
Brugsgenstand til fødevarer	❑	❑	❑	❑	❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvem der bruger dem (børn/voksne))

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27. Bruger I brugte produkter af TRÆ?

(Angiv kun ét svar)

❑ Ja

❑ Nej - Gå til 33

28. TRÆ

Anvender I følgende brugte produkter til fremstillingen af 'nye' kreative produkter og hvordan behandles/forarbejdes de brugte produkter i fremstillingen (angiv gerne flere svar)?

Rent træ (f.eks. ispinde, rent resttræ fra værksteder)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, slibe, høvle)	Opvarmning (f.eks. med brænderpen)	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Lakeret eller malet træ (f.eks. træ fra møbler, trælegetøj, hegn)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, slibe, høvle)	Opvarmning (f.eks. med brænderpen)	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Trykimprægneret træ (grønt eller brunt, f.eks. fra terrasser, hegn)

Anvender ikke produktet	Manuel opdeling (f.eks. skære, klippe, hamre, slibe, høvle)	Opvarmning (f.eks. med brænderpen)	Anden forarbejdning (f.eks. male, sammenføje (f.eks. ved tape, søm, limpistol))
❑	❑	❑	❑

Andet (angiv andre produkter eller produkttyper og forarbejdningen af produkterne (manuel opdeling/opvarmning/anden forarbejdning))

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29. TRÆ

Hvilke 'nye' produkter bliver fremstillet af et givent brugt produkt (Angiv gerne flere svar)?

Rent træ (f.eks. ispinde, rent resttræ fra værksteder)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Lakeret eller malet træ (f.eks. træ fra møbler, trælegetøj, hegn)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Trykimprægneret træ (grønt eller brunt, f.eks. fra terrasser, hegn)

Anvender ikke produktet	Pyntegenstand (f.eks. kunst)	Smykke (f.eks. armbånd eller halskæde)	Legetøj (f.eks. robot, dukke eller bil)	Brugsgenstand (f.eks. bordskåner)	Brugsgenstand til fødevarer
❑	❑	❑	❑	❑	❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvilke produkter de fremstilles ud fra)

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30. TRÆ

Hvem bruger de 'nye' produkter, der indeholder brugte træprodukter?

(Angiv kun et svar pr. spørgsmål)

	Fremstilles ikke	Børn	Voksne	Både børn og voksne	Ved ikke
Pyntegenstand (f.eks. kunst)	❑	❑	❑	❑	❑
Smykke (f.eks. armbånd eller halskæde)	❑	❑	❑	❑	❑
Legetøj (f.eks. robot, dukke eller bil)	❑	❑	❑	❑	❑
Brugsgenstand (f.eks. bordskåner)	❑	❑	❑	❑	❑
Brugsgenstand til fødevarer	❑	❑	❑	❑	❑

Andet (angiv evt. andre 'nye' produkter der fremstilles og hvem der bruger dem (børn/voksne))

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31. Har du kommentarer, der knytter sig til en eller flere af de nævnte produktkategorier elektronik, gummi, metal, plast og/eller træ?
F.eks. omkring forarbejdningsprocessen, de 'nye' produkter eller brugen af de 'nye' produkter?

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32. ANDRE PRODUKTER

Anvender I andre produkter og materialer, som du gerne vil beskrive nærmere? Angiv venligst forarbejdning (f.eks. opdele/opvarme) og anvendelse (f.eks. kunst/brugsgenstand/smykke) samt brugeren af det 'nye' produkt (børn/voksne) mv.

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**33. Spørgeundersøgelsen er næsten færdig.
Oplys venligst kontaktinformation (navn og email / telefonnr.), hvis vi må kontakte jer i forhold til evt. opfølgning på spørgeskemaet.**

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Appendix 4 Problematic substances found in the literature survey

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
Elektronik Diverse apparater og dele (tastatur, printplader, små apparater (f.eks. lommeregner, musikafspiller, telefon, vægur, harddisk og lyskæder) stik og skærm)	Problematiske stoffer fundet i nye TV, monitor, spillekonsol og transformere (Malmgren-Hansen et al. 2003)		
	Benzen	71-43-2	Fundet i TV og monitor Asp. Tox. 1, Skin Irrit. 2, Eye Irrit. 2, Muta. 1B, Carc. 1A, STOT RE 1
	Formaldehyd	50-00-0	Fundet i TV, monitor, spillekonsol og transformere Acute Tox. 3, Skin Corr. 1B, Skin Sens. 1, Acute Tox. 3, Muta. 2, Carc. 1B Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og CoRAP-listen[1]
	Acetaldehyd	75-07-0	Fundet i TV, monitor, spillekonsol og transformere Eye Irrit. 2, STOT SE 3, Carc. 2
	3-caren	13466-78-9	Fundet i TV og monitor Selvklassifikation: Asp. Tox. 1, Skin Irrit. 2, Skin Sens. 1
	Butylhydroxytoluen (BHT)	128-37-0	Fundet i TV, monitor og transformere Selvklassifikation: Acute Tox. 4, Skin Irrit. 2, Eye Irrit. 2, STOT SE 3
	Styren	100-42-5	Fundet i TV, monitor og spillekonsol Skin Irrit. 2, Eye Irrit. 2, Acute Tox. 4, Repr. 2, STOT RE 1 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
			2010)
	Ethylbenzen	100-41-4	Fundet i TV, monitor og transformere Skin Irrit. 2, Eye Irrit. 2, Acute Tox. 4, Repr. 2, STOT RE 1, mistænkt fosterskadende Opført på CoRAP-listen[1]
	2-ethylhexansyre	149-57-5	Fundet i transformere Repr. 2
	Cyclohexanon	108-94-1	Fundet i monitor og transformere Acute Tox. 4, mistænkt kræftfremkaldende
	Dibutylftalat	84-74-2	Fundet i TV, monitor, spillekonsol og transformere Repr. 1B Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) kandidatlisten[2]
	Problematiske stoffer fundet ved brug af produkterne: printer, hårtørrere, mobiltelefon, strygejern, dekorative lamper, computere, TV, el-paneler (multistikdåser) (Mortensen 2005)		
	2-Ethylhexansyre	149-57-5	Repr. 2 Opført på CoRAP-listen[1]
	2-ethylhexylacrylat	103-11-7	Skin Irrit. 2, Skin Sens. 1, STOT SE 3
	Acetaldehyd	75-07-0	Eye Irrit. 2, STOT SE 3, Carc. 2

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
	Benzothiazol	95-16-9	Selvklassifikation: Acute Tox. 3, Eye Irrit. 2Eye Irrit. 2, Acute Tox. 4
	Butyleret Hydroxytoluen (BHT)	128-37-0	Selvklassifikation: Acute Tox. 4, Skin Irrit. 2, Eye Irrit. 2, STOT SE 3
	Dibutylphthalat	84-74-2	Repr. 1B Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) kandidatlisten[2]
	Ethylbenzen	100-41-4	Skin Irrit. 2, Eye Irrit. 2, Acute Tox. 4, Repr. 2, STOT RE 1, mistænkt fosterskadende
	Ethylglycolacetat;	111-15-9	Repr. 2;R60-61 Xn;R20/21/22 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) kandidatlisten[2]
	Formaldehyd	50-00-0	Acute Tox. 3, Skin Corr. 1B, Skin Sens. 1, Acute Tox. 3, Muta. 2, Carc. 1B Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og CoRAP-listen[1]
	Hydroxyethylmethacrylat	868-77-9	Skin Irrit. 2, Skin Sens. 1, Eye Irrit. 2 Opført på CoRAP-listen[1]
	Kodaflex (1-isopropyl-2,2-dimethyltrimethylene diisobutyrate)	6846-50-0	Selvklassifikation: Skin Irrit. 2
	Longifolen (2-ethylhexyl acrylate)	103-11-7	Skin Irrit. 2, Skin Sens. 1, STOT SE 3
	Naphtalen	91-20-3	Acute Tox. 4, Carc. 2 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
			2010) og CoRAP-listen[1]
	Methylmethacrylat	80-62-6	Skin Irrit. 2, Skin Sens. 1, STOT SE 3 Opført på CoRAP-listen[1]
	Phenol	108-95-2	Acute Tox. 3, Skin Corr. 1B, Muta. 2, STOT RE 2 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)
	Phthalsyre anhydrid	85-44-9	Acute Tox. 4, Skin Irrit. 2, Skin Sens. 1, Eye Dam. 1, Resp. Sens. 1, STOT SE 3
	Problematiske stoffer i printplader (Remmen et al. 1999):		
	Epoxy (kan indeholde Bisphenol A)	80-05-7 (Bisphenol A)	Skin Sens. 1, Eye Dam. 1, STOT SE 3, Repr. 2 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010), CoRAP-listen[1] samt på den norske prioritetsliste[3].
	Bromerede flammehæmmere	-	Visse bromerede flammehæmmere er opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)
Elektronik Ledninger	Problematiske stoffer, der kan være til stede i ledninger (Hansen et al. 2014)		
	Bly og blyforbindelser (Stabilisator i PVC)	-	PVC-producenterne i EU forventer en total substitution i 2015 (Hansen et al. 2014). Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og på den norske prioritetsliste[3]
	Dibutyltin diklorid (Stabilisator i PVC)	683-18-1	Acute Tox. 3, Acute Tox. 4, Skin Corr. 1B, Acute Tox. 2, Muta. 2, Repr. 1B, STOT RE 1 Opført på kandidatlisten[2] samt på listen over registrering af

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
			intentioner[4]
	Medium-kæde klorinerede paraffiner (MCCP) (blødgører og flammehæmmer i PVC)	85535-85-9	Lact. Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010), CoRAP-listen[1] og den norske prioritetsliste[3].
	Octylphenol and dens ethoxylater (Antioxidant)	140-66-9, 1806-26-4, 9004-87-9, 9036-19-5, 9063-89-2, 11081-15-5, 68987-90-6, 69011-84-3	140-66-9, 1806-26-4 og 11081-15-5 er opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) Opført på kandidatlisten[2] og den norske prioritetsliste[3].
	Perfluoroctancarboxylat (PFOA) og lignende forbindelser (Dispergeringsmiddel i plasten Polytetrafluorethylene (PTFE))	-	Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010), kandidatlisten[2], den norske prioritetsliste[3], samt listen over registrering af intentioner[4]
	Ledninger af plastmaterialer er tilsat blødgørere, f.eks. ftalater (Nils Nilsson, personlig kommunikation 2014)		
	Ftalater	-	Flere ftalater er mistænkt for at være hormonforstyrrende Opført på kandidatlisten[2] Opført Miljøstyrelsens liste over uønskede stoffer (Miløstyrelsen 2009)
	Ledninger af gummimaterialer er tilsat gummikemikalier. Nogle gummityper vulkaniseres med organiske svovlforbindelser, f.eks. benzothiazol. Hvis ledningen er sort, vil der også være forskellige PAH'er til stede (Nils Nilsson,		

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
	personlig kommunikation 2014)		
	Organiske svovlforbindelser, herunder benzothiazol	95-16-9 (Benzothiazol)	Selvklassifikation: Acute Tox. 3, Eye Irrit. 2Eye Irrit. 2, Acute Tox. 4 (Benzothiazol)
	PAH'er	-	En del PAH'er er klassificerede som kræftfremkaldende (Nilsson et al. 2005).
Elektronik Pærer	Der er ikke fundet reference vedrørende problematiske stoffer i glødepærer.		
	Der er i lysstofrør og energisparepærer (Poulsen og Merrild 2010) følgende problematiske stoffer:		
	Kviksølv	7439-97-6	Acute Tox. 2, Repr. 1B, STOT RE 1 Opført på Miljøstyrelsens liste over uønskede stoffer I lysstofrør og energisparepærer er der kviksølv til stede i mængder, der er problematiske ved indånding, hvis en lyskilde går itu. Afhængig af ventilationen i rummet tager det 10 min. – 2 timer førend kviksølvskoncentrationen kommer under 33 µg Hg/m3 (DNEL-værdi for kort eksponeringstid) i indåndingszonen (Poulsen og Merrild 2010).
Gummi Dæk (cykler, biler og traktorer)	Nye og brugte dæk er undersøgt for tilstedeværelse af PAH'er og aromatiske aminer (Nilsson et al. 2005)		
	Fluoranthen	206-44-0	Fundet i 21 ud af 21 analyserede dæk Selvklassifikation: Acute Tox. 4
	Pyren	129-00-0	Fundet i 21 ud af 21 analyserede dæk Selvklassifikation: Skin Irrit. 2, Eye Irrit. 2, STOT SE 3
	Benz(a)anthracen	56-55-3	Fundet i 20 ud af 21 analyserede dæk

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
			Carc. 1B
	Chrysen	218-01-9	Fundet i 20 ud af 21 analyserede dæk Muta. 2, Carc. 1B
	Benzo(b+j+k)fluoranthen	205-99-2 205-82-3 207-08-9	Fundet i 20 ud af 21 analyserede dæk Carc. 1B
	Benzo(e)pyren	192-97-2	Fundet i 21 ud af 21 analyserede dæk Carc. 1B
	Ben(a)pyren	50-32-8	Fundet i 21 ud af 21 analyserede dæk Skin Sens. 1, Muta. 1B, Carc. 1B, Repr. 1B Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)
	Indeno(1,2,3-cd)pyren	193-39-5	Fundet i 16 ud af 21 analyserede dæk Selvklassifikation: Carc. 2
	Benzo(ghi)perylen	191-24-2	Fundet i 21 ud af 21 analyserede dæk Ingen data vedrørende sundhedsfare i ECHA C&L fortegnelsen
	Dibenz(ah)anthracen	53-70-3	Fundet i 4 ud af 21 analyserede dæk Carc. 1B
	N-(1,3-dimethylbutyl)-N´-phenyl-p-phenylendiamin	793-24-8	Fundet i 21 ud af 21 analyserede dæk

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
	(6PPD)		Selvklassifikation: Acute Tox. 4, Skin Sens. 1
	N-isopropyl-N´-phenyl-p-phenylendiamin (IPPD)	101-72-4	Fundet i 18 ud af 21 analyserede dæk Acute Tox. 4, Skin Sens. 1,
	N,N´-diphenyl-p-phenylendiamin (DPPD)	74-31-7	Fundet i 9 ud af 21 analyserede dæk Skin Sens. 1
	1-naphthyl-phenyl-amin (PAN)	90-30-2	Fundet i 1 ud af 21 analyserede dæk Acute Tox. 4, Skin Sens. 1, STOT RE 2 Opført på CoRAP-listen[1]
Gummi Slanger (cykler, biler og traktorer)	Slanger til dæk er lavet af Butylgummi. Det vulkaniseres typisk med organiske svovlforbindelser, som f.eks. benzothiazol. Hvis slangen er sort, vil der der også være forskellige PAH'er til stede (Nils Nilsson, Personlig kommunikation 2014).		
	Organiske svovlforbindelser, herunder Benzothiazol	95-16-9 (Benzothiazol)	Acute Tox. 3 , Eye Irrit. 2 , Acute Tox. 4 (Benzothiazol)
	PAH'er	-	En del PAH'er er klassificerede som kræftfremkaldende (Nilsson et al. 2005).
Metal Dåser	Dåser til fødevarer og drikkevarer er enten lavet af hvidblik, der fortinnes eller aluminium. Både hvidblik og aluminumsdåser bliver forsejlet med et lag lak, typisk exopy- og organosol, der kan indeholde Bisphenol A (Hansen 2014).		
	Bisphenol A	80-05-7	Skin Sens. 1, Eye Dam. 1, STOT SE 3, Repr. 2 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010), CoRAP-listen[1] samt på den norske prioritetsliste[3].
Metal	Skruer og bolte kan indeholde følgende tungmetaller (Thomsen et al 2003):		

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
Byggevarer (søm, skruer, møtrikker, spændeskiver, vvs-rør og rørsamlinger)	Bly	7439-92-1	Rørfittings af messing er typisk messing med bly (Thomsen et al. 2003). Selvklassifikation: Repr. 1A, STOT RE 1 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og på den norske prioritetsliste[3]
	Cadmium	7440-43-9	I "Bekendtgørelse om ændring af bekendtgørelse om udstedelse af godkendelser for byggevarer i kontakt med drikkevand", BEK nr. 31 af 21/01/2013, er det oplistet at armaturer, fittings, ventil og lignende, hvor metal er i kontakt med drikkevand, bl.a. skal testes for Cadmium." Acute Tox. 2, , Muta. 2, Carc. 1B, Repr. 2, STOT RE 1 Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og kandidatlisten[2]
	Krom	7440-47-3	Beslag, kroge mm af messing samt skruer og bolte af messing og rustfrit stål er ofte forkromede (Thomsen et al 2003). Selvklassifikation: Skin Sens. 1, Resp. Sens. 1
	Nikkel	7440-02-0	I "Bekendtgørelse om ændring af bekendtgørelse om udstedelse af godkendelser for byggevarer i kontakt med drikkevand", BEK nr. 31 af 21/01/2013, er det oplistet at armaturer, fittings, ventil og lignende, hvor metal er i kontakt med drikkevand, bl.a. skal testes for nikkel. Skin Sens. 1, Carc. 2, STOT RE 1
Papir Tryksager (f.eks. aviser, blade og reklamer)	Problematiske flygtige forbindelser, der afgives fra nye tryksager (Hansen og Eggert 2003):		
	Toluen	108-88-3	Asp. Tox. 1, Skin Irrit. 2, STOT SE 3, Repr. 2, STOT RE 2

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
	Terpener		Terpenerne er generelt slimhindeirriterende (Hansen og Eggert 2003).
	Aldehyder		Aldehyder irriterer hud, øjne og de øvre luftveje (Hansen og Eggert 2003).
	Langkædede alifatiske kulbrinter		For mange af de alifatiske kulbrinter er der observeret dermatitis, irritation, påvirkninger af centralnervesystemet og bedøvende virkninger (Hansen og Eggert 2003).
Plast CD og DVD	CD'er består næsten udelukkende af polycarbonat plast med et tyndt lag aluminium eller i nogle tilfælde guld. Desuden er CD'en lakeret for at beskytte metallet(www.chemistry.about.com).		
	Problematiske stoffer, der kan være til stede i polycarbonat plast (Hansen et al. 2014):		
	Bisphenol A findes meget ofte i polycarbonat plast.	80-05-7	Skin Sens. 1, Eye Dam. 1, STOT SE 3, Repr. 2 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010), CoRAP-listen[1] samt på den norske prioritetsliste[3].
	4-tert-Butylphenol, 2,6-Di-tert-butylphenol	98-54-4, 128-39-2	Skin Irrit. 2, Eye Dam. 1, Repr. 2 Selvklassifikation: Skin Irrit. 2 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)
Plast Emballage, der ikke er fødevaregodkendt (f.eks. shampooflasker og rengøringsartikler)	Plastemballage, der ikke er fødevaregodkendt, kan være opbygget af alle former for plast. Plast kan indeholde problematiske stoffer inden for grupperne (Hansen et al. 2014):		
	Antimikrobielle forbindelser		
	Blødgørere		
	Farvestoffer indeholdende tungmetaller		

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
	Flammehæmmere		Visse bromerede flammehæmmere er opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)
	Monomerer, hærdere og katalysatorer		
	Opskumningsmidler		
	Organiske farvestoffer		
	Solventer		
	UV stabilisatorer, antioxidanter og andre stabilisatorer		
Plast Engangsservice i plast (kopper, bestik og tallerkener)	Engangsservice er underlagt lovgivningen for fødevarekontaktmaterialer og er lavet af enten af Polyethylen (PE), Polyetylentereftalat (PET) eller Polystyren (PS) (www.forbrugerkemi.dk "Fakta om engangsservice", Jensen et al. 2000). Ved opvarmning af PS kan der frigives styrenmonomere (Nils Nilsson, personlig kommunikation 2014)		
	Styren	100-42-5	Skin Irrit. 2, Eye Irrit. 2, Acute Tox. 4, Repr. 2, STOT RE 1 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010).
Plast Flamingo	Flamingo er en polymer af styren. Styren forventes ikke at blive frigivet fra flamingo eller evt. fri styren forventes at være fordampet inden evt. brug som brugt produkt i kreativ sammenhæng (Nils Nilsson, personlig kommunikation 2014)		
	Styren	100-42-5	Skin Irrit. 2, Eye Irrit. 2, Acute Tox. 4, Repr. 2, STOT RE 1 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
			2010)
	Flammehæmmere	-	Kun relevant i polystyren brugt som isoleringsmaterialer i bygninger (Nils Nilsson, personlig kommunikation 2014). Visse bromerede flammehæmmere er opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)
Plast Haveslange	Er som oftest lavet af PVC. En undersøgelse i 2013 af 21 haveslanger viste at 14 ud af 21 var lavet af PVC (www.healthystuff.org). Der blev desuden fundet følgende problematiske stoffer:		
	Antimon	7440-36-0	Fundet i 11 ud af 21 slanger Selvklassifikation: Acute Tox. 4
	Bly > 100 ppm	7439-92-1	Fundet i 3 ud af 21 slanger. PVC-producenterne i EU forventer en total substitution i 2015 (Hansen et al. 2014) Selvklassifikation: Repr. 1A, STOT RE 1 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og på den norske prioritetsliste[3]
	Bisphenol A	80-05-7	Fundet i vand fra 2 udvalgte PVC haveslanger Skin Sens. 1, Eye Dam. 1, STOT SE 3, Repr. 2 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010), CoRAP-listen[1] samt på den norske prioritetsliste[3].
	Ftalater	-	Undersøgt i 4 udvalgte PVC haveslanger

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
			Mistænkt for at være hormonforstyrrende DEHP, DBP og DiBP er opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) DEHP, DIBP, 1,2-Benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich (DiHepP) og DBP er opført på kandidatlisten[2]
	Tin stabilasatorer (fundet i 4 ud af 14 PVC haveslanger)	-	Liste over registrering af intentioner[4] (Hansen et al. 2014)
Plast Liggeunderlag og skummadrasser	Legetøj og børneartikler af skumplast er typisk produceret af EVA og PUR skum og kan indeholde følgende problematiske stoffer (Borling et al. 2006):		
	C10-C14 hydrocarboner (Flygtige organiske forbindelser)	-	En del PAH'er er klassificerede som kræftfremkaldende (Nilsson et al. 2005).
	Ftalater Dimethylphthalat (DMP) Diisobutylphthalat (DIBP) Di-n-butylphthalat (DBP) Di-2-(ethylhexyl)phthalat (DEHP) Di-n-octyl-phthalat (DNOP) Diisodecylphthalat (DIDP) Diisononylphthalat	 131-11-3 84-69-5 84-74-2 117-81-7 117-84-0 26761-40-0 28553-12-0	De lavmolekylære ftalater (DEHP, BBP, DBP og DIBP) er klassificerede som reproduktionsskadelige (Plastindustrien, www.plast.dk). Di(2-ethylhexyl)phthalat, (DEHP), Dibutylphthalat, (DBP), Benzylbutylphthalat, (BBP), Di(2-methoxyethyl)phthalate, (DMEP) og Diisobutylphthalat, (DIBP) er opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) Diallyl phthalate, diundecyl phthalate, diethyl phthalate, diundecyl phthalate og bis(2-propylheptyl) phthalate er opført på CoRAP-listen[1].
	Organotinforbindelser	-	Opført på den norske prioritetsliste[3] (Hansen et al. 2014)

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
	Der er fundet problematiske stoffer i nye baby skummadrasser (Tønning et al. 2008):		
	2-Ethyl hexansyre	149-57-5	Repr. 2 Opført på CoRAP-listen[1]
	2,4-Diisocyanat-1-methylbenzen	584-84-9	Skin Irrit. 2, Skin Sens. 1, Eye Irrit. 2, Acute Tox. 2, Resp. Sens. 1, STOT SE 3, Carc. 2 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)
	Hexaethylenglycol dimethylether	1072-40-8	Ingen data i ECHA C&L fortegnelsen
	Tetrapropylenglycol monomethyl ether	20324-34-9	Ingen data i ECHA C&L fortegnelsen
	Fleksibelt PUR skum fremstilles ved hjælp af toluen diisocyanater (TDI) og methylen difenyl diisocyanater (MDI) (Christensen et al. 2014) og kan forekomme som rester i skummet.		
	Toluen diisocyanater (TDI)	584-84-9 (2,4-TDI) 91-08-7 (2,6-TDI) 26471-62-5 (Mix af 2,4 TDI og 2,6 TDI)	Skin Irrit. 2, Skin Sens. 1, Eye Irrit. 2, Acute Tox. 2, Resp. Sens. 1, STOT SE 3, Carc. 2 Mix af 2,4 TDI og 2,6 TDI (CAS-nr. 26471-62-5) er opført på CoRAP-listen[1]. TDI er opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)
	Methylen difenyl diisocyanater (MDI)	101-68-8 (4,4'-MDI) 26447-40-5 (uspecificeret mix af	Skin Irrit. 2, Skin Sens. 1, Eye Irrit. 2, Acute Tox. 4, Resp. Sens. 1, STOT SE 3, Carc. 2, STOT RE 2 4,4'-MDI er opført på CoRAP-listen[1]. MDI er opført på Miljøstyrelsens liste over uønskede stoffer

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
		MDI)	(Miljøstyrelsen 2010)
Plast LP-plader	LP-plader er fremstillet af PVC og kan indeholde bly og cadmium som tidligere har været anvendt som stabilisator i PVC. Derudover kan der forekomme PAH. Ved opvarmning kan der frigives klorbrinte-gasser (Nils Nilsson, personlig kommunikation 2014).		
	Bly	7439-92-1	Selvklassifikation: Repr. 1A, STOT RE 1 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og på den norske prioritetsliste[3]
	Cadmium	7440-43-9	Acute Tox. 2, , Muta. 2, Carc. 1B, Repr. 2, STOT RE 1 Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og kandidatlisten[2]
	PAH	-	En del PAH'er er klassificerede som kræftfremkaldende (Nilsson et al. 2005).
	Klorbrinte (g)	7647-01-0	Skin Corr. 1B, STOT SE 3
Plast Kassettebånd og videobånd	Kassetter til lyd og videobånd er fremstillet af polystyren (PS) (Norrild 1988). Magnetbåndet er fremstillet af polyester og belagt med enten jern oxid, jernoxid med kobolt, krom dioxid med jern eller andre metallegeringer (Dumont et al. 1992) Der er ikke fundet referencer, der viser, at kassette eller magnetbånd afgiver problematiske stoffer.		
Plast Plexiglas	Methylmethacrylat - monomer kan frigives ved opvarmning (Nils Nilsson, Personlig kommunikation 2014). Opvarmning af plexiglas fandt dog sted under punktsug i denne kortlægning.		
	Methylmethacrylat - monomer	80-62-6	Skin Irrit. 2, Skin Sens. 1, STOT SE 3 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
Plast Slikposer	Slikposer og plastposer er underlagt lovgivningen for fødevarekontaktmaterialer og er som oftest lavet af LDPE. Der er ikke fundet referencer, der peger på en udskillelse af problematiske stoffer fra LDPE ved normal brug. Ved opvarmning er der en minimal risiko for dannelse af oxidationsprodukter og aldehyder (Nils Nilsson, Personlig kommunikation 2014)		
Træ Lakeret træ (f.eks. træ fra møbler, trælegetøj og hegn)	Der kan i lakeret træ være rester af lakkens monomerer og katalysatorer, der kan være problematiske. Ved opvarmning med brændepen kan der dannes en række nedbrydnings- og omdannelsesprodukter af ukendt natur. Dannelse afhænger af laktypen, temperatur og tid (Nils Nilsson, Personlig kommunikation 2014)		
	Rester af monomerer og katalysatorer	-	-
	CMR-stoffer i legetøj af træ (malet/behandlet), som er fundet i databasen RAPEX (Heckmann et al., endnu ikke offentliggjort)		
	Formaldehyd	50-00-0	Forventes at være fordampet i brugte produkter Acute Tox. 3, Skin Corr. 1B, Skin Sens. 1, Acute Tox. 3, Muta. 2, Carc. 1B Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og CoRAP-listen[1]
	Bly	7439-92-1	Selvklassifikation: Repr. 1A, STOT RE 1 Opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010) og på den norske prioritetsliste[3]
	Krom	7440-47-3	Selvklassifikation: Skin Sens. 1, Resp. Sens. 1
	O-toluidin	95-53-4	Acute Tox. 3, Eye Irrit. 2, Carc. 1B Opført på kandidatlisten[2]
Træ	På hjemmesiden Forbrugerkemi.dk (Forbrugerkemi.dk; Fakta om imprægnering af træ) er der fundet følgende		

Produkter og materialer	Problematiske stoffer	CAS-nr.	Bemærkning*
Trykimprægneret træ (grønt eller brunt, f.eks. fra terrasser og hegn)	problematiske stof:		
	Fungicider	-	-
	På Miljøstyrelsens hjemmeside (www.mst.dk; Trykimprægneret træ og naturligt træ samt Creosot) er der fundet følgende problematiske stoffer:		
	Arsen	7784-42-1	Acute Tox. 2, STOT RE 2
	Krom	7440-47-3	Selvklassifikation: Skin Sens. 1, Resp. Sens. 1
	Creosot En blanding af creosot, creosotolie, stenkulstjære, naphtalenolie, acenaphtenolie, anthracenolie og tjæresyrer	-	Creosot indeholder blandt andet benzo-a-pyren, som er kræftfremkaldende. Ved kontakt med creosot kan der desuden opstå allergisk kontakteksem (www.mst.dk; Creosot). Creosotforbindelser med kræftfremkaldende "urenheder" er opført på Miljøstyrelsens liste over uønskede stoffer (Miljøstyrelsen 2010)

How Child Care Centres Apply Material from Used Products

A survey on materials and products applied by kids for creative projects in child care centers has been performed. 26 products have been analyzed for problematic chemical substances that might be released during production or use of the produced products. In the analysis phthalates in PVC, triarylphosphate in PCBs and lead and cadmium in plastic was identified. For the phthalates, triarylphosphate and cadmium no risk could be found. The concentration of lead was higher than in the coming EU-legislation of 500 mg/kg and thus it is assumed that the kids might be at risk depending on the actual use of the products.

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