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Toxic Substances in Articles: The Need for Information

Rachel I. Massey, Janet G. Hutchins
Massachusetts Toxics Use Reduction Institute

Monica Becker
Monica Becker & Associates

Joel Tickner
Lowell Center for Sustainable Production

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Nordic Council of Ministers
Store Strandstræde 18
DK-1255 Copenhagen K
Phone (+45) 3396 0200
Fax (+45) 3396 0202

Nordic Council
Store Strandstræde 18
DK-1255 Copenhagen K
Phone (+45) 3396 0400
Fax (+45) 3311 1870

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Preface

There is a growing interest and understanding of the potential exposure to chemicals contained in commonly used articles, such as personal computers, textiles, and toys. Information exchange is here one key factor to enabling actors to avoid hazardous chemicals and to manage risks. While an information system is not a substitute for other policy mechanisms to mitigate the harms from toxic substances in articles, it can be a powerful compliment.

This report aim at contributing to the continued discussion on the various measures needed to achieve improved chemicals management at national, regional and global levels, by exploring the benefits from information on chemicals in articles. The report is an input to the further development of the Strategic Approach to International Chemicals Management (SAICM), adopted in February 2006, in particular to the objectives on knowledge and information (Objective 15) of its Overarching Policy Strategy and to some of the activities in the Global Plan of Action. The report is to be presented at an informal international workshop on stakeholders´ information needs on chemicals in articles in Bangkok, December 2008.

The report was commissioned by the Swedish Chemicals Agency (KemI), with funding from the Nordic Chemicals Group under the Nordic Council of Ministers. Responsibility for its contents rests with the authors. The authors are Rachel I. Massey and Janet G. Hutchins at the Massachusetts Toxics Use Reduction Institute, Joel Tickner at the Lowell Center for Sustainable Production and Monica Becker, Monica Becker & Associates.

Executive Summary

This report describes the problem of the lack of information on chemicals in articles. It illustrates specific cases where problems caused by chemicals in articles occur in all life cycle stages: manufacturing, use, recycling and disposal. The report explores the benefits that could result from the development of an internationally standardized information system for the chemical contents of articles; the challenges of disseminating such information; and existing models that could inform such a system. While an information system is not a substitute for other policy mechanisms to mitigate the harms from toxic substances in articles, it can be a powerful compliment.

PART I: Toxic substances in articles: the need for information

1. Introduction

Chemical substances provide important functionality in a wide range of products. Many chemicals can be used with a high degree of safety when best practices are followed. However, the use of toxic chemicals in articles is a growing concern for public health and the environment.

International trade results in substances being transported among regions. In particular, trade in articles is an increasingly important factor in the global transport of toxic substances. From toys and household items to electronic equipment and automobiles, toxic substances in articles make a significant contribution to the global burden of toxic substances.

Solving the problems posed by toxic substances in articles will require action on many levels, from research and development to information systems or regulations. In this report, we consider a strategy that is critical for the sound management of substances in articles: increasing the availability of information.

At present, there is no global system for management of information about substances in articles. The lack of such a system has implications for everyone making decisions about substances in articles – including product designers, manufacturers, workers, retailers, consumers, recyclers, government regulators, and others. The development of an internationally standardized information system for substances in articles could help to ensure that actors at every point in the supply chain are able to make sound decisions.

In addition, risk management measures based on relevant information are essential for protection of workers, the environment, and public health. In the absence of sufficient information, appropriate risk management measures cannot be put in place.

Part I of this report explores the problem of toxic substances in articles, with detailed case studies of selected examples. Part II considers existing models for the generation and dissemination of information about substances in articles. Finally, Part III offers questions for discussion, to inform future efforts to develop information systems for toxic substances in articles.

2. Scope and Definitions

This report considers the problem of toxic substances in articles. In this discussion, we rely upon the definition of the term "article" found in the EU chemicals regulation, REACH, which defines articles as "an object which during production is given a special shape, surface or design which determines its function to a greater degree than its chemical composition." Examples of articles range from automobile tires to electronic equipment to toys. Our discussion does not encompass chemical mixtures, preparations or products, such as inks, adhesives, or cleaning materials.

3. Understanding the Problem: Case Studies of Toxic Substances in Articles

Historically, activities to address toxic chemical risks have focused primarily on releases to air and water connected to the manufacturing process. Increasingly, it is clear that toxic substances are also released from articles during use and at the end of their useful life. For some chemicals, the majority of human and environmental exposures occur through product use and disposal, rather than in the manufacturing stage.

We present four detailed examples that illustrate the extent of the problem.

- *Perfluorinated compounds (PFCs) in waterproof textiles.* Perfluorinated compounds (PFCs) are persistent, bioaccumulative substances, many of which are toxic to humans and animals. In textiles, PFCs are used to give a stain- and water-repellent finish to textile products, including some clothing. This case study illustrates the intentional use of a toxic chemical in an article, leading to releases throughout the article's life cycle.

- *Lead in children's toys and jewelry.* Lead is a well-known neurotoxincant, with particularly harmful effects on infants, children, and the developing fetus. Despite widespread recognition of its toxic effects, lead continues to appear in a variety of articles, including toys and some jewelry intended for children. Manufacturers may use lead as an inexpensive toxic substitute for more expensive alternatives even though it is not specified by the product designer. Lead may leach out of these products during use and disposal. Children in many regions are exposed to lead in toys. The use of lead in toys has also led to costly recalls for companies.
- *Nonylphenol ethoxylates: Water contaminants from textile manufacturing and use.* Nonylphenol ethoxylates (NPEs) are persistent and toxic to aquatic organisms, and their breakdown products are endocrine disruptors. NPEs are used as surfactants, or cleaning agents, in a wide variety of applications, including in textile manufacturing. They are released into the environment in all phases of the life cycle of a textile article. This case sheds light on instances where a chemical, used as a processing aid in one region, remains in the final product and is released into the environment in other regions during use and disposal.
- *Toxic materials in personal computers.* Toxic materials in personal computers include lead, cadmium, mercury, beryllium, antimony, brominated flame retardants, perfluorinated compounds, and polyvinyl chloride plastic. A typical personal computer is assembled from numerous parts, made by manufacturers around the globe. Exposures occur during manufacture, use, and disposal. At the end of their useful life, few computers go to state-of-the-art electronics recycling facilities; most recycling is conducted in developing countries or countries with economies in transition, using methods that can be extremely hazardous to human health and the environment.

4. Advantages to a standardized approach to information on articles

Lack of information about toxic substances in articles increases the difficulty of managing those substances in use, recycling and disposal. An internationally standardized approach to information management would offer benefits for manufacturers, workers, recyclers, consumers, members of the public, governments, and others.

- *Benefits for the private sector.* Greater transparency at every stage of the supply chain would reduce costly recalls and liability problems.

An internationally standardized system would offer efficiencies, avoiding a patchwork of national requirements. Firms at every stage of the supply chain would benefit. For example, manufacturers would have better information about the chemical content of components; and recyclers could make appropriate decisions about disposal and recycling of articles.

- *Benefits for workers.* Workers manufacturing, using, or recycling articles would benefit from knowing what is in articles and how to handle them safely. To the extent that market signals lead to the replacement of toxic substances with safer substitutes, workers will benefit from safer work places.
- *Benefits for consumers.* A standardized information system would make it possible for consumers to make informed choices about purchases. Better information would also allow consumers to protect themselves, others and the environment from risks from toxic substances, through safe handling during use, and through correct handling of waste.
- *Benefits for members of the public.* Members of the public would benefit to the extent that greater information leads, directly or indirectly, to less use of toxic substances in articles, and to safer handling of articles containing toxic substances.
- *Benefits for governments.* Information can allow governments to identify sources of pollution; determine which product types contain high priority substances; and identify priority focus areas for regulatory action, public education, or technical assistance. Furthermore, an internationally standardized system could simplify regulatory processes and help to avoid duplication of effort among jurisdictions.
- *Benefits for the economy.* The economy will benefit when the private sector takes health and environmental impacts of substances into account in making long-term investment decisions.
- *Benefits for trade.* A standardized system for communication of information on substances would facilitate trade. While countries may differ in the stringency of the standards they apply, all would benefit from using a common language to communicate about chemicals in articles.

PART II: Models for information management

In developing an information system for chemicals in articles, a number of existing systems around the world are worth examining. These include legal requirements for information disclosure; information management systems that have been created by the private sector; and the Globally Harmonized System for Classification and Labeling of Chemicals.

5. Regulatory Systems

In the absence of any internationally standardized approach to information on chemicals in articles, some jurisdictions have created information disclosure requirements. We discuss a few innovative policies that may be of interest as models for future policy efforts.

- California’s Safe Drinking Water and Toxic Enforcement Act of 1986 (commonly referred to as Proposition 65) requires notification of chronic health effects. In addition, new legislation adopted in 2008 expands the ability of the state to manage and disseminate information about chemicals.
- Recent legislation in the US states of Maine and Washington requires that the state be notified of the presence of selected toxic substances in children's products.
- Mercury products legislation in a number of US states requires manufacturers to submit detailed information to a centralized database on products to which they have intentionally added mercury.
- The EU's Restriction on Hazardous Substances (RoHS) Directive prohibits the use of certain toxic substances in electrical and electronic equipment. The directive does not focus on information management; however, in order to comply with the directive, manufacturers and suppliers have had to develop complex information management systems to pass information along the supply chain.
- A similar law in China requires labeling of electronic products to indicate the presence of specific toxic substances and how long the article may be used before these substances are expected to be released from the article.
- The EU's chemicals regulation, REACH, requires registration of toxic substances in articles when certain criteria are met, as well as notification of toxic substances under another set of criteria. In some instances, REACH requires that information be provided to the recipient of the article as well as to consumers on request.
- The Globally Harmonized System (GHS) for Classification and Labelling of Chemicals is a standardized system for communicating about chemical hazards. It applies only to chemicals and chemical products; it does not apply to articles. However, some elements of the GHS may be useful for the development of an information system for chemicals in articles.

Over all, these examples illustrate that models for information systems exist and that there is a growing need for standardization to avoid a patchwork system.

6. Voluntary systems

Some chemical information systems have been developed on a voluntary basis.

- *Sector-specific information for industry.* Some have been developed for specific industry sectors. We discuss specific examples for the automotive, electronics, and building material industries, as well as a system that is currently in development for retailers.
- *Restricted chemical lists.* Some businesses have adopted restricted chemical lists to provide guidance to their suppliers on chemicals to be avoided. Complying with these lists of restrictions may also require management of detailed information on chemicals up and down the supply chain.
- *Information for consumers.* Systems have been developed to organize and deliver information on chemicals in products with a specific focus on helping consumers to make informed choices.
- *Ecolabeling.* Finally, a wide variety of ecolabeling schemes have been developed, in part as an effort to compensate for the lack of internationally standardized information systems.

PART III: The way forward

7. Toward an Internationally Standardized System

The implementation of a standardized, international system for providing information on chemicals in articles will face challenges in several areas. However, the lack of information about toxic substances in articles creates difficulties for actors at every stage of the supply chain. Going forward, the international community may wish to consider a variety of possible initiatives to fill the information gap.

One option is to work toward the development of an internationally standardized system for information on toxic substances in articles. In designing an information system, it would be necessary to make decisions about its scope. Key questions include the following.

- What are the needs of the various target audiences for the system?
- What chemicals should be included in the system?
- What articles should be included in the system?
- What information should be provided?
- In what format should the information be provided?

PART I: Toxic substances in Articles: The need for information

1. Introduction

Chemical substances provide important functionality in a wide range of products. Many chemicals can be used with a high degree of safety when best practices are followed. However, the use of chemicals in articles is a growing concern for public health and the environment.

Toxic substances can pose threats to human health and the environment when they are released from articles during their manufacture, use, and disposal or recycling. Some substances travel through the environment from one region of the world to another, accumulating in regions far from where they were originally discharged into the environment. International trade also results in substances being transported among regions. Trade in articles and their ultimate recycling or disposal far from the point of manufacture is an increasingly important factor in the global transport of toxic substances. [1] From toys and household items to electronic equipment and automobiles, toxic substances in articles are a major aspect of the global burden of toxic substances.

Toxic substances in articles may pose threats at every stage of the product life cycle – manufacturing, use, and disposal. Solving the problems posed by toxic substances in articles will require action on many levels, from research and development to information systems or regulations.

Simplified Life Cycle Diagram

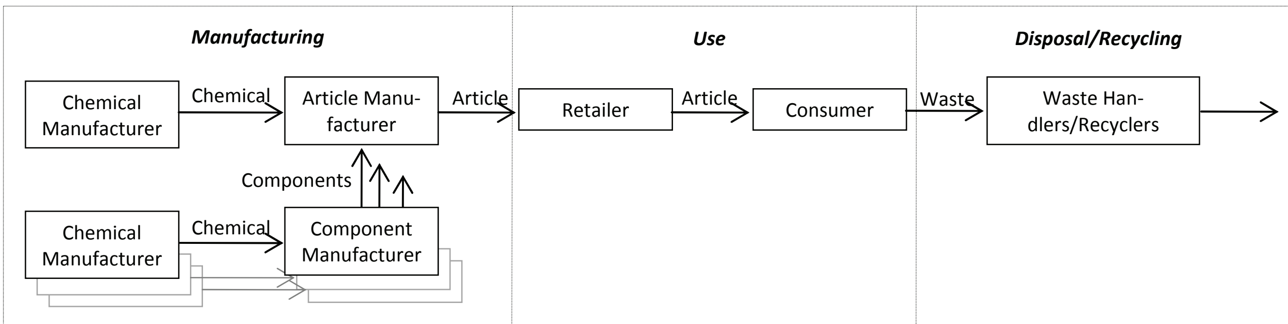

Figure 1. Simplified diagram of the life cycle of an article.

In this report, we consider a factor that is critical for the sound management of substances in articles: the availability of information. At present, there is no global system for provision of information about substances in a wide range of articles. The lack of such a system has implications for everyone making decisions about substances in articles –including product designers, manufacturers, importers, workers, retailers, individual consumers, recyclers, and government regulators. In addition, risk management measures based on relevant information are one of the key elements for labour protection and for protection of the environment and public health. In the absence of sufficient information, adequate risk management measures cannot be put in place.

The development of an internationally standardized information system for substances in articles could help to ensure that actors at every point in the supply chain are able to make sound decisions -- whether they are decisions about how to design and manufacture an article, or decisions about which article to import or purchase at a store, or decisions about how to dispose of an article at the end of its useful life.

Part I of this report describes the problem of toxic substances in articles, with detailed case studies of selected examples. It illustrates hazards that result from use of toxic substances in articles, shows the difficulties that result from lack of information, and considers the advantages that would result from better information management systems.

Part II considers existing efforts to generate and disseminate information about substances in articles. Government programs range from a California law that requires that consumers be notified if they are purchasing an item containing a substance that causes cancer or reproductive disorders, to Chinese labelling requirements for electronic products containing selected toxic substances. This discussion also covers the efforts that industry associations and individual companies have made to fill the information gap themselves.

Part III offers suggestions as to the questions and themes that would need to be considered in order to improve management of information about substances in articles.

2. Scope and Definitions

This report considers the problem of toxic substances in *articles*, and the options for addressing it via improved collection, management, and dissemination of information. In this discussion, we rely upon the definition of the term *article* found in the EU chemicals regulation, REACH.[2] According to this definition, an article is "an object which during production is given a special shape, surface or design which determines its function to a greater degree than its chemical composition." Examples of articles range from automobile tires to electronic equipment to toys.

Our discussion does not encompass those items whose primary functionality is determined by the properties of a chemical substance or mixture, such as inks, adhesives, or cleaning materials. These items are considered to be chemical mixtures. While there are also important challenges for the management of information about chemical mixtures, these are not the focus of the present report.

The reason we do not consider chemical mixtures in this report is that some progress has been made toward addressing the problem of information about chemical substances and mixtures. The Globally Harmonized System (GHS) for Classification and Labelling of Chemicals provides a standardized format and guidance for providing information on substances on their own, as well as for substances in mixtures. To the extent that individual jurisdictions wish to adopt classification and labeling requirements for chemicals, they can rely upon the GHS in developing these requirements. Technical assistance for the development of such requirements is available through the United Nations Institute for Training and Research (UNITAR) and other institutions.

The development of an internationally standardized template does not ensure adoption of notification requirements at the regional or national level. In much of the world, classification and labelling requirements for chemical substances on their own or in mixtures are minimal or nonexistent. However, the GHS takes a first step by providing the globally harmonized building blocks for the development of such requirements. Since at present there is no system for management of information on *toxics in articles*, that gap is the focus of this report.

3. Understanding the Problem: Case Studies of Toxic Substances in Articles

Some tens of thousands of substances are used in commerce today. Some of these substances are known to pose a threat to health and the environment; many others have never been tested to determine their health and environmental effects. While no precise figure is available on total volume, it is clear that large amounts of substances known to be toxic are incorporated into articles each year. Little information is available to the people who come into contact with these articles as they move through the global economy.

This section presents an overview of the problem of toxic substances in articles. We begin with a discussion of the magnitude and pervasiveness of the problem. We then present detailed case studies of a few specific examples of toxic substances in articles, highlighting the problems that arise at each phase of the life cycle.

3.1. Overview

Toxic substances in articles may pose direct threats to people in every region of the world and in every stage of the product life cycle: manufacture, use, and disposal or recycling. Exposure scenarios range from environmental contamination surrounding facilities that manufacture lead-acid batteries, to release of persistent, bioaccumulative compounds from chemically treated clothing with global distribution.

Historically, activities to address toxic chemical risks have focused primarily on releases to air and water connected to the manufacturing process. Increasingly, it is clear that toxic substances are also released from articles during use and at the end of their useful life. For some chemicals, most human and environmental exposures occur through product use and disposal, rather than in the manufacturing stage. For example, in the case of DEHP, used as a plasticizer in polymer products, about 95 % of the emissions occur from end-product uses and waste handling.[3]

When disposal and recycling take place in countries with inadequate infrastructure, the impacts are amplified. The lack of information about toxics in articles exacerbates the problem, making it difficult for actors at every stage of the supply chain to make informed choices or sound management decisions.

The problem of toxic substances in articles affects every region of the world, but the burden is not evenly distributed. As manufacturing shifts increasingly to developing countries and countries with economies in transition,[4] chemical exposures increase in those regions. Some articles containing toxic substances, such as electrical and electronic equipment, may be purchased in wealthy countries, then disposed of or recycled under unsafe conditions in poorer countries. When some countries restrict or ban the sale of a particularly hazardous article, sales of that article may be diverted to countries that have not yet adopted similar regulations.

In addition, there are important interactions between poverty and risk from chemical exposures. Children who live in poverty may work in manufacturing or recycling of articles containing toxic substances. The health effects of toxic exposures are exacerbated by poor nutrition, co-exposures and pre-existing conditions, factors in which poverty plays a significant role.[5]

Table 1, below, shows a selection of examples of toxic substances in a range of products. These brief descriptions illustrate the breadth of the problem, although the list shows just a small sampling of the many cases of toxic substances in articles. The table is followed by four case studies that provide a view of the problem in greater depth and illustrate the role that information can play in mitigating these problems.

- *Case Study 1* examines the use of perfluorinated compounds (PFCs) in waterproof textiles. This case study illustrates the intentional use of a toxic chemical in an article, leading to releases throughout the article's life cycle.
- *Case Study 2* deals with the use of lead in children's products. Manufacturers may use lead as an inexpensive toxic substitute for more expensive alternatives even though it is not specified by the product designer. This case study describes how the use of lead in toys has resulted in childhood lead exposures around the world, as well as costly recalls for companies manufacturing and selling these products.
- *Case Study 3* addresses the use of the toxic surfactant nonylphenol ethoyxylate (NPE) in textile production. This case sheds light on instances where a chemical, used as a processing aid in one region, remains in the final product and is released into the environment in other regions during use and disposal.
- *Case study 4* deals with toxic substances that are used, intentionally, in personal computers. In this example, articles are produced by assembling multiple components. In order to track information about substances in these articles, it is also necessary to deal with the substances in each component. This case study also illustrates the

hazards that result from disposal and recycling of articles containing toxic substances.

Table 1. Examples of Toxic Substances in Articles

Product	Hazardous Properties	Pathways of Exposure
Automobiles		
Mercury in automotive switches	Mercury can be transformed into the highly toxic chemical methylmercury, which readily bioaccumulates in fish. Humans are exposed to methylmercury when they eat fish. In fetuses, infants, and children, methylmercury impairs neurological development.	When scrapped automobiles with mercury-containing switches are crushed or shredded, mercury is released into the environment.[6]
PAHs in tires	Polycyclic aromatic hydrocarbons (PAHs) are carcinogenic and bioaccumulative.	Highly aromatic oils -- containing polycyclic aromatic hydrocarbons (PAHs) -- are added in the manufacturing of automotive tires to make the rubber polymer easier to work and to make the tire tread soft. Every year, large quantities of small rubber particles containing PAHs wear off tires, dispersing PAHs along roads and ultimately into the environment.[7]
Electronic Products		
Heavy metals and brominated flame retardants in electronic products	Lead, mercury, cadmium, and brominated flame retardants are bioaccumulative and create numerous adverse health and environmental effects.[8]	Heavy metals and brominated flame retardants are released during disposal or recycling of electronic wastes. Developing countries and countries with economies in transition bear a particularly large burden from unsafe disposal and recycling of these articles.[9]
Personal Care Products		
Mercury in soap	Mercury exposure can cause damage to the central nervous system, organs of the body and developmental effects.	In Kenya, mercury in European-made soap caused high levels of mercury in hair, causing tremors and vertigo. Mercury-containing soap is used primarily for bleaching of skin rather than cleaning.[10]
Toys		
Lead in toys	Lead exposure causes harmful effects to almost every organ and system in the human body. Infants, children, and the developing fetus are particularly vulnerable to the toxic effects of lead.	Toys and children's jewelry can contain lead in the form of lead paint and metal clasps, chains or charms. Lead is also used as a stabilizer in some toys and other children's items made from PVC plastics. Lead is also used in crayons. Lead can leach out of these products during use.[11]
Phthalates in toys	Certain phthalates used in toys have been shown to impair the fetal development of male laboratory animals at high doses. Phthalates or their metabolites are widely found in human blood and urine samples.[12]	Phthalates are used as plasticizers (i.e., chemical agents that make plastics soft and flexible) in toys made of polyvinyl chloride (PVC) plastics. These substances leach out of toys during use.
Batteries		
Lead in batteries	Lead exposure causes harmful effects to almost every organ and system in the human body.	Lead-acid batteries are used in cars, trucks, motorcycles, boats, and other motorized equipment. The average battery contains 17.5 pounds of lead and 1.5 gallons of sulfuric acid.[13] In Senegal, 18 children died in a five month period from lead exposure caused by a neighboring lead recycling facility. The World Health Organization (WHO) found that siblings and mothers of the dead children had "extremely high" blood lead levels.[14]

Product	Hazardous Properties	Pathways of Exposure
Furniture		
Dimethyl fumarate in furniture	This fungicide can cause skin irritation and allergenic effects.[15]	In 2008, consumers in France, the UK, Sweden, and Finland developed serious skin irritations and infections from using recliners and sofas that contained large amounts of dimethyl fumarate.[16]
Textiles		
Perfluorinated compounds in waterproof garments	Perfluorinated compounds (PFCs) are persistent, bioaccumulative and toxic to humans and animals. Degradation products of PFCs have been found in human and animal blood samples, water and soil throughout the world, even in remote places such as the Canadian Arctic.	PFCs are commonly used to give a stain- and water-repellent finish to textile surfaces and are applied during the production of all-weather clothing and other textiles such as tents and tablecloths. Unbound PFC chemicals on treated textiles are released during wear, washing and disposal. PFCs are also released during the manufacturing of the chemical agents and treatment of textiles.
Nonylphenol ethoxylates (NPEs) in textiles	NPEs are persistent and toxic to aquatic organisms. NPE metabolites (breakdown products) are even more persistent and toxic than their parent chemical, and are endocrine disruptors.	NPEs are surfactants used in textile manufacturing. Manufacturers using NPEs release large amounts of the chemical into waterways. NPEs can enter the environment from the washing and disposal of textile products. NPEs and their metabolites are found in waterways in many parts of the world.
Building Products		
Formaldehyde in trailer homes	Formaldehyde can cause asthma, allergies and other adverse health effects. It is considered a probable carcinogen by the U.S. Environmental Protection Agency.[17]	In the U.S., Hurricane Katrina evacuees suffered from breathing difficulties, nosebleeds and persistent headaches while living in temporary trailer houses with hazardous levels of toxic formaldehyde gas. The trailer homes were manufactured from ply-wood and composite wood products made with glues that contain formaldehyde. The glues release formaldehyde into the air.[18]
Other		
Short chain chlorinated paraffins in rubber and PVC products	These chemicals are extremely persistent, bioaccumulative, and toxic to aquatic organisms and are categorized by IARC as possibly carcinogenic to humans.[19]	Short chain chlorinated paraffins (SCCPs) are added to rubber formulations to provide flame retardancy. They are also added as plasticizers to polyvinyl chloride (PVC) products.[20]
Tributyltin (TBT) anti-fouling agents in boat paints	TBT acts as a potent endocrine disruptor in marine invertebrates and is highly toxic to other aquatic organisms.	TBT has been used as an anti-fouling agent in paints for boats and aquaculture nets since the 1960s.[21] The compound is slowly released from the paint on the hull of the boat into the adjoining water. Consequently, TBT concentrations in harbors and bays in Britain, France and the United States were high enough to significantly affect oyster and mussel production.[22]
DEHP in products intended for outdoor use (houses, roofing, tarps, car undercoating)	DEHP may have endocrine disrupting effects, is classified in the EU as toxic to reproduction, and bioaccumulates in aquatic invertebrates.[23]	DEHP is a plasticizer used to soften otherwise rigid plastics, such as PVC. It is not chemically bound to the plastic, so can leach out when exposed to water. It is a priority substance under the EU Water Framework Directive, and has been found in drinking water, wastewater, sludge, sediments, fish, and human breast milk.[24]

3.2. Case Study 1: Perfluorinated compounds (PFCs) in waterproof textiles

Summary: Perfluorinated compounds (PFCs) are persistent, bioaccumulative substances, many of which are toxic to humans and animals. PFCs are used in many different applications; this case study focuses on the use of PFCs to give a stain- and water-repellent finish to textile products, including some clothing. The degradation products of PFCs have been found in humans, wildlife, and the environment throughout the world.

Perfluorinated compounds (PFCs) are persistent, bioaccumulative substances, many of which are toxic to humans and animals. PFCs are commonly used to give a stain- and water-repellent "finish" to all-weather clothing and other textile products. Human exposure to PFCs stemming from PFC-treated textile manufacturing occurs in all stages of the product life cycle: manufacturing, use and disposal of textile products containing PFCs.

Chemical Description

PFCs are a group of synthetic compounds characterized by a carbon chain in which hydrogen atoms have been replaced with fluorine atoms. Carbon-fluorine bonds are exceptionally strong, creating compounds that are highly persistent and resistant to degradation. The properties that make PFC-based products effective in their numerous applications also result in their long-lived persistence in the environment.[25]

Industrial Uses

PFCs have been produced and used since the 1950s. They are thermally stable and repel water, soil and grease. They are used as ingredients in fire-fighting foams, hydraulic fluids, photo images, in semiconductors for personal computers, carpet spot removers, mining and oil well surfactants, and other specialized chemical formulations.[26] They are also used as water, oil, soil and grease repellents on carpets, fabric, upholstery, and food packaging, among other applications.

This case study focuses on the use of PFCs to impart water and stain resistance to textiles products, including all-weather clothing, tablecloths, upholstery, tents, shoes, carpets and bed linens.[27] Two primary classes of PFCs are used for this purpose: perfluorooctane sulphonates (PFOS) and fluorotelomers.[28]

The first synthetic waterproofing chemical products were based on PFOS chemistry. In the 1990s, as evidence mounted concerning environmental and human contamination from PFOS and governments began to restrict the use of these chemicals, the U.S.-based major manufacturer of these products switched its waterproofing products to an alternative perfluorinated compound. By 2002, the company shut down its PFOS (and PFOA) manufacturing facilities.[29] PFOS-based products are no longer being used in the U.S. or in Europe for waterproofing of textiles.

However, PFOS continues to be produced in other parts of the world and is still used in textile waterproofing and in a number of other applications. In China, for example, large-scale production of PFOS began in 2003. From 2005 on, while production in developed countries was restricted, China's annual output of PFOS has grown rapidly due to expanding demand domestically and overseas. China also imports significant quantities of fluorine-containing textile finishing agents for treatment of clothing.[30] These garments are exported worldwide.

Health and Environmental Concerns

Perfluorinated compounds and their breakdown products can be released into the environment through the manufacturing of the chemicals themselves. They can also be released through the manufacturing of textiles treated with the chemicals, as well as the use and disposal of those textiles.

In the environment, PFCs are highly persistent, bioaccumulative and toxic. They have been found in human[31] and animal blood samples throughout the world as well as in the environment.[32] PFCs have been found in remote locations such as the Canadian Arctic.[33] A study of liver samples from Swedish otters found that the concentration of 20 perfluorinated substances increased between 7 and 32% per year over the period 1972 to 2006.[34]

Researchers have documented a decline in PFOS concentrations in human blood in the U.S. (from 2000 to 2006) and in Germany (from 1985 to 2005), which the researchers attribute in part to the decline of PFOS manufacturing and use in those countries. In contrast, blood concentrations have increased in China (from 1987 to 2002), where production of PFOS-based materials continues.[35] Studies have shown PFOS to cause liver and developmental toxicity.[36]

Fluorotelomers break down into perfluorinated carboxylic acids (PFCAs), including perfluorooctanoic acid (PFOA).[37] In laboratory tests, PFOA has been shown to cause cancer in rats and adverse effects on the immune system in mice. PFOA can also display reproductive or developmental toxicity in rodents at moderate levels of exposure, and moderate to high systemic toxicity in rodents and monkeys following long-term exposure.[38]

Parts of the Life Cycle Affected

Environmental contamination and human exposure can occur in each stage of the life cycle of PFCs: through the manufacturing of the water-proofing chemicals, and through the manufacturing, use, and disposal of textiles treated with the chemical.[39]

Manufacturing. Occupational exposure to perfluorinated compounds has been documented for employees of plants manufacturing the compounds. A study of employees at US manufacturing plants in the 1990s, for example, found that they had measured blood levels of PFOA ranging from 0.1 to 81.3 ppm, approximately ten times greater than levels found in the general population.[40] It has been known since the 1960s that PFCs build up in the bodies of workers at plants producing PFC chemicals.[41] Studies also point to the risk for heart attack and stroke from exposures to PFOA, including a study showing elevated cholesterol levels in workers exposed to the chemical.[42]

High levels of PFCs have been reported in the environment near active and former production facilities.[43] PFCs have been found in groundwater contaminated by the landfilling of industrial waste from chemical manufacturing.[44] In Germany, drinking water sources for approximately 5 million people were contaminated with PFCs from the widespread application of PFC-containing sludge from manufacturing and processing industries on agricultural fields, forests and grazing areas. Residents utilizing drinking water with the highest level of contamination showed levels of PFOA in their blood five to eight times higher than background levels in Germany.[45]

Source: U.S. National Park Service

Use. The use of textile products treated with PFCs is a source of both human and environmental exposure. In a collaborative study by the Norwegian, Swedish and Danish Societies for Nature Conservation, new all-weather jackets sold for children in the Nordic market in 2005 were tested for levels of unbound fluorochemicals, an indication of potential direct and rapid contamination to the environment. (The analytical work was performed by the Norwegian Institute for Air Research, one of the world's most advanced laboratories for analyzing these chemicals.) Fluorotelomers and PFOA were found in all the clothes examined. Five out of the six jackets tested had considerable amounts of PFOA. Some jackets contained what the researchers considered to be an extremely high level of fluorotelomers (approximately 400 and 1,000 micrograms per square meter of textile, respectively). The study noted that these results are likely an underestimate of total life-cycle releases from treated garments, since the study did not include chemical releases from repeated cycles of washing, drying and wearing.[46]

Disposal. As noted above, PFCs are found as contaminants throughout the world, including in remote Arctic regions. Specific data on measured levels of PFCs that are released from treated garments after disposal were not identified in preparing this report. However, the available data on releases during use suggest that similar releases would occur after the useful life of the product has ended. Thus, the disposal of garments containing residual PFCs can be assumed to result in the release of these substances into the environment.

Regulatory and Voluntary Initiatives

Canada, the US, and the EU have begun to take regulatory actions to address the hazards posed by PFCs. For example, in 2006, the Canadian government proposed regulations to permanently ban four fluorotelomers from manufacturing, sale and importation. In 2006, the U.S. EPA initiated a voluntary PFOA Stewardship Program, in which the eight major companies in the industry committed voluntarily to reduce facility emissions and product content of PFOA and related chemicals on a global basis by 95 percent no later than 2010, and to work toward eliminating emissions and product content of these chemicals by 2015.[47] In 2007, the EU prohibited the use of PFOS in the manufacturing of textile and other products as well as the marketing of textile products that contain more than 1 ug/m^2 of coated material (effectively banning the sale of textile products in the EU where PFOS was intentionally added).[48] PFOS and its precursor PFOSF (perfluorooctanesulfonyl fluoride) are under consideration for a global ban (with probable exemptions for a number of critical uses) within the Stockholm Convention on Persistent Organic Pollutants (POPs).

While some governments are taking action to regulate PFCs, these efforts have lagged behind the continued dispersion of these chemicals into the environment. Providing information about the presence of these substances in articles would facilitate the task of governments in addressing these hazards.

Increased information would make it possible for consumers to avoid articles containing PFCs, thus protecting their own health and their local environment. Information on garments would allow retailers to choose products with safer waterproof coatings. In addition, there would be benefits for human health and the environment in the countries where these articles are manufactured, as a result of decreasing demand for these toxic substances and increasing demand for safer alternatives. If PFOS is banned under the Stockholm Convention on POPs, information on chemical content in articles could be useful during the phase-out period, as it was for many countries for ozone-depleting aerosols.

3.3. Case study 2: Lead in children's toys and jewelry

Summary: Lead is a well-known neurotoxicant, particularly harmful to infants, children, and the developing fetus. Despite widespread recognition of its toxic effects, lead continues to appear in a variety of articles, including toys and some jewelry intended for children. Toys and children's jewelry can contain lead in the form of lead paint and metal clasps, chains or charms. Lead is also used in crayons, as a stabilizer in some toys and other children's items made from PVC plastics. Lead may leach out of these products when they are used by children and when disposed.

The toxic effects of lead, especially on infants, children, and the developing fetus, are well known. In every phase of the product life cycle, and in every region of the world, children suffer permanent neurological damage from exposure to lead associated with the manufacture, use, and disposal of articles containing lead. Despite widespread recognition of its toxic effects, lead continues to appear in a variety of articles, including toys and some jewelry intended for children.

In the absence of information, it is impossible for retailers, consumers, recyclers, regulators, and others to make informed choices about these products. So long as there is a demand for the low-cost toys and jewelry that may contain lead, and consumers have no means to identify the hazard at the point of purchase, manufacturers will continue to produce these hazardous articles. Continued production and sale of these articles creates an on-going threat both in the communities where the toys and jewelry are used, and in the communities where they are manufactured. Market signals encourage manufacturers to keep costs low, but not to avoid toxic inputs.

Chemical Description

In its elemental form, lead is a gray, soft, ductile, and heavy solid. Lead compounds (for example, lead chromate and lead carbonate, which are used in pigments for paint) vary in their chemical characteristics.[49]

Industrial Uses of Lead

There are many uses for lead and lead compounds in industry. These include radiation and sound shields, batteries, wheel weights, fishing sinkers, ammunition, and other products. Lead and lead compounds are also used in making paints and pigments, and heat stabilizers for polyvinyl chloride (PVC) plastics.[50]

Toys and children's jewelry can contain lead in the form of lead paint and metal clasps, chains or charms. Lead is also used in crayons, as a stabilizer in some toys and other children's items made from PVC plastics. Lead may leach out of these products when they are used by children and when discarded.[51] An analysis made by the Swedish Chemical and Consumer agencies of a sample of imported pastel crayons found migration values of lead and chromium more than 20 times the permitted value under the EU Toys Directive. The import certificate incorrectly indicated that the crayons complied with the standard.[52]

Health and Environmental Concerns

The acute and chronic effects of lead exposure on humans are well documented. These include blood and central nervous system impacts, kidney damage, blood pressure and reproductive effects, and interference with the metabolism of Vitamin D. The International Agency for Research on Cancer (IARC) and the U.S. Environmental Protection Agency (US EPA) classify elemental lead as a probable human carcinogen (Group 2A and B2, respectively). Children are especially sensitive to the health effects of lead. Hearing, growth, and intellectual development may be impaired at blood lead levels of 10ug/dL or less. Lead exposure is likely to be fatal at blood levels of 125 ug/dL or more.[53]

Parts of the Life Cycle Affected

Manufacture. Workers are exposed to lead in the manufacture of lead paint and children's jewelry, in the painting of toys, and in the manufacture and handling of PVC materials. Worker safety standards in countries where most toys are made are often not strong enough, nor enforced stringently enough to protect workers.[54] [55] In India, which does not have an enforceable standard for the total concentration of lead and other toxic metals in toys, toy manufacturing in the "unorganized" sector – small, informal workshops and home-based production units – has been estimated to have a volume of $1.5 billion per year.[56] Such small enterprises are unlikely to implement adequate worker safety precautions.

Use. Children can be exposed to lead through ingestion of lead paint or metal items containing lead, and chewing of crayons containing lead or PVC plastics containing lead stabilizers. [57] Young children, who are most affected by exposure to lead, frequently mouth toys and jewelry. Awareness of the hazards of lead in children's items has been raised in developed countries, but the inexpensive items that most often have high lead levels are commonly sold in developing countries where the problem is less generally known.

A recent study tested lead and cadmium levels in soft plastic toys in three cities in India that are major sites of toy manufacturing. The study found lead and cadmium in all 30 items that were sampled. Over 25 percent exceeded 200 ppm of lead; five items exceeded 600 ppm.[58] Children living in these cities may be exposed to toxic metals in toys in two ways: through pollution associated with the manufacturing process, and by playing with toys containing the substances.

Disposal. Since lead is a metal, and does not biodegrade, toys containing lead that are landfilled or incinerated will further contribute to lead contamination in the environment.

Electronic toys that are recycled or disposed also lead to the release of heavy metals and toxic flame retardants to the environment and to people handling these materials.

Regulatory and Voluntary Initiatives

The medical community has known about the dangers of lead poisoning since the 19th century, with the effects of lead paint ingestion on children being noted by the early 20th century. Public awareness of the issue in the United States increased after an article in *Time* magazine in 1943 described the work of two pediatricians who had documented the connection between developmental disorders and childhood lead exposure, primarily from paint used on interior surfaces and wooden articles such as toys.[59]

Many countries, over many years, have tried to address the problem of lead in products for children. The U.S. Consumer Product Safety Commission first restricted the use of lead in children's products in 1978.[60] However, items with high levels of lead continue to be sold.

In the US, the death of a Minnesota child in 2006 due to ingestion of a metallic charm with a high level of lead (and the associated product recalls) drew the attention of the public, regulators and the media. The massive recall (1.7 million units) in the United States of popular toys and additional recalls of toys, jewelry and other children's items totaling nearly 45 million units in 2007 led to public demand for stronger consumer product legislation.[61]

Recall notice for lead in children's jewelry

Source: U.S. Consumer Product Safety Commission Commission

In August 2008, the U.S. Consumer Product Safety Improvement Act was passed, lowering the amount of lead permissible in children's products. The Act has two labelling requirements. First, it requires manufacturers to label products with information that will make it possible to identify the manufacturer and to determine when the product was made. Second, advertisements for the product must also include cautionary statements. However, neither of these requirements explicitly requires notification of the presence of toxic substances in the product.

In the European Union, the Toys Directive, enacted in 1988, limits the amount of lead in toys. The directive does not apply to fashion jewelry. The RoHS Directive also applies to electronic and electrical components of toys.[62] In Europe there have been major recalls of toys exceeding EU standards for lead. For example, over 100,000 toy cars were recalled in August of 2007.

The amount of lead in toys and children's jewelry in Canada is regulated by the Hazardous Products Act and the Children's Jewelry Act. Several countries, including Australia, New Zealand, and Japan, have adopted variations on the ISO 8124 Toy Safety Standard. The toy cars that were recalled in Europe also were subject to a voluntary recall in Japan by the company that distributed them, when the cars were found to violate the Toy Safety Standard. [63]

Since the 2007 recalls, two major U.S.-based retailers, have strengthened their guidelines for the amount of lead that is permissible and increased the frequency of third-party testing. A major U.S.-based toy company announced that it will require its own laboratories or laboratories that it certifies to test toys that are made overseas.

Recalled items that are returned to the distributors are treated as hazardous waste. However, only a small percentage of recalled items (5 to 20 percent, on average) actually are returned to the distributing companies. The remainders are sold online or in low-cost retail outlets, or are exported to countries that do not regulate the amount of lead in children's products.[64]

Despite these regulatory and voluntary efforts, many children's products still contain lead and consumers still lack a reliable way to identify them.

Most toys and jewelry that are manufactured with lead are not intentionally designed to contain lead. Rather, lead is used as an inexpensive substitute for more appropriate materials. Greater availability of information through the supply chain could help to make manufacturers more aware of the design materials they are expected to use, as well as helping to ensure that purchasers downstream are able to send clear market signals to manufacturers and suppliers. In turn, this would decrease the likelihood of exposures in the countries where manufacturing occurs.

3.4. Case study 3: Nonylphenol ethoxylates: Water contaminants from textile manufacturing and use

Summary: Nonylphenol ethoxylates (NPEs) and their breakdown products are found as contaminants in water in many parts of the world. NPEs are persistent and toxic to aquatic organisms, and their breakdown products are endocrine disrupters. NPEs are used as surfactants, or cleaning agents, in a wide variety of applications, including in textile manufacturing. NPEs pose serious environmental problems in all phases of the lifecycle of a textile article. This case sheds light on instances where a chemical, used as a processing aid in one region of the world, remains in the final product and during product use and disposal, is released into the environment in other regions.

Nonylphenol ethoxylates (NPEs) are surfactants, or cleaning agents, used widely in consumer and commercial products as well as in industrial applications. NPEs and their metabolites (breakdown products) are found as contaminants in water in many parts of the world.

NPEs are persistent and toxic to aquatic organisms, and their metabolites are endocrine disrupters. In the early 1990s, scientists began raising concerns about water pollution resulting from the use of NPEs. Responding to these concerns, governments in Europe and North America took action to limit NPE use and discharge into water. Despite these efforts, NPEs continue to appear as widespread contaminants in these regions.

In countries that manufacture and export textile products, textile manufacturing facilities release large amounts of NPEs into water sources. In countries that import and use those textile products, NPEs also enter the environment from the washing and disposal of textile products themselves.

Chemical Description

Nonylphenol ethoxylates (NPEs) are produced by adding chemical groups to the parent chemical nonylphenol (NP). NPEs belong to a larger group of compounds called alkylphenol ethoxylates.

Industrial Uses of NPEs

NPEs have long been produced in high volumes in many parts of the world. They are used as ingredients in consumer items such as personal care products, laundry detergents and cleaners; in commercial products such as floor and surface cleaners; and in industrial applications. NPEs have also been used widely in textile manufacturing for scouring fibers,[65] as wetting and de-wetting agents, as dispersion agents for dyes, and in bleaching, finishing, printing, cleaning of equipment and other processes.

Health and Environmental Concerns

NPEs and their degradation products, in particular nonylphenol (NP) compounds, enter the environment primarily via effluents from industries and municipal waste water treatment plants, but also by direct discharge. NPEs are persistent and toxic to aquatic organisms. NPE metabolites are even more persistent and toxic and are endocrine disrupters. Many studies report acute and chronic toxicity effects of NPE metabolites in aquatic biota. [66]

Parts of the Life Cycle Affected

NPEs pose environmental problems in all three stages of the product life cycle.

Manufacture. During textile manufacturing, NPEs and their toxic metabolites are discharged to waterways either directly as an effluent or in liquid and sludge after wastewater treatment. Textile mills using NPEs can be a major source of these chemicals in the environment. Wastewater treatment decreases the concentration of NPEs but increases the concentration of the toxic metabolites of NPEs.[67]

Use. Studies have found that textiles manufactured in factories that use NPEs frequently contain residual NPEs in the final product. When textile products are used and then laundered, either in homes or in industrial/institutional laundry facilities, NPEs are released to the environment – either directly or through wastewater treatment plants.[68]

This pattern is illustrated by a study conducted in 2007 by the Swedish Society of Nature Conservation on T-Shirts purchased in Sweden. Of 17 T-shirts tested, 16 had measurable levels of NPE (detection level was 1 mg/kg). All the T-shirts that contained more than 100 mg/kg of NPEs and where the country of origin could be identified had been manufactured outside the EU. Similar findings resulted from tests to determine the presence of NPEs in towels, indicating widespread presence of these contaminants in textile products. Calculations by the Stockholm Water Company assume that the contamination of NPEs in the sludge that they regularly measure is explained by the imported textiles.[69]

Disposal The disposal of textile products containing residual NPEs can result in the release of these substances into the environment. For the purposes of this case study we have not identified specific information on releases of NPEs to the environment from landfills or other forms of end-of-life disposal of products. However, based on existing information about the release of NPEs from textile products during the use phase, NPEs remaining in textile products at the time of disposal are likely to be released into the environment gradually over time.

Regulatory and Voluntary Initiatives

Legislative measures have been taken to reduce the negative environmental impact associated with NPE use in textile manufacturing. For example, EU Directive 2003/53/EC prohibits the use of NP and NPEs in textile manufacturing unless a closed manufacturing process is used and the chemicals are completely eliminated in wastewater treatment. Since wastewater treatment is unable to fully eliminate these chemicals, the effectiveness of this strategy is quite limited.

It has been well documented that countries where manufacturing of textiles occurs bear a significant burden of the continued use of NPEs. However, new research is demonstrating how the use of these articles is having an impact on the environment as well. A system providing information on the presence of NPEs in articles would create an incentive for firms manufacturing textiles to adopt safer alternatives. This would create environmental benefits, globally, for the manufacturing and exporting countries as well as countries importing these articles.

3.5. Case study 4: Toxic materials in personal computers

Summary: Toxic materials in personal computers include lead, cadmium, mercury, beryllium, antimony, brominated flame retardants, PFOS and polyvinyl chloride plastic and its additives. A typical personal computer is assembled from numerous parts, made by numerous contract manufacturers around the globe. Health and environmental effects from manufacturing processes vary in severity depending on local conditions. In the use stage, flame retardants in plastic components are released in the form of dust. At end-of-life, few computers find their way to state-of-the-art electronics recycling facilities; most 'recycling' is conducted in developing countries or countries with economies in transition, using methods that can be extremely hazardous to human health and the environment

Personal computers are assembled from a number of separate components: these include semiconductors, printed wiring (circuit) boards, wiring, switches and plastic casings. A personal computer system also typically includes a monitor – a cathode ray tube (CRT) or liquid crystal display – and a keyboard. Among the toxic materials in personal computer systems are lead, cadmium, mercury, beryllium, antimony, brominated flame retardants, PFOS and polyvinyl chloride plastic and its additives.[70] A single CRT may contain as much as 1.8 kilograms of lead.[71]

Chemical description and industrial uses

This case study does not include sections on chemical description and industrial uses because these are covered elsewhere, and because a number of chemicals are discussed here.

Health and environmental concerns

The health and environmental effects of lead, cadmium and mercury are well-documented:

- Lead exposure affects the blood and central nervous system, kidneys, reproductive system, and metabolism in humans. In the environment, it is toxic to wildlife. [72]
- Cadmium is carcinogenic to humans, is a potential reproductive and developmental toxicant, may damage the lungs and kidneys if inhaled, and affect the blood, liver, and nervous system if consumed. [73]
- Mercury affects the central nervous system and can cause developmental impairment of fetuses, infants and children. Some forms of mercury exposure can result in kidney damage and neuromuscular effects. [74]

Research on the health effects of polybrominated diphenyl ether (PBDE) flame retardants indicates that they adversely impact human thyroid function. Exposure in the perinatal period may affect neurobehavioral development of children.[75] Health and environmental effects of PFOS are discussed in Case Study 1, above.

Parts of the life cycle affected

Manufacturing. A typical personal computer is assembled from hundreds or thousands of individual parts, made by many different contract manufacturers in many different locations globally. This fact makes it difficult to generalize about computer manufacturing and assembly working conditions and the potential for workers to be exposed to hazardous materials. If inadequate protective controls are employed in a manufacturing or assembly operation – as is the case in many countries with transitional economies -- workers may be exposed to heavy metals, flame retardants, and solvents and acids used in production processes.

Use. Users of personal computers – in particular the people whose work involves the use or repair of computers, such as clerks and computer technicians[76] -- are exposed to the brominated flame retardants used in plastic casings, keyboards, and other peripheral devices. Computer repair technicians may come in contact with the other toxic materials found inside the casing, as well.

Several recent studies have shown that PBDE flame retardants are found in elevated concentrations in indoor air and dust in North American households. The source is believed to be the many consumer products – including personal computers – that incorporate PBDEs. Individuals are exposed to the PBDEs through touching items (such as keyboards) that contain PBDEs or getting PBDE-laden household dust on their hands, and inadvertently consuming it through activities like eating oily snack foods.[77] Children are at higher risk for exposure, as they often put their hands, toys, and household objects in their mouths. A sampling of PBDE blood levels in 20 U.S. families found that the small children (ages 1.5 to 4) who were sampled had, on average, PBDE concentrations 3.2 times greater than their mothers.[78]

Disposal. There are a few state-of-the-art electronics recycling facilities in North America and Europe.[79] Most ‘recycling’ of personal computers, however, is conducted in China, India, and Africa. Brokers buy used computers from dealers in developed countries and export them overseas for re-sale. If a computer is in working condition, it may be refurbished and resold or reused. In most cases, however, small businesses salvage and resell any usable parts (such as switches, motors, and integrated circuits) and sell the rest to other small businesses. They, in turn, process the remaining parts to extract any components of value that can be used or sold: for example, gold, copper, lead, other metals, and plastics.[80]

The methods used to reclaim these materials are extremely hazardous to the workers involved – often women and children – and to the environment. For example[81]:

- Recovery of the lead solder on circuit boards typically is done by heating the board over a gas flame suspended over a tub of water, which catches the molten solder. The board is then burned or put in an acid bath to remove copper.
- Wires are burned to remove the PVC plastic coating from the underlying copper. When burned, polyvinyl chloride plastic (PVC) generates a variety of toxics, including hydrogen chloride gas, carbon monoxide, dioxins and furans.
- Plastic casings are melted down and mixed with other materials to make inexpensive plastics often used in cheap toys.

This work most often is done in informal workshops with minimal, if any, worker protection measures or environmental controls. Materials remaining at the end of a recovery process are dumped or landfilled.

An example of an area where this kind of uncontrolled electronics recycling takes place is Guiyu in southeast China. Scientists studying the effects on human health and the environment found:

- Elevated levels of heavy metals in dust collected from nearby food markets and schoolyards;[82]
- Average blood serum levels of PBDEs in Guiyu residents three times that of a control group; some of the blood levels were the highest ever found in humans;[83]
- High levels of PBDEs and polychlorinated dibenzo-*p*-dioxins and dibenzofurans (highly hazardous by-products from burning of PBDE-treated plastics) in surface soil and combusted residue from e-waste recycling sites;[84]
- Ambient air in the e-waste dismantling area of Guiyu containing some of the highest levels of polychlorinated dibenzo-*p*-dioxins and dibenzfurans ever found globally.[85]

The supply chain for production of electronics, including personal computers, is particularly complex, with multiple producers of components and components of components. This makes it a particular challenge to track all the chemicals included in electronic equipment. However, as discussed below in the sections on regulatory and voluntary approaches to information management, significant progress has been made in management of information about chemicals in electronics, including personal computers.

3.6 Implications for policies addressing information on substances in articles

As illustrated by the preceding case studies, the absence of information on the hazardous chemicals in articles can lead to many adverse outcomes:

- *Manufacturers of chemical substances and mixtures* are not getting market signals and sufficient information from article manufacturers, retailers, consumers and governments on which chemicals are considered unacceptable and are to be avoided. Increasingly, the manufacture of chemicals and mixtures occurs in developing countries and countries with transitional economies.
- *Manufacturers of articles,* many of which are also located in developing countries, are also not receiving market signals or information on which chemicals to avoid. Current market signals create pressure to select low cost inputs, but not to select safe materials. These market pressures contribute to continuing toxic exposures associated with the manufacture of articles containing toxic substances.
    - An important sub-set of manufacturers that would benefit from an information system are manufacturers of articles from other articles (i.e., manufacturers of finished products such as computers from components). Due to the lack of information on chemicals in component articles, these companies have difficulty taking responsibility for the safety of the articles that they place on the market. In the absence of information, these companies cannot effectively demand safer chemicals from upstream manufacturers.
- *Workers* in manufacturing companies that produce toxic chemicals are at risk. Without information they are unable to protect themselves from hazards posed by toxic substances. The same is also true for workers in manufacturing facilities that make articles, workers using articles and workers in waste handling and recycling businesses.
- *Retailers* are unable to choose safer or safest available products to offer to their customers.
- *Consumers* are unable to protect themselves from hazards posed by toxic substances in articles.
- *Recyclers, disposal facilities* and others dealing with articles at the end of their useful life do not have a reliable way to identify articles that are hazardous or that require special end of life treatment (for example, articles that must not be incinerated).
- *Health care providers* are unable to provide targeted advice on how to avoid toxic exposure and lack important information to treat exposures.
- *Governments* are unable to identify the sources of toxic substances in air, water, soil, and the human body and to craft appropriate policies to protect their citizens.
- *Communities* are not able to make informed decisions about the types of industries they would like to host.

Increasing the availability of accurate information can help to avert individual and public health, and environmental impacts. For example, if suppliers of components and article manufacturers were required to provide information about the presence of PFCs and their health and environmental effects, both manufactures and consumers would be able to make more informed choices. Health and environmental groups are advising consumers to limit their exposure to PFCs by avoiding garments treated with Teflon® or other water or stain resistant chemicals.[86] But unless the manufacturer specifically labels the product with information on the chemical, it is difficult for consumers to know which articles contain these chemicals.

Information on chemicals in articles could help companies that are manufacturing articles from component parts make informed choices about which components or which suppliers to select. Such information may allow manufacturers to simplify supply chains, purchasing only from suppliers that provide both information and safer alternatives. Information could also be used by recyclers and disposal facilities to ensure that products are handled safely at the end of their useful life.

Chemical information can also help to solve the problem upstream, at its source, by creating incentives for change at the top of the supply chain. For example, if textile products containing NPEs were required to carry information on chemicals, manufacturers might be more likely to seek alternatives to NPEs. As textile manufacturers create demand for safer alternatives, surfactant manufacturers would be more likely to supply those alternatives. In the case of NPEs, manufacturing countries bear the largest burden of environment contamination of the continued use of the chemical, though a switch to alternatives would create environmental benefits for countries importing textiles as well.

Information is not only important as a driver of substitution. It is also important for promoting safe handling during the use and recycling/disposal of articles. For example, information alone would be unlikely to change the market in lead-acid batteries for automobiles. Individual car owners are not in a position to make choices about which batteries to use in their cars. Research and development are necessary in order for safer substitutes to be developed and adopted by car manufacturers. However, labelling or other forms of notification could help to ensure safe handling at the disposal or recycling stages.

Information is not an alternative to restrictions, economic instruments or other policy mechanisms that address the use or discharge of toxic chemicals. Rather, it is a measure that can work well in combination with restrictions and other policy measures. Information can support these policies and provide useful information to help target and determine the effectiveness of policies. Finally, information can lead to safer handling of articles and wastes where restrictions or other policies are currently absent or in development.

4. Advantages to a standardized approach to information on articles

As we have seen in the case studies in Section 3, the lack of information about toxic substances in articles increases the difficulty of managing those substances and adequately protecting human health and the environment. In efforts to address this problem, individual jurisdictions have begun working to fill the information gap by creating disclosure requirements for specific categories of substances or article types. Over time, more efforts of this kind are likely to arise. If each system is developed independently, it may be increasingly difficult to navigate the wide variety of requirements and formats. It is inefficient to have multiple, often overlapping, information systems for substances in articles. Also, for the purposes of global trade, it is impractical to have systems that differ among countries.

In this section, we consider some of the advantages that could be achieved by developing an internationally standardized approach to information on substances in articles. A standardized approach would offer benefits for companies, workers, consumers, members of the public, and governments, and would facilitate international trade, avoiding unnecessary disruptions due to problems with lack of information about whether a given product complies with a given restriction. [87] The actors we consider below could benefit both from greater availability of information on toxic substances in articles generally, and from greater standardization of that information.

Benefits for the private sector. Companies would benefit from increased efficiency associated with having a single system to work with, rather than a patchwork of potentially inconsistent national requirements. For those companies wishing to implement information management systems internally, an internationally standardized system could provide a template for gathering and managing that information; companies would not need to invest in developing their own, individual information systems from the ground up.

Greater transparency at every stage of the supply chain would reduce the likelihood of costly recalls, accidental exposures, and liability problems resulting from the sale of hazardous articles or damage caused at the end of the product life cycle.

For manufacturers and distributors, an internationally standardized system would make it possible to develop forward-looking chemical management plans rather than reactive plans responding to regulations. It would also facilitate compliance with laws restricting specific substances in articles. For instance, many of these firms will need to begin tracking substances in articles to a greater extent than they have in the past, in order to comply with the requirements for substances in articles under the new EU chemicals regulation, REACH (described in section 5.5). The availability of an internationally standardized system would facilitate the process of complying with REACH.

For downstream users of articles containing toxic substances, standardized information systems would make it possible for firms to know what they are purchasing -- making it possible, in turn, to protect workers, deal appropriately with waste, make informed purchasing choices, and comply with national regulations.

For recyclers, the availability of a standardized information system would make it possible to avoid hazardous worker exposures and make appropriate decisions about disposal and recycling of articles.

Benefits for workers handling chemicals. Workers manufacturing chemicals used in articles, or manufacturing the articles themselves, would benefit to the extent that market signals are passed up the supply chain from consumers, creating incentives to replace toxic substances with safer substitutes.

Benefits for workers handling articles (including components). Greater availability of information, including safe handling directions, would help to ensure safer work places for workers handling articles -- including components -- containing toxic substances.

Benefits for consumers. A standardized information system would make it possible to make informed choices about purchases. In addition, better information would make it more possible for consumers to protect themselves, others and the environment from risks from toxic substances, through safe handling during use, and through correct handling of waste.

Benefits for members of the public. Members of the public would benefit to the extent that greater information leads, directly or indirectly, to less use of toxic substances in articles. People who are affected by pollution associated with the manufacturing phase of the product life cycle would benefit from the incentives to use safer materials that would result from improved communication up the supply chain from retailers and consumers. People who are affected by pollution associated with the use and disposal or recycling of articles would also benefit from the incentives that would be created throughout the supply chain to produce safer articles.

Benefits for governments. In the absence of an internationally standardized system, individual jurisdictions must work independently to develop information systems. This process can require significant investments of time and resources into developing chemical lists, defining product types, ensuring consistency, and other tasks. An internationally standardized system could simplify regulatory processes and help to avoid duplication of effort among jurisdictions.

Information systems can improve governments' ability to monitor the use of chemicals and trade in products that contain potentially problematic chemicals. They can allow governments to learn what products contain toxic substances; identify sources of pollution (as in the example of nonylphenols in Swedish waters); determine which product types contain high priority substances; track chemicals in product or waste imports; and identify priority focus areas for regulatory action, public education, or technical assistance to producers.

Improved information about substances in articles can translate into a greater ability to protect human health and the environment. This can lead in turn to reductions in product recalls, fewer cases of accidental injury or death due to toxic substances in products, lower health care costs, and reductions in pollution resulting from disposal of products containing toxics.

The benefits of an information system for governments depend largely on how the system is structured. For example, a comprehensive system providing centralized information on a large number of chemicals in articles could create a significant amount of work for governments. It may be important to create a system that could be used modularly, and/or to which the private sector could contribute where appropriate. It may make sense for such a system to begin with tracking chemicals of highest concern in articles.

Greater standardization could also facilitate the task of developing information requirements within individual countries or regions.

Benefits for the economy. Economic inefficiencies can be avoided through greater availability and standardization of information about substances in articles. Economic inefficiency can result from building an industrial infrastructure around manufacturing based on use of substances that may need eventually to be phased out. In some instances, due to lack of timely information, firms are required to make significant investments in changing from an existing production system to a new one. Getting it right the first time makes good economic sense.

In seeking alternatives to toxic substances, some manufacturers may be able to find drop-in replacements, while others must invest in a significant amount of re-tooling. For example, many firms are capitalized in lead-based soldering or manufacture of plastics with toxic additives. Many of these investments were made when the hazards were known, but were not communicated to all actors in the supply chain. Industrializing countries in particular may suffer serious economic consequences if they are encouraged to produce articles that are already known to be hazardous. Prompt communication of relevant information can help facilities to avoid investing in hazardous technologies from the start. The sooner accurate market signals are provided, the better, from the perspective of building a healthy economy.

Benefits for trade. Reliable information on the contents of articles also will make it easier for countries to gain market access when exporting to countries with restrictions or other requirements for which such information is needed. As we have seen in a number of the case studies, information problems have led in some cases to significant trade disruptions, such as large recalls. While countries may differ in the stringency of the standards they apply, all would benefit from using a common language to communicate about chemicals in articles.

PART II: Models for information management

In the following two sections, we look at existing models for management of information about chemicals in articles.

Section 5 looks at information disclosure requirements for substances in articles that exist in various jurisdictions - at the state, national, or regional level. Some of these requirements provide models for methodologies of providing information – for example, the type of information that may be included on a label, or systems for submitting information to government-managed databases. Section 6 looks at systems that have been developed by the private sector, in an effort to overcome the lack of a standardized system. Some of these systems have been developed to help firms to comply with existing regulations such as those described in Section 5, and they can also help firms to go beyond those regulations and do more detailed tracking of substances in articles.

5. Existing legal requirements for information on substances in articles

In the absence of any internationally standardized approach to information on chemicals in articles, some jurisdictions have created information disclosure requirements. Some systems require labelling, while others require firms to submit information to government registries. Some provide chemical names, while others provide information on chronic health effects. In this section, we summarize the requirements of selected legal systems of interest. In this discussion, we focus strictly on articles, and do not discuss the many additional regulations governing chemical products.

Examples are drawn from North America, Europe, and Asia. The examples from the United States refer to individual states that have adopted legislation going beyond standards that exist at the national level. This discussion does not attempt to provide an exhaustive account of existing legislation. Rather, we focus on describing a few innovative policies that may be of interest as models for future policy efforts.

5.1. California: Notification of chronic health effects and Toxics Information Clearinghouse

California's Safe Drinking Water and Toxic Enforcement Act of 1986 (commonly referred to as Proposition 65) provides for the annual publication of a list of chemicals that are "known to the state of California to cause cancer or reproductive toxicity."[88] The list includes approximately 775 chemicals.[89]

Under Proposition 65, businesses must provide a 'clear and reasonable' warning when a product or workplace will expose people to listed chemicals. This warning can be provided through a label, signs posted at a workplace, "distributing notices at a rental housing complex, or publishing notices in a newspaper." The law also restricts the discharge of listed chemicals into drinking water sources.[90]

Notification is not required if the exposure is below a scientifically established "no observable effect level" (NOEL), divided by 1,000.[91] Where a NOEL has not been established for a chemical, this provision creates an incentive for firms to generate data that could serve as the basis for establishing a NOEL.

Because of the requirements of Proposition 65, some products sold in California bear a label stating that “This product contains chemicals known to the state of California to cause cancer or reproductive toxicity.” These labels make it possible for consumers in California to make informed choices about the products they purchase. This information makes it possible for consumers, in turn, to send clear market signals up the supply chain. If a similar requirement were adopted elsewhere in the world as well, the market signals could be further reinforced.

In September 2008, California adopted two new laws that increase the state’s ability to manage information on toxic chemicals, including those found in articles.[92] Moving beyond the approach of legislation that focuses on one or a few chemicals at a time, the new laws provide a broad approach to all chemicals in commerce. The state is directed to create a Toxics Information Clearinghouse to identify the chemicals of highest concern, inventory comprehensive information on these chemicals, and provide information to the public. An earlier version of the legislation, which was not adopted, would have significantly expanded requirements for firms to disclose information on chemical ingredients and health effects.

Sample label under California's Proposition 65

5.2 Maine and Washington: Notification of toxics in children's products

In 2008, the states of Maine and Washington adopted toxics legislation that requires submission of toxics data to the state, among other provisions.

- Maine's Act to Protect Children’s Health and the Environment from Toxic Chemicals in Toys and Children’s Products[93] provides for the creation of a list of chemicals of high concern. Once this list is created, manufacturers and distributors will be required to provide written notification to the state if they use a listed chemical in a "children’s product" for sale in the state. The definition of "children's products" is broad, meaning that a wide range of consumer products could be affected by this requirement.

- Washington's Children's Safe Products Act[94] provides for a phase-out of the use of lead, cadmium, and phthalates in "children's toys and other products" as well as a comprehensive approach to toxics in children's products. In addition, the legislation provides for the state to "identify high priority chemicals that are of high concern for children." Manufacturers must provide notice to the state of any product that contains a chemical designated as a high priority.

Both of these laws have the potential to increase significantly the amount of information available to state government regarding toxic substances in children's articles. The focus is on providing information to the state, not directly to the public, but much of this information can be expected to be publicly available as well. Some questions about confidential business information remain to be worked out in the implementation process.

Establishing the necessary databases to manage this information can be a large undertaking for a state government. This includes creating the information infrastructure, as well as defining rules as to what entities must comply, and providing for enforcement. Maine and Washington, along with other states, have entered into discussions to create a new interstate entity called the Interstate Chemicals Clearinghouse, through which states can pool resources, share data collected on different product types, collect information from initiatives in other countries, and share the burden of conducting assessments of safer substitutes. Such collaboration could be facilitated by the availability of a harmonized classification system for chemicals in articles.

5.3 Mercury products legislation

More than two dozen US states have passed legislation restricting the use of mercury in some way. A number of these laws include provisions to increase the availability of information on the presence of mercury in articles, by requiring labelling and/or submission of information to a centralized database.

For example, Massachusetts adopted the Mercury Management Act in 2006.[95] Among other provisions, this law requires manufacturers to "identify the components of their products that contain mercury, and the amount of mercury in them." As of 2008, the law phases out selected products containing mercury. In addition, as of 2008, "manufacturers of products that contain mercury must label them, so that users will know that the products need to be recycled at the end of their useful life or disposed of as hazardous waste."[96]

Thirteen states currently belong to the Interstate Mercury Education and Reduction Clearinghouse (IMERC), a vehicle through which the states work together to implement the requirements of their respective laws.[97] One collaborative project of IMERC is a Mercury-Added Products Database. Seven states have adopted legislation requiring firms selling mercury-added products to submit information to this centralized database.

The database provides information for “consumers, recyclers, policy makers, and others” about “the amount and purpose of mercury in consumer products.” It can be used to identify mercury-added products; find out the amount of mercury in a specific product; identify manufacturers of mercury-added products; and answer other, related questions. The database is open to the public and is searchable by sector, product category, or manufacturer, or level of mercury content.[98]

For example, a search under the category of toys in September 2008 revealed 82 results. For each result, the database provides information, including: contact information for the manufacturer; a description of the type of product; amount of mercury per product; total annual mercury use; and the purpose of mercury in the product.

This database of mercury-containing products makes it possible for government agencies to identify product categories that are posing a particular hazard, and to assess the relative contribution of various product types to the overall mercury burden. The database is also a resource for consumers, who can use it to make informed purchasing choices. In those states where labelling is required, labels also facilitate the task of diverting mercury-added products from municipal waste streams.

5.4 Restriction on Hazardous Substances: EU and China

The EU Restriction on Hazardous Substances (RoHS) Directive went into effect in July 2006. The directive restricts the use of six toxic substances in electrical and electronic products: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs). The RoHS Directive does not require either labelling or submission of information to registries, although some manufacturers have chosen to label their products as RoHS compliant for marketing purposes. Rather, the EU directive relies on self certification: for any article subject to the directive in the EU, the manufacturer or supplier is responsible for ensuring that it is in compliance with RoHS.

China’s Restriction on Hazardous Substances (China RoHS) went into effect about a year later, in March 2007. While the EU directive applies to both electrical and electronic devices, China RoHS applies only to electronic devices. (Within the category of electronic devices, the scope of China RoHS is broader than that of EU RoHS because it contains fewer exemptions.)

Labelling requirements are a key element of China RoHS. The first phase of the requirements, which are in effect currently, refer solely to labelling. The second phase will make use of the information provided on product labels to develop specific restrictions. Thus, China RoHS is an example of a regulation that uses labelling requirements as an intermediate step in the process of putting restrictions into place. It also illustrates the use of a visually simple logo to convey information that is useful for suppliers, retailers, consumers, and recyclers.

In phase 1, the information disclosure phase, all electronic products sold in China and subject to China RoHS are subject to product labelling and packaging material disclosure requirements.[99] The product label provides an easy-to-understand symbol that summarizes key information. Additional requirements provide for more detailed information to be provided in product instructions.

Labelling symbols required under China's RoHS law

No targeted toxic substances present:

Targeted toxic substances present (may be released after 10 years):

- Product labelling: The product labelling requirements under China RoHS provide for a significant amount of information to be communicated in a simple format.
    - The letter "e" within a circle signals a product that does not contain any of the six targeted toxic substances above the allowable maximum concentration value.
    - A number within a circle identifies a product that does contain one or more of the targeted substances. The number shown in the circle indicates the "environmental protection use period," defined as the number of years during which the article is guaranteed not to release one or more of the targeted toxic substances under normal use conditions. Thus, an article labeled with the number 10 can be expected to release toxic substances ten years after the date of manufacture. (See Figure 5, below.)
- Product instructions: China RoHS also requires additional, more detailed information to be provided in product instructions. For items containing one of the targeted substances, the product instructions must include a "material self declaration table" indicating which of the targeted substances are present. Product instructions must also specify

appropriate use for the article during the environmental protection use period.

In the second phase, specific restrictions will be put in place. Electronic equipment that does not meet these standards will be prohibited for sale in China. In contrast with the EU RoHS, which relies on self declaration by the manufacturer or importer, China RoHS will require that articles actually be tested by a government-approved laboratory to verify that they are free of the targeted materials.

5.5 Management of Information on Chemicals in Articles under REACH

The new EU chemicals regulation, REACH, is designed to improve information flow and enhance chemicals management in multiple dimensions. It mandates information sharing about both chemical hazards and chemical uses.

The information requirements under REACH will make it necessary for firms to obtain and disclose to their supply chains (and to some degree the public) significantly more information about chemicals in articles than is currently available. As a result, REACH will lead to greater information flow up and down the supply chain.

Substances in articles: Registration and notification requirements

Article 7 of REACH includes two requirements that apply specifically to substances in articles: registration and notification.

- *Registration.* If an article contains a substance that is intended to be released "during normal and foreseeable conditions of use" and is manufactured or imported at more than 1 tonne per year per manufacturer or importer, then that substance is subject to registration requirements. This means that the manufacturer or importer must submit information to the European Chemicals Agency on toxicity and other inherent properties of the substance, as well as its expected uses, including the use in the article in question.
- *Notification.* In addition, there are notification requirements for articles that contain substances of very high concern (SVHCs) included on the candidate list for authorization. This means that the manufacturer or importer must notify the European Chemicals Agency of the presence of that substance in the article. This requirement applies when the substance is present in a concentration above 0.1% (w/w) and the substance is present at more than 1 tonne per year per producer or importer.

The notification requirement is waived if "the producer or importer can exclude exposure of the substances to humans or the environment during normal or reasonably foreseeable conditions of use including disposal," or if the substance has already been registered for the use in question.[100]

According to article 33 in REACH any supplier of an article containing substances of very high concern (SVHC) included on the candidate list for authorization in a concentration above 0.1% (w/w) has to provide the recipient of the article with sufficient information, available to the supplier, to allow safe use of the article. This would include, at a minimum, the name of the substance. The term “recipient” does not refer to individual consumers. However, if requested by a consumer, the same information shall be provided, free of charge, within a 45 day period.

This requirement to communicate information applies at any quantity; there is no annual tonnage threshold below which it does not apply. This requirement cannot be waived based on exclusion of exposure, or based on the substance already having been registered for the use in question.

Other relevant requirements

In addition to the information disclosure requirements that refer specifically to articles, other requirements under REACH will also lead to greater availability of information about substances in articles.

In completing a registration for a chemical product, the manufacturer or importer is required to determine, and document, how that chemical will be used downstream, requiring communication with the supply chain to determine such uses. This means that if the chemical will be incorporated into an article downstream, this information must be provided to the European Chemicals Agency. Further, if the chemical is produced or imported in quantities from ten tonnes per year, the manufacturer or importer must produce a Chemical Safety Report which will provide information on the risks the substance poses in different use/exposure scenarios.

In summary, the information requirements under REACH are likely to ensure better data about how substances are used in articles. They should also ensure greater information about the flow of chemicals, from initial manufacture through incorporation in a final product and eventual disposal of that product.

These information requirements will make it necessary for firms to do much more detailed accounting of chemical flows and product chemical content than they have done in the past. This is a particular challenge for firms that have complex products and for retailers which sell thousands of products that contain chemicals. This makes it all the more important to develop a standardized information management system that firms will be able to use as they work to comply with REACH.

5.6 Globally Harmonized System (GHS) for Classification and Labelling of Chemicals

The Globally Harmonized System (GHS) for Classification and Labelling of Chemicals standardizes communication about toxic chemicals internationally. The GHS applies only to chemicals and chemical products; it does not apply to articles. However, some elements of the GHS may be useful for the development of an information system for chemicals in articles.

The GHS differs from other systems described in this section because it is not a set of requirements; rather, it is a standardized system for communicating about chemical hazards. The GHS serves as a resource for governments as they create new regulations or revise existing laws. It is expected to provide consistency and predictability for firms involved in international trade in chemical substances and preparations. For more information about the GHS, see Appendix 2.

6. Voluntary systems

The section above has discussed governmental approaches to requiring information disclosure. In this section, we consider information systems that have been developed on a voluntary basis. These systems illustrate the categories of information that can be collected and disseminated, as well as the variety of formats in which that information may be presented.

- First, we consider systems that provide for information management up and down the supply chain for specific industries, such as the automotive, electronics, and building material industries.
- Second, we consider another effort that has been undertaken by businesses: the creation of restricted chemical lists. Some businesses have adopted restricted chemical lists as a way of providing guidance to their suppliers.
- Third, we consider efforts that have been made to organize information for consumers. Again, we consider examples for the automotive and electronics industries.
- Finally, we briefly consider the variety of ecolabelling schemes that have been developed in an effort to compensate for the lack of internationally standardized information systems.

Together, this range of systems illustrates the level of effort that is being invested at many levels of the supply chain to remedy the problem of the lack of information. Some of these systems could, potentially, provide a starting point for the development of internationally standardized information systems. In addition, the existence of an internationally standardized information system would significantly facilitate the task of industry associations, consumer groups, and others working to generate useful information in sectors for which no system has been developed yet.

6.1. Industry-specific systems

Some industry sectors have implemented international systems to facilitate information exchange between manufacturers and suppliers. These systems typically track data on the substances present in products or components, and indicate whether those substances are subject to any standards, laws or regulations in the countries where the products are manufactured, sold, discarded or recycled. We consider three major article types here -- automobiles, electronics, and construction materials – as well as a system under development for use by retailers.

Automotive Industry.

Automobiles contain a large number of components, which in turn are composed of a wide variety of materials. Toxic substances used in automobiles include mercury in switches, lead in batteries, PVC plastic and its additives in interiors, including phthalates used as plasticizers.

A variety of factors have motivated the automotive industry to track chemicals in components and products. One is the European Union's End-of-Life Vehicle (ELV) Directive, which is designed to increase recycling of materials used in vehicles, and to reduce pollution associated with vehicle dismantling and recycling.[101] In order to comply with the directive, it has been necessary for automotive manufacturers to collect detailed information from their suppliers.

To accomplish this goal, a consortium of auto manufacturers developed the International Material Data System (IMDS). The IMDS is an online database. Suppliers register for the database and use it to provide information on substances in the parts they sell to auto manufacturers. The system is designed to facilitate communication of information within the production supply chain; it is not designed to provide information to consumers. As of 2006, IMDS listed over 8,000 substances. With the implementation of REACH, IMDS is also being used by some manufacturers to manage information on substances that could be restricted under REACH in the future.[102]

The IMDS includes a default list of 111 substances that are expected to be present in a vehicle at the point of sale and must be declared. This is known as the Global Automotive Declarable Substance List (GADSL). Substances on the list are identified as either "prohibited" or "declarable," along with information on why they are designated in this way. For example, fluorotelomers (discussed in the case study in Section 3, above) are declarable "for assessment," meaning that they are not yet regulated, but are "projected to be regulated by government agencies." PFOS (also discussed in Section 3) is listed as "prohibited," due to legal requirements in some countries.[103]

The IMDS could be a useful model for information management in other sectors. There may also be ways in which it could be improved upon. An industry representative has noted that electronic data management tools have improved since the IMDS was first developed, and that a tool built today could offer advantages not available in the IMDS. In particular, newer information technology tools could be employed to make the system more efficient.[104]

Electronics Industry.

The European Union's RoHS Directive restricts the use of several toxic substances in electrical and electronic equipment sold in the EU. The adoption of this legislation created new challenges for the electronics industry, and provided an incentive for firms to begin communicating with one another about the chemicals used in their products.

In order to determine what chemicals were present in their products, manufacturers needed to communicate with suppliers upstream. Many manufacturers developed questionnaires asking suppliers for information on chemicals contained in components. In the early stages of the process, each questionnaire had its own format, so completing the questionnaires was time- and resource-intensive.[105]

Responding to the lack of standardization, industry representatives worked together to develop the Joint Industry Guide for Material Composition Declaration for Electronics Products (JIG). This document establishes "a standardized list of materials [that] suppliers must disclose when present in products and components provided to electrical and electronic equipment manufacturers." The JIG was first issued in 2005 and updated in 2007 (JIG-101A.)[106]

The goals of the JIG are to: satisfy legal and regulatory requirements; drive improvements in product design; and respond to inquiries from customers, product recyclers and other stakeholders. The JIG provides guidance on material composition declarations for products and subparts, in order to standardize such requests across the international supply chain. It is intended to facilitate information flow among businesses, rather than to inform consumer purchasing decisions.[107]

In addition to setting forth a framework for data disclosure, the JIG contains lists of materials and substances for disclosure; threshold levels for reporting; regulatory requirements establishing reporting thresholds; and recommended data fields. There are 15 "Level A" materials and substances (those that are subject to bans or restrictions) and 9 "Level B" materials and substances (those that may not be banned or restricted, but are "relevant" to electronic product material declarations). Unlike IMDS, the JIG does not require suppliers to use any specific database or other data tool.[108]

The creation of the JIG has streamlined supply chain communication about chemical constituents in electrical and electronic components. The materials declaration process, previously a disorganized ad hoc process, has now become a recognized component of communications between supplier and purchaser. Developing this system initially required significant investment on the part of manufacturers, but has paid off as a streamlined transparent system.

Construction Industry.

The four largest construction companies in Sweden, in association with the Swedish Construction Federation and the Swedish Environmental Research Institute, developed the BASTA project, beginning in 2003.

BASTA is intended to reduce the use of hazardous materials in construction.[109]

The BASTA system includes a database of registered materials that have been self-declared by suppliers to meet "fundamental requirements in relation to environmental and health properties." In order to be registered, a substance must not be carcinogenic, mutagenic, toxic to reproduction, persistent in the environment, or bioaccumulative. The database currently contains around 13,000 records.

The BASTA system sets up "terms of qualification" and standard "terms of agreement" that suppliers must meet in order to participate in the system. Suppliers must certify that they know the chemical composition of a product, and have the knowledge and competence to determine the properties of its constituents. Validation of suppliers' compliance with the system is accomplished through audits of selected participants by impartial auditors.

Retailers.

Retailers increasingly need to obtain information on the chemicals contained in products they offer for sale. One large retailer, Wal-Mart, has entered into an agreement with suppliers, trade associations, a data management company and others to create a new data management system to meet current and emerging data needs.

This system is being designed initially with a focus on chemical intensive products sold by retailers (such as cleaning and personal care products). Once the tool is tested on chemical intensive products, there is interest in adapting it to manage information on chemicals in articles. This could involve screening chemicals known to be in articles (e.g. flame retardants, finishes, softeners) or it could be applied to chemicals used in the manufacture of articles. If successful, the system could be used in the future by a range of retailers and suppliers.

The system will be contained within the Global Data Synchronisation Network (GDSN). The GDSN is an existing platform that allows companies to manage product information on a wide variety of parameters.[110] Within the GDSN, the project will create a new set of functionalities to track information on chemical ingredients.

The system will be designed so that suppliers can provide detailed information on chemical contents to a third party who will keep the information confidential. Retailers can then access selected information from the third party, if the supplier grants permission. The information released may be the results of screening based on company-specific restrictions, regulatory requirements, or other specifications. The system allows retailers to select products that meet their specifications, while allowing suppliers to maintain confidentiality about their formulations.

The system will also allow for tracking of information that may be relevant for future regulations, sustainability and/or purchasing initiatives. The third party manager of the data can store data from suppliers on all chemical ingredients. As new chemical concerns or restrictions arise, retailers can add them to their specifications.

Advantages that the developers of the system envision include safer shipping, handling, storage, and disposal; accurate data in a consistent format; improved regulatory compliance; and cost reductions and efficiency improvements.

Table 2 summarizes some of the key characteristics of these industry-specific systems.

Table 2. Key Characteristics of Industry-Specific Systems on Substances in Articles

System Name	Industry	Goal	Database	Information included	Target audience
IMDS	Automotive	Facilitating recycling of automobiles and complying with the ELV Directive	Yes	All materials used in car manufacture (8000 now in database.) 111 substances on the GADSL list of regulated and "relevant" substances are used as the default declaration list.	Manufacturers and suppliers
JIG	Electronics	Standardizing business-to-business material declarations	No	24 materials and substances that are regulated or "relevant" to electronics material declarations	Manufacturers and suppliers
BASTA	Construction	Reducing hazardous materials in construction	Yes	Materials that are self-declared by suppliers to comply with BASTA's criteria for health and environmental performance. Contains approximately 13,000 records.	Manufacturers, suppliers, and downstream users
GDSN	Retailing (under development)	Tracking information on chemical ingredients	Yes	Chemical contents, company restrictions, regulatory requirements, other specifications	Retailers and suppliers

6.2. Corporate Restricted and Preferred Substance Lists

In recent years, corporations have increasingly made use of restricted and preferred substances lists. This trend is driven in part by the need to manage complex international supply chains and to comply with the chemical restriction policies of multiple jurisdictions through the provision of information on restricted and preferred chemical composition of materials. It also is driven by increasing demands from consumers and stockholders for safer products, and, in some cases, by corporate values.[111] Complying with these lists of restrictions may also require management of detailed information on chemicals up and down the supply chain.

The following examples illustrate the use of restricted and preferred substances lists by corporations and trade associations.

Scania (Commercial vehicles manufacturer)

Scania, based in Sweden, produces trucks, buses, and engines. Its corporate environmental policy designates “black” and “grey” lists: chemicals that are not to be used under any circumstances, and those that can be used in limited circumstances. Scania has an interdisciplinary team that maintains and revises the list, and that helps suppliers find alternatives to listed substances when they have difficulty identifying a viable substitute.

Customers are provided with an Environmental Product Declaration, which provides selected information on the environmental impact of the vehicle over the course of the product life cycle, including exhaust emissions, oils and liquids used in the vehicle, type of paints used on the vehicle, and recommendations about disposal and recycling for the vehicle components. It is not clear, however, whether this declaration necessarily informs the customer about the presence or absence of grey-listed substances in the vehicle.[112]

American Apparel & Footwear Association (AAFA) (Clothing and shoes trade association)

The American Apparel & Footwear Association (AAFA) Restricted Substances List “is intended to provide apparel and footwear companies with information related to regulations and laws that restrict or ban certain chemicals and substances in finished home textile, apparel, and footwear products around the world.”

This list is limited to data about requirements for finished products. Regulations outside of chemical management, or those related to the manufacturing process are not included. It also does not include California Proposition 65 requirements for labelling, or U.S. EPA labeling for ozone-depleting compounds.[113]

Some firms are using this list to develop internal materials tracking programs to ensure that restricted substances are accounted for. These companies require that suppliers sign agreements certifying that specified products do not contain restricted substances. In addition, some agreements specify that if testing identifies a restricted material, the supplier must cover all associated costs.

Wal-Mart (Retailer)

Wal-Mart issued its “Preferred Chemical Principles,” a policy for product ingredients, in 2006. The principles state that Wal-Mart will favor products that do not contain carcinogens, mutagens, or reproductive toxicants, and that are not persistent, bioaccumulative or toxic in the environment. As an initial step in implementing the principles, the company identified three “priority chemicals”: two pesticides (permethrin and propoxur) and nonylphenol ethoxylates. It is developing a screening tool to identify additional chemicals of concern, and to recommend alternatives.[114]

Wal-Mart is also working with a third party to develop a broad information management system that may be used by other companies as well (see GDSN, above).

Microsoft (Computer Hardware)

Microsoft provides its suppliers with a list of substances that are restricted in hardware products and batteries supplied to the company. It also bans the use of certain ozone-depleting substances during the manufacture of parts that are to be sold to Microsoft, and includes a list of substances that suppliers must disclose, if used above certain threshold amounts. The company states that it is "committed to phasing out the use of substances in its consumer hardware electronic products that pose a risk or threatened risk to human health and the environment" and has developed a procedure for identifying and restricting additional substances. It currently plans to phase-out the use of brominated flame retardants and phthalates by the end of 2010.[115]

6.3. Consumer-oriented Databases

Consumer-oriented databases relevant to toxics in articles aim to help consumers make informed purchasing decisions. Regulatory compliance information of interest to manufacturers and suppliers may be included, but the emphasis is on health and environmental issues of interest to consumers.

The Consumer Action Guide to Toxic Chemicals in Cars[116]

In contrast to the IMDS, which serves the automotive industry, the Consumer Action Guide to Toxic Chemicals in Cars is intended for use by those who purchase vehicles and child car seats. While IMDS relies on suppliers to provide information on substances in auto parts, the Consumer Action Guide is based on actual product testing by a non-governmental organization, the Ecology Center of Ann Arbor, Michigan.

Ecology Center staff used a portable X-Ray Fluorescence device (XRF) to determine the chemical composition of interior components of automobiles and the major components of child car seats. Over 200 vehicles from the 2006-2008 model years and 130 child seats from 2007-2008 were tested for selected elements of concern: antimony, arsenic, bromine, chlorine, chromium, cobalt, copper, lead, mercury, nickel and tin.

The test results were then used to give each vehicle or car seat a high, medium, or low "level of concern" rating for bromine, chlorine, lead, and “other chemicals,” as well as an overall rating. Consumers can search the free, web-based database of results by vehicle make and class, and car seat type and brand. Full reports which provide details of the methodology, information on hazards, and test results and rankings, can be downloaded from the web page. One limitation of this approach is that XRF technology only identifies individual elements; it cannot, for example, distinguish among different brominated flame retardant molecules. (See Appendix 1 for more information on XRF technology.)

The Ecology Center also maintains a similar database on toxic substances in toys, called The Consumer Action Guide to Toxic Chemicals in Toys. That database contains the XRF testing results for over 1200 items.

Electronic Product Environmental Assessment Tool (EPEAT)[117]

EPEAT is a voluntary system that facilitates communication between manufacturers and purchasers regarding the environmental attributes of computers and monitors[118] “The system is administered by the Green Electronics Council, part of the non-profit International Sustainable Development Foundation. It was designed to facilitate decision-making by large-volume institutional purchasers, but it can be used by individual consumers as well.

EPEAT allows manufacturers to show that their products conform to a set of voluntary environmental performance criteria.[119] Manufacturers sign an agreement with EPEAT, certifying that the information that they provide is accurate, and pay a fee. EPEAT selects and tests a certain number of products from the registry to verify information, and publishes verification reports.

The free, online product registry database can be searched by product type or name, manufacturer, and performance level. Each product record contains details on the product’s rating for each criterion, and indicates how it does or does not meet the standard.[120]

6.4. Voluntary Environmental Performance Labelling (Eco-labels)[121]

The International Standards Organization (ISO) Standard 14020 describes three types of voluntary environmental performance labels. ISO states that the goal of these labels is to employ “verifiable and accurate information… to encourage the demand for and supply of those products and services that cause less stress on the environment, thereby stimulating the potential for market-driven continuous environmental improvement."

The criteria for eco-labels contain requirements for chemical composition to a degree that varies between different product groups. They do not convey information on the content as such but if chemical requirements are included in the criteria they give indirect information on what the article doesn't contain (or contain below given limits).

Type I labels are generally referred to as "eco-labels." They form part of a "voluntary, multiple-criteria based, third party program that awards a license that authorizes the use of environmental labels on products indicating overall environmental preferability of a product within a particular product based on life cycle considerations."

Type I labels are well-established in countries throughout the world. The first such program – the Blue Angel label – was implemented in Germany in 1977.[122] The Global Eco-labelling Network lists 25 programs, with some countries (for example, Sweden) having more than one program. Among the best known eco-labels are the European Union "Flower," the North American "Green Seal," and the Nordic "Swan." The United Nations is working on a project to promote eco-labels in selected countries – Mexico, Kenya, Brazil, India, South Africa and China -- with an emphasis on specific export sectors in each location.[123]

Sample Type I labels

Type II labels are self-declarations by manufacturers. These often apply to a single attribute of a product, such as energy efficiency. Examples of Type II labels are the Energy Star label[124] and the widely used recycling emblem.

Sample Type II labels

Type III labels are "voluntary programs that provide quantified environmental data of a product, under pre-set categories of parameters set by a qualified third party and based on life cycle assessment, and verified by that or another qualified third party."

The criteria for these labels are relatively new, and few industries have performed the complex and costly life cycle analyses that they require. One of the better developed Type III programs is the EcoLeaf label of the Japan Environmental Management Association for Industry (JEMAI). Some of the products for which 'Product Category Rules' have been developed are photocopiers, digital cameras, and scanners.[125]

PART III: The way forward

7. Toward an Internationally Standardized System

The lack of information about toxic substances in articles creates difficulties for actors at every stage of the supply chain. As governments, industry associations, consumer organizations and others work to fill the information gap, the challenge is exacerbated by the lack of an internationally standardized approach.

The implementation of a standardized, international system for providing information on chemicals in articles will face challenges in several areas. The complexity and global nature of modern day product supply chains will require the communication of chemical information from raw material suppliers, to manufacturers of components, to manufacturers of final products used by consumers. Even for a rather simple textile product, the supply chain can be complex and spread out over multiple countries. Maintaining an unbroken chain of information along the supply chain may be difficult.

Going forward, the international community may wish to consider a variety of possible initiatives to fill the information gap. Individual countries or regions may wish to adopt notification requirements; existing laws such as those summarized in Section 5 may serve as a starting point for this effort.

The international community may also wish to work toward the development of an internationally standardized information system for toxic substances in articles. The existence of such a system would facilitate the development of notification requirements at the national, regional, or international level. It would also help to ensure consistency, making it easier for firms to comply with multiple countries' requirements. Even in the absence of any new laws requiring notification, it could provide a template for voluntary disclosure initiatives.

In this section, we offer suggestions regarding the questions and themes that the international community may wish to consider, if the development of an internationally standardized information system is selected as a priority for future collaborative efforts.

7.1 Scope of the system

In designing an information system, it would be necessary to make decisions about its scope. Key questions include the target audience for the information; what chemicals to include; what article types to include;

what information to provide; and what format to use for communicating that information.

Audience

It is important to consider the target audiences for the information and their specific informational needs. For example, consumers need to know whether an article contains a substance that may put a child at risk. Waste managers and recyclers, on the other hand, need to know whether a given article should not be shredded or incinerated. Product manufacturers need to know about hazardous material content in order to find the safest materials or components for a particular need.

What chemicals are included in the system?

Notification requirements can apply to just a few chemicals, or many chemicals, or classes of chemicals based on health and/or environmental hazards. An internationally standardized information system could, similarly, be designed to encompass relatively few substances or a larger number.

Advantages to a system that includes relatively few chemicals include the fact that it is relatively manageable to create and maintain, avoids information overload problems for users, and may be less of a concern from a business confidentiality standpoint. A disadvantage is that it may omit important information.

An exhaustive system that includes all chemicals, regardless of their hazard rating, has the least likelihood of omitting important information. On the other hand, a highly complete and exhaustive system has the disadvantage of being more difficult to create and maintain.

There are many intermediate options. One option is to create a system that focuses initially on a limited number of chemicals of highest concern, but that can be expanded over time if there is a compelling case to do so. The initial development of infrastructure for data collection is likely to be the most resource intensive aspect of such a system. Including additional chemicals should have lower marginal costs.

If the international community wishes to develop a system that is focused on a defined set of high priority chemicals, there are several options for how to define the set of chemicals covered by the system:

- Include all chemicals listed on selected regulatory lists (such as the California Proposition 65 list; the substances listed as priorities in the Canadian Domestic Substances List categorization; or the substances subject to authorization or restriction under REACH).
- Include all chemicals identified as having certain health or environmental effects (PBTs, carcinogens, mutagens, reproductive

toxicants, neurotoxicants, endocrine disrupters, or substances of equivalent concern).
- Include all substances measured as significant anthropogenic contaminants in the environment or in the bodies of humans and/or wildlife.

What articles are included in the system?

A system could be designed to include either a wide range of article types, or a limited range. Article types for inclusion in an information system could be identified by the following criteria:

- *Users:* prioritize articles that are intended for use by, or likely to be used by, vulnerable populations such as infants, children, and pregnant women.
- *Exposure potential:* prioritize articles containing substances that are likely to be released during use or disposal.
- *Presence of priority chemicals:* prioritize articles containing more than a specified concentration of a priority chemical.

What information is provided?

In considering what types of information to include in a system, decisions must be made about how to strike a balance between providing enough information to meet the needs of users, on the one hand, and ensuring the system is manageable, on the other. Ideally, an internationally standardized system would standardize several types of information, which could then be used as independent modules depending on the situation. Types of information that could be provided include chemical contents; chemical properties (health, safety and environmental impacts); and guidance on safe handling

Thus, for example, an object with lead paint could be identified in one or more of the following ways. Some of the information below could also be communicated via pictograms, making the information comprehensible in any language.

Information type	**Label**
Chemical contents	Contains lead
Chemical properties	Contains a substance that causes cancer and developmental disorders
Guidance on safe handling	Do not allow children to put this object into their mouths. Wash children's hands after contact with this object. *Or*: Keep out of the reach of children.

Another option is to provide information certifying the absence of toxic substances as is done, for example, in the China RoHS labelling system.

In what format is the information provided?

Information can be provided via several possible formats:

- Product labels ensure that information is available to all users, including individual consumers.
- Databases provide scope for more information than may be included on product labels.
  - Publicly searchable databases help to harness market forces, making it possible for any user to gather comparative information on products and, if desired, to select those that are safest for human health or the environment.
  - Databases with limited accessibility may be useful for managing information that is confidential or proprietary.
- Safety data sheets may be an appropriate intermediate option in some cases, providing for more detail than is available on a product label.

In developing an internationally standardized information system, it would be important to consider the requirements of each of these formats, as well as the ways in which they can be used in combination, and to create a system that includes options for communicating in each of them.

In addition, it may be useful to create database templates for use by multiple jurisdictions. This could facilitate the use of databases by jurisdictions that lack the resources to create them independently. It would also ensure consistency among databases, facilitating compliance as well as information sharing among governments.

To summarize, in designing an information system, it would be necessary to make decisions about its scope. Key questions to address include the following:

- What are the needs of the various target audiences for the information system?
- What chemicals should be included in the system?
- What articles should be included in the system?
- What information should be provided?
- In what format should the information be provided?

Sammanfattning

Denna rapport beskriver problemen med bristen på information om kemikalier i varor. Den visar på specifika fall av problem orsakade av kemikalier i varor i alla stadier av livscykeln: tillverkning, användning, återvinning och bortskaffande. I rapporten undersöks vilka fördelar utvecklingen av ett internationellt standardiserat informationssystem för kemikalieinnehållet i varor skulle kunna innebära, utmaningar för spridning av sådan information och befintliga modeller som kan bidra till ett sådant system. Även om ett informationssystem inte är en ersättning för andra styrmedel för att mildra effekterna från giftiga ämnen i varor, så kan det vara ett effektivt komplement.

Del I: Giftiga ämnen i varor: Behovet av information

1. Inledning

I ett brett spektrum av varor är kemiska ämnen viktiga för att ge önskad funktion. Många kemikalier kan användas med en hög grad av säkerhet när bästa hanteringskrav följs. Men användningen av giftiga kemikalier i varor är ett växande problem för folkhälsan och miljön.

Internationell handel resulterar i att ämnen transporteras mellan olika regioner. Framförallt är handeln med varor en allt viktigare faktor i den globala spridningen av giftiga ämnen. Giftiga ämnen i varor, från leksaker och hushållsartiklar till elektronisk utrustning och bilar, ger ett betydande bidrag till den globala belastningen av giftiga ämnen.

Att lösa de problem som orsakas av giftiga ämnen i varor kommer att kräva insatser på flera nivåer, från forskning och utveckling till informationssystem eller lagstiftning. I denna rapport överväger vi en strategi som är avgörande för en hållbar hantering av ämnen i varor: att öka tillgången på information.

För närvarande finns det inget globalt system för hantering av information om ämnen i varor. Avsaknaden av ett sådant system får konsekvenser för alla som fattar beslut om ämnen i varor - inklusive produktdesigners, tillverkare, anställda, återförsäljare, konsumenter, återvinningsföretag, lagstiftare med flera. Utvecklingen av ett internationellt standardiserat informationssystem för ämnen i varor skulle kunna bidra till att aktörer i alla led i distributionskedjan kan fatta mer hållbara beslut.

Riskhanteringsåtgärder som bygger på relevant information är dessutom avgörande för att skydda arbetstagarna, miljön och folkhälsan. I avsaknad av tillräcklig information kan lämpliga riskhanteringsåtgärder inte införas.

Del I av denna rapport undersöker problemet med giftiga ämnen i varor, med detaljerade fallstudier av valda exempel. Del II beskriver befintliga modeller för generering och spridning av information om ämnen i varor. Del III, slutligen, föreslår frågor för diskussion, för att bidra till framtida arbeten med att utveckla ett informationssystem för giftiga ämnen i varor.

2. Omfattning och definitioner

Rapporten beskriver problemen med giftiga ämnen i varor. I denna beskrivning använder vi oss av definitionen av en "vara" som återfinns i EU: s förordning om kemikalier, Reach, som definierar varor som "ett föremål som under produktionen får en särskild form, yta eller design, vilken i större utsträckning bestämmer dess funktion än dess kemiska sammansättning". Exempel på varor sträcker sig från bildäck till elektronisk utrustning till leksaker. Det som inte omfattas är kemiska blandningar, preparat eller kemiska produkter såsom tryckfärg, lim eller rengöringsmedel.

3. Förståelse av problemet: Fallstudier av giftiga ämnen i varor

Historiskt sett har åtgärder för att hantera giftiga kemiska risker fokuserat främst på utsläpp till luft och vatten från tillverkningsprocessen. Det är alltmer uppenbart att toxiska ämnen också avges från varor under användningen och i slutet av sin livslängd. För vissa kemikalier sker den övervägande exponeringen av människor och miljön under varans användning och vid bortskaffandet i stället för i samband med tillverkningen.

Vi presenterar fyra detaljerade exempel som visar problemets omfattning.

- *Perfluorföreningar (PFC) i vattentäta textilier.* Perfluorföreningar (PFC) är långlivade, bioackumulerande ämnen, varav många är giftiga för människor och djur. I textilier används PFC för att ge en fläck- och vattenavstötande yta till textilprodukter, inklusive vissa kläder. Denna fallstudie illustrerar avsiktlig användning av giftiga kemikalier i en vara som leder till utsläpp under hela varans livscykel.

- *Bly i leksaker och smycken.* Bly är ett välkänt neurotoxiskt ämne, med särskilt skadliga effekter på spädbarn, barn, och utvecklingen av foster. Trots utbredd insikt om dess giftiga effekter fortsätter bly att användas i ett antal olika varor, bland annat leksaker och en del smycken avsedda för barn. Tillverkarna kan använda bly som en billig ersättning för dyrare alternativ även om det inte anges av varans formgivare. Bly kan avges från varorna under användning och destruktion. Barn i många regioner exponeras för bly i leksaker. På grund av användningen av bly i leksaker har företag fått återkalla stora mängder leksaker från marknaden.
- *Nonylfenoletoxilat: Vattenföroreningar från textiltillverkning och användning.* Nonylfenoletoxilater (NPE) är svårnedbrytbara och giftiga för vattenlevande organismer och deras nedbrytningsprodukter är hormonstörande. NPE används som ytaktiva ämnen eller rengöringsmedel i en mängd olika tillämpningar, bland annat i textil tillverkning. De släpps ut i miljön i alla faser av livscykeln för en textil vara. Detta exempel belyser de fall där en kemikalie som används i tillverkningsprocessen i en region finns kvar i den färdiga varan och släpps ut i miljön i andra regioner under dess användning och bortskaffande.
- *Giftiga ämnen i persondatorer.* Datorer innehåller giftiga ämnen så som bly, kadmium, kvicksilver, beryllium, antimon, bromerade flamskyddsmedel, perfluorerade föreningar, och polyvinylklorid-plast. En typisk dator är sammansatt av många komponenter från ett flertal tillverkare runt om i världen. Exponering uppstår vid tillverkning, användning och bortskaffande. I slutet av sin livslängd hamnar få datorer i för ändamålet anpassade återvinningsanläggningar, då merparten av återvinningen sker i utvecklingsländer eller länder med ekonomier i omvandling och ofta med metoder som kan vara mycket farliga för människors hälsa och miljön.

4. Fördelar med en standardiserad metod för information om varor

Brist på information om giftiga ämnen i varor ökar svårigheten att hantera dessa ämnen under användning, vid återvinning och vid bortskaffande. En internationellt standardiserad metod för informationshantering skulle medföra fördelar för tillverkare, arbetstagare, återvinningsföretag, konsumenter, medborgare, myndigheter och andra berörda.

- *Fördelar för den privata sektorn.* Större öppenhet i varje led av distributionskedjan skulle minska risken för kostsamma återkallelser av olämpliga varor och problem med ansvarsfrågor. Ett internationellt standardiserat system skulle ge effektivitetsvinster genom att undvika ett lapptäcke av nationella krav. Företag i varje led av distributionskedjan skulle gynnas. Till exempel skulle tillverkare ha tillgång till bättre information om den kemiska sammansättningen av komponenter, och återvinningsföretag skulle kunna fatta lämpliga beslut om omhändertagande och återvinning av varor.

- *Fördelar för arbetstagare.* Arbetstagare som tillverkar eller återvinner varor skulle ha nytta av att veta vad varorna innehåller och hur man ska hantera dem på ett säkert sätt. I den mån marknadens signaler leder till utbyte av giftiga ämnen mot säkrare alternativ kommer arbetare att gynnas av en säkrare arbetsplats.
- *Fördelar för konsumenter.* Ett enhetligt informationssystem skulle göra det möjligt för konsumenterna att fatta välgrundade beslut om inköp. Bättre information skulle också ge konsumenterna möjlighet att genom säker hantering under användning och genom korrekt hantering av avfall, skydda sig själva, andra och miljön från riskerna med giftiga ämnen
- *Fördelar för allmänheten.* Allmänheten skulle gynnas då ökad information kan leda till, direkt eller indirekt, mindre användning av giftiga ämnen i varor och säkrare hantering av varor som innehåller giftiga ämnen.
- *Fördelar för lagstiftare.* Information underlättar för lagstiftare att identifiera källor till föroreningar, avgöra vilka varutyper som innehåller högprioriterade ämnen och identifiera prioriterade områden för åtgärder, utbildning eller tekniskt bistånd. Ett internationellt standardiserat system skulle dessutom förenkla regelverket och bidra till att undvika dubbelarbete mellan myndigheter.
- *Fördelar för ekonomin.* Ekonomin kommer att gynnas när den privata sektorn beaktar hälso- och miljöeffekter av ämnen när de fattar långsiktiga investeringsbeslut.
- *Fördelar för handeln.* Ett standardiserat system för kommunikation av information om ämnen skulle underlätta handeln. Även om länder kan skilja sig åt i hur stränga standarder som de tillämpar så skulle alla tjäna på att använda ett gemensamt angreppssätt för att utbyta information om kemikalier i varor.

Del II: Modeller för informationshantering

När man utvecklar ett informationssystem för kemikalier i varor finns det ett antal befintliga system runt om i världen som är värda att studera. Dessa omfattar lagkrav för utlämnande av information, informationshanteringssystem som har skapats av den privata sektorn, och det globalt harmoniserade systemet för klassificering och märkning av kemikalier.

5. Regleringssystem

I avsaknad av en internationellt standardiserad metod för information om kemikalier i varor har vissa berörda instanser skapat egna krav på information som ska anges. Rapporten diskuterar några sådana innovativa strategier vilka kan vara intressanta som modeller för framtida insatser.

- Kaliforniens Safe Drinking Water and Toxic Enforcement Act från 1986 (som vanligtvis kallas Proposition 65) kräver anmälan av kroniska hälsoeffekter. Dessutom har ny lagstiftning som antogs 2008 ökat möjligheten för staten att hantera och sprida information om kemikalier.
- Ny lagstiftning i de amerikanska delstaterna Maine och Washington kräver att förekomsten av utvalda giftiga ämnen i barnprodukter ska anmälas till staten.
- Lagstiftning för kvicksilverprodukter i ett antal delstater i USA kräver att tillverkare lämnar detaljerad information till en central databas över produkter till vilka de har tillsatt kvicksilver avsiktligt.
- EU:s direktiv om begränsning av farliga ämnen (RoHS) förbjuder användningen av vissa giftiga ämnen i elektriska och elektroniska produkter. Direktivet är inte inriktat på hantering av information, men för att följa direktivet har tillverkare och leverantörer varit tvungna att utveckla komplexa system för informationshantering för att vidarebefordra information i distributionskedjan.
- En liknande reglering i Kina kräver märkning av elektroniska produkter för att visa på närvaron av vissa giftiga ämnen och hur länge varan får användas innan dessa ämnen förväntas avges från varan.
- EU:s förordning om kemikalier, REACH, kräver registrering av giftiga ämnen i varor när vissa kriterier är uppfyllda samt anmälan av giftiga ämnen under en annan uppsättning kriterier. I vissa fall kräver REACH att information ska lämnas till mottagare av varan samt till konsumenter på begäran.
- Det globala harmoniserade systemet (GHS) för klassificering och märkning av kemikalier är ett standardiserat system för att informera om kemiska risker för ämnen och kemiska produkter. Det omfattar inte kemiska ämnen i varor men vissa delar av GHS kan vara användbara för utvecklingen av ett informationssystem för kemikalier i varor.

Alla dessa exempel visar att modeller för informationssystem finns och att det finns ett växande behov av standardisering för att undvika ett lapptäcke av olika system.

6. Frivilliga system

Vissa informationssystem om kemikalier har utvecklats på frivillig basis.

- *Sektorsspecifik information för industrin.* Vissa informationssystem har utvecklats för specifika branscher. Rapporten diskuterar konkreta exempel för bil-, elektronik- och byggmaterialindustrin, liksom ett system som för närvarande är under utveckling för detaljhandeln.
- *Listor över begränsade kemikalier.* Vissa företag har infört listor över begränsade kemikalier för att ge råd till sina leverantörer om kemikalier som bör undvikas. För att leva upp till begränsningslistorna kan det även krävas hantering av detaljerad information om kemikalier uppåt och nedåt i distributionskedjan.
- *Information för konsumenter.* System har utvecklats för att organisera och tillhandahålla information om kemikalier i varor med en särskild inriktning på att hjälpa konsumenterna att göra informerade val.
- *Miljömärkningssystem.* Slutligen, ett stort utbud av miljömärkningssystem har utvecklats, delvis som ett försök att kompensera för bristen på internationellt standardiserade informationssystem.

Del III: Vägen framåt

7. Mot ett internationellt standardiserat system

Genomförande av ett standardiserat internationellt system för information om kemikalier i varor kommer att ställas inför utmaningar inom flera områden. Men då bristen på information om giftiga ämnen i varor skapar svårigheter för aktörer i varje led av försörjningskedjan, kan det internationellt framöver finnas en vilja att överväga olika möjligheter för att fylla informationsgapet.

En möjlighet är att verka för utvecklandet av ett internationellt standardiserat system för information om giftiga ämnen i varor. Vid utformningen av ett informationssystem blir det nödvändigt att fatta beslut om dess omfattning. Viktiga frågor är följande.

- Vilka är behoven hos olika målgrupper för systemet?
- Vilka kemikalier bör ingå i systemet?
- Vilka varor bör ingå i systemet?
- Vilken information bör ges?
- Vilket form bör informationen ha?

Appendix 1. XRF testing equipment

Many existing information systems rely on self-disclosure and accurate management of information through the supply chain. Testing devices can also be used to provide information on the substances contained in an article, even if no paper trail is available to document the article's contents through the supply chain.

One promising technology for this purpose is X-ray fluorescence (XRF) technology. XRF technology exposes the object of study to an excitation source such as an X-ray tube, ionizing individual atoms within the object. As the atoms return to their original energy state, each atom emits a specific X-ray energy, which is detected and analyzed by the XRF meter.

The XRF meter is useful for identifying the elements contained in an article. Thus, for example, it is useful for determining whether an article contains lead or cadmium. XRF technology offers many advantages. It is fast (results are obtained within minutes); relatively low cost (the instrument costs approximately $60,000); non-destructive (there is no change in the material as a result of being tested); "portable, small, and convenient;" and it requires "minimal sample preparation."[126]

Weaknesses of XRF technology include the fact that it has "limited penetration depth"; it is sensitive to the thickness and smoothness of the sample; there can be some spectral interference among elements, leading to potential inaccuracies; and it only detects elements (thus cannot, for example, distinguish among different types of brominated flame retardants).[127]

XRF meters can be used to verify compliance with specific standards. For example, XRF meter detection limits are below the limits required by the EU Restriction on Hazardous Substances, making it possible to test RoHS compliance using an XRF meter.

Perhaps the most important aspect of XRF technology for the purposes of the present discussion is that it can be used regardless of the availability of a broader information management infrastructure. A handheld XRF analyzer can be used to generate information on individual articles, and that information can be used to populate a database. In the absence of any database, it can be used to test articles at any point in the supply chain. It can also be used to verify supplier claims about the chemicals present in an article. Manufacturers can use XRF meters to test components received from suppliers; retailers can use them to test articles before choosing to sell them; and border control authorities can use them to test imports.

Making hand-held XRF analyzers widely available may be one of the most efficient ways to increase the availability of information up and down the supply chain and to ensure that all countries can make informed decisions about what articles enter their borders. At the same time, it is important to recognize that while XRF technology is very useful, the use of this technology cannot substitute for the availability of information on contents of an article, provided by the producer or other appropriate actor in the supply chain.

Appendix 2. The Globally Harmonized System for Classification and Labelling of Chemicals

The Globally Harmonized System (GHS) for Classification and Labelling of Chemicals standardizes communication about toxic chemicals internationally. The GHS serves as a resource for governments as they create new regulations or revise existing laws, and it provides consistency and predictability for firms involved in international trade in chemical substances and preparations. The GHS applies only to chemicals and chemical products; it does not apply to articles. However, the classifications developed within the GHS may be useful for the discussion of chemicals in articles.

The GHS covers both physical hazards and toxicity. The health hazards covered by the GHS include[128] acute toxicity; skin and eye irritation and damage; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; target organ systemic toxicity (single and repeated exposures); and aspiration toxicity.

For example, for carcinogenicity, substances and mixtures are assigned to two main categories: Category 1 (Known or Presumed Carcinogen), and Category 2 (Suspected Carcinogen: Limited evidence of human or animal carcinogenicity). Category 1 is further divided into Subcategory 1A (Known human carcinogen, based on human evidence) and

Subcategory 1B (Presumed human carcinogen, based on demonstrated animal carcinogenicity).[129]

Similarly, for reproductive toxicity, the GHS categorizes substances into Category 1 (Known or presumed to cause effects on human reproduction or development), and Category 2 (Suspected: Human or animal evidence possibly with other information). Category 1 is further subdivided into Subcategory 1A (Known: Based on human evidence) and Subcategory 1B (Presumed: Based on experimental animals). There is also an additional category for "effects on or via lactation."

In addition to standardizing the ways in which chemical hazards are categorized, the GHS standardizes the words and symbols used to communicate about those hazards on chemical product labels. The GHS specifies three key label elements: symbols (pictograms); signal words (“Danger” or “Warning”); and hazard statements (“standard phrases assigned to a hazard class and category that describe the nature of the hazard.")[130] The GHS also provides for additional label elements. Depending on the context, some or all of these elements may be employed. These include precautionary statements; product identification information (name or number of a chemical); and supplier identification.

The GHS also provides standardized guidance for the creation of Safety Data Sheets. The GHS Safety Data Sheets are designed primarily to provide information on workplace hazards, but they are also useful for emergency responders, poison centers, professional users, consumers, and others.[131]

The advantage of the GHS is that it provides a single approach to classification and labelling that can be used world-wide. It promises to eliminate inefficiencies and inconsistencies that can result from classification and labelling systems that vary from one country to another. The GHS also provides a framework that countries can use in developing new regulations.[132]

In order to make use of the GHS, countries and regions with existing systems for chemical classification, labelling, and safety data sheets need to modify those systems to make them consistent with the GHS. For example, in 2008 the European Parliament adopted legislation to phase in the GHS in Europe, replacing existing labelling rules.

The GHS is not a set of requirements; it is simply a standardized system for communicating about chemical hazards. It can be used in modular fashion; for example, labelling components can be adopted on their own, or in combination with other elements. There continue to be many gaps in communication of key information about the toxicity of chemical products, and many countries have minimal or nonexistent notification requirements. However, the GHS provides a basis on which regulations can be built, and a means for harmonizing existing regulations with one another.

Appendix 3. Glossary of Acronyms

AAFA	American Apparel & Footwear Association
CRT	Cathode ray tube
ELV	End-of-Life Vehicle
U.S. EPA	United States Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
EU	European Union
GADSL	Global Automotive Declarable Substance List
GDSN	Global Data Synchronisation Network
GHS	Globally Harmonized System for Classification and Labelling of Chemicals
IARC	International Agency for Research on Cancer
IMDS	International Material Data System
IMERC	Interstate Mercury Education and Reduction Clearinghouse
ISO	International Standards Organization
JEMAI	Japan Environmental Management Association for Industry
JIG	Joint Industry Guide for Material Composition Declaration for Electronics Products
NOEL	"no observable effect level"
NP	Nonylphenol
NPE	Nonylphenol ethoxylate
PAH	Polycyclic aromatic hydrocarbon
PBB	Polybrominated biphenyl
PBDE	Polybrominated diphenyl ether
PBT	Persistent bioaccumulative, and toxic
PFC	Perfluorinated compound
PFCA	Perfluorinated carboxylic acid
PFOA	Perflourooctanoic acid
PFOS	Perfluorooctane sulphonates
PFOSF	Perfluorooctanesulfonyl fluoride
POP	Persistent organic pollutant
PVC	Polyvinyl chloride
REACH	Registration, Evaluation and Authorization of Chemicals
RoHS	Restriction on Hazardous Substances
SCCP	Short chain chlorinated paraffins
SVHCs	Substances of very high concern
TBT	Tributyltin
UNITAR	United Nations Institute for Training and Research
XRF	X ray fluorescence

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[132] A Guide to the Globally Harmonized System for Classification and Labelling of Chemicals (United Nations document, 2005). p. 7