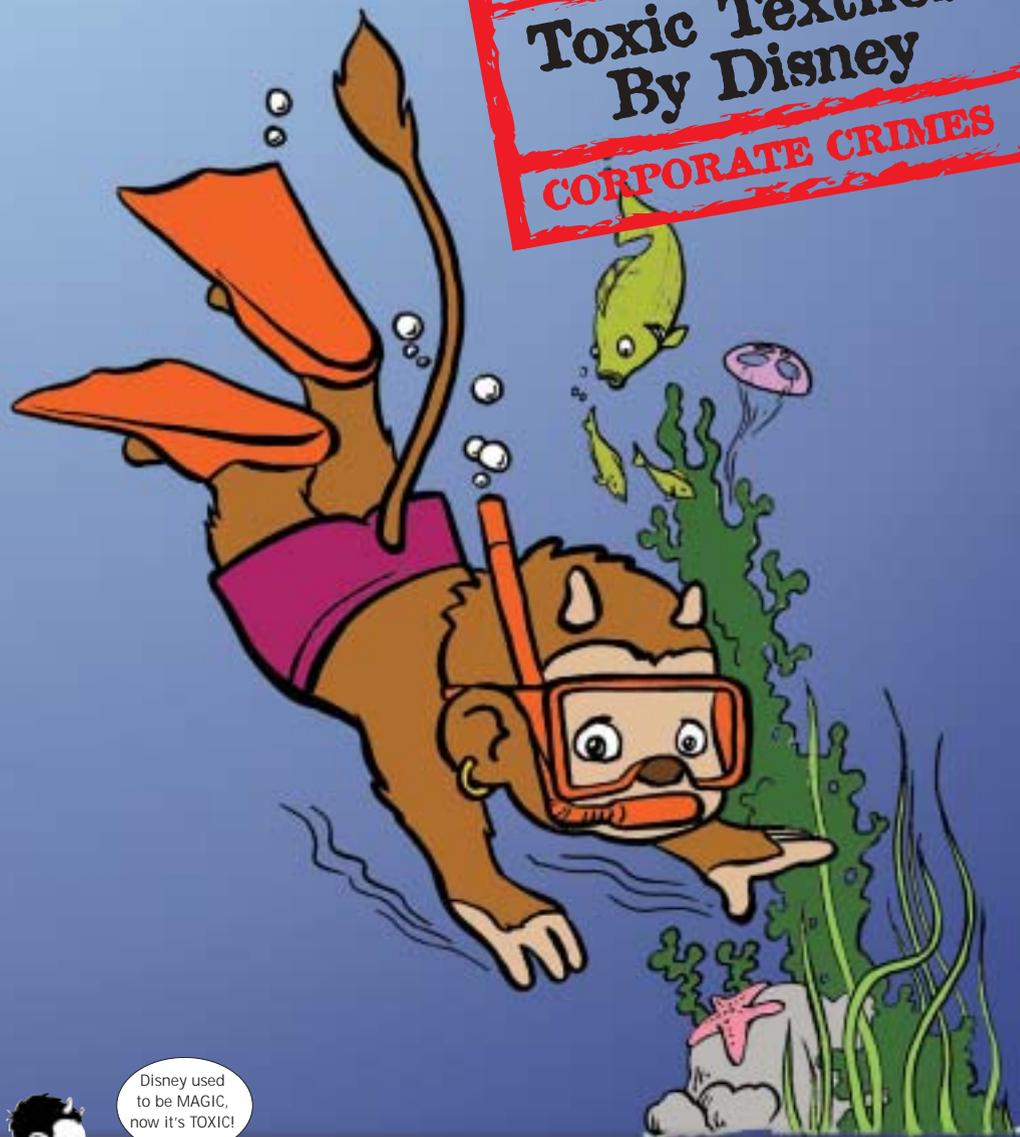


GREENPEACE

**GREENPEACE
INVESTIGATIONS**
**Toxic Textiles
By Disney**
CORPORATE CRIMES



Disney used
to be MAGIC,
now it's TOXIC!

 Toxic Childrenswear By Disney

*“The Walt Disney Company is always
concerned with quality and safety”*

LETTER TO GREENPEACE 28. OCTOBER 2003

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TOXIC CHILDRENSWEAR BY DISNEY

— A WORLDWIDE INVESTIGATION OF HAZARDOUS CHEMICALS IN DISNEY CLOTHES

EXECUTIVE SUMMARY

This report shows that chemicals that may present a long-term hazard to human health are present in Disney childrenswear. Disney garments, including T-shirts, pyjamas and underwear, were bought in retail outlets in 19 countries around the world and the printed logo sections analysed for a number of chemicals by the Danish independent laboratory Eurofins.

The results show clear differences in the chemical content of the finished garments. The bad news is that most prints contained high levels of one or other of the hazardous chemicals. The good news is that some Disney prints have been produced without using certain of these hazardous chemicals. This provides a strong indication that, if Disney cared about chemical contaminants in their childrenswear, hazardous substances could be substituted or simply avoided.

Greenpeace has urged Disney to take responsibility for avoiding or substituting harmful chemicals in their products. When licensing their logo and characters for use on their products, Disney should demand that their licensees implement a chemical policy that protects children's health. Disney reacted by stating that their products are in line with the law, and therefore took no further action.

While voluntary initiatives to phase out hazardous substances by retailers such as H&M are welcome and show that chemical substitution is possible, the reaction by Disney demonstrates that only legislation can ensure that these chemicals are not allowed to be produced and used. For this reason, Greenpeace demands that the global Stockholm Convention on Persistent Organic Pollutants and the European Union's chemical policy reform embrace the principle of mandatory substitution, which requires replacing the use of hazardous chemicals with safer alternatives.

INTRODUCTION

Although the widespread presence of hazardous man-made chemicals in the environment is increasingly being documented, few people are aware that many of these same chemicals are found in children's clothes. Greenpeace undertook this investigation as part of its campaign to show how dangerous chemicals are out of control, turning up in house dust, in household products, food, rain water, in our clothes.....and ultimately in our bodies.¹

Before a garment reaches the shops, it has been through many processing steps that contribute to its overall chemical footprint and the final chemical residues remaining in the finished product. Manufacture of fibres and yarn, pretreatment, dyeing, printing, aftercare and preservation all involve the use of chemicals, including inevitable direct releases to the environment during manufacture and the potential for long-term dispersive releases of chemicals from the finished textiles during wear, laundering and final disposal.

Chemically processed textiles inevitably contribute to our overall exposure to chemicals from consumer products, as well as providing a more direct route of chemical exposure through contact with the skin. Of course, whilst it has not been conclusively proven that such exposure is causing adverse health effects, given the hazards associated with the chemicals in question, there is absolutely no reason for complacency.

To date, the issue of chemical exposure in consumer products has generally been poorly investigated and improperly assessed. It is vital that consumer products

should be safe to use and are free from hazardous chemicals. So far, there is no guarantee that this is the case and growing evidence to the contrary. In effect, the consumer currently has no right to know which products contain hazardous additives or contaminants and no way to make informed decisions to minimise or avoid their exposure to hazardous chemicals.



TESTING OF DISNEY CHILDRENSWEAR

In late 2003, Greenpeace bought a range of Disney childrenswear, including t-shirts, vests, pyjamas, rainwear and underwear, from 19 countries around the world, including Europe, Asia, North and South America and New Zealand. The printed sections of the garments bearing the Disney logo or a Disney trademarked character were analysed for substances which may be capable of causing reproductive and immune system disorders, hormone mimicking or even cancer in a variety of living organisms (see Annex A).

¹ See Campaigns, Toxics at: <http://www.greenpeace.org.uk/>

The independent Danish laboratory, Eurofins², conducted the chemical analyses on behalf of Greenpeace.

THE SUBSTANCES THAT GREENPEACE ASKED EUROFINS TO LOOK FOR WERE:

1. Phthalates – toxic and widely used for plasticizing (softening) PVC. PVC prints are one of the uses of phthalate-plasticized PVC that could lead to long periods of direct skin contact in children, plus the potential for inhalation and even ingestion of additional quantities (Lewis et al. 1994)³. The EU has classified two types of phthalates – DEHP and DBP – as ‘toxic to reproduction’ (EU 2003a).
2. Alkylphenol ethoxylates – including octyl and nonyl phenoethoxylates. Alkylphenol ethoxylates (APEs) are used in industrial detergents, though these chemicals, and the related alkylphenols, have many other commercial applications. Alkylphenols, which are also formed through the environmental degradation of their ethoxylates, are best known for their hormone-disrupting properties, which can lead to altered sexual development in some organisms (Jobling et al. 1995).
3. Organotins – toxic and used as stabilisers in PVC. Textiles containing polymer parts, like T-shirts with prints, can contain organotin compounds such as butyl- and octyltin compounds. Approximately 15,000 tonnes of organotins were used in PVC in Europe in 1995. (Ortepa, 2000) Organotins have been shown to have immunotoxic and developmental properties in mammals (Kergosien and Rice 1998).

4. Lead – toxic and used in colours and as a stabiliser in PVC. In 2002, stabiliser usage was reported as 120,000 tonnes/year (ENDS 2002). The impacts of lead on the developing nervous system of children are of extreme concern, and can result in a permanent lowering of IQ (Nielsen et al. 2001).
5. Cadmium – toxic and used as pigment and a stabiliser. Recent data derived from cadmium flows in the EU for around the year 2000 indicate that 300-350 tonnes of cadmium were used in pigments and 150 tonnes in stabilisers per year (EC 2002). The International Agency for Research on Cancer and the US Department of Health and Human Services both classify cadmium and cadmium compounds as carcinogenic to humans (USDHHS 2000 and IARC 1994).
6. Formaldehyde – toxic and used for pre-shrinkage treatment and fixation of dyes & pigments. The International Agency for Research on Cancer has classified formaldehyde as a probable carcinogen in humans (IARC 1995).

Disney used to be fun
– now it turns out
to be TOXIC



DIVERSE RESULTS

Eighteen of the products tested were Disney prints applied to woven fabric, such as T-shirts, pyjamas and underwear. The results show that these Disney prints contain chemicals that are inher-

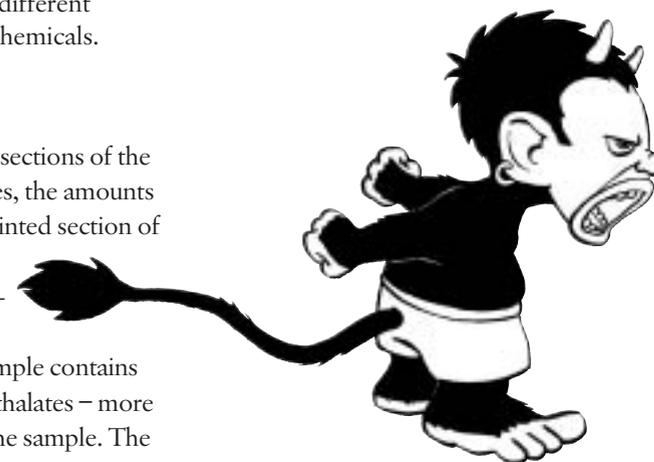
ently hazardous.⁴ A comparison of the chemical content of various printed sections of the fabrics reveals that similar products contain vastly different amounts of hazardous chemicals.

1. PHTHALATES

Although all the printed sections of the fabrics contain phthalates, the amounts vary enormously. The printed section of the Danish Tigger vest has a total phthalate content of 1.4 mg/kg, while the Slovak Tigger bib sample contains 200,000 mg/kg total phthalates – more than 20% by weight of the sample. The Dutch Donald Duck T-shirt print contained 170,036 mg/kg total phthalates – more than 17% by weight of the sample. This suggests that the garments may have been printed with PVC-based plastisol prints. Whilst the prints on garments from Belgium, Canada, Norway, China, Spain and USA contained high levels of phthalates, at between 42 and 101 g/kg or 4% - 10% by weight (Eurofins, 2003), by comparison 6 other prints contained less than 0.1 gram of phthalates/kg.

Really necessary?

Substitution of PVC plastisol printing with non-PVC alternatives is undoubtedly the simplest way to avoid the use of phthalates in children's clothing. In 2002, global clothes retailer Hennes & Mauritz entirely substituted PVC and PVC prints for all their applications, amply showing that there is positive solution to the current “laissez faire” chemical policy of Disney. The low levels of phthalates in the H&M-purchased vest from Denmark indicate



We know that these chemicals are toxic. So why are Disney using them when they can be avoided?

phthalate contamination from e.g. carry-over of processing chemicals rather than deliberate addition of phthalates to the clothing, as these lower concentrations would be unlikely to confer any significant plasticizing effect. Marks & Spencer is currently phasing out the use of PVC, phthalates and alkylphenol ethoxylates: by autumn 2003, 70% of childrenswear with printed motifs was free of these substances, and by autumn 2004, all childrenswear with prints is to be free of these substances.

2. ALKYLPHENOL ETHOXYLATES (APES)

This chemical group includes: nonylphenol ethoxylates (NPEs) and octylphenoethoxylates (OPEs). They were found in all the Disney products tested, in levels ranging from 34.1 mg/kg in the Princess T-shirt from Canada to 1,700 mg/kg in the Austrian Minnie Mouse pyjamas.

² Eurofins Danmark A/S, Smedeskovvej 38 DK-8464 Galten. Website: www.eurofins.dk

³ The draft EU Risk Assessment Report for the phthalate DEHP recognises the significance of dermal and inhalation exposure routes for DEHP from toys and childcare articles, especially in children, Document R042 0109 env hh 0-3 and 4-6 at: <http://ecb.jrc.it/existing-chemicals/>

⁴ Dalgaard et al. 2001; EC 2002a; Harreus et al. 2002; Kergosien and Rice 1998; Nielsen et al. 2001; ATSDR 2000; USDHHS 2000; IARC 1994; IARC 1995

Really necessary?

Marks & Spencer is currently phasing out the use of PVC, phthalates and alkylphenol ethoxylates. By autumn 2004, their target is to phase out the use of these substances in all their childrenswear bearing printed motifs. Hennes & Mauritz are to investigate the use of these substances to try to find candidates for substitution (Hennes & Mauritz 2004). The Danish EPA (2000) has recommended nonylphenoethoxylates for substitution or for their use to be limited to an absolute minimum, stating that: "for all uses and in all circumstances it is possible to find suitable alternatives".

3. ORGANOTINS

Of the 16 products tested for organotins, 7 did not have levels above the detection limit. However the Dutch Donald Duck T-shirt contained 474 microg/kg total organotins, indicating the use of organotin as a PVC stabiliser.

Organotins are hazardous! What did the Dutch Donald Duck do to deserve so much, when it can't even be detected in the Danish Disney Tigger?

*Really necessary.*

The fact that organotins were not present at levels above detection limits in some of the garments analysed suggests that the substance is not necessary or that alternative substances are available to perform the same function, either in processing or in the final product, such that the presence of organotin compounds in finished garments could be avoided entirely.

4. LEAD

Lead was found in all of the Disney products sampled, ranging from 0.14 mg/kg to 2,600 mg/kg in a Canadian Princess T-shirt and 76 mg/kg of lead in the Belgian Mickey Mouse T-shirt.

Not fair! The Canadian Princess is so toxic, that she'd be illegal in Denmark

*Really necessary?*

The presence of lead is unacceptable and according to clothes retailer Hennes & Mauritz (2004), the low levels are probably due to contamination, since there is no reason to add lead to the production process. The Danish EPA (2000) similarly concludes that: "low level concentrations are likely to be impurities in colours" and that: "the big producers have all developed special metal-free colour and pigmentation series". Alternatives to lead stabilisers are also available e.g. calcium-zinc based or organic stabilisers (ENDS 2003). Lead stabilisers are already phased out in Sweden, and Denmark recently imposed a wide-ranging ban on the import, marketing and manufacture of lead and products containing lead (MEE 2000), making the Canadian Disney Princess T-shirt illegal on the Danish market.

5. CADMIUM

Cadmium was identified in 14 of the 18 Disney products tested, at levels ranging from 0.0069 mg/kg in the Finding Nemo T-shirt bought in the UK to 38 mg/kg in the Belgian Mickey Mouse T-shirt. Five

of the products tested did not have levels above the detection limit.

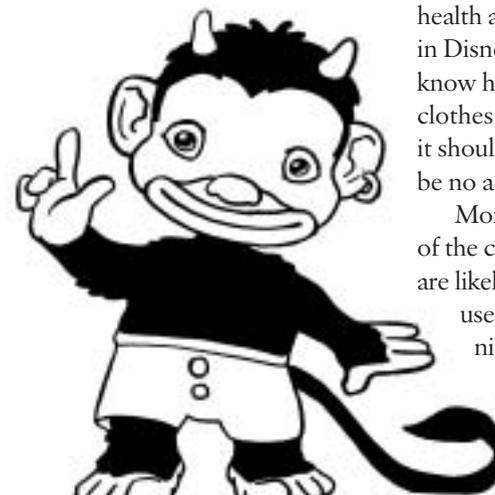
Really necessary?

The presence of cadmium in textiles is unacceptable. The Danish EPA (2000) suggests that high levels of cadmium in textiles are probably caused by cadmium used as PVC stabiliser or (less likely) as pigmentation. Given that PVC print can be readily substituted and the fact that cadmium is not found in all samples, demonstrates that materials or process substitution can avoid the presence of cadmium.

6. FORMALDEHYDE

Formaldehyde was found in 8 of the 15 products tested for this chemical, in levels ranging from 23 mg/kg in the Princess Ariel T-shirt bought in Argentina to 1,100 mg/kg in the Finding Nemo T-shirt bought in the UK.

Wow! If Buzz Lightyear from the Philippines can be formaldehyde-free - why is poor Nemo from the UK drowning in this nasty chemical?

*Really necessary?*

The fact that formaldehyde is not detected in half of the garments is a strong indication that this toxic chemical is not an essential component of finished garments. Formaldehyde might have been eliminated by using formaldehyde-free processes, or by effective washing processes that remove the chemical. In the latter case, only consumer exposure is eliminated, but environmental and occupational health problems remain.

A nineteenth sample

A nineteenth sample tested by Eurofins was a German Winnie the Pooh PVC raincoat - the only non-textile to be analysed. This contains an astounding 320,000 mg/kg total phthalates, or 32% by weight of the raincoat! The PVC raincoat also contained 1,129 micrograms/kg organotins, indicating the use of organotin as a PVC stabiliser.

CHEMICALS OUT OF CONTROL IN DISNEY CLOTHES

These results show that chemicals which, due to their intrinsic properties, may present a long-term hazard to human health and the environment are present in Disney garments. While we cannot know how much their presence in clothes contributes to overall exposure, it should not be assumed that there will be no adverse effects.

Moreover, it would appear that many of the chemicals identified in this study are likely to be present as a result of the use of PVC plastisol printing techniques which, through comparison of products, prove to be by no means essential. Such prints may be relatively cheap to

apply in complex and attractive designs, but other printing techniques that do not rely on the use of phthalates, alkylphenol ethoxylates and other hazardous chemicals are widely available. Much of the chemical exposure which could result from the wearing and laundering of many of the Disney garments analysed in this study can be avoided entirely by the mandatory substitution of hazardous chemicals where they are unnecessary. Greenpeace believes that Disney, who is marketing garments for children, should not disregard the fact that hazardous chemicals are being used in the production of garments.



Hmmm! Doesn't it make sense for Disney to withdraw these toxic products?

EVIDENCE OF SUBSTITUTION

The results show that some of the prints have been produced without using certain hazardous chemicals.

The good news is that these chemicals are not necessary and it is possible to make a printed T-shirt without them. Clearly, some manufacturers have avoided the use of hazardous chemicals or have substituted them with safer alterna-

tives. An important player in reducing the presence of hazardous chemicals is the retailer. The Danish Tigger vest was bought at Hennes & Mauritz (H&M), a global clothes retailer which in 2002 decided to substitute PVC and PVC prints in all their products. This explains the low or non-detectable levels of PVC additives in the Tigger vest, bought at an H&M outlet in Denmark.

The bad news is that most prints contained high levels of one or other of the hazardous chemicals. Clearly, if Disney is concerned about the chemical contaminants in its products, it would impose on their licensees a chemical policy which protects children.

LEGAL POLLUTION

Existing legislation on chemicals fails to prohibit the use of hazardous chemicals in consumer products. The high levels of one or other of the hazardous chemicals found in Disney childrenswear are legally allowed. Until chemicals legislation is reformed to make the use of harmful chemicals in the production of consumer goods illegal, corporations should take responsibility for avoiding or substituting harmful chemicals in their products. Companies like Marks & Spencer and Hennes & Mauritz are actively promoting and implementing substitution.

Despite enquiries by Greenpeace, in letters from Greenpeace UK to Disney dated 18th February 2003, 16th May 2003, 20th October and 31st October 2003⁵, Disney have so far not shown any interest in phasing out and substituting hazardous chemicals in their products. Indeed, in a letter to Greenpeace dated

5 Letter from Disney Managing Director UK dated 28th October 2003, to Mark Strutt at Greenpeace UK

28th October 2003, Disney confirms that they react only to legislation, stating: *"We take all comments on this subject seriously and constantly review our policies and procedures to make certain that they continue to be in full conformity with all relevant legislation."*

GREENPEACE DEMANDS: CORPORATE RESPONSIBILITY

Common to all the clothes tested by Eurofins on behalf of Greenpeace are that they are Disney merchandise with Disney prints and motifs. Disney places strict conditions on the use of its copyright characters, including the design and use of colours. It should also ensure hazardous chemicals are not used in products it licences or produces.

When licensing their logo and characters for use on their products, Disney should demand that their licensees avoid the use of hazardous substances or substitute them with safer alternatives. An examination of Disney's code of conduct⁶ reveals that Disney indeed exerts a lot of control over their licensees, so there should be no excuse for not making demands of their licensees on clean production standards.

While such voluntary initiatives to phase out hazardous substances by retailers are to be welcomed and show that chemical substitution can not only be achieved, but insisted upon, the inaction by Disney, and its response to Greenpeace's enquiries, shows that only legislation can ensure that these chemicals are not allowed to be used in the production of garments.

6 See Disney's code of conduct at: <http://disney.go.com/corporate/compliance/code.html>

WHAT IS THE SUBSTITUTION PRINCIPLE?

The Principle of Substitution states that hazardous chemicals should be systematically substituted by less hazardous alternatives or preferably alternatives for which no hazards can be identified.



GREENPEACE DEMANDS: MANDATORY CHEMICAL SUBSTITUTION

As this report shows, existing legislation on chemicals fails to prohibit the use of hazardous chemicals in consumer products. This policy failure is being addressed in two political forums.

Globally, the 2001 Stockholm Convention seeks to ban the production and use of 12 identified persistent organic pollutants (POPs), the "dirty dozen". They include 10 intentionally produced chemicals, such as pesticides and PCBs, and two by-products: cancer-causing dioxins and furans, released from industries that use chlorine and from waste incinerators that burn products containing chlorine.

The Stockholm Convention serves two main objectives:

- incorporating additional chemicals and groups of chemicals with POPs characteristics under the remit of the Convention.
- banning or phasing out POPs by identifying environmentally safer alternatives.

The success of the Stockholm Convention in protecting human health and the environment from hazardous chemicals will depend on the active implementation of these broad objectives. By May 2006, parties to the Stockholm Convention have to draw up action plans on measures to identify, characterise and minimise with a view to eliminating releases of POPs. Article 5 of the Stockholm Convention requires that: *“The action plan shall promote the development and, where it deems appropriate, require the use of substitute or modified materials, products and processes to prevent the formation and release of the chemicals listed in Annex C”*⁷

One measure of the effectiveness of the Convention will be the rate at which new POPs - besides the ‘dirty dozen’ - are identified for phase out. Another indicator will be the effort put into finding safer substitutes and the adoption of existing alternatives and substitutes where they already exist.

In 1998, the European Community embarked on an ambitious programme to reform European chemical regulations. The proposed reform is to be based on a system of Registration, Evaluation and Authorisation of CHEMicals, known as REACH. Although the framework of REACH and the mechanism – authorisation – is there, as it stands the draft legislation continues with the regulatory paradigm of ‘adequate control’ for chemicals of very high concern. The principle of ‘adequate control’ is not one that should be applied to persistent, bio-accumulative substances, because their intrinsic proper-

ties make exposure virtually impossible to control. Even small doses from diverse sources lead to significant accumulation of these chemicals in the food chain and consequently in humans.

The EU is in the process of ratifying the Stockholm Convention on POPs. It sees the proposed REACH regulation as *“an appropriate instrument by which to implement the necessary control measures on production, placing on the market and use of the listed substances and the control measures on existing and new chemicals and pesticides exhibiting persistent organic pollutants characteristics.”* (EU 2004)

Substitution is the solution to pollution



However, if REACH is to provide an effective means of protection against harmful chemicals, authorisation should never be given for the continued use of a hazardous chemical where a viable, safer alternative exists. This is the principle of **mandatory substitution**. If this principle is enshrined in EU law we will have taken a giant step towards ridding our environment, our homes and our lives of chemicals that can enter our bodies and linger there, threatening us with cancer, genetic damage or any of the other effects we know they can cause. Until this happens, consumers are at the mercy of the chemical producers and industrial users of chemicals.

Clearly, companies are responding to increasing consumer awareness of synthetic chemicals in products and some have policies in place to phase out certain harmful chemicals and substitute them with safer alternatives. Disney and other companies should follow their lead. However, for ‘mandatory substitution’ to become comprehensive, institutionalised and embedded in business decisions, requires legislation. The global

Stockholm Convention and the European reform of chemicals policy, REACH, should provide the legally-binding structures on which to build a toxic-free future.

Data on the hazard, use, environmental distribution and body burden for the individual substances are given in Annex A.

Full details on sampling methodology and results are available in Annex B.

RECOMMENDED GREENPEACE REPORTS:

“Chemical legacy – Contamination of the child”, October 2003

“Consuming Chemicals – hazardous chemicals in house dust, May 2003”

“Safer Chemicals within Reach – Using the Substitution Principle to drive Green Chemistry, Oct 2003”

All available at www.greenpeace.org

⁷ http://www.pops.int/documents/convtext/convtext_en.pdf

SUMMARY OF ANALYTICAL RESULTS FOR KEY CHEMICAL GROUPS IN DISNEY CLOTHES

DISNEY CHARACTER, GARMENT TYPE AND COUNTRY OF PURCHASE	RETAILER	SUM ALL PHTHALATES mg/kg	SUM OF ALKYL- PHENOL ETHOXY-LATES mg/kg	SUM OF ORGANO-TINS microg/kg	LEAD mg/kg	CADMIUM mg/kg	FORMALDEHYDE mg/kg
Tigger vest, Denmark	H&M	1.4	620	nd	0.23	nd	32
Mickey Mouse T-shirt, Belgium	Carrefour	101,150.8	264.3	4	76	38	nd
Princess, T-shirt, Canada	Wall Mart	96,050.6	34.1	14	2,600	0.1	nd
Donald Duck T-shirt, Netherlands	C&A	170,036	1,220	474	1.3	nd	nd
Minnie Mouse T-shirt, Spain	El Corte Ingles S.A	57,129.1	122	8	1.4	0.017	nd
Finding Nemo T-shirt, UK	Disney store London	791.6	1,045	nd	0.21	0.0069	1,100
Mickey Mouse T-shirt, USA	Disney Store	42,913	49	12	0.14	0.018	nd
Tigger baby bib Slovakia	Tesco	200,000	1,153	nd	0.2	0.018	25
Snow White T-shirt, New Zealand	Farmers Trading Co.	17.9	440	36	0.21	nd	90
Minnie Mouse pyjamas, Austria	C&A	73.1	1,700	nd	0.41	0.02	*
Finding Nemo T-shirt, Turkey	Marks & Spencer	7,770	1,190	nd	0.42	0.014	86
Mickey Mouse underwear, Norway	Fru Lyng	92,729	*	*	0.22	0.018	*
Treasure Planet pyjamas, Mexico	Woolworth	12	357	nd	0.14	nd	100
Snow White underwear, France	Disney Store	1,838	*	*	1.3	0.017	*
Buzz Lightyear vest, Philippines	Disney outlet in SM dept store	12	548	34	3.2	0.015	nd
Princess Ariel T-shirt, Argentina	Produced for Rolfy S.A. Bajo	2,303.7	640	8	0.73	nd	23
Mickey Mouse sweatshirt, China	Constant Gain International Ltd.	87,340	83	nd	8.3	0.011	nd
Snow White T-Shirt, Thailand	Disney outlet at Emporium Shopping Mall, Bangkok	41.6	1,390	50	0.45	0.015	230
Winnie the Pooh PVC raincoat, Germany	ToysRUS, Hamburg-Eidelstedt	320,000	73.2	1,129	0.33	0.0073	nd

Note: The concentrations given are per unit mass of the printed sections of the garments only, not per unit mass of the entire garment.

Note: Retailers handling these products should also be urged to review their own policies, and encouraged to insist on clean production standards, in the same way Hennes & Mauritz and Marks & Spencer, for example, are doing.

nd means less than the limit of detection

* means not analysed due to lack of sample

DISNEY CLOTHES SAMPLED
and the country of purchase



DENMARK



BELGIUM



CANADA



NETHERLANDS



SPAIN



GERMANY



U.K.



US



SLOVAKIA



NEW ZEALAND



AUSTRIA



TURKEY



NORWAY



MEXICO



FRANCE



PHILIPPINES



ARGENTINA



CHINA



THAILAND

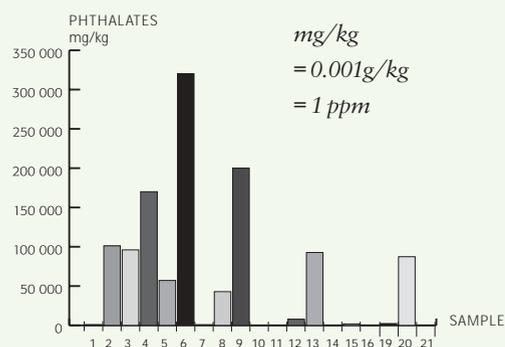
ANNEX A

RESULTS AND CHEMICAL HAZARDS

Annex A provides a comprehensive discussion of the study results, including further information on the different phthalates, organotins and other substances that have been found in Disney childrenswear. The results, common uses of these chemicals, their environmental effects, effects on human health and, where available, body burdens in adults and children are discussed. Finally, existing regulations and controls on the targeted substances are outlined.

For the full results obtained by the Eurofins laboratory, see Annex B.

1. PHTHALATES



Phthalates were found in all 19 of the Disney garments analysed in this study. The levels, expressed as mg phthalate per kg of printed section of garment, varied between 1.4 mg/kg in the Tigger vest from Denmark and 200,000 mg/kg in the Slovak Tigger bib.

The highest level of phthalates was 320,000 mg/kg found in a PVC Winnie the Pooh rain jacket bought in Germany, which

differed from the other products, which were all woven textiles with printed motifs.

Analysis of results

The results showed great differences in the type and amounts of chemicals found in the samples. The dominant phthalates found in this investigation were DEHP (di-ethylhexyl phthalate), BBP (benzyl-butyl phthalate), DINP (diisononyl phthalate) and DHP (diheptyl phthalate). Other unidentified phthalates were found in the garment from USA. Some printed sections of the clothes contained very high amounts of phthalates, e.g. samples from Belgium and Slovakia. These garments are probably printed with the PVC-based plastisol prints.

Hazards of Phthalates

PVC prints are one of the uses of phthalate-plasticized PVC that could lead to long periods of direct skin contact in children, plus the potential for inhalation and even ingestion of additional quantities. They are a large group of chemicals. The phthalates examined in this study include:

Phthalates in clothes find their way to the environment when the consumers wash their clothes. Phthalates are washed out and enter the environment via water treatment plants or via sewage sludge (Danish EPA 1998). Phthalates have long been recognised as one of the most abundant and widespread man-made environmental contaminants, resulting in widespread and continuous exposure to phthalates. Phthalates are relatively persistent, especially in soils and sediments. Direct exposure to phthalates in textiles can occur during normal wear.

DBP, BBP, DEHP, DINP, DIDP and DEP. (For full results see Annex B)

DEHP is still the most widely used phthalate in Europe. DEHP constitutes about 30% of the market for plasticizers in Western Europe (EC, 2004). It is a known reproductive toxin, interfering with testes development in mammals (Part et al. 2002), and is classified in the EU as “toxic to reproduction” (EU 2003a). Similarly, DBP (dibutyl phthalate) is classified in the EU as “toxic to reproduction” (EU 2003a). Very recent research suggests possible effects on human sperm development for a breakdown product of DEP, diethyl phthalate (Duty et al. 2003), widely used in cosmetics and perfumes and, until now, considered to be of relatively little toxicological significance.

Substantial concerns exist among scientists with regard to the toxicity of phthalates to wildlife and humans, although the precise mechanisms and levels of toxicity vary from one compound to another. In many cases, it is the metabolites of the phthalates which are responsible for the greatest toxicity (Dalgaard et al. 2001 and Ema, M. & Miyawaki, E. 2002). With respect to humans, although substantial exposure can occur through contaminated food (the CSTEE has also highlighted concerns relating to secondary poisoning, i.e. the build up of phthalates through the food chain), direct exposure to phthalates from consumer products and/or medical devices is likely to be very significant. Perhaps the best-known example is the exposure of children to phthalates used in soft PVC teething toys (Stringer et al. 2000), now subject to emergency controls within Europe (see Existing Controls).

Phthalates & body burden

Because of their extensive use in building materials and household products, phthalates are common contaminants in indoor air (Otake et al. 2001, Wilson et al. 2001). They have also been reported as substantial components of house dust, in some cases at more than 1 part per thousand (1g/kg) of the total mass of dust (Butte and Heinzow 2002; Santillo et al. 2003).

Several recent studies have reported the presence of phthalates and their primary metabolites in the human body (Colon et al. 2000, Blount et al. 2000). Metabolites of phthalates in the urine indicate a wide exposure of humans to phthalates (Barr et al., 2003; CDC, 2003; Koch et al., 2003). A study on premature breast development (thelarche) in female children, aged 6 months to 8 years, found phthalate esters in 68% of serum samples from the thelarche patients. The phthalate esters DEHP and DBP, with the most common commercial uses, were detected in the highest concentrations. For those samples with high concentrations of DEHP, one of the major DEHP metabolites, mono(2-ethylhexyl)phthalate (MEHP), was also detected. DEHP was detected in only 14% of the control samples, and then only in lower concentrations.

Animal studies show that phthalates cross the placenta and pass into breast milk (Dostal et al. 1987; Parmar et al. 1985; Srivastava et al. 1989); therefore, phthalates can be passed onto developing foetuses and newborn children via their mothers. Additionally, children seem to be more exposed to phthalates than adults. In the US CDC study, of the seven urine phthalate metabolites tested, the highest levels of metabolites for DEHP, DBP and monobenzylphthalates were found in the youngest age group tested: 6 - 11-year-old children (CDC 2003).

Uses of phthalates

Phthalates have a wide range of applications, although by far their greatest use is as plasticizing (softening) additives in flexible PVC. They are produced in very large quantities; for example, in Europe, almost 1 million tons is produced per year (CSTEE 2001a).

Environmental distribution of phthalates

The use of phthalates results in large-scale losses to the environment (both indoors and outdoors) during the lifetime of products, and again following disposal, amounting to thousands of tons per year across the EU (CSTEE 2001a). Phthalates in garments find their way into the environment during laundering when the rinse water enters the environment via water treatment plants or via sewage sludge (Danish EPA 1998). As a consequence, phthalates have long been recognised as one of the most abundant and ubiquitous man-made environmental contaminants (Mayer et al. 1972) and our exposure to phthalates is therefore widespread and continuous. Although some degradation is possible, phthalates are considered to be relatively persistent, especially in soils and sediments. They also have an inherent ability to accumulate in biological tissues, although continuous exposure undoubtedly contributes to tissue levels. Risk assessments, conducted under the EU system, have documented the widespread distribution of phthalates in all environmental compartments (e.g. see CSTEE 2001b,c).

Existing controls

At present, there are few controls on the marketing and use of phthalates, despite their toxicity, the volumes used and their

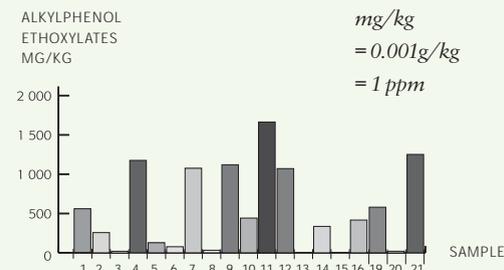
propensity to leach out of products throughout their lifetime. Of the controls which do exist, probably the best known is the EU-wide emergency ban on the use of six phthalates in children's toys designed to be chewed - first agreed in 1999 and regularly renewed since then (EU 2003b). While this ban addressed one important exposure route (via toys), exposure from other consumer products, as well as exposure via PVC medical devices, remains unaddressed.

Following the conclusion of the EU risk assessment for DEHP, there are proposals for a ban on uses in certain medical devices and tight restrictions for other applications, though these remain under discussion at EU level. No formal proposals have yet been made for the other phthalates undergoing assessment within the EU.

In 1998, the Ministerial Meeting of OSPAR agreed on the target of cessation of discharges, emissions and losses of all hazardous substances to the marine environment by 2020 – the “one generation” cessation target. The phthalates DBP and DEHP were on the first list of chemicals for priority action towards this target (OSPAR 1998). DEHP is also proposed as a “priority hazardous substance” under the EU Water Framework Directive (EU 2001), such that action to prevent releases to water within 20 years will be required throughout Europe, though a decision on this classification remains under consideration.

2. ALKYLPHENOL ETHOXYLATES

Alkylphenol ethoxylates were present in all the Disney clothes tested (17). Nonylphenol ethoxylates (NPEs) were found at levels ranging from 31 to 1,200 mg/kg printed textile section, octylphenol ethoxylates (OPEs) at levels ranging



from 1.2 - 650 mg/kg, giving a sum of alkylphenol ethoxylates in Disney textile prints of 34.1-1,700 mg/kg (Eurofins 2003).

Analysis of results

The wide range of concentrations shows that it is possible to produce textile prints containing levels of OPEs in the low mg/kg (ppm) range. The levels of NPEs were higher, with a maximum of 1,700 mg/kg (0.17% by weight of the printed textile area). In some of the garments, the levels of NPEs were lower, at between 49 and 83 mg/kg. Given the toxicity of these compounds and their breakdown products, possible sources of NPEs and OPEs in finished textiles clearly require urgent investigation, with a view to their elimination from the final products and the processes used in textile manufacture.

Hazards of Alkylphenols and their ethoxylates

Alkylphenol ethoxylates (APEs) are probably best known for their use in industrial detergents, though these chemicals, and the related alkylphenols (which were not quantified in this study), have many other commercial applications.

The main hazards associated with APEs result from their partial degradation to shorter-chain ethoxylates and to the parent alkylphenols (APs) themselves (i.e.

nonylphenol and octylphenol), both of which are persistent, bio-accumulative and toxic to aquatic organisms. The EU risk assessment for nonylphenol (NP) identified significant risks from many current uses of NPEs, that included risks to the aquatic environment, to soil and to higher organisms through secondary poisoning (i.e. resulting from the accumulation of NP in food (EC 2002a).

The most widely recognised hazard associated with both NPs and octylphenols (OPs), is undoubtedly their estrogenic activity, i.e. their ability to mimic natural estrogen hormones. This can lead to altered sexual development in some organisms, most notably the feminisation of fish (Jobling et al. 1995, 1996), a factor thought to have contributed significantly to the widespread changes in fish sexual development and fertility in UK rivers. Jobling et al. (2002) and Aienzar et al. (2002) recently described direct effects of NPs on DNA structure and function in barnacle larvae, a mechanism that may be responsible for the hormone disruption effects seen in whole organisms.

Hazards to human health remain unclear, although recent studies have highlighted concerns directly relevant to humans. For example, Chitra et al. (2002), and Adeoya-Osiguwa et al. (2003), describe effects on mammalian sperm function, while DNA damage in human lymphocytes has also recently been documented (Harreus et al. 2002).

Disney character, garment type and country of purchase	Alkylphenol ethoxylates mg/kg
1. Tigger vest, Denmark	620
2. Mickey Mouse T-shirt, Belgium	264.3
3. Princess, T-shirt, Canada	34.1
4. Donald Duck T-shirt, Netherlands	1,220
5. Minnie Mouse T-shirt, Spain	122
6. Winnie the Pooh PVC-raincoat, Germany	73.2
7. Finding Nemo T-shirt, UK	1,045
8. Mickey Mouse T-shirt, USA	49
9. Tigger baby bib, Slovakia	1,153
10. Snow White T-shirt, New Zealand	440
11. Minnie Mouse pyjamas, Austria	1,700
12. Finding Nemo T-shirt, Turkey	1,190
13. Mickey Mouse underwear, Norway	*
14. Treasure Planet pyjamas, Mexico	357
15. Snow White underwear, France	*
16. Buzz Lightyear vest, Philippines	548
19. Princess Ariel T-shirt, Argentina	640
20. Mickey Mouse sweatshirt, China	83
21. Snow White T-Shirt, Thailand	1,390

Alkylphenols & body burden

There are only a few studies on levels of human contamination by alkylphenols, but those that have been performed clearly show that children are contaminated before and after birth. (Guenther et al. 2002, Takada et al. 1999) Nonylphenol has been detected in human umbilical cords (Takada et al. 1999), confirming that it crosses the placenta from the contaminated mother to the growing foetus. The authors stressed the importance of further studies using larger numbers of umbilical cords, and analyses of maternal and cord blood to estimate the fraction of contaminants passing from the blood to the foetus. Nonylphenol also contaminates breast milk (Guenther et al. 2002).

Uses of alkylphenols and their ethoxylates

Alkylphenols (APs) are non-halogenated chemicals manufactured almost exclusively to produce alkylphenol ethoxylates (APEs), a group of non-ionic surfactants. The most widely used APEs are ethoxylates of nonylphenol (NPEs) and, to a lesser extent, octylphenol (OPEs). NPEs have been used as surfactants, emulsifiers, dispersants and/or wetting agents in a variety of industrial and consumer applications. Of the 77,000 tonnes used in Western Europe in 1997, the share of textile finishers was 10 % (OSPAR 2001). APEs are found in industrial detergents, such as for wool washing and metal finishing; industrial processes such as emulsion polymerisation, leather and textile finishers and even the spermicidal lubricant nonoxynol-9. Outside Europe, APEs may also be used in many domestic products, such as in liquid clothes detergents in the USA. Once released to the environ-

ment, APEs can degrade back to APs, which are persistent, bioaccumulative and toxic to aquatic life.

Environmental distribution of alkylphenols and their ethoxylates
Nonylphenol and its derivatives are widely distributed in fresh and marine waters and in particular, in sediments, in which these persistent compounds accumulate. Because of releases to wastewater, APEs and APs are also common components of sewage sludge, including sludge applied to land (Danish EPA 1998). Research into levels in wildlife remains very limited, although there have been reports of significant levels in fish and aquatic birds downstream from sites of manufacture and/or use of APEs. Both NP and OP are known to accumulate in the tissues of fish and other organisms (OSPAR 2001, EC 2002a). Recent research demonstrated the widespread presence of NP in a variety of foods in Germany (Guenther et al. 2002), although the consequences for human exposure have yet to be fully evaluated. The extent and consequences of direct exposure from use in consumer products are poorly described, although both NP and OP residues have recently been reported as contaminants in house dust (Butte and Heinzow 2002 and Santillo et al. 2003)

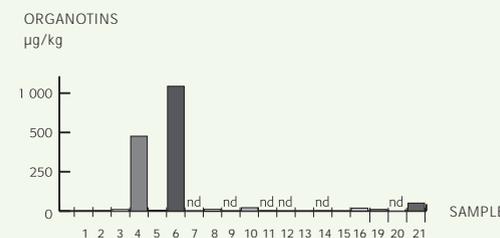
Existing controls

In 1998, the Ministerial Meeting of OSPAR agreed on the target of cessation of discharges, emissions and losses of all hazardous substances to the marine environment by 2020 - the "one generation" cessation target. NP/NPEs were included on the first list of chemicals for priority action towards this target (OSPAR 1998).

Since then, NP has been included as a "priority hazardous substance" under the EU Water Framework Directive, such that action to prevent releases to water within 20 years will be required throughout Europe (EU 2001). A decision on the prioritisation of OP/OPEs under the Directive remains under consideration.

Already, however, the widely recognised environmental hazards presented by AP/APEs have led to some restrictions on use. As noted earlier, the risk assessment conducted under the EU system concluded that, for NPs, there is a need for further risk reduction in some areas, although proposals for restrictions on marketing and use of NP and its derivatives remain under discussion. At the same time, very little information exists regarding the ongoing uses of NPs, OPs and their derivatives in consumer products and, as a consequence, our direct exposure to them.

3. ORGANOTINS



Organotins were present in 10 of the 17 Disney products tested for this chemical group, in concentrations ranging from 4 to 474 µg/kg (microgram/kg) in printed sections of the woven garments.

The highest concentration - 1,129 µg/kg - was found in a Winnie the Pooh PVC raincoat, indicating use of organotin as a PVC stabiliser.

Analysis of results

Samples from Belgium, Spain, New Zealand, the Philippines, Argentina, Thailand, USA and Canada contained 4 - 50 µg total organotins per kg of printed textile area. Higher concentrations, 474 - 1,129 µg/kg, were found in the Dutch and the German Disney prints. Monobutyltin (MBT) and dibutyltin (DBT) were the substances most frequently found and at the highest concentrations of all organotin compounds measured. The German sample contained greater amounts of mono-octyltin (MOT) and dioctyltin (DOT). Tributyltin (TBT) concentrations ranged from 4 - 12 µg/kg, possibly reflecting TBT contamination of other organotin compound preparations used in the textile production process.

Hazards of Organotins

Organotins are used as stabilisers in PVC. Textiles containing polymer parts, like T-shirts with prints, can contain organotin compounds such as butyl- and octyltin compounds.

Organotins are known to be toxic at relatively low levels of exposure not only to marine invertebrates but also to mammals. In marine invertebrates, TBT is generally more toxic than DBT, which is in turn more toxic than MBT (Cima et al. 1996). However, this is by no means always the case, as DBT is more toxic than TBT to certain enzyme systems (Bouchard et al. 1999, Al-Ghais et al. 2000).

The widespread use of tributyl tin (TBT) in antifouling paints on ships, combined with the relative persist-

Disney character, garment type and country of purchase	Organotins µg/kg
1. Tigger vest, Denmark	nd
2. Mickey Mouse T-shirt, Belgium	4
3. Princess, T-shirt, Canada	14
4. Donald Duck T-shirt, Netherlands	474
5. Minnie Mouse T-shirt, Spain	8
6. Winnie the Pooh PVC-raincoat, Germany	1,129
7. Finding Nemo T-shirt, UK	nd
8. Mickey Mouse T-shirt, USA	12
9. Tigger baby bib, Slovakia	nd
10. Snow White T-shirt, New Zealand	36
11. Minnie Mouse pyjamas, Austria	nd
12. Finding Nemo T-shirt, Turkey	nd
13. Mickey Mouse underwear, Norway	*
14. Treasure Planet pyjamas, Mexico	nd
15. Snow White underwear, France	*
16. Buzz Lightyear vest, Philippines	34
19. Princess Ariel T-shirt, Argentina	8
20. Mickey Mouse sweatshirt, China	nd
21. Snow White T-shirt, Thailand	50

ence of butyl tins and their affinity for biological tissues, has led to their widespread occurrence in fish, seals, whales and dolphins in all major sea areas (Kannan et al. 1996 Iwata et al. 1995, Ariese et al. 1998). Of the few studies which have been conducted in terrestrial systems, Takahashi et al. (1999) reported the presence of butyltin residues in the livers of monkeys and other mammals in Japan, as well as in human livers, and suggested that uses in consumer products may represent an important exposure route.

Organotins have been demonstrated to have immunotoxic and teratogenic (developmental) properties also in mammalian systems (Kergosien and Rice 1998), with DBT again frequently appearing more toxic than TBT (De Santiago and Aguilar-Santelises 1999). DBT is neurotoxic to mammalian brain cells (Eskes et al. 1999). Ema et al. (1996, 1997) demonstrated the importance of the precise timing of exposure to DBT in induction of defects in developing rat embryos. Very recently, Kumasaka et al. (2002) have described toxic effects on testes development in mice.

Estimates of the significance of human exposure to organotins from consumption of contaminated seafood have taken the potential immunotoxicity of these compounds to humans as an effect parameter (Belfroid et al. 2000). While seafood probably remains the predominant source of organotin exposure for many consumers, exposure to consumer products that contain them or to dusts in the home may also be significant.

Organotins and body burden

Although organotins, particularly TBT, have been found in a wide range of mol-

luscus, fish, marine birds, marine mammals, and freshwater birds (IPCS, 1999), aside from a few reports, levels of contamination in humans are largely unknown. Takahashi et al. (1999) found butyltins in human male livers in concentrations ranging from 59 - 96 ng/g (with an average of 79% present as TBT). Recently Lo et al (2003) found TPT in human blood in concentrations ranging from 0.17 - 0.67 mg/L. There are no readily available reports on child contamination.

Uses of Organotin compounds

There are three major applications for organotin compounds:

1. TBT in anti-fouling paints for ships, which, as a result of its widespread use, has led to changes in sexual development in marine snails;
2. Triphenyltin (TPT) as a pesticide, and
3. Butyl- and octyltin compounds as plasticizer in polymers.

Many textile products containing polymer parts, like T-shirts with prints, sanitary bandages, plasters and diapers, can contain organotin compounds (Gaikema F.J. et al 1999). In some cases, organotin compounds are used as fungicides on textiles that are exposed to extreme weather conditions, such as canvas or in sports gear. Although antifouling paints account for the majority of TBT used, this compound is also used as an antifungal agent in some consumer products, including certain carpets, textiles and PVC (vinyl) flooring (Allsopp et al. 2000, 2001). Most abundant in consumer products, however, are MBT and DBT, used as heat stabilisers in rigid (pipes, panels) and soft (wall-coverings, furnishings, flooring,

toys) PVC products and in certain glass coating applications (Matthews 1996). PVC represents about two-thirds of the global consumption of these compounds (Sadiki and Williams 1999), which can comprise up to 2% by weight of the finished product. According to industry figures (Ortepa 2004), approximately 15,000 tons of organotins were used in PVC production in Europe in 1995.

Environmental distribution of organotins
Much of the research describing the environmental distribution of organotin compounds has, understandably, focused on the spread of TBT and its breakdown products (including DBT) in the marine environment. The global use of TBT antifouling paints has resulted in contamination on a global scale. The relative persistence of butyl tins, combined with their affinity for biological tissues, has led to their widespread occurrence in fish, seals, whales and dolphins in all major sea areas (Kannan et al. 1996; Iwata et al. 1995; Ariese et al. 1998).

Much less information is available concerning the distribution of organotins in other environmental compartments. In one of the few studies which have been conducted, Takahashi et al. (1999) reported the presence of butyltin residues in the livers of monkeys and other mammals in Japan, as well as in human livers, and suggested that uses in consumer products may represent an important exposure route. The presence of organotin compounds in a wide range of construction and consumer products, especially PVC products, has already been highlighted. It has also been recognised for some time

that butyltin plasticizer can migrate from such products during normal use (Sadiki and Williams 1999, Santillo et al. 2003).

Existing controls

To date, legislative controls on organotin compounds have focused primarily on TBT in antifouling paints. A series of national bans on its use on small vessels, starting in France and the UK, was followed by an EU wide ban on vessels less than 25m in length in 1991 (Evans 2000). More recently, the International Maritime Organisation (IMO) agreed on a global phase-out of all TBT applications (from January 2003) and TBT presence on ships (from 2008) under its Convention on Harmful Anti-fouling Systems (Imo 2004). The first of these deadlines has recently been transposed into EU law (EU 2002a). TBT substances are also "priority hazardous substances" under the EU Water Framework Directive (EU 2001), such that action to prevent releases to water within 20 years will be required throughout Europe.

At the same time, and despite the toxicity to mammals noted above, TBT continues to be used as an additive in some consumer products, as do uses of other butyltins and octyltins. Organotin compounds must not be used for certain textiles to qualify for an "eco-label" within the EU (EU 2002b). Otherwise, there are no restrictions on use, unless the treated materials or products are used in contact with water. This is despite the fact that TBT is classified under the EU's labelling Directive as "harmful in contact with skin, toxic if swallowed, irritating to the eyes and skin" and as presenting a "dan-

ger of serious damage to health by prolonged exposure through inhalation or if swallowed”.

In 2001, Germany notified the European Commission of its intention to introduce stricter controls on organotins, including controls on use in consumer products. However, the proposed controls were rejected by the Commission as “inadmissible” (EC 2002). In 1998, the Ministerial Meeting of OSPAR agreed on the target of cessation of discharges, emissions and losses of all hazardous substances to the marine environment by 2020 - the “one generation” cessation target - and included organotin compounds on the first list of chemicals for priority action towards this target (OSPAR 1998). Initially, OSPAR’s action focused on the achievement of the IMO Convention on

Harmful Anti-fouling Systems (OSPAR 2000). In 2001, OSPAR began to consider the scope for action on other uses and other organotin compounds besides TBT, including the widespread use of butyltin stabilisers, though so far, no further measures are proposed.

4. LEAD

Lead is present in all the clothes tested (19), in levels ranging from 0.14 to 2,600 mg/kg. Most of the prints

analysed exhibited concentrations towards the lower end of this range (i.e. <10 mg/kg). However, samples from Belgium and Canada contained lead at 76 and 2,600 mg/kg respectively.

Hazards of Lead

Exposure to this toxic heavy metal can cause a range of effects including anaemia and harm to the nervous and reproductive systems and the kidneys. The toxic effects of lead are the same, irrespective of whether it is ingested or inhaled. The impacts of lead upon the developing nervous system of children are of extreme concern, since a permanent lowering of IQ can result. (Nielsen et al. 2001; ATSDR 2000, Bernard et al. 1995, Goyer 1993) A growing body of evidence suggests that there may be no level of lead in blood that does not induce a toxic effect. The developing central nervous system is considered particularly vulnerable (ATSDR 2000, Goyer 1993). The substance has no known biological function and is highly toxic to plants, animals and humans (Danish EPA 1998).

Lead & body burden

Since 1976, the US Centres for Disease Control and Prevention (CDC) have been measuring levels of lead in children’s blood as part of a large national survey. The survey shows that for children of 1-5 years old, lead levels were 2.23 micrograms per decilitre for the period 1999-2000. Fortunately blood lead levels are going down: during the period 1991-1994, 4.4% of 1-5 year olds had more than 10 micrograms of lead per decilitre of blood; in the period 1999-2000, 2.2% of children in this age group had lead levels that were

above 10 micrograms per decilitre. (USDHSS 2003). These decreases show that public health efforts to reduce children’s exposure to lead are improving the situation. However, children’s exposure to lead in homes containing lead-based paint and lead-contaminated dust is still a serious public health concern.

Uses of lead

Lead and its compounds have many applications. Every year, many tons of lead is used in products such as batteries, in alloys, for lead keels (sailboats), ammunition, in additives to gasoline and in pigments. Lead is also used as a stabiliser in PVC. In 2002, lead usage was reported as 120,000 tonnes/year, and making up 87% of the PVC stabiliser market in Western Europe. (ENDS 2002)

Environmental distribution of lead

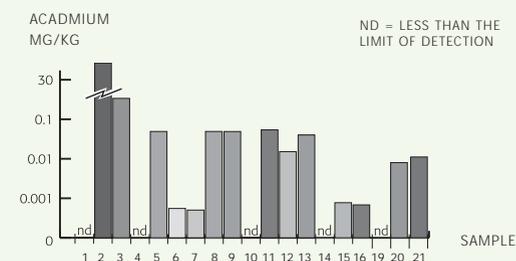
When lead is released into the environment it has a long residence time, compared with most pollutants, and tends to accumulate in soils and sediments (ATSDR 2000, Alloway 1990). Lead is an element and therefore cannot be destroyed, only converted from one form to another.

Existing Controls

In the EU, industry has a voluntary agreement to phase out lead stabilisers; 15% by 2005, 50% by 2010, 100% by 2015. Lead stabilisers have already been phased out in Sweden. Denmark recently imposed a wide-ranging ban on the import, marketing and manufacture of lead and products containing lead (MEE 2000).

Alternatives are available; e.g. calcium-zinc based or organic stabilisers (ENDS 2003).

5. CADMIUM



Cadmium was identified in 14 of the 19 garments tested for this toxic metal at concentrations ranging from 0.0069 – 38 mg/kg of printed textile section. The T-shirt print from Belgium has a significantly higher content - 38 mg/kg - than those of the other garments.

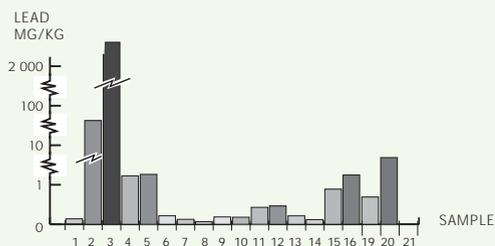
HAZARDS OF CADMIUM

Cadmium is a heavy metal which is highly toxic to plants, animals and humans, having no known biochemical function (ATSDR 2000, WHO 1992). It is toxic at very low levels of exposure, and has both acute and chronic effects on health and the environment.

Cadmium is persistent in the environment, with a residence half-life of 10-30 years. In aquatic environments, however, cadmium compounds can be more mobile than most other metals (ATSDR 2000). When present in bio-available forms, cadmium is able to bio-accumulate in many aquatic and terrestrial organisms. Cadmium especially accumulates in the kidneys and kidney damage is probably the critical effect (Nordic Council of Ministers 2003).

Disney character, garment type and country of purchase	Cadmium mg/kg
1. Tigger vest, Denmark	nd
2. Mickey Mouse T-shirt, Belgium	38
3. Princess, T-shirt, Canada	0.1
4. Donald Duck T-shirt, Netherlands	nd
5. Minnie Mouse T-shirt, Spain	0.017
6. Winnie the Pooh PVC-raincoat, Germany	0.0073
7. Finding Nemo T-shirt, UK	0.0069
8. Mickey Mouse T-shirt, USA	0.018
9. Tigger baby bib, Slovakia	0.018
10. Snow White T-shirt, New Zealand	nd
11. Minnie Mouse pyjamas, Austria	0.02
12. Finding Nemo T-shirt, Turkey	0.014
13. Mickey Mouse underwear, Norway	0.018
14. Treasure Planet pyjamas, Mexico	nd
15. Snow White underwear, France	0.017
16. Buzz Lightyear vest, Philippines	0.015
19. Princess Ariel T-shirt, Argentina	nd
20. Mickey Mouse sweatshirt, China	0.011
21. Snow White T-Shirt, Thailand	0.015

Disney character, garment type and country of purchase	Lead mg/kg
1. Tigger vest, Denmark	0.23
2. Mickey Mouse T-shirt, Belgium	76
3. Princess, T-shirt, Canada	2,600
4. Donald Duck T-shirt, Netherlands	1.3
5. Minnie Mouse T-shirt, Spain	1.4
6. Winnie the Pooh PVC-raincoat, Germany	0.33
7. Finding Nemo T-shirt, UK	0.21
8. Mickey Mouse T-shirt, USA	0.14
9. Tigger baby bib, Slovakia	0.2
10. Snow White T-shirt, New Zealand	0.21
11. Minnie Mouse pyjamas, Austria	0.41
12. Finding Nemo T-shirt, Turkey	0.42
13. Mickey Mouse underwear, Norway	0.22
14. Treasure Planet pyjamas, Mexico	0.14
15. Snow White underwear, France	1.3
16. Buzz Lightyear vest, Philippines	3.2
19. Princess Ariel T-shirt, Argentina	0.73
20. Mickey Mouse sweatshirt, China	8.3
21. Snow White T-Shirt, Thailand	0.45



Accumulation of cadmium in the food chain has important implications for human exposure (ATSDR 2000). The International Agency for Research on Cancer (IARC) and the US Department of Health and Human Services both classify cadmium and cadmium compounds as carcinogenic to humans (USDHHS 2000 and IARC 1994).

Other targets of cadmium toxicity are the bones, where cadmium accumulation can result in osteoporosis, or osteomalacia (softening of the bones) (WHO 1992, ATSDR 2000). In addition, cadmium appears to play a role in the development of hypertension (high blood pressure) and heart disease (ATSDR 2000, Goyer 1996 and Elinder & Jarup 1996).

Cadmium & body burden

Since 1976, US Centres for Disease Control and Prevention (CDC) have been measuring levels of cadmium in children's blood as part of a national survey. Blood cadmium levels for children 1-11 years old are not reported since the proportion of results below limit of detection was too high to provide a valid result. 2135 persons in the age 12-19 had an average of 0,333 micrograms per decilitre of blood. 4200 persons in the age 20 years and older have an average of 0,468 micrograms of cadmium per litre of blood (USDHSS 2003).

Uses of cadmium

Cadmium and its compounds are also used in metal plating, in pigments for glasses and plastics, as a stabiliser in polyvinyl chloride (PVC), and as a component of various alloys (ATSDR 2000, Nordic Council of Ministers 2003). Cadmium compounds are used as stabil-

ising agents in PVC, to provide long-term weathering, heat and UV resistance to prolong the life of a product. (OSPAR 2002). Recent data derived from cadmium flows in the EU for around the year 2000 indicate that 300-350 tonnes of cadmium were used in pigments and 150 tonnes in stabilisers per year (EC 2002).

Environmental distribution of cadmium

Accumulation of cadmium in the food chain has important implications for human exposure (ATSDR 2000) and The International Agency for Research on Cancer (IARC) and the US Department of Health and Human Services both categorise cadmium and cadmium compounds as carcinogenic to humans (USDHHS 2000 and IARC 1994). Waste disposal is expected to be a major anthropogenic source of cadmium releases to the environment. The most effective means of reducing the cadmium content of waste flows is to remove it from the goods which will in due course become waste (OSPAR 2000).

In 1998, the Ministerial Meeting of OSPAR agreed on the target of cessation of discharges, emissions and losses of all hazardous substances to the marine environment by 2020 - the one generation cessation target - and included cadmium compounds on the first list of chemicals for priority action towards this target (OSPAR 1998).

A number of EC directives restrict the marketing of products containing cadmium. The use of cadmium and its compounds is prohibited for product surface treatment, as well as for colouring or plastic stabiliser agents in a wide range of products (including PVC) where the cad-

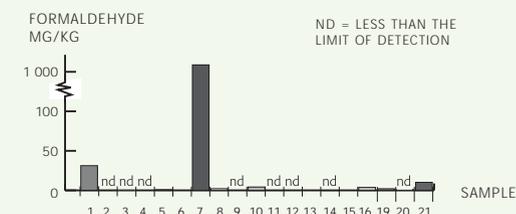
mium content exceeds 0.01 %, with some exceptions for safety reasons (Directive 76/769/EEC, as amended by Directive 91/338/EEC).

Furthermore, batteries and accumulators containing more than 0.025 % cadmium by weight or more than 0.4 % lead by weight are also prohibited under EC Directive 91/157/EEC. The current revision of the EU battery waste directive is looking to tackle hazardous materials in batteries, including cadmium, lead and mercury.

The EU Directives on End-of-Life Vehicles (Directive 2000/53/EC) and Waste from Electrical and Electronic Equipment/Restriction of Hazardous Substances (Directives 2002/96/EC and 2002/95/EC respectively) ban the use of lead, cadmium and other substances in new cars and electronics, with some exemptions.

National legislation of some member states places more stringent restrictions on the use of cadmium in products. In Sweden, cadmium is in principle only permitted for use in certain batteries. Bans exist for its use in surface treatment, as stabiliser and colouring agent. Products that have been surface-treated with cadmium are not allowed to be imported. Common consumer batteries must not contain more than 0.025 % cadmium by weight. (Förordning (1998:944) om förbud m.m. i vissa fall i samband med hantering, införsel och utförsel av kemiska produkter.1998-06-25, Swedish Government) Denmark has similarly wide ranging restrictions on the use of cadmium in surface treatments, and as stabiliser and colouring agents above 0.0075 % by weight, and in batteries and accumulators above 0.025 % by weight. (Statutory order No. 1199 af 23/12/1992)

6. FORMALDEHYDE



Formaldehyde was found in 8 of the 16 Disney products tested for this chemical. The levels vary from 23 – 1100 mg/kg of printed textile area (i.e. a maximum of 0.11% by weight of printed motif section).

The highest value of 1,100 mg/kg of formaldehyde was found in a textile sample from the UK.

Hazards of Formaldehyde

Formaldehyde can enter the body through skin and by eye contact, inhalation and digestion. Although it does not accumulate in the body, acute exposure can cause various effects, such as allergic asthma in sensitive individuals. Formaldehyde is a relatively strong contact allergen, prompting contact allergy in humans who have been in contact with products that contain less than 1 % formaldehyde (Danish EPA 2004). The substance is acutely toxic and is suspected of causing cancer (Danish EPA, 2001). The International Agency for Research on Cancer (IARC) has concluded that there is sufficient evidence for carcinogenicity in experimental animals and has classified formaldehyde as a probable

Disney character, garment type and country of purchase	Formaldehyde mg/kg
1. Tigger vest, Denmark	32
2. Mickey Mouse T-shirt, Belgium	nd
3. Princess, T-shirt, Canada	nd
4. Donald Duck T-shirt, Netherlands	nd
5. Minnie Mouse T-shirt, Spain	nd
6. Winnie the Pooh PVC-raincoat, Germany	nd
7. Finding Nemo T-shirt, UK	1,100
8. Mickey Mouse T-shirt, USA	nd
9. Tigger baby bib, Slovakia	25
10. Snow White T-shirt, New Zealand	90
11. Minnie Mouse pyjamas, Austria	*
12. Finding Nemo T-shirt, Turkey	86
13. Mickey Mouse underwear, Norway	*
14. Treasure Planet pyjamas, Mexico	100
15. Snow White underwear, France	*
16. Buzz Lightyear vest, Philippines	nd
19. Princess Ariel T-shirt, Argentina	23
20. Mickey Mouse sweatshirt, China	nd
21. Snow White T-Shirt, Thailand	230

carcinogen in humans (IARC 1995).

Uses of formaldehyde

In textiles, formaldehyde is used to produce easy-care textiles and for fixation of colours. Cross-linking agents used in textile printing are also possibly diffuse sources of formaldehyde release (Danish EPA 2004a). Formaldehyde is used in various steps in textile production. Due to its volatility, formaldehyde can be transferred readily from treated to previously untreated garments.

Environmental distribution and hazards of formaldehyde

Formaldehyde is very biodegradable and hence the potential for accumulation in aquatic organisms is considered to be

low. Data of effects to aquatic organisms, obtained from the IUCLID register, are in the range 2 mg/L (*Daphnia magna*, 48 h) to 74 mg/l (*Scenedesmus quadricauda*, 8 d) (Danish EPA, 2001).

Existing controls

Formaldehyde is listed as a dangerous substance, in annex 1 of Council Directive 67/548/EEC. Here formaldehyde is classified as toxic, R23/24/25 (by inhalation, in contact with skin and if swallowed), corrosive, R34 (causes burns), Carc3, R40 (possible risk of irreversible effects) and R43 (may cause sensitization by skin contact) (Danish EPA 2001).

* * * * *

ANNEX B

SAMPLE MATERIAL

On 2 December 2003, the Eurofins laboratory (Smedskovvej 38, DK-8464 Galten) received 17 samples of Disney clothing. An additional two samples were delivered on 3 and 4 December 2003. On receipt the samples were identified with continuous numbers from 1 to 16 and from 19 to 21. The samples were stored at room temperature until analysis. The sample preparation and analysis were carried out during the period 4 – 23 December 2003.



So what chemicals did the independent Danish Laboratory Eurofins find?

ANALYTICAL METHODS

SAMPLE PREPARATION

The print was cut out as a right-angled square from every piece of textile. Since the thickness of the textiles and the prints were different, the weight/area ratio was determined for all samples. The samples

were cut into pieces of 3-4 mm and mixed thoroughly. Part samples of the mixed sample were taken as representative as possible for the following analyses.

DETERMINATION OF PHTHALATES

Dichloromethane was added to the sample, shaken for 2 hours, and left to stand at room temperature for 16 hours. A part sample of the extract was analysed directly at combined gas chromatography and mass spectrometry (GC/MS). The quantification is performed using external standards where possible.

PHTHALATES:

Uncertainty: 10-15%RSD
The limit of detection: 1-10 mg/kg

Determination of alkylphenol ethoxylates

The sample is extracted with methanol and an aqueous ammonium acetate solution. The extract is analysed with combined high performance liquid chromatography and mass spectrometry with positive mode electro spray ionization (LC/MS). The analyses include the octyl- and nonylphenol ethoxylates from 3 to 15 ethoxy groups. The analyses are performed as true double determinations.

Uncertainty: 10-15%RSD
The limit of detection: 0.2 mg/kg

DETERMINATION OF ORGANIC TIN COMPOUNDS

The sample is extracted with acetic acid in methanol. After filtration and addition of an aqueous media, the tin compounds are derivatised with sodium tetraethylborate, and transferred to n-pentane by the means of extractive derivatisation. The

pentane phase is added isooctane, concentrated and analysed with combined gas chromatography and mass spectrometry (GC/MS) at selective ion monitoring of the specified tin organic compounds. The content is quantified versus relevant standards.

Uncertainty: 10-15%RSD
The limit of detection:
Monobutyltin (MBT): 0.005 mg/kg
Dibutyltin (DBT): 0.003 mg/kg
Tributyltin (TBT): 0.002 mg/kg
Triphenyltin: 0.005 mg/kg
Monooctyltin: 0.010 mg/kg
Dioctyltin: 0.005 mg/kg
Tricyclohexyltin: 0.010 mg/kg

DETERMINATION OF FORMALDEHYDE

The sample is extracted with demineralised water. Accordingly the formaldehyde reacts with Hantzsch-reagent during formation of 3,5-diacetyl-1,4-dihydro-lutidin that is quantified spectrophotometrically.

Uncertainty: 10-15%RSD
The limit of detection: 20 mg/kg

Determination of cadmium and lead

The sample is digested using nitric acid. The extract is filtered and the dissolved amounts of specified metals are determined with combined Inductively Coupled Plasma and mass detection (ICP/MS).

LEAD:
Uncertainty: 10%RSD
The limit of detection: 0.05 mg/kg

CADMIUM:
Uncertainty: 10%RSD
The limit of detection: 0.005 mg/kg

EUROFINS ANALYTICAL RESULTS												
SUBSTANCE:	DBP	BBP	DEHP	DINP	DHP#	DIDP	DEP	SUM OTHER PHTHALATES	SUM ALL PHTHALATES	OPE	NPE	SUM OF PHENOLS
UNIT:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SAMPLE DISNEY CHARACTER, GARMENT TYPE AND COUNTRY OF PURCHASE												
1	Tigger vest, Denmark	nd	nd	1.4	nd	nd	nd	nd	1.4	200	420	620
2	Mickey Mouse T-shirt, Belgium	46	4.8	99,000	nd	nd	2100	nd	101,150.8	4.3	260	264,3
3	Princess, T-shirt, Canada	1.6	49	96,000	nd	nd	nd	nd	96,050.6	3.1	31	34,1
4	Donald Duck T-shirt, Netherlands	nd	36	170,000	nd	nd	nd	nd	170,036	510	710	1,220
5	Minnie Mouse T-shirt, Spain	5.3	400	220	53,000	3,500	nd	3.8	57,129.1	29	93	122
6	Winnie the Pooh PVC raincoat, Germany	nd	nd	nd	320,000	nd	nd	nd	320,000	1.2	72	73.2
7	Finding Nemo T-shirt, UK	1.6	380	410	nd	nd	nd	nd	791.6	45	1,000	1,045
8	Mickey Mouse T-shirt, USA	13	5,900	nd	nd	nd	nd	37,000	42,913	32	17	49
9	Tigger baby bib, Slovakia	nd	nd	nd	200,000	nd	nd	nd	200,000	53	1,100	1,153
10	Snow White T-shirt, New Zealand	3.6	6.4	7.9	Nd	nd	nd	nd	17.9	340	100	440
11	Minnie Mouse pyjamas, Austria	64	nd	9.1	nd	nd	nd	nd	73.1	500	1,200	1,700
12	Finding Nemo T-shirt, Turkey	Nd	290	180	7,300	nd	nd	nd	7,770	650	540	1,190
13	Mickey Mouse underwear, Norway	41	1,600	88	69,000	22,000	nd	nd	92,729	*	*	*
14	Treasure Planet pyjamas, Mexico	nd	nd	12	nd	nd	nd	nd	12	37	320	357
15	Snow White underwear, France	770	nd	68	1,000	nd	nd	nd	1,838	*	*	*
16	Buzz Lightyear vest, Philippines	nd	nd	12	nd	nd	nd	nd	12	58	490	548
19	Princess Ariel T-shirt, Argentina	3.7	nd	2,300	nd	nd	nd	nd	2,303.7	220	420	640
20	Mickey Mouse sweatshirt, China	440	22,000	2,900	19,000	43,000	nd	nd	87,340	3.0	80	83
21	Snow White T-Shirt, Thailand	32	4.9	4.7	nd	nd	nd	nd	41.6	500	890	1,390
No. of positive samples	12	11	16	7	3	1	1	1	19	17	17	
No. of not detected	7	8	3	12	16	18	18	18	0	0	0	

nd means less than the limit of detection
 * means not analysed due to lack of sample
 # means calculated using diisononylphthalate as external standard

EUROFINS ANALYTICAL RESULTS												
SUBSTANCE:	MBT	DBT	TBT	TPT	MOT	TEBT	DOT	TCHT	SUM OF ORGANOTIN	CADMIUM	LEAD	FORMALDEHYDE
UNIT:	microg/kg	microg/kg	microg/kg	microg/kg	microg/kg	microg/kg	microg/kg	microg/kg	microg/kg	mg/kg	mg/kg	mg/kg
SAMPLE DISNEY CHARACTER, GARMENT TYPE AND COUNTRY OF PURCHASE												
1	Tigger vest, Denmark	nd	nd	0.23	32							
2	Mickey Mouse T-shirt, Belgium	nd	nd	4	nd	nd	nd	nd	4	38	76	Nd
3	Princess, T-shirt, Canada	nd	nd	nd	nd	nd	14	nd	14	0.1	2,600	Nd
4	Donald Duck T-shirt, Netherlands	100	370	4	nd	nd	nd	nd	474	nd	1.3	Nd
5	Minnie Mouse T-shirt, Spain	nd	8	nd	nd	nd	nd	nd	8	0.017	1.4	Nd
6	Winnie the Pooh PVC raincoat, Germany	19	100	nd	nd	170	nd	840	1,129	0.0073	0.33	Nd
7	Finding Nemo T-shirt, UK	nd	0.0069	0.21	1,100							
8	Mickey Mouse T-shirt, USA	7	5	nd	nd	nd	nd	nd	12	0.018	0.14	nd
9	Tigger baby bib, Slovakia	nd	0.018	0.2	25							
10	Snow White T-shirt, New Zealand	13	23	nd	nd	nd	nd	nd	36	nd	0.21	90
11	Minnie Mouse pyjamas, Austria	nd	0.02	0.41	*							
12	Finding Nemo T-shirt, Turkey	nd	0.014	0.42	86							
13	Mickey Mouse underwear, Norway	*	*	*	*	*	*	*	*	0.018	0.22	*
14	Treasure Planet pyjamas, Mexico	nd	nd	0.14	100							
15	Snow White underwear, France	*	*	*	*	*	*	*	*	0.017	1.3	*
16	Buzz Lightyear vest, Philippines	23	11	nd	nd	nd	nd	nd	34	0.015	3.2	nd
19	Princess Ariel T-shirt, Argentina	5	3	nd	nd	nd	nd	nd	8	nd	0.73	23
20	Mickey Mouse sweatshirt, China	nd	0.011	8.3	nd							
21	Snow White T-Shirt, Thailand	21	17	12	nd	nd	nd	nd	50	0.015	0.45	230
No. of positive samples	7	8	3	0	1	0	2	0	10	14	19	8
No. of not detected	10	9	14	17	16	17	15	17	7	5	0	8

nd means less than the limit of detection
 * means not analysed due to lack of sample

References

- Adeoya-Osiguwa, S.A., Markoulaki, S., Pocock, V., Milligan, S.R. & Fraser, L.R. (2003) 17-beta-estradiol and environmental estrogens significantly affect mammalian sperm function. *Human Reproduction* 18(1): 100-107
- Al-Ghais, S.M. & Ahmad, A.B. (2000) Differential inhibition of xenobioticmetabolizing carboxylesterases by organotins in marine fish. *Ecotoxicology and Environmental Safety* 46(3): 258-264
- Alloway, B.J. (1990) Heavy metals in soils. John Wiley and Sons, Inc. New York, ISBN 0470215984
- Allsopp, M., Santillo, D. & Johnston, P. (2000). Hazardous chemicals in PVC flooring. Greenpeace Research Laboratories Technical Note 14/00, November 2000: 10 pp. [published under cover title 'Poison Underfoot: Hazardous Chemicals in PVC Flooring and Hazardous Chemicals in Carpets', ISBN 90-73361-68-0]
- Allsopp, M., Santillo, D. & Johnston, P. (2001) Poison underfoot. Hazardous chemicals in PVC flooring and hazardous chemicals in carpets. Publ. Greenpeace Research Laboratories/ Healthy Flooring Network, ISBN 90-73361-68-0
- Allsopp, M., Costner, P. & Johnston, P. (2001) Incineration and Human Health: State of knowledge of the impacts of waste incinerators on human health. Publ. Greenpeace International, Amsterdam, ISBN 90-73361-69-9. 81 pp. <http://www.greenpeace.to/html/commreps.htm>
- Ariese, F., van Hattum, B., Hopman, G., Boon, J. & ten Hallers-Tjabbes, C. (1998) Butyltin and phenyltin compounds in liver and blubber samples of sperm whales (*Physeter macrocephalus*) stranded in the Netherlands and Denmark. Institute for Environmental Studies, Vrije Universiteit, Amsterdam, Report W98-04, March 1998
- Atienzar, F.A., Billingham, Z. & Depledge, M.H. (2002) 4-n-nonylphenol and 17-beta-estradiol may induce common DNA effects in developing barnacle larvae. *Environmental Pollution* 120(3): 735-738
- ATSDR (2000) ATSDR's toxicological profiles on CD-ROM, CRC Press, Boca Raton, FL
- Barr DB, Silva MJ, Kato K, Reidy JA, Malek NA, Hurtz D, Sadowski M, Needham LL, Calafat AM (2003). Assessing human exposure to phthalates using monoesters and their oxidized metabolites as biomarkers. *Environ Health Perspect*:111(9):1148-51.
- Bellfroid, A.C., Purperhart, M. & Ariese, F. (2000) Organotin levels in seafood. *Marine Pollution Bulletin* 40(3): 226-232 Bergman, Å., Osiman, C., Nyborn, R., Sjödin, A., Carlsson, H., Nilsson, U. & Wachtmeister, C.A. (1997) Flame retardants and plasticizers on particulates in the modern computerized indoor environment. *Organohalogen Compounds* 33: 414-419
- Bernard, A.M., Vyskočil, A., Kriz, J., Kodl, M. & Lauwerys, R. (1995) Renal effects on children living in the vicinity of a lead smelter. *Environmental Research* 68: 91-95
- Blount, B.C., Silva, M.J., Caudill, S.P., Needham, L.L., Pirkle, J.L., Sampson, E.J., Lucier, G.W., Jackson, R.J. & Brock, J.W. (2000) Levels of seven urinary phthalate metabolites in a human reference population. *Environmental Health Perspectives* 108(10): 979-982
- Bouchard, N., Pelletier, E. & Fournier, M. (1999) Effects of butyltin compounds onphagocytic activity of hemocytes from three marine bivalves. *Environmental Toxicology and Chemistry* 18(3): 519-522
- Butte, W. & Heinzow, B. (2002) Pollutants in house dust as indicators of indoor contamination. *Reviews in EnvironmentalContamination and Toxicology* 175: 1-46 Chen, H.Y., Xiao, J.G., Hu, G., Zhou, J.W., Xiao, H. & Wang, X.R. (2002) Estrogenicity of organophosphorus and pyrethroid pesticides. *Journal of Toxicology and Environmental Health-Part A* 65(19): 1419- 1435
- CDC (2003). Second National Report on Human Exposure to Environmental Chemicals. (Revised version). Atlanta, GA, USA: Centres for Disease Control and Prevention, National Center for Environmental Health. NCEH Pub. No. 02-0716. Accessed Sept 2003 at: <http://www.cdc.gov/exposurereport/pdf/secondNER.pdf>
- Chen, Z.-S. (1991) Cadmium and lead contamination of soils near plastic stabilizing materials producing plants in Northern Taiwan. *Water, Air & Soil Pollution*. 57-58: 745-754
- Chitra, K.C., Latchoumycandane, C. & Mathur, P.P. (2002) Effect of nonylphenol on the anti-oxidant system in epididymal sperm of rats. *Archives of Toxicology* 76(9): 545-551
- Cima, F., Ballarin, L., Bressa, G., Martinucci, G. & Burighel, P. (1996) Toxicity of organotin compounds on embryos of a marine invertebrate (*Styela plicata*: Tunicata). *Ecotoxicology and Environmental Safety* 35(2): 174-182
- Colon, I., Caro, D., Bourdony, C.J. & Rosario, O. (2000) Identification of phthalate esters in the serum of young Puerto Rican girls with premature breast development. *Environmental Health Perspectives* 108(9): 895-900
- CSTEE (2001a) EC Scientific Committee on Toxicity, Ecotoxicity and the Environment, Opinion on the results of the Risk Assessment of: 1,2-Benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9- rich and di-'isononyl' phthalate – Report version (Human Health Effects): Final report, May 2001. Opinion expressed at the 27th CSTEE plenary meeting, Brussels, 30 October 2001: 7 pp. http://europa.eu.int/comm/food/fs/sc/sct/ou1122_en.
- CSTEE (2001b) EC Scientific Committee on Toxicity, Ecotoxicity and the Environment, Opinion on the results of the Risk Assessment of: 1,2-Benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9- rich and di-'isononyl' phthalate – Report version (Environment): Final report, May 2001. Opinion expressed at the 27th CSTEE plenary meeting, Brussels, 30 October 2001: 5 pp. http://europa.eu.int/comm/food/fs/sc/sct/ou1122_en.pdf
- CSTEE (2001c) Scientific Committee on Toxicity, Ecotoxicity and the Environment (European Commission), Opinion on the results of the Risk Assessment of: 1,2- Benzenedicarboxylic acid di-C9-11- branched alkyl esters, C10-rich and di-'isododecyl'phthalate – Report version (Environment): Final report, May 2001. Opinion expressed at the 24th CSTEE plenary meeting, Brussels, 12 June 2001, 5 pp. http://europa.eu.int/comm/food/fs/ sc/sct/ou1121_en.pdf
- Dalgaard, M., Nellemann, C., Lam, H.R., Sorensen, I.K. & Ladefoged, O. (2001) The acute effects of mono(2- ethylhexyl)phthalate (MEHP) on testes of prepubertal Wistar rats. *Toxicology Letters* 122: 69-79
- Danish EPA 1998: Environmental project no. 432: Effects of Organic Chemicals in Sludge Applied to Soil.
- Danish EPA 2000: Environmental project no. 534: Chemicals in textiles.
- Danish EPA 2004: Accessed Jan 2004 at: <http://www.mst.dk/>
- Danish EPA 2004a: Accessed Feb. 2004 at: <http://www.mst.dk/kemi/O2053611.htm>
- Danish EPA 2004b: Accessed Feb 2004 at: http://www.mst.dk/udgiv/publications/2001/87-7944-596-9/html/kap08_eng.htm
- de Santiago, A. & Aguilar-Santelises, M. (1999) Organotin compounds decrease in vitro survival, proliferation and differentiation of normal human B lymphocytes. *Human and Experimental Toxicology* 18(10): 619-624
- Di Gangi, J. (1997) Lead and cadmium in vinyl children's products. Publ: Greenpeace USA, 38pp.
- Dostal LA, Weaver RP, Schwelz BA (1987). Transfer of di(2-ethylhexyl) phthalate through rat milk and effects on milk composition and the mammary gland. *Toxicol Appl Pharmacol* 91(3):315-25.
- Duty, S.M., Singh, N.P., Silva, M.J., Barr, D.B., Brock, J.W., Ryan, L., Henrick, R.F., Christiani, D.C. & Hauser, R. (2003) The relationship between environmental exposures to phthalates and DNA damage in human sperm using the neutral comet assay. *Environmental Health Perspectives* 111(9): 1164-1169
- EC (2002a) European Union Risk Assessment Report, 4-nonylphenol (branched) and nonylphenol. 2nd Priority List, Volume 10, EUR 20387 EN, European Communities 2002, Luxembourg: 230 pp.
- EC (2002b) European Community Common Position (EC) No 19/2002 of 4 December2001 adopted by the Council, acting in accordance with the procedure referred to in Article 251 of the Treaty establishing the European Community, with a view to adopting a Directive of the European Parliament and of the Council on the restrictions of the use of certain hazardous substances in electrical and electronic equipment (RoHS). *Official Journal of the European Communities*, 2002 /C 90/E, Vol.45: 12-18
- EC (2002) Heavy Metals in Waste. European Commission DG ENV, E3. Available at <http://europa.eu.int/comm/environment/waste/heavymetalsreport.pdf>
- EC 2004. Accessed Jan 2004 at: <http://www.dehp-facts.com/index.asp?page=5>
- Elinder, C.G. & Jarup, L. (1996) Cadmium exposure and health risks: recent findings. *Ambio* 25.5: 370-373
- Ema, M., Kurosaka, R., Amano, H. & Ogawa, Y. (1995) Comparative developmental toxicity of n-butyl benzyl phthalate and di-n-butyl phthalate in rats. *Archives of Environmental Contamination and Toxicology* 28(2): 223-228
- Ema, M., Iwase, T., Iwase, Y., Ohyama, N., Ogawa, Y. (1996) Change of embryotoxic susceptibility to di-n-butyltin dichloride in cultured rat embryos. *Archives of Environmental Contamination and Toxicology* 70: 742-748
- Ema, M., Harazono, A., Miyawaki, E., Ogawa, Y. (1997) Effect of the Day of Administration on the Developmental Toxicity of Tributyltin Chloride in Rats. *Archives of Environmental Contamination and Toxicology* 33: 90-96
- Ema, M. & Miyawaki, E. (2002) Effects on development of the reproductive system in male offspring of rats given
- butyl benzyl phthalate during late pregnancy. *Reproductive Toxicology* 16: 71-76
- ENDS 2002. Report #328, May 2002
- ENDS 2003. Report #344, p27, September 2003
- Eskes, C., Honegger, P., Jones-Lepp, T., Varner, K., Matthieu, J.-M., and Monnet-Tschudi, F. (1999) Toxicology in vitro 13:555-560
- EU (2001) Decision No 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC, *Official Journal L* 249 , 17/09/2002: 27-30
- EU (2002a) Commission Directive 2002/62/EC of 9th July 2002 adapting to technical progress for the ninth time Annex 1 to Council Directive 76/769/EEC on the approximations of the laws, regulations and administrative provisions of the member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (organostannic compounds). *Official Journal L* 183, 12.7.2002: 58-59
- EU (2002b) Commission Decision 2002/371/EC of 15 May 2002 establishing the ecological criteria for the award of the Community eco-label to textile products and amending Decision 1999/178/EC. *Official Journal L* 133, 18/05/2002: 29-41
- EU (2003a) Directive 2003/36/EC of the European Parliament and of the Council of 26 May 2003 amending, for the 25th time, Council Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (substances classified as carcinogens, mutagens or substances toxic to reproduction - c/m/r), *Official Journal of the European Union L* 156: pp. 26-30
- http://europa.eu.int/eur-lex/priv/en/oj/dat/2003/L_156/L_15620030625en00260030.pdf
- EU (2003b) Commission Decision 2003/819/EC of 19 November 2003 amending Decision 1999/815/EC concerning measures prohibiting the placing on the market of toys and childcare articles intended to be placed in the mouth by children under three years of age made of soft PVC containing certain phthalates. *Official Journal of the European Union L* 308, 25.11.2003: 23-24
- EU (2004) Regulation of the European Parliament and of the Council on Persistent Organic Pollutants and amending Directive 79/117/EEC, February 2004, Preamble (6)
- Eurofins (2003) Analytical report: Testing of textile with prints (Disney products), December 2003.
- Evans, S.M. (2000) Marine antifoulants. In: C. Sheppard [Ed.], *Seas at the Millenium: An Environmental Evaluation, Volume III: Global Issues and Processes*, Elsevier Science Ltd, Oxford, ISBN: 0-08-043207-7, Chapter 124: 247-256
- EWG 2004. Accessed Jan 2004 at: http://www.ewg.org/reports/bodyburden/table_exposures.php
- Forordning (1998:944) om forbud m.m. i vissa fall i samband med hantering, införelse och utförelse av kemiska produkter.1998-06-25, Swedish Government
- Gaikema F.J., Alberts P.J. Gaschromatografische bepaling van residuen van organotinverbindingen in textielproducten. De Ware(n)-Chemicus 1999, 23-33.
- Goyer, R.A. (1993) Lead toxicity: current concerns. *Environmental Health Perspectives* 100: 177-187
- Goyer 1996. Goyer, R.A. (1996) Toxic effects of metals. In Casarett & Doull's Toxicology. The Basic Science of Poisons, Fifth Edition, Klaassen, C.D. [Ed.], McGraw-Hill Health Professions Division, ISBN 0071054766
- Guenther, K., Heinke, V., Thiele, B., Kleist, E., Prast, H. & Raecker, T. (2002) Endocrine disrupting nonylphenols are ubiquitous in food. *Environmental Science and Technology* 36(8): 1676-1680
- Hennes & Mauritz 2004: Email communication from Ingrid Schullstrom, environment manager, H&M Stockholm, 22 January 2004.
- Harreus, U.A., Wallner, B.C., Kastenbauer, E.R. & Kleinsasser, N.H. (2002) Genotoxicity and cytotoxicity of 4-nonylphenol ethoxylate on lymphocytes as assessed by the COMET assay. *International Journal of Environmental Analytical Chemistry* 82(6): 395-401
- IARC (1994) Cadmium and certain cadmium compounds. In International Agency for Research on Cancer (IARC) monograph: Beryllium, Cadmium, Mercury, and Exposures in the Glass Manufacturing. IARC monograph, Vol. 58. ISBN 92 832 1258 4
- IARC (1995) IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 62, Wood dust and Formaldehyde, ISBN 92 832 1262 2: 405 pp.
- IARC (2004): Website accessed Jan 2004 at: <http://www.inchem.org/documents/iarc/vol62/formal.html>
- IMO 2004. Accessed Feb. 2004 at: <http://www.imo.org/home.asp>
- IPCS (1999). Tributyltin oxide. International Programme on Chemical Safety Concise International Chemical Assessment Document: 14. Accessed Sept 2003 at: <http://www.inchem.org/documents/cicads/cicads/cicad14.htm#PartNumber:14>
- Iwata, H., Tanabe, S., Mizuno, T. & Tatsukawa, R. (1995) High accumulation of toxic butyltins in marine mammals from Japanese coastal waters. *Environmental Science and Technology* 29: 2959-2962.
- Jackson, A. P., and Alloway, B. J. (1992) The transfer of cadmium from agricultural soils to the human food chain. In 'Biogeochemistry of Trace Metals' (Ed. D. C. Adriano.) pp. 109-58. Publ: Lewis, USA. ISBN 0873115233
- Jobling, S., Coey, S., Whitmore, J.G., Kime,D.E., van Look, K.J.W., McAllister, B.G., Beresford, N., Henshaw, A.C., Brighty, G., Tyler, C.R. & Sumpter, J.P. (2002) Wild intersex roach (*Rutilus rutilus*) have reduced fertility. *Biology of Reproduction* 67(2): 515- 524
- Jobling, S., Reynolds, White, R., Parker, M.G. & Sumpter, J.P. (1995) A variety of environmentally persistent chemicals, including some phthalate plasticizers, are weakly oestrogenic. *Environmental Health Perspectives* 103(6): 582-587
- Jobling, S., Sheahan, D., Osborne, J.A., Matthiessen, P. & Sumpter, J.P. (1996) Inhibition of testicular growth in rainbow trout (*Oncorhynchus mykiss*) exposed to estrogenic alkylphenolic chemicals. *Environmental Toxicology and Chemistry* 15(2): 194-202
- Kannan, K., Corsolini, S., Focardi, S., Tanabe, S. & Tatsukawa, R. (1996) Accumulation pattern of butyltin compounds in dolphin, tuna and shark collected from Italian coastal waters. *Archives of Environmental Contamination and Toxicology* 31: 19-23
- Kergosien D.H. and Rice C.D. (1998) Macrophage secretory function is enhanced by low doses of tributyltin-oxide (TBTO), but not tributyltin-chloride (TBTCl). *Arc. Environ. Contam. Toxicol.* 34: 223-228
- Koch HM, Drexler H, Angerer J (2003). An estimation of the daily intake of di(2-ethylhexyl) phthalate (DEHP) and other phthalates in the general population. *Int J Hyg Environ Health*; 206(2):77-83.
- Kumasaka, K., Miyazawa, M., Fujimaka, T., Tao, H., Ramaswamy, B.R., Nakazawa, H., Makino, T. & Satoh, S. (2002) Toxicity of the tributyltin compound on the testis in premature mice. *Journal of Reproduction and Development* 48(6): 591-597
- Lewis, R.G., Fortmann, R.C. & Camann, D.E. (1994) Evaluation of methods for monitoring the potential exposure of small children to pesticides in the residential environment. *Archives of Environmental Contamination and Toxicology* 26: 37-46
- Lo S, Allera A, Albers P, Heimbrecht J, Jantzen E, Klingmuller D, Steckelbroeck S (2003). Dithioerythritol (DTE) prevents inhibitory effects of triphenyltin (TPT) on the key enzymes of the human sex steroid hormone metabolism. *J Steroid Biochem Mol Biol*: 84(5):569-76.
- Loo TW, Clarke DM (1998). Nonylphenol ethoxylates, but not nonylphenol, are substrates of the human multidrug resistance P-glycoprotein. *Biochem Biophys Res Commun*: 247(2):478-80.
- Matthews, G. (1996) PVC: production, properties and uses. Publ: The Institute of Materials, London., ISBN 0 9017 16 59 6, 379pp.
- Mayer, F.L., Stalling, D.L. & Johnson, J.L. (1972) Phthalate esters as environmental contaminants. *Nature* 238: 411-413
- MEE (2000) Statutory order on prohibition of import, marketing and manufacture of lead and products containing lead, Number 1012. Ministry of Environment and Energy (MEE), Danish Environmental Protection Agency. Available at: <http://www.mst.dk/rules/O2030000.htm>
- Nielsen, E., Thorup, I., Schnipper, A., Hass, U., Meyer, O., Ladefoged, O., Larsen, J.C., Ostergaard, G. & Larsen, P.L. (2001) Children and the unborn child. Publ: Danish Environmental Protection Agency, Miljøprojekt No. 589, 117pp.
- Nordic Council of Ministers 2003. Cadmium Review, January 2003.
- Nriagu, J.O. (1988) A silent epidemic of environmental metal poisoning. *Environmental Pollution* 50: 139-161
- Ortepa 2004. Accessed Jan 2004 at: <http://www.ortepa.org/stabilisers/pages/markets.htm>
- OSPAR (1998) OSPAR Strategy with Regard to Hazardous Substances, OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, OSPAR 98/14/1 Annex 34
- OSPAR (2000) OSPAR Background Document on Organic Tin Compounds, OSPAR Priority Substances Series, OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, OSPAR Commission, London, ISBN 0- 946956-56-1: 16pp.
- OSPAR (2001) Nonylphenol/nonylphenolethoxylates, OSPAR Priority Substances Series, OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, OSPAR Commission, London, ISBN 0- 946956-79-0: 18 pp.
- OSPAR (2002) OSPAR Background Document on Cadmium, OSPAR Priority Substances Series, OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, OSPAR Commission, London, ISBN 0-946956-93-6: 56pp.
- Otake, T., Yoshinaga, J. & Yanagisawa, Y. (2001) Analysis of organic esters of plasticizer in indoor air by GC-MS and GC/PCD. *Environmental Science and Technology* 35(15): 3099-3102
- Park, J.D., Habeebu, S.S.M. & Klaassen, C.D. (2002) Testicular toxicity of di-(2-ethylhexyl) phthalate in young Sprague-Dawley rats. *Toxicology* 171: 105-115
- Parmar D, Srivastava SP, Srivastava SP, Seth PK (1985). Hepatic mixed function oxidases and cytochrome P-450 contents in rat pups exposed to di-(2- ethylhexyl)phthalate through mother's milk. *Drug Metab Dispos*:13(3):68-70.
- Pirkle, J.L., Kaufman, R.B., Brody, D.J., Hickman, T., Gunter, E.W. & Paschal, D.C. (1998) Exposure of the U.S. population to lead, 1991-1994. *Environmental Health Perspectives* 106(11): 745-750
- Sadiki, A.-I. & Williams, D.T. (1999) A study on organotin levels in Canadian drinking water distributed through PVC pipes. *Chemosphere* 38(7): 1541-1548
- Santillo D, Labunski I, Davidson H, Johnston P, Strutt M and Knowles O. Consuming Chemicals, Greenpeace Research Laboratories Technical Note 01/2003 (GRL-TN-01-2003), 2003.
- Srivastava S, Awasthi VK, Srivastava SP, Seth PK (1989). Biochemical alterations in rat fetal liver following in utero exposure to di(2-ethylhexyl)phthalate (DEHP). *Indian J Exp Biol* 27(10):885-8.
- Statutory order: Bekendtgørelse om forbud mod salg, import og fremstilling af cadmiumholdige produkter. No. 1199 af 23/12/1992. Danish Government
- Stringer, R., Labunski, I., Santillo, D., Johnston, P., Siddorn, J. & Stephenson, A. (2000) Concentrations of phthalate esters and identification of other additives in PVC children's toys. *Environmental Science and Pollution Research* 7(1): 27-36
- Takada H, Isobe T, Nakada N, Nishiyama H, Iguchi T, Irie H, Mori C (1999).Bisphenol A and nonylphenols in human umbilical cords. Proceedings of the International Scientific Conference on Environ mental Endocrine Disrupting Chemicals, Monte Verita , Ascona, Switzerland, March 7-12, 1999
- Takahashi, S., Mukai, H., Tanabe, S., Sakayama, K., Miyazaki, T. & Masuno, H. (1999) Butyltin residues in livers of humans and wild terrestrial mammals and in plastic products. *Environmental Pollution* 106: 213-218
- USDHHS (2000) 9th report on carcinogens. Publ: US Department of Health and Human Services.
- USDHSS 2003. Second National Report on Human Exposure to Environmental Chemicals by the Department of Health and Human Services Centers for Disease Control and Prevention, National Center for Environmental Health, Division of Laboratory Sciences, Atlanta, Georgia. NCEH Pub. No. 02. Available at <http://www.cdc.gov/exposurereport/>
- WHO, World Health Organisation (1992) Cadmium. *Environmental Health Criteria* 135. ISBN 9241571357
- Wilson, N.K., Chuang, J.C. & Lyu, C. (2001) Levels of persistent organic pollutants in several child day care centers. *Journal of Exposure Analysis and Environmental Epidemiology* 11(6): 449-458
- Yin, L.M., Rhoads, G.G. & Liou, P.J. (2000) Seasonal influences on childhood lead exposure. *Environmental Health Perspectives* 108 (2): 177-182



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