



NATIONAL CHEMICALS INSPECTORATE

# **Chemicals in articles**

## **- where is the knowledge?**

**A project aimed at developing methodology for  
follow-up of chemical contents in articles**



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## Foreword

Difficulties in obtaining knowledge about the chemical content of articles were given much attention in the Government Bill 2000/01:65 “Kemikaliestrategi för Giftfri miljö” (Eng. = Chemicals strategy for a Non-toxic Environment). In June 2001 funds were granted for a project aimed at developing methodology for the follow-up of chemical contents of articles (other than chemical products and preparations) by the Swedish Monitoring Board. This study is a step towards the follow-up of chemical contents of articles.

The project group carried out the study during the autumn of 2001 under the leadership of Eva Ljung. The project group also consisted of Lisa Anfält and Ola Holmgren. An internal reference group consisted of Ingela Andersson, Taina Bäckström, Lars Gustafsson, Karin Thorán, Gudrun Wahlén and Margareta Östman.

Representatives of the Swedish Environmental Protection Agency, Statistics Sweden, the Environment and Health Administration in Stockholm, the Board of Swedish Industry and Commerce for better Regulation, the Swedish Federation of Trade and Services and the Swedish Commerce and Industry constituted an external reference group that was summoned on two occasions to give their points of view on, among other things, the questionnaire.

Solna in January 2002

Eva Ljung



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## Summary

The aim of this project was to develop a methodology for obtaining information on the chemical content of articles. Products that are chemical preparations were not considered in the study.

The conditions for acquiring information vary between different groups of articles. To illustrate these differences articles with varying conditions were studied. The articles were chosen on the basis of factors that affect the amount of information available and where it is available. Examples of such factors are: the product is produced within the country or is imported, its chemical content is/is not regulated by law, research is being carried out on the product within the country, the industry comprises few dominating or many small companies, a trade association/organisation exists and the product is composed of parts from many different suppliers. Product groups were chosen in order to cover as many different factors as possible. The investigated product groups are newsprint, plastic wrapping intended for processed meat products, trousers made of stretch fabric, jet engines, ceramic flat gaskets, still cameras and Costume jewellery necklaces.

The methods used to locate the knowledge of chemicals in articles were literature studies, questionnaires, telephone interviews and chemical analysis. Information from producers, importers, trade organisations, research centres and recycling companies was gathered.

The level of knowledge varied widely between the different trades. It turned out that it is much more difficult to acquire information about chemical substances than materials in the articles. Concentrations of chemical substances were practically impossible to obtain.

During the project, several factors that influence the development of knowledge and the information flow were identified. These included conditions of purchase, legislation, consumer demands and environmental labelling. Secrecy, lack of resources and lack of demand for information are examples of factors that had a negative influence.

Since only seven product groups, all with very different characteristics, were investigated it was difficult to say with certainty which methods and sources of information that are suitable for product groups with similar, characteristic factors. Some conclusions that can be drawn are that if a small number of companies dominate the market the information is well collected and can relatively easily be obtained directly from the producers and importers. If there are many importers and producers within a trade, it is difficult to get an overall knowledge through them. In these cases the knowledge might be found at the research and development centre or at the trade organisation. Generally, if a research and development centre exists within the trade, it is probable that they have the greatest knowledge.



## 1. Introduction

The Government has designated 15 environmental objectives (Bill 1997/98:145, bet. 1998/99: MJU6, rskr. 1998/99:87). One aims at achieving a Non-toxic Environment within a generation (by the year 2020). This objective has been subdivided into six Targets (Bill 2000/01:65 and bill 2000/01:130). Several of the Targets are to reduce the risk presented by chemical substances in both chemical preparations and other products. Knowledge of where the substances occur is necessary to work on achieving these Targets. So one Target concerns environmental and health information on articles. Knowledge of where the substances occur is also necessary in following up progress towards reaching the Targets.

Existing rules on product information for chemical products must be followed in the supply chain. In this way, parties along the supply chain gain access to information on the contents of substances contributing to the environmental and health hazards of products. Manufacturers and importers must also register their chemical products with the National Chemicals Inspectorate's Products Register. The Register is a central database on the contents of chemical products.

The situation is different for items other than chemical products. In the Bill 2000/01:65 "Kemikaliestrategi för Giftfri miljö" (Eng. = Chemicals strategy for a Non-toxic Environment), the Government noted that "The great ignorance about the health and environmental properties of chemical substances and the occurrence of chemical substances in articles is a fundamental problem in efforts to achieve a Non-toxic Environment." This problem must be solved if the objective of a Non-toxic Environment is to be attained within a generation. An important part of these efforts for a Non-toxic Environment concerns goods that are not chemical products.

These efforts primarily concern Targets 2-4 in the Government Bill 2000/01:65. Knowledge of product contents is a requirement all three Targets have in common. Target 2 in the Strategy for a Non-toxic Environment requires goods to be provided with health and environmental information about any hazardous contents by 2010 at the latest. Target 3 deals with the phasing out of particularly hazardous substances. The Government's proposal means that newly manufactured goods must be as free as possible from carcinogenic, mutagenic, reproduction-toxic, persistent and bio-accumulating substances. The heavy metals mercury, cadmium and lead must also be phased out. Target 4 concerns continuous reduction of the environmental risks posed by chemicals by the year 2010. Risks must be reduced in the manufacturing and use of chemical substances not covered by Target 3. The presence and use of substances that impede recycling of materials must also be reduced.

Work is in progress on the development of indicators for following-up the various Targets in a Non-toxic Environment. These indicators must be devised so they show whether action taken is sufficient to achieve the Target or whether additional measures are necessary.

We employed different methods in this project for determining *what* knowledge about chemicals in goods is available *where* in our society. On the basis of the results contained, we tried to develop a suitable method for collecting information. During the course of the project, we encountered obstacles and forces capable of influencing the aggregation of knowledge. They are described in the Discussion. The Conclusions are intended to be of help in future work on the development of indicators for following up progress towards a Non-toxic Environment.

## **2. Project structure and demarcations**

The aim of the project was to develop methods for gathering information on the chemical contents of articles. The prerequisites for obtaining information varied from one product group to another. In an effort to shed light on these differences, we studied widely varying products. We let different factors of importance to where and what knowledge is available serve as criteria in our selection of articles.

We tested different methods for obtaining information on several articles. To the greatest extent possible, all the methods were used on all the articles. The goal of the project was to arrive at a matrix of suitable methods for collecting information, depending on factors characteristic of the product or product group.

### **2.1. Factors characterising an article**

The possibility of obtaining information on the contents of a product depends on many different factors. The factors, which can be of major importance are listed below. The factor extremes are shown under each point.

- Manufacturing entirely inside the country – Everything is imported
- An environmentally active trade organisation exists – No trade organisation exists
- Research in the product field is conducted in Sweden – No research is conducted
- Binding regulations exist on the chemical contents of the product – No regulations exist
- There are numerous sub-contractors – There are no sub-contractors
- The market has many different importers and manufacturers of the product group – The market only has a few manufacturers and importers
- The sector has previously had chemicals-related contacts with the authorities – There have been no chemicals-related contacts.

No articles fall only under one point, so the main features characterised an article.

### **2.2. Choice of articles for testing the method**

The product groups were selected to cover as many different factors as possible. Several articles, which had not previously been studied by the National Chemicals Inspectorate were intentionally selected. One product group in the textile field, in which the National Chemicals Inspectorate had carried out a Government assignment entailing many textile trade contacts, which continued after the assignment was concluded, served as a comparison.

<b>Choice of articles</b> Different factors affect the ability to collect information on chemical contents. The Table lists the factors, which can be associated with the respective product. Factors above the dashed line are assumed to have a positive influence, whereas factors under the line make gathering information more difficult.	<b>Selected articles</b>						
	Newsprint	Plastic wrapping for processed meat products	Trousers made of stretch fabric	Jet engines	Ceramic flat gaskets	Still cameras	Costume jewellery necklaces
<b>Sector and product properties</b>							
All manufacturing inside the country	■						
One/few predominant actor(s)	■			■		■	
Homogenous product group	■	■	■		■		
Sector previously had chemicals-related contacts with the authorities			■				
Trade organisation with environmental involvement	■	■	■				
Trade research institute or the like in the country	■	■	■	■	■		
Binding rules exist on the product's chemical contents		■				■	
Product is recycled	■	■		■		■	
Environmental labelling occurs	■						
Extensive imports			■		■	■	■
Many actors			■				■
Diversified product group						■	■
Numerous sub-contractors				■		■	

### 2.3. Demarcations

Goods, which are not chemical products were not included in the study. There are rules containing stipulations on information on substances in chemical products hazardous to health and the environment. The information is to be submitted to the Products Register, the chemical product must be labelled and safety data sheets must be supplied to professional users. These stipulations do not apply to other products.

The information collected was on the contents of a product when the product is placed on the market. Any changes occurring during usage, emissions and final disposal were outside the scope of this study.

The intention of the study was to obtain answers to questions about the knowledge available in Sweden on chemical contents. So no foreign companies were contacted. Importing companies were always able to contact their foreign suppliers.

### **3. Methods used**

#### **3.1. Review of the literature**

The aim of the initial review of the literature was to obtain an orientation on the respective product. Information was collected on e.g. the structure of the sector, manufacturing, trade statistics and contents. The review of the literature also supplied some information on the search methods most appropriate to different articles, the extent to which information is available and the type of information available.

The literature was searched in the National Chemicals Inspectorate's library database, Bibline. Library databases on the web, such as Libris, were also used. Information on specific chemical substances was sought in web-based databases, such as ToxNet. Searches were also made with the aid of conventional web-based search engines, such as AltaVista and InfoSeek.

Sector-specific information was sought in contacts with trade organisations. Information on the magnitude of the import and export of the different product groups was obtained from the website of Statistics Sweden (SCB).

Addresses to different actors on each market were obtained from the trade organisations, the Internet and the Swedish Patent and Registration Office's address lists.

#### **3.2. Questionnaire survey**

Questionnaires were sent to companies, which manufacture or import food packaging, cameras, stretch trousers and jewellery. Half of the companies trading in stretch trousers received their questionnaires by mail and the other half were contacted by telephone in order to allow a comparison between the two methods. To the greatest possible extent, companies of varying size and companies affiliated to or not affiliated to the trade organisation were selected. Companies that import or manufacture aircraft engines, ceramic flat gaskets and newsprint were contacted by telephone.

The questionnaire was devised in such a way that even businesses with less detailed knowledge about contents would be able to answer some of the questions. The companies selected a specific product and filled in the questionnaire on the basis thereof. The questionnaires sought information on product contents on different levels of detail i.e.

- Constituent material groups (e.g. plastic)
- Constituent materials in each material group (e.g. polycarbonate, polystyrene)
- Chemical substances in the material (e.g. the flame retardant tetrabromo bisphenol A)

On all levels, it was possible to specify quantity and concentration. A number of substances hazardous to health and the environment, which can be found in each product group according to the review of the literature were listed, and the companies were able to tick off substances found in the product in question. The intention was to determine whether it was easier to answer questions about chemical contents when the substances were named.

The questionnaire also contained more general questions about the product, the time used for replying to the questionnaire, the companies' sources of information and comments on the questionnaire. Any company requesting an English version of the questionnaire received one in order to facilitate contacts with their sub-contractors.

The companies were given three weeks to reply to the questionnaire, and companies, which had not answered after that received two reminders by telephone. When answers to questions were ambiguous, the companies were contacted in an effort to obtain clarification. An example of a questionnaire is shown in Appendix 2.1.

### **3.3. Telephone contacts**

Companies, which import or manufacture the newsprint, aircraft engine and ceramic flat gaskets product groups were contacted by telephone, as the small number of companies involved did not warrant a questionnaire survey. As noted above, half of the companies trading in stretch trousers were contacted by telephone.

The objective of the project was presented at the initial contact in order to clarify the issues and accordingly facilitate the companies' work in obtaining the requested information. The question of whether or not any earlier tabulation of information was available on the materials and chemicals in the product group was also discussed at the initial contacts. Questions were also asked about the companies' environmental work with respect to product contents. A project description and a list of questions with about the same structure as the questionnaires were sent out, and the companies were asked to check available information. Two weeks later, the companies were again contacted for a review of the questions.

A more open discussion on somewhat different issues was held with the trade organisations and research institutes. We asked them about e.g. any previous or ongoing work in the field and the opportunities they had for collecting information.

### **3.4. Chemical analysis**

Five different analysis companies were contacted in order to determine what information chemical analysis can yield. The analysis companies were asked to supply examples of their prices for still cameras, newsprint, costume jewellery and stretch trousers. The companies also indicated the substances they were able to analyse. A costume jewellery necklace (i.e. made of non-precious materials) was purchased and sent off for analysis in order to obtain a concrete example of the kind of information an analysis can supply.

## 4. Discussion and conclusions

Most of the assumptions made at the start of the project proved to be correct. Factors impeding the acquisition of information were e.g. a product was only imported to the Swedish market, no specific trade organisation existed and the circumstance that a product was made of many different materials and chemicals. Factors facilitating the acquisition of information were e.g. fabrication in the country, the existence of a trade organisation, legislation concerning the product and the presence of few actors on the market.

The level of knowledge varied considerably in the different trade sectors. Obtaining information on chemical contents proved to be much more difficult than obtaining information on the materials used in articles. Determining the concentrations of different constituent chemicals was virtually impossible.

In addition to our initial assumptions, we also encountered other forces and obstacles affecting our acquisition of information. They will be considered in the Discussion below.

### 4.1. Forces and obstacles

Experience from this study showed that obtaining representative information on the chemical contents of articles is difficult. Most articles undergo a number of production phases, and chemical information readily disappears along the way. Especially if the customer never asks for it! Which forces are then able to make it easier for information to accompany the product from the raw materials stage to the final product? We tried to identify a few:

- **Legislation.** Legislation concerning a particular product group, such as food packaging, requires the responsible manufacturer to know what the product contains, at least in respect to the points covered by the legislation. EU directives on the phasing out of individual substances also cause more information to be passed on along the production chain. This mainly applies to substances due to be discontinued, but the level of knowledge is probably raised even for other substances. One example of this is in the camera and electronics industry. Information available for costume jewellery usually concerned nickel, a substance subject to regulation in the EU.

Manufacturer responsibility is another kind of rule which promotes environmental efforts in a business sector and which leads to greater use of recyclable materials. This increases interest in knowing what a product contains and which constituents can cause problems in recycling. This can be a help in following up Target 4.

- **Customer demands (the customer is a company).** If an importer or some other customer demands that certain substances must not be used in the product they buy, some knowledge is generated about these substances. However, some kind of certificate, such as an assay report, is required from the seller if that knowledge is to be reliable. This tool is widely used in the clothing business. A norm is established, as many European importers make similar purchase demands. Clothing manufacturers all over the world adapt to norms required to facilitate sales on the European market. The problem with this method in the follow-up of Target 4 is that it supplies knowledge of whether or not certain well-known substances are included in a product but could miss less hazardous substances or substances not yet well-known to be hazardous.
- **Eco-labelling.** If voluntary eco-labelling is widespread in a product group, many manufacturers demand that sub-contractors are able to certify that constituents meet labelling criteria. Newsprint has no eco-labelling. This may be because the rolls of newsprint never reach the end consumer but are delivered to printing plants. However, they do comply with environmental criteria, as the printed matter (newspapers) often have eco-labelling. Eco-labelling causes manufacturers to acquire better knowledge about the chemicals used in their manufacturing operations. Even in product groups in which eco-labelling is not especially widespread, such as the clothing trade, information acquisition would be facilitated if eco-labelling were used on constituents to a greater

extent. This is the case for cloth, which in Europe frequently carries *Öko-Tex* labelling. Much of the information needed for labelling articles with health and environmental information according to Target 2 is already available in product groups with eco-labelling.

- **Safety demands.** Knowledge is often good when demands are made on the properties of material used in a product. One example of this is manufacturers of aircraft engines who have a natural interest in possessing knowledge about the materials in the constituents they buy, because safety requirements are so stringent. The materials must comply with strict demands on durability, wear-resistance etc.
- **Work environment.** For work environment reasons, many industries have an interest in knowing what chemicals are used in their manufacturing processes, as hazardous chemicals require correct handling. The paper industry and the manufacturing of aircraft engines are examples of such industries. However, information on the chemicals employed in manufacturing is not always the same as information on the residual chemicals in the finished product, but it does provide some indication of the substances the articles might contain. The demand by recycling companies for a good work environment can also lead to demands for information on the content of hazardous substances. Companies handling finished articles, such as repair shops and maintenance businesses, may also have an interest in knowing what the articles contain. Demands on the work environment can increase information on the risks associated with chemicals. This could be beneficial in the follow-up of Target 4.
- **Consumer demands (from consumers).** Consumer demands for e.g. nickel-free jewellery are a driving force in ensuring that this information is available. Increased information on hazardous substances in other product groups can create more demands from consumers.
- **Interest from authorities and media.** Interest by the authorities in some product group increases the willingness of the involved parties to know what the articles contain. It also encourages efforts in the trade organisations. The clothing and textile trades are obvious examples of this. Attention in the media also stimulates efforts to determine what articles are actually made of.
- **Other factors.** Another factor facilitating the flow of information between e.g. importers and suppliers is when the importer is a large, big-spending customer, i.e. an important client. This increases interest in supplying information quickly. Old, close business contacts and mutual respect between customer and seller also facilitate communications and make the procurement of the requested information seem more urgent. An import company with close links to the manufacturer (e.g. a sales agency for articles made within the group) will find it easier to gain access to information on a product's contents.

The reverse applies when importers and importing countries often shift. This may be the case when imports are dictated by fashion trends. No in-depth contacts are established with supplier companies, and there is no aggregation of knowledge.

Large multinational companies, e.g. camera manufacturers, produce information on contents to a greater degree, as they strive to maintain the same standard all over the world. If any country tries to obtain information on constituent materials and chemicals, this information becomes available throughout the entire group.

Some factors can also have a negative impact on the ability and willingness of a business sector's actors to collect information. These factors may also impair the transfer and dissemination of information in the sector. Some examples of impeding factors are listed below:

- **Secrecy.** Company secrecy has proved to be a major problem in the collection of information. This applies in particular when the product's function largely depends on the choice of materials instead of on technical design. The problem of secrecy has accordingly been greater for plastic

packaging, newsprint and ceramic flat gaskets than for cameras, clothing and costume jewellery. Secrecy was also a problem in the aircraft engine product group because of the military use of the engines.

Information the National Chemicals Inspectorate receives from companies is confidential according to the Secrecy Act. Despite this, many companies refrained from supplying complete answers to the questionnaire in order to protect trade secrets. The National Chemicals Inspectorate can, pursuant to Chapter 14, Paragraph 9, of the Swedish Environmental Code, demand information on chemicals in articles from manufacturers and importers.

- **Hazardousness.** One product group often containing hazardous substances or which is used in such a way that hazardous substances in the product pose a great risk to health and the environment are often monitored better than a product group which does not contain any known hazardous substance. For example, the final contents of newsprint have not been elucidated very well, despite the existence of good trade knowledge of the substances it might contain. This may be because newsprint manufacturers regard newsprint as an innocuous product in terms of use and contents. Ceramic flat gaskets are also a product for which there is no pressure for information, as the product is regarded as inert by the manufacturer and does not release any emissions.
- **No demand.** No knowledge of contents of articles accumulates in companies in which there is no demand for such knowledge.
- **Long chain of production.** When different companies make a product in many stages, obtaining information on contents is difficult, especially regarding the initial stages. Demands by end customers may not reach the whole way. Secrecy problems are almost always encountered at some stage. This also applies to articles assembled from constituents supplied by numerous sub-contractors. One obvious example of this is that it is often difficult to account for all the chemical substances in different chemical products used in manufacturing and whether any persist in the final product, as the chemicals manufacturer regards this as a trade secret. However, there are product information requirements for substances contributing to a product's hazardous nature.
- **Product and process development.** Following up the contents of articles is more difficult in business sectors displaying rapid developments in articles and/or manufacturing processes. Constant changes in the use of additive chemicals, making it hard to know which residual chemical may remain in the product, is one example.
- **Shortage of resources.** Many companies lack resources in the form of time and money for acquiring knowledge on the contents of their articles.

## 4.2. Experience of methods

**Reviews of the literature** should be regarded as an important, initial step in a study. Possessing advanced knowledge about a product and its contents is important to the ability to ask the right questions and make the most of contacts in a business sector. On the other hand searches in databases may yield better results if they are also performed at a later stage when the searcher has greater knowledge in the field and has acquired a greater number of relevant search words. Searches on a subject or a material in most databases yields many more hits than when the product itself is used as a search word.

Generally speaking, the review of the literature found examples of materials and chemicals, which *could* be found in the articles but not very often information on how common they are and the quantities in which they occur. It should be kept in mind that information in the literature often reflects what *has been* commonly used. However, it does not supply a representative picture of the present situation if product development has moved on.

Before a **questionnaire** is sent out, calling the company first to find a person to whom the questionnaire can be sent is a good idea. This is especially true when a large company is involved, as finding the best questionnaire recipient can be difficult when the envelope is merely addressed to e.g. "The person in charge of environmental issues." The questionnaire should be sent by E-mail in Swedish and English to facilitate faster contacts with sub-contractors in other countries.

Questionnaires should be as clear and simple as possible, as many people expressed an unwillingness to fill in a questionnaire, which seems too complex. This is particularly true in business sectors unaccustomed to questions of this kind. When a questionnaire is designed, it should be remembered that obtaining replies is much easier when chemical substances are listed and the respondent indicates whether or not a substance is in the product than asking the respondent to list all constituent substances.

The reliability of questionnaire information varies considerably. In some instances, companies have been found to answer with guesses.

Companies contacted by telephone were better motivated to answer questions and did so more rapidly than companies only contacted by mail. Only a very few companies contacted by mail sent in their answers before receiving reminder calls after the final date for answering. Telephone contacts also provided an opportunity to discuss issues and related information on e.g. production stages, general environmental efforts and work with chemicals at the company.

Performing a **chemical analysis** is a relatively expensive way of obtaining information on the contents of a product, especially if the wish is to examine many articles of the same type in order to obtain 'typical' contents. On the other hand, chemical analysis can supply detailed information on the contents of a product, information that also is objective. Chemical analysis can be a last resort when information is unavailable elsewhere.

Even if it were theoretically possible to analyse most substances, using chemical analysis to obtain a complete list of the contents of a product with a complex chemical composition is difficult in practice. It would be far too labour-intensive and expensive. For the method to be more effective, it is necessary to know a range of substances that the sample might contain and to search for them. Analysis companies have considerable knowledge and know from experience which substances different product groups or different materials usually contain. Different companies specialise in different materials.

### **4.3. Time and costs**

A comparison between telephone and mail contacts with businesses in the clothing industry showed that companies contacted by telephone responded more rapidly than companies contacted by mail. The response frequency was also higher. On the other hand, the National Chemicals Inspectorate spent more time on telephone calls. However, the difference was not very great, as the poor response frequency of companies contacted by mail made reminders by telephone necessary.

More than 60% of the companies contacted by mail replied to the questionnaire. One-fifth of them replied that they neither import nor manufacture the product in question. The response frequency was lowest for the costume jewellery necklace product group and highest for the food packaging product group. Virtually every company contacted by telephone answered our questions more or less fully.

The companies devoted five minutes to eight hours, effective time, on obtaining information and filling in the questionnaire. The actual time, from the moment the company received the questionnaire until they submitted an answer, was considerably longer. It ranged from two weeks to more than two months. Generally speaking, camera and clothing companies spent more time on the questionnaire than packaging and jewellery companies.

Costs for the information retrieval mainly consisted of salary and were related to the time spent on each method. One method entailing major costs was chemical analysis which, in this instance, cost SEK 11,000 (not including VAT) for a necklace. Getting a report from the analysis company took about a week.

#### **4.4. Choice of method according to the product**

Since only seven product groups were studied, all with different prerequisites, identifying with any certainty the methods or sources of information suitable for articles with similar characteristic factors was difficult. However, we tried to make a few conclusions on the choice of method, most of which rather obvious. A larger number of product groups would need to be tested in order to arrive at a systematic method applicable to all product groups.

We regard the following information sources as good, as they contain considerable information on the chemical contents in the product group. We did not take into account whether information was readily available to outsiders.

- The greatest knowledge is likely to be found at any trade research institute.
- Few dominant actors contribute to the relative accumulation of information and the relative ease of information access by turning directly to importers and manufacturers. When there are numerous importers and manufacturers in a sector, obtaining information from them on the overall picture is difficult. This information may then be available on a higher level, e.g. at a trade research institute.
- Contacting a trade organisation may prove useful if a product is manufactured in the country and the business sector has begun chemicals-oriented environmental work because of e.g. legal requirements or pressure from the authorities or media.
- Reviews of the literature may be worthwhile for product groups, which have already begun to be studied, companies that have established contacts with the National Chemicals Inspectorate or some other authority and companies with a trade organisation involved in chemical issues.

#### **4.5. Follow-up of the environmental objective a “Non-toxic Environment”**

The Environmental Objectives Committee’s report (SOU 2000:52) contains proposals for 17 indicators for use in following up the environmental objective a Non-toxic Environment and associated targets. The indicators are very different and cover e.g. the concentration of chemicals in sludge from sewage treatment plants, the value of the consumption of environmentally labelled goods and services in society and the concentration of hazardous substances in animals and people. Existing indicators can provide a rough idea of whether the trend towards goal achievement is positive or negative but are unable to supply a definite answer about whether a target has been met or is likely to be met. Additional development work is therefore needed in order to achieve target follow-up.

The purpose of this work was to ascertain which methods are suitable for gathering information on the chemical content of goods. The work did not attempt to find any indicators for following up targets in the Non-toxic Environment, but some useful experience and ideas from the work can be mentioned. We discovered that finding a suitable indicator for following up target fulfilment is apparently very difficult for chemicals in goods. The circumstance that some sectors in which measurements are made change their behaviour, due to the attention, to a greater extent than other sectors is hard to avoid.

Targets, which could be affected by this work are primarily Target 3 and, to some extent, Targets 2 and 4 in the Government bill 2000/01:65. The demand for knowledge about the contents of articles is a common feature of these targets.

The phasing out of particularly hazardous substances (Target 3) could be accelerated if users demanded it. This assumes that knowledge of product contents is available. Broad-based knowledge on the contents of hazardous substances in newly produced goods is needed in order for following up the target. It might be a good idea for the follow-up to concentrate on several specific substances in a few product groups, as answering whether a product contains a number of specific, well-known substances has proved to be easier for respondents than supplying information on constituent ingredients. One type of follow-up could entail selecting the four largest companies in a sector and having them prepare material reflecting the average chemical contents of a product group. The emphasis would then suitably be on product groups in which a small number of companies supply the entire market. The National Chemicals Inspectorate would then provide support for this work. Work on tabulating follow-up information could be assigned to trade organisations or research institutes such as *Normpack* and STFI, which already gather information on the contents of products. Clearly identifying the financiers of this information acquisition is important. Another follow up approach would be to have recycling companies, which register the presence of certain substances, tabulate the information. This could be a good source of information about articles with a short life cycle, as the follow-up of targets is mainly concerned with the contents of articles being produced and used today. The knowledge and information available at analysis companies should also be used.

Environmental and health information about articles (Target 2) is based on the view that the party supplying information about a product knows which chemical substances the product contains and how hazardous they are. The party to label a product with this information must have access to information on what the product contains and how hazardous constituent substances are to health and the environment. Knowledge is also needed on whether use of the product can cause exposure and how the product is to be processed at the disposal stage. Effective transfer of information throughout the chain of production will be important in achieving the target. Actual follow-up of the target can consist of some kind of annual inventory, performed in different kinds of shops, of how much of the goods on sale are labelled or provided with some other kind of information. Measuring how well the flow of information works and the quality of labelling is also another type of follow-up.

A continuous decline in the health and environmental hazards posed by chemical in goods (Target 4) assumes that knowledge is available on constituent chemicals in goods and on how changes in the contents of the product affect the risks to health and the environment. For this target, it is important for knowledge to be broadened, and follow-up must concentrate on substances in current use or which may be used at a later date, not just on exhaustively studied environmental toxins, which are already banned or subject to severe restrictions. Merely asking for information through the chain of production on a number of particularly hazardous substances is not enough. Information on the complete contents of the product will be needed. Experience from this study shows that it is unrealistic to believe that complete lists of contents could be obtained today. Here, some other kind of follow-up is needed, e.g. a measurement of risk-reducing measures.

Different articles impact on the environment in different ways during their life cycle. Some consume large amounts of energy and materials. Others cause problems at the disposal stage. Some articles pose a risk because of their content of hazardous substances. Increased knowledge of the environmental impact of articles at every stage is needed to follow up and make collective environmental efforts more efficient. At the request of the Government, the Swedish Environmental Protection Agency is identifying the knowledge required for this follow-up.

Future efforts to collect information about the chemical content of goods should make use of information already available at different authorities. Licenced companies submit e.g. an annual environmental report to their county administrative board on their use of chemicals. Manufacturers and importers of chemical products send information to the National Chemicals Inspectorate on the contents of chemical products and use of the products. This type of information does not indicate which substances are in different articles but can, with other information, still contribute to estimates of the contents of articles. In addition to the benefit of having access to the information, the use of information already collected is one way to avoid extra work at the manufacturing enterprises.



## Appendix 1 – Results of information acquisition

### 1.1 Newsprint

#### Summary

Paper manufacturing has a long history in Sweden. The business is highly structured with close collaboration between manufacturers, a trade organisation and trade research institute. Environmental work is highly advanced. These factors contribute to consistently good knowledge on all levels on the manufacturing process as a whole and on the contents of paper as well.

Information on the contents of newsprint was collected from all contacted parties. However, the information was mainly based on assessments. No investigation of the contents has been performed, largely due to the fact that the product is not regarded in the trade as presenting any risk to health or the environment.

The secrecy rules at paper mills to protect their ‘manufacturing recipes’ were a complicating factor in efforts to obtain information. Sub-contractors to the mills also withheld some information for secrecy reasons.

Most of the knowledge was found in the companies themselves and the Forest Industry Research Institute (STFI).

#### 1.1.1. Description of the product

Newsprint belongs to the category ‘paper with wood content’ and is mainly made from mechanical wood pulp. The use of chemicals in manufacturing mechanical wood pulp is relatively limited compared to use in the manufacturing of chemical pulp. Mechanical pulp consists largely of wood chips refined to release the fibres. Most of the contents therefore consist of cellulose fibres and lignin. A small part also consists of filler, usually made of clay.

However, some chemicals must be added in the manufacturing process. Basically, this means that the paper pulp is formed into paper, and water is removed. The chemical additives can adhere to the paper and persist in the final product as residual chemicals.

Retention agents are chemical additives used to keep the fibres in the paper web while water is removed. Biocides are employed to prevent the growth of microorganisms in the backwater. The bleaching methods used for bleaching mechanical pulp leave the lignin behind but with a lighter colour. Sodium dithionite, sodium hydroxide and sodium peroxide are used for bleaching pulp. The bleaching method chosen depends on how light the paper needs to be.

Since the raw material consists of wood, newsprint can also contain a number of naturally occurring substances, which may be difficult to detect, including metals and resins.

Newsprint is mainly made with a weight per unit area of 40-48 g/m<sup>2</sup>.

#### 1.1.2. Description of the business sector

Newsprint was selected because this business sector meets many criteria regarded as favourable to information acquisition. The product is manufactured in the country, information is concentrated to a few companies and organisations and research is well developed.

Swedish paper production is large. The country's geographic position and long history of paper-making know-how are contributory factors. The most important paper products are packaging, writing paper and printing paper. Three large companies dominate newsprint manufacturing in Sweden with operations at five paper mills.

Newsprint is the paper product produced in the largest quantity on the Swedish market and accounts for about 25% of paper production. Most of the newsprint produced is exported, mainly to countries in Western Europe. In 2000, production amounted to about 2.5 million tonnes. The import of newsprint is marginal in relation to the scope of domestic production.<sup>1</sup>

All newsprint-manufacturing companies are members of the trade organisation the Swedish Forest Industries Federation which deals with issues in the field of e.g. forest policies, transportation policies, recycling, sawmills, research policies and environmental and energy policies.

In Sweden, research on paper manufacturing is conducted at several different places. The Trade Research Institute (STFI), i.e. the forest industry's technical research institute, is one of the world's leading research and development institutes in the paper and pulp field.

The paper industry has been working with environmental issues for a relatively long time, as serious environmental problems were linked at an early date to effluent from paper mills,

Newsprint is affected by the regulation (1994:1205) on manufacturer responsibility for waste paper. This means that manufacturers have an obligation to collect and dispose of used newsprint. In 2000, a total of 1.4 million tonnes of paper were recycled, and 1.8 million tonnes of recycled paper were consumed. The difference was covered by imports. About 0.8 million tonnes of the recycled paper were used for the production of newsprint.<sup>1</sup>

### 1.1.3. Who knows what?

#### **Review of the literature**

A large amount of documentary information is available on the pulp and paper field. Sweden is one of the world's leading paper-manufacturing countries and is highly advanced in the research and development field. Research and development is mainly conducted by the companies themselves and at a number of universities and research institutes. Research has mainly concentrated on factors related to production and the production process and its parts.

Information has also been collected at the Swedish Environmental Protection Agency, which since the beginning of the 1990's, has been collecting information on the use of chemicals in the paper industry for the purpose of identifying substances hazardous to the environment and to health. The most recent investigation was conducted in 1998.

The literature is comprehensive, and finding the most relevant material can be difficult and, not the least, time-consuming. Finding information on the contents of paper products also proved to be difficult. From the environmental point of view, issues dealing with effluents and energy usage had priority, so this kind of information was better documented.

The websites maintained by the trade organisation, manufacturing companies and research institutions were a great source of information. Relatively general information on the manufacturing of paper and various paper products was obtained from these sources.

Searches of chemical databases, such as *ToxNet*, can supply some information on chemicals, hazardous to health and the environment, which can be found in newsprint. However, they do not provide any overview information on the contents in general but concentrate on the presence of a

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<sup>1</sup> Swedish Forest Industries' Federation (2001), *Skogsindustrin 2000 – En faktasamling*

specific substance at a specific concentration. However, this information can be important, especially if a commonly occurring substance proves to be harmful to the environment or health.

The criteria document on the environmental labelling of newsprint<sup>2</sup> can be used to some extent in obtaining information on the possible contents of newsprint. No newsprint made in Sweden is eco-labelled, however some newspapers, including the morning newspapers, are eco-labelled. For use of the Swan eco-label on printed matter, as newspapers are, at least 90% of the paper employed must meet the eco-labelling criteria. This means that newsprint does meet eco-labelling criteria to some extent. The criteria document on environmental labelling of printed matter lists different chemicals, which may not be used in manufacturing or substances whose permissible concentration is restricted.

## **Manufacturers**

A large part of the information acquisition was through contacts at paper manufacturing companies. Three companies manufacture newsprint in Sweden. Manufacturing is at five paper mills, all of which were contacted.

The environmental work at the paper mills had concentrated on coming to grips with effluents from the manufacturing process. One phase of these efforts involved a review of the use of chemical products in manufacturing. The most notable example of this is the switch from bleaching with chlorine to the use of wholly or partially chlorine-free bleaching chemicals in the manufacturing of bleached chemical pulp. As a result, the paper mills currently have good overview of the chemicals purchased and used in production. In their work with the National Chemicals Inspectorate, the companies have been aided by a database on the chemical products used in the forestry industry. The Trade Research Institute (STFI) administers this database.

Obtaining exhaustive information on the contents of produced newsprint is more difficult. No assays of contents have been performed, to a large extent because the product, both in terms of use and contents, is not deemed hazardous to health and the environment. However, investigations have been performed of the chemical contents of other types of paper whose use or contents can, at worst, pose risks primarily to health, such as products in contact with food.

The paper mills are able to report the main constituents in newsprint. The mills have knowledge of the chemicals used in manufacturing and, on the basis of knowledge of the substances' usage and properties, can assess which substances persist in newsprint and estimate their quantities. Assays must be performed in order to identify residual chemicals with certainty. This would represent a major additional expenditure for the companies. One factor in determining contents is the circumstance that newsprint is a natural product based on refined wood. This means that a large number of wood substances persist in the product.

Assessing the contents of newsprint is more difficult when waste fibres are used, as the raw product has a somewhat different composition. Recycled paper can introduce contaminants, hard to monitor, into the process. One example is bacteria from a previous use. Suppliers of recycled paper certify that this paper does not contain any PCB.

The paper mills have primarily used product information from their sub-contractors in answering our questions. To some extent, sub-contractors were also contacted by telephone. The paper mills have noted that the sub-contractors' product information sheets are often summary and expressed the wish for specific information on measurable constituents.

One factor complicating the possibility of determining the contents of newsprint concerns the companies' secrecy rules. The manufacturing process and the chemical products used in making paper and pulp can be described as a 'recipe' the companies are anxious to keep secret from competitors. This does not primarily apply to newsprint but mainly to types of paper made using more chemicals.

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<sup>2</sup>Nordisk märkning av Tryckpapper 044/2.1 (2000)

However, the paper mills did cite trade secrecy on a number of occasions in discussions on the contents of newsprint. Sub-contractors to the paper mills also conceal certain information for reasons of secrecy.

### **Trade organisation**

Work on environmental issues in the forest industry has made relatively great progress compared to other business sectors. The sector is also well organised. These two factors have given the Swedish Forest Industries Federation, in its capacity as a coordinating body, major opportunities to supply information and counselling on manufacturing enterprises, sub-contractors and people with know-how in particular areas.

The Swedish Forest Industries Federation possesses some knowledge about the contents of newsprint but can, when necessary, turn to the STFI and the paper mills for more detailed information.

According to the Swedish Forest Industries Federation, the paper mills have good control over the chemicals used in paper manufacturing and should therefore be able to identify the quantities, intended to remain in the paper, left in the final product. Identifying the presence of other chemicals on the basis of their affinity for the fibres should also be possible. However, determining the impact of the recycled paper used in paper manufacturing on chemical contents is more difficult.

In total, all kinds of paper contain a very large number of substances. This study only selected a small number of possible residual chemicals. According to the Swedish Forest Industries Federation, work on obtaining information on contents would be greatly facilitated if a selection of substances and substance group were specified in the questions.

Determination of the contents of paper products other than newsprint is of greater interest. Some uses of paper may pose a risk to health. One example is food packaging made of paper, which has been investigated with respect to the migration of different chemicals into food.

### **Research institutes**

Two research institutes were contacted, i.e. The Department of Paper and Pulp Technology at the RIT and the Forest Industry's Technical Research Institute (STFI). No investigation of the contents of newsprint has previously been performed. The main reason is that newsprint is regarded as an innocuous product which poses no risk to the environment or health.

According to the STFI, a number of additives can persist in the paper product. However, obtaining complete information on the amount of the respective additive and whether specific substances persist in the paper can be difficult. If e.g. a retention chemical containing biocides is used, it can be hard to tell in some instances, which biocide is involved and how much of the biocide is in the solution and paper respectively. The STFI has good information on the substances in additive chemicals, which could adhere to the fibre web and remain in the paper.

The STFI has access to a database on chemicals used in the forest industry. On the basis of this information, information can be obtained and assessments made of the substances, which could be found in paper. This assumes that complete recipes for the chemicals are available. Changes in contents can be followed up, as substances being phased out are listed in the database.

As noted above, no investigation has been conducted on the contents of newsprint. However, the STFI and the paper-manufacturing companies are in favour of starting a project whose aim is to increase knowledge about the contents of paper products.

A chemical assay must be performed to ascertain the contents of newsprint with any certainty. In an assay, it may be appropriate to start by identifying the group of substances suspected of being in the paper, primarily substances of interest from an environmental and health perspective.

## **Analysis companies**

The contents of paper can be analysed by different companies, including the STFI. The chemical composition of the main constituents in newsprint, i.e. carbohydrates and lignin, can be determined in the analyses. Analyses can also be made of extractive substances, such as resin acid, and the concentration of chlorinated organic compounds, solvents and heavy metals. Analyses of specific chlorophenols, organic tin compounds and dioxins are also possible.

### *1.1.4. Contents of product groups*

Mechanical pulp is the main raw material in the manufacturing of newsprint and constitutes about 90% of the original raw material. However, the percentage is lower when recycled paper is used. Mechanical pulp is made from refined wood and consists primarily of cellulose fibres and lignin.

A few fabrication substances are also included to some extent. One example is filler in the form of starch or clay. According to the paper mills, the concentration of filler amounts to 1-5%.

Some additives contain chemical substances found to varying degrees in the finished newsprint. This study identified the following additives capable of leaving residual chemicals in paper.

- Slime retardants (biocides)
- Fixatives
- Wet strength agents
- Bleaches
- Retention agents
- Fillers
- Dyes
- Opalescents (to give the paper the desired brightness)

The use of retention agents can result in the persistence of the following substances in the paper:

- Polyacrylamide
- Polyethyloxide
- Sodium bentonite clay
- Phenol resin

However, the concentration of polyacrylamide in retention agents is small (750 ppm), and the amount persisting in the paper product is uncertain.

Biocides, used in small quantities in the manufacturing process, may persist to some degree in paper. The substance 2-methyl-4-isotiazolin-3-one may be present in very small amounts as the result of biocide usage. Other possible residual chemicals are methin dyes, triarylmethane dyes and talc.

Heavy metals and different resin acids are examples of naturally occurring substances in wood.

## 1.2 Stretch trousers

### Summary

The manufacturing of a fabric consists of many different processes, which are often performed in different countries. Information on chemicals used is often lost along the way, so importers and manufacturers of clothing in Sweden have relatively poor knowledge about the chemical contents of their products. However, many companies make demands on their sub-contractors about certain substances and therefore know which substances are *not* contained in garments and fabrics.

In 1997, the National Chemicals Inspectorate reported on a Government assignment on chemicals in textiles. It provided a complete picture of the chemicals, which can be found in textiles. The level of knowledge in trade organisations also rose in conjunction with the Government assignment.

Research institutes and analysis companies have great experience of the contents of clothing. However, this knowledge is hard to collect, as different principals own the reports and analysis results.

### 1.2.1 Description of the product

The investigation concerned trousers made from a stretch material of the kind common in most clothing shops, especially shops for women's clothing. Here, "stretch material" refers to a woven fabric with some elasticity, although not knitwear. A stretch fabric is a mixed material, often consisting of both natural and synthetic fibres, and is now being sold in large quantities. Natural fibres are plant fibres, such as cotton and linen, and animal fibres such as wool and silk. Semisynthetic fibres are regenerated fibres, such as viscose rayon, and synthetic fibres are of petrochemical origin, such as polyester and polyamide. Synthetic fibres are often mixed with natural fibres to improve textile properties. Elastane is the synthetic fibre most often used in stretch trousers. Elastane is an elastic, rubber-like fibre made from at least 85% by volume of segmented polyurethane<sup>3</sup>. Lycra and Spandex are two well-known trademarks for elastane fibres.

Fibre manufacturing, spinning, weaving, bleaching, dyeing, wrinkle-resistance and non-shrinkage processing, water, oil and soil repellent treatment are examples of different processes in textile manufacturing. Many of the product stages, post-processing in particular, utilise chemicals, which persist in the finished textile material.

### 1.2.2 Description of the business sector

The production of clothing in Sweden is small. Only a few percent of the clothing sold on the Swedish market are made in Sweden. The biggest percentage of imported clothing comes from China and Hong Kong. A great deal is also imported from European countries<sup>4</sup>. There are a large number of clothing manufacturers around the world, and there are also a large number of importers in Sweden. Manufacturing encompasses many stages, so a garment can be made in many different parts of the world. The fabric can e.g. be woven in one country, dyed in another and sewn in a third. Swedish producers often buy fabric from abroad and have the clothing sewn in Estonia, Latvia, Poland or Hungary.

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<sup>3</sup> European Parliament and Council Directive 96/74/EG on designations for textiles

<sup>4</sup> Textile Importers' Association 1998

The clothing sector has several trade organisations. TEKÖ – The Swedish Textile and Clothing Industries Association – represents about 75% of all Swedish clothing manufacturers. The Textile Importers' Association has importers, wholesalers, agents, retail businesses etc. as members. It has 120 members, and these businesses represent about 65% of the value of total deliveries to the Swedish market. The Shoe and Textile Traders Association (STIL) has the same MD as the Textile Importers' Association. The Swedish Textile Industries Association (STIF), whose member-companies represent about 20% of the clothing industry in Sweden, are part of the Swedish Industrial Association, a service organisation for small and medium-sized businesses.

Research in the textiles field is conducted at the Centre for Textile Research (Borås College) in collaboration with the Chalmers Department of Polymer Engineering and the Institute of Fibres and Textile, Plastics and Rubber (IFP Research AB). Many laboratories are able to perform analyses of textiles, including the Textile and Leather Laboratory, the IFP Research AB and SGAB.

The Swedish Consumer Agency has guidelines for clothing and textiles. Certain substances are also regulated in the Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations. A few countries have rules on the presence of certain substances in clothing. Eco-labelling has not had a breakthrough in the clothing field. The Swan, the EU Flower, *Öko-tex* and *Bra Miljöval* have criteria for labelling textiles, but the labelling is only found on clothing to a marginal extent. The National Chemicals Inspectorate has good knowledge about the chemical contents of clothing, as it has conducted a Government assignment on the subject.

### 1.2.3 Who knows what?

#### **Literature**

During the reviews of the literature, we found that good, broad-ranging information on chemicals was available in the literature from the authorities and trade organisations. The Government assignment "Chemicals in Textiles" (KemI 1997) covered the knowledge to be found in the sector and appears to be the basis of much of the information obtained from trade organisations and research institutes.

*ToxNet* can supply examples of substances hazardous to health in clothing. However, there is no information showing the prevalence of the chemicals and the kind of clothing in which they are found. A search of the Internet found legal texts on the labelling of clothing with certain information on materials as well as eco-labelling documents.

#### **Manufacturers**

Four of the six manufacturers contacted submitted replies. Knowledge about chemicals appears to be generally poor among manufacturers. Certain information on the materials in items such as buttons, thread and labels was stated, in addition to the material used in fabric. A couple of manufacturers were able to supply examples of residual chemicals in the garment.

The various components in trousers described in the questionnaire replies were received from 5-11 different sub-contractors. Three of the manufacturers had contacted their fabric supplier. The supplier in all cases replied (Appendix 2) that the amounts of residual substances in the fabric were less than the limit value for the respective substance in the *Öko-tex* standard. One remark about the questionnaire was that certain questions did not seem relevant.

#### **Importers**

Nine of the 14 importers contacted submitted replies. Four preferred not to answer the questionnaire. The importers had relatively good knowledge about what garments did *not* contain, as they made demands on their sub-contractors regarding certain substances. However, only tests would show if the demands were being met. The extent to which importers test their clothing varies. Maintaining a good check on chemicals is more difficult for a small business, as the cost of analyses is relatively high. The IFP or an international test company, such as SGS, usually performs the tests in the country in which the garment is made. The terms of purchase issued by the Textile Importers' Association are the ones

usually used. They stipulate that certain substances may only be found in very small quantities or not at all. Some big companies make more stringent demands.

All companies replying to the questionnaire were able to report which fibre materials their fabric was made of, and most could state which substances were not included (according to Appendix 2). Only a few reported chemicals, which could persist in a garment. No concentrations of chemicals were reported. Only one importer was able to state which metals buttons and zippers were made of. However several could report that the nickel content of metal parts was under certain limit values or that the parts did not contain any nickel. When plastics were used in garments (buttons, brand labels), no company was able to identify the type of plastic.

Only one importer reported that a garment contained any of the substances in Appendix 2. This importer stated that azo dyes and nickel were present “within limit values” and that dyes containing cadmium were present “in a very small percent”. This information came from the manufacturer, and the importer then sent the trouser off for chemical analysis in order to find out which azo dyes and which quantities were involved. However, the analysis report showed that the garment did not contain any of these dyes.

Most questionnaire replies stated that their garments did not contain any of the substances listed in Appendix 2, sometimes that they followed *Öko-tex* limit values and sometimes avoided providing any answer about certain substances. In most instances, the replies appeared to be based on the fact that manufacturers are not allowed to have these substances in their garments. One company submitted an analysis report on certain of the substances.

One facilitating factor in information acquisition is the greater willingness of sub-contractors to supply fast answers on the chemical content of a garment when the buyer is a large and important customer. A strength for a small company is that they often have close contacts with their supplier. A weakness is that they have poor purchasing power and therefore lack the same ‘clout’ in imposing their will.

It should be noted that one of the large clothing importers in Sweden refused to reply to the questionnaire, commenting that it would take too much time and that the questionnaire was devised in a way, which was too abstract.

There is no major difference in knowledge between manufacturers and importers, apart from the fact that manufacturers are better informed about the chemicals used in post-processing. However, we should point out that the manufacturers we contacted import all their fabric.

### **Trade organisations**

The Swedish Association of Textile and Clothing Manufacturers and Textile Importers’ Association both work with chemical issues. The Textile Importers’ Association’s “*Handledning till inköpsvillkor for kemikaliehalter in textilier*” (Eng. = Manual on purchasing terms for the chemical contents of textiles) has been distributed by members to about 5,000 suppliers around the world. The Swedish Association of Textile and Clothing Manufacturers has published a handbook on textiles and the environment and prepared a template for environmental product declarations for its members. However, the template has proved to be a little too complicated and has therefore not been used by many companies.

The Swedish Association of Textile and Clothing Manufacturers could conduct a study among its members about the chemical contents of e.g. stretch trousers, but it believes that the quality of the information disseminated on different levels would be inadequate. Suppliers of chemicals are often reluctant to reveal the contents of their products, so clothing manufacturers are therefore ignorant of the exact contents of their products.

Matters would be facilitated if the queries concerned specific substances. Large companies with product groups with extensive manufacturing in Sweden, such as car seat covers, should be able to provide a rather accurate account of the contents of their products.

The Textile Importers Association has limited knowledge of the chemicals in clothing. They mainly deal with trade policies, not environmental issues. However, their manual on purchasing terms for chemicals in textiles is widely used. The member companies often have sub-contractors perform garment analyses in the country of production.

The Swedish Textile and Clothing Industries Association (SIF) has no knowledge of chemical contents but refers all questions to the TEKO and IFP Research AB. None of the member companies is likely to manufacture stretch trousers.

### **Research institutes**

IFP Research AB has considerable experience of the contents of clothing. Information on the basic material used is desirable in ascertaining what stretch trousers can be expected to contain. An analysis profile can be devised from the trouser material, colour, shade etc., as the chemicals, which could conceivably be used are known. The IFP has published numerous research and analysis reports, but they belong to the companies, which ordered them. The principal's permission is required for access to these reports. A reasonable estimate of the cost of an overview of the contents of stretch trousers is SEK 50-100,000.

The Centre for Textile Research does not perform any testing of chemicals. However, it does hold courses on the chemicals in textiles, using e.g. the National Chemicals Inspectorate's "Kemikalier i textilier" (Eng. = Chemicals in textiles) as course literature. The Centre is also interested in becoming involved in collaboration in this field.

### **Analysis companies**

A number of companies perform analyses. They can determine the presence of metals, arylamines, allergenic dyes, chlorophenols, formaldehyde, organic tin compounds, phthalates, pesticides, chlorinated organic carriers and flame retardants.

### **Miscellaneous**

A quick check in a large clothing shop provided an overview of the fibre materials commonly used in stretch trousers.

The Västra Götaland County Administrative Board has a database containing extensive statistics on the consumption of chemicals by companies licenced for textile production in the county. This information can provide an indication of the chemicals one could expect to find in the finished textiles. The companies in the county mainly manufacture furniture fabrics and car seat covers, not clothing.

### **1.2.4 Product group contents**

According to information collected, a typical pair of stretch trousers is made from 96-98% cotton and 2-4% elastane (sometimes specified as Lycra or Spandex). Other fibre materials found are wool, polyester, viscose, polyamide and metallic fibres.

The following chemicals were reported as constituents in the fabrics: reactive dyes from BASF & DYESTAR, auxiliary chemicals such as surfactants, antifoaming agents and salts from BASF & DYESTAR, indigo as a dye, silicon from silicone treatment of the fabric, *Öko-tex* dyes (sodium hydroxide, hydrogen peroxide and resin were used in dyeing but should not persist in the trousers) and Cibacron reactive dyes.

The following chemicals were reported as persisting in the finished garment: softeners and pH stabilisers from BASF & DYESTAR, softeners from garment washing, rinsing agent, such as silicone oil, and Isatin left after indigo dyeing (water-soluble).

Examples of metals, which could be found in buttons, rivets and zippers are copper, zinc, manganese, aluminium and galvanised palladium. Cotton-wrapped polyester is an example of a thread material. Labels can be made of paper.

### 1.3 Still cameras

#### Summary

A small number of multinational companies dominate the Swedish camera market. Since no organised environmental work is conducted at the trade organisation level, information was largely obtained from contacts with individual companies.

Considerable knowledge is available to the importing companies, and they take environmental efforts seriously. Electronic dismantlers also appear to have a good overview of the contents of cameras.

Knowledge and environmental interest has increased in the sector after introduction of regulations on producer responsibility.

#### 1.3.1 Description of the product

The aim was to create an overall picture of the chemicals and materials used in the 'still cameras' group, including digital cameras, system cameras, disposable cameras, Polaroid cameras and conventional compact cameras. Information on all kinds of still cameras intended for consumers was therefore sought, i.e. not still cameras for microfilming documents, underwater photography, aerial photography or medical or surgical examination of internal organs etc.

#### 1.3.2 Description of the business sector

According to Customs statistics for 1993, about 5 times more cameras were imported than were exported. Most of the imports were from Japan. A small number of multinational companies dominate the Swedish market. There is only one Swedish camera manufacturer.

According to photo retailers' statistics, about 460,000 still cameras (disposable cameras not included) were sold in Sweden in 2000, about 85,000 of which were digital. The percentage of digital cameras is increasing rapidly.

The camera is a product made of components supplied by many different sub-contractors. However, many different brands use components from the same sub-contractors.

Producer responsibility for electrical and electronic products, which came into force on 1 July 2000, extends to cameras. Sending off electrical or electronic articles for demolition, incineration or deposition on a refuse dump is therefore prohibited. Certified technicians must first remove environmentally hazardous parts. *El-retur*, a nationwide system for collecting and recycling electrical and electronic scrap, is organised by the municipalities and *El-Kretsen AB*.

The Association of Swedish Photographic Dealers, a part of the Swedish Consumer Electronics Retailers' Association, has 150 members. Of the 450-500 photo dealers in Sweden, all of the major dealers are affiliated to the trade organisation. The biggest importers of cameras are affiliated to the Association of Swedish Photographic Suppliers, which has eleven members.

No research is apparently being conducted in Sweden on materials for cameras. There is no eco-labelling for cameras.

### 1.3.3 Who knows what?

#### **Literature**

Reviews of the literature yielded very little information on the materials and chemicals used in cameras. Certain information on the general contents of electronic scrap is available in reports from the authorities.

#### **Manufacturers**

Sweden only has one camera manufacturer. This firm was contacted and asked to reply to a questionnaire. No answers have yet been received.

#### **Importers**

Six of the ten contacted importers replied to the questionnaire. Since the product group was studied on a broad front, the companies were allowed to select the kind of camera to which their answers applied. The five replies received also reflect this. Two of the replies concerned compact APS cameras with zoom lenses, two concerned disposable cameras (with and without a flash) and one concerned a conventional compact camera with a zoom lens. Three of the companies contacted the supplier/manufacturer (in e.g. Germany, the Netherlands, the U.S. and Japan) for information. One chose not to contact the supplier and therefore failed to supply any information on chemicals or materials.

Most of the questionnaire answers were of good quality and supplied extensive information. They stated the kinds and quantities of plastics used in the camera. Additives in the plastic were reported to some extent, but this information was not complete. The contents of metal parts were not given in detail. In most instances, the respondents reported which of the substances listed in Appendix 2 the camera contained, although without stipulating any amounts. The companies failed to report in detail on the contents of circuit boards and batteries. This may have been due to ignorance or secrecy.

The companies differed in their perception of how easy or difficult it was to obtain the requested information. Factors facilitating acquisition were established information channels and clearly phrased questions. Complicating factors were e.g. the deadline for answers was too tight, obtaining information from the supplier took time, and giving priority to this kind of activity was difficult. One comment was that it was easy to list all the constituent substances they knew with certainty were present. However, it was hard to say with any certainty that a specific substance was *not* present, as there were gaps in their knowledge, especially regarding contaminants and additives.

The companies were not accustomed to receiving questions about the contents of camera, but a great deal of knowledge still seemed to be available. Most importers made an effort to obtain answers to our questions. Many companies appear to be enthusiastic about environmental work and willingly contribute their know-how in the field. A number of the companies conducted their own environmental programmes and had re-use/recycling systems for disposable cameras. Disposable cameras are re-cycled up to ten times before being consumed. Environmental declarations are available for digital cameras. They state e.g. whether the camera contains cadmium, mercury or lead.

#### **Trade organisation**

The Association of Swedish Photographic Dealers, a part of the Swedish Consumer Electronics Retailers' Association, has 150 members. It would be difficult for the Association of Swedish Photographic Dealers to conduct an investigation of material contents among its members, as dealers do not have any environmental information about the articles.

Knowledge and environmental interest has increased in the business after introduction of producer responsibility. Environmental interest previously centred on batteries and camera film. Additives in plastics are now attracting interest.

The Association of Swedish Photographic Suppliers, which has eleven members, covers the largest importers of cameras. This association does not carry out any coordinated environmental work but refers queries to the respective companies.

### **Recycling companies**

Two companies, which recycle electronic scrap were contacted. Cameras are only a small part of the electronic scrap covered by producer responsibility. By way of comparison, *El-retur* receives SEK 80 for a TV set or a computer but only SEK 0.80 for a camera. However, many cameras are never turned in. People keep them at home until they acquire value as antiques. The Camera Recycling Act is still so new that few cameras have yet been turned in for processing.

A camera is dismantled, and environmentally hazardous parts, such as batteries and button cells and capacitors and relays, are removed. The company has a simple laboratory, which examines the types of plastic and brominated flame retardants. It does not determine the exact flame retardant used, only whether or not it is brominated. They are able to determine if plastics contains other additives but do not do so routinely, only if a company asks them to do so. They also check capacitors for PCB. Certain hazardous substances, such as beryllium oxide, are always clearly indicated on components so they can be easily removed.

The recycling companies appear to have a rather good idea of what cameras contain. The information primarily concerns somewhat older cameras and may not be representative of the contents of currently manufactured cameras.

### **Analysis companies**

A camera is first dismantled for analysis of the individual parts. The plastic parts in a camera can be analysed to identify the type of polymer and any residual monomer and additives in the plastic, such as filler, antioxidants and flame retardants. The metallic contents of an entire camera can also be ascertained.

### **Miscellaneous**

A review of advertising catalogues and questions in photo shops supplied examples of a few materials used.

#### **1.3.4 Product group contents**

Cameras were found to contain 25-75% plastic and 3-50% metal.

The following plastics were reported as being in cameras: PC (polycarbonate), POM (polyoxymethylene), ABS (acrylonitrile-butadiene-styrene copolymer), PMMA (polymethyl methacrylate, "plexiglass"), PS (polystyrene), PP (polypropene) and PA (polyamide). The following additives are found in the different plastics; glass fibres, carbon fibres, potassium titanate fibres and brominated flame retardants (in ABS).

The following metals were reported as being in cameras: stainless steel, copper alloy, steel, zinc alloy, iron, brass, copper and aluminium. The various alloys include e.g. iron, chromium, nickel, manganese, magnesium, copper, zinc, lead, carbon, aluminium, phosphorous, sulphur, silicon, beryllium and palladium.

Other substances found in the studied camera were lead, nickel, beryllium, chromium, cadmium and brominated flame retardants. About 0.7 tonnes of tetrabromo bisphenol A (TBBP-A) entered Sweden in cameras in 1991. Heavy metals, such as lead and cadmium, are often found in cameras. On the average, a camera contains 35 cm<sup>2</sup> of circuit boards, and most of the heavy metals are located there. Mercury ampoules (as switches for shutters, relays) have also been discovered in cameras. Military cameras sometimes contain beryllium oxide.

## 1.4 Jet engines

### Summary

Jet engines are a complex product assembled from up to 40,000 components supplied by a large number of sub-contractors, making it difficult for most actors in this business sector to acquire exhaustive knowledge of contents. Companies not required to have knowledge of material contents do not have detailed knowledge about the materials used in making the engines. The airlines do make certain demands on material contents and can, when necessary, obtain knowledge, primarily about materials hazardous to the environment and health, from engine manufacturers.

Detailed information can be procured from the country's only manufacturer of aircraft engines, Volvo Aero. The choice of material used in the aircraft industry is very important, as stringent demands are made on durability and function from the safety point of view. The engine manufacturer has commenced work on creating a database on the materials used in all engine components. The work is a result of work environment and environmental requirements. A dismantling analysis conducted by the FMV (Defence Materiel Administration) is another source of exhaustive information on the contents of engines. It was ordered to facilitate the dismantling of obsolete aircraft models in an environmentally sound manner.

### 1.4.1 Description of the product

Aircraft engines are a product with a complex composition (up to 40,000 parts). This means that any tabulation of information on material contexts would be rather comprehensive and that information/knowledge on the material contents of the various components can be widely disseminated among many different sub-contractors. In this study companies were contacted which deal with engines with varying needs for knowledge of materials. Only one of the contacted companies manufactures aircraft engines.

The constituent materials consisted to the greatest extent of metals, metal alloys and ceramic materials. Engines also contain electronic components, plastic materials, glue and joint sealants.

The collected information concentrated on jet engines, as this type of engine is manufactured in the country.

### 1.4.2 Description of the business sector

The development and manufacturing of aircraft engines is extremely expensive, and only a few large manufacturers have the resources to make entire engines. So the business sector consists to a large degree of companies specialised in the manufacture of components in a specific area.

There is only one manufacturer of aircraft engines on the Swedish market, Volvo Aero. Volvo makes jet engines used in Swedish military aircraft. Volvo also makes components for civilian aircraft.

Some aircraft engines are imported. Volvo dominates this import. Other large importers are airlines (SAS, Malmö Aviation) and companies, which maintain and repair aircraft.

*Svenskt Flyg* is a trade organisation representing companies and organisations in the aviation sector, including manufacturers, airlines and maintenance companies. The trade organisation mainly works with issues involving the continued competitiveness and financial development of aviation.

Research related to the aviation industry is conducted in the country. Research in aviation materials engineering is being conducted at the KTH and the Linköping Institute of Technology.

Jet engines are recycled to some extent. Hazardous waste and materials with an economic value are removed and processed. A work method has been devised to describe the way in which military engines from aircraft scheduled for scrapping are to be dismantled and what items are to be salvaged.

### 1.4.3 Who knows what?

#### **Literature**

The initial review of the literature yielded varying results. Using the Internet to find general information on the materials and chemicals contained in aircraft engines is difficult. Research related to the aviation industry is conducted in the country. Information on various aircraft engine components and their materials (metals, alloys, ceramic materials, composites etc.) can be found in the technical literature. The information often concentrates on individual components and does not provide an overall picture of engine contents.

Searches in *ToxNet* provided indications on aviation industry-related substances presenting risks to health and the environment. However, it had no information on the prevalence of the substances or their quantities.

#### **Importers**

A total of six importing companies were contacted. They can be roughly divided into three different categories: three companies maintain and repair aircraft engines, two companies are primarily importers and users of engines and one company manufactures aircraft.

#### *Repair and maintenance companies*

Generally speaking, the level of knowledge about material contents was poor in companies performing repairs and maintenance of engines. Their business does not require knowledge of materials. However, information can be obtained on components and chemical additives from product information sheets and product specifications. However, this applies to far from all articles purchased.

The greatest control concerns the chemical products used. One company has a database supplying information on the content of additives, such as glue, metal powder, paint and sealants. The company uses about 145 chemical products in its business and employs an average of about 140 kg in each engine.

#### *Airlines*

Airlines usually buy complete aircraft, including engines. Individual engines are purchased to allow engine replacement. However, this only happens rarely.

The knowledge of materials is often not very great. The airlines usually perform only minor maintenance work on engines. Repair and maintenance companies are used for major engine overhauls. According to one airline, the knowledge of materials was much greater when the company had its own aircraft workshop. One of the companies only performs minor maintenance on the external components of engines and therefore has some knowledge of the components located there, such as pipes and electronic parts.

One of the airlines has a clause in contracts with engine suppliers stipulating that information on engine contents will be made available to it when necessary.

Airlines refer to the engine manufacturers regarding information on the materials used in engines. Some engine manufacturers are conducting internal projects for elucidating and improving materials used in engines. The aim of this work is both to improve the cost of engine materials as well as pursue environmental aspects.

## **Manufacturers**

One company in Sweden manufactures aircraft engines, the Volvo Aero Corporation AB. The company only makes engines for the *JAS 39 Gripen* military aircraft. Civilian production is limited to aircraft engine components,

Volvo has begun work on elucidating the materials used in the RM-12 military engine. The project was started for several reasons: to enable people working on the engine to know which materials they are handling as a result of demands made by engine users and because Volvo wanted control over the environmental aspects related to the use of the materials in e.g. dismantling. A database is being created in which every component part is linked to information about the price, environmental properties, maintenance regulations etc. The materials are to be described in detail with respect to chemical substances and the respective concentration.

The work on collecting information on the material contents of engine components has proceeded sluggishly. One reason is that some sub-contractors are reluctant to state the contents of their products. The difficulty often lies in circumventing the manufacturers' secrecy rules.

Volvo has also developed a database for the chemical products used in the manufacturing process. It contains information obtained from the chemical products' safety sheets, reworked to enable all employees to access the information.

SAAB Aircraft manufactures the *JAS 39 Gripen* aircraft. Volvo supplies the complete engines. Saab wants to be able to report to its customers which materials are employed in the aircraft and therefore require Volvo to avoid the use of substances on the restricted use list. The Defence Materiel Administration (FMV), in its capacity as a buyer of aircraft, makes demands on Saab. The FMV has drawn up a list of environmental stipulations for suppliers and demand declarations of materials describing the location of environmentally hazardous substances in the plane.

## **Recycling companies**

One project has been performed at the request of the FMV. Here, a jet engine was taken apart, and its constituent materials were studied. The project resulted in a system safety analysis performed by the SCC, in collaboration with Volvo, entailing the documentation of the complete contents of an RM-6 engine used in the *Draken* aircraft. The reason was that *Draken* aircraft were being withdrawn from service and their engines scrapped. 100 to 200 engines are involved.

The study was performed on an engine with an afterburner. A total of 43,000 components were involved. Information on the constituent materials was obtained from a spare parts catalogue with the aid of documentation in the form of drawings and the manufacturers' material specifications. All substances in individual components occurring in amounts exceeding 0.2% were noted. The final result is a theoretical table of contents for the entire engine, and each material used can be described in terms of weight/percentage.

The system safety analysis was performed in order to optimise the processing of these materials according to environmental and work environment legislation and economic aspects. With the Environmental Act as a starting point, the constituent materials were valued in terms of their environmental aspects, and dismantling and processing instructions were prepared for environmentally hazardous materials. Materials with some economic value are to be processed separately. Consideration was also paid as to whether the dismantling of individual parts was technically feasible.

The analysis was performed as an inventory of the present state of affairs, but the work method can be used with future engines.

Volvo has prepared similar material specifications for the S-8 automobile engine.

### **Trade organisation**

The aviation industry trade organisation, *Svenskt Flyg*, does not possess any knowledge of matters concerning the materials used in jet engines. The environmental information available concerns emissions generated in engine operation. e.g. CO<sub>2</sub> and NO<sub>x</sub>. However, the trade organisation does have information on people and companies with know-how in the field.

### **Research institutes**

The Department of Construction and Production Engineering at The Linköping Institute of Technology has a unit, which conducts research on e.g. materials used in engines. The Department examines the contents of individual components and is then interested in substances affecting material properties. Companies commonly order an investigation of the real contents of a component. No tabulation of the total material contents of jet engines has been performed. However, information on the contents of individual components is available in studies and reports.

#### ***1.4.4 Product group contents***

As already noted, a jet engine consists of a large number of components made of different materials, and work on describing the contents of an engine is therefore comprehensive. For this reason, this project did not seek any detailed information. The project's aim was to study the information sources and types of information available. During the course of the project, however, some general information was obtained. The information concerns the RM-6 engine. However, its contents are similar to those found in other jet engines.

Most of a jet engine is made of metals, i.e. about 95%. The main metals are aluminium, steel and titanium. Other metals used, pure or as alloys, are nickel, cobalt, thorium, cadmium and magnesium.

Some non-metallic materials, such as joint sealant, electronic material, plastics etc. are also employed.

## 1.5 Ceramic flat gaskets

### Summary

Ceramic flat gaskets are made from relatively simple chemical substances. The chemical composition affects product properties. These two factors contribute to companies' knowledge of product contents. Companies importing and selling gaskets and which also have a consultancy-oriented business have a greater need for information on contents than companies using the products in their consultancy business.

The trade organisations the Swedish Ceramic Society and the Swedish Ceramic Institute have detailed information on contents and even other knowledge specific to the trade.

### 1.5.1 Description of the product

Structural ceramics are made of synthetic ceramic substances which, to put it simply, are conjoined using different methods such as pressing and heating (sintering). Distinguishing features of structural ceramics today are great tensile strength and/or great resistance to pressure, chemical attack, abrasion and high temperatures. They can also be given properties such as high or low thermal conductivity and be electrically conductive or insulating. Structural ceramics have many applications. They are used in e.g. tools such as machinery parts, in the process industry, for various energy uses and in the electronics industry.

In this study we decided to study flat gaskets made of ceramic material. The ceramic component consists of a ring made of compact ceramic material, usually silicon carbide or aluminium oxide. The gaskets are widely used in pumps and stuffing boxes. Our choice of flat gaskets as a subject of study was mainly because many different companies employ the product, thereby increasing the possibility of obtaining information. We were unable to find any company in Sweden, which manufactures its own ceramic materials. However, there are companies, which manufacture rotating flat gaskets and underwater pumps using the ceramic component in their products. There are also companies, which import and sell gaskets.

### 1.5.2 Description of the business sector

Structural ceramics are a relatively heterogeneous product with many different applications and varied contents. Companies manufacturing structural ceramics frequently also manufacture products made from other materials, often metals and plastic composites. The same company often only make ceramics for a specific use. This means that few companies on the Swedish market make ceramics for the same application. The use of ceramic materials in machinery components is relatively new, so knowledge in the industry is still relatively limited.

The import of structural ceramics in general is relatively extensive. A number of agents import and sell structural ceramics. The agents often have a large assortment and combine, in some instances, sales operations with consultancy.

The Swedish Ceramic Society is a trade organisation for companies offering ceramic products and works for the development and increased use of ceramic materials. They collaborate closely with the Swedish Ceramic Institute, a trade research institute financed by manufacturing enterprises and importers.

### 1.5.3 Who knows what?

#### **Literature**

As previously noted, the use of structural ceramics in the heavy engineering industry is relatively new and not fully exploited, according to certain people working with ceramics. An important part of the work in the ceramic trade is to increase knowledge of ceramic materials in the industry and counteract the previously held view that ceramics are brittle and delicate. Research is mainly concentrating the development and testing of ceramic materials, as the available literature reflects. Some research reports and course literature are available at university libraries. However, the initial review of the literature yielded considerable information of use to this study. Searches were performed in the *Libris* library database, the National Chemicals Inspectorate's *Bibeline* and the *ToxNet* chemicals database, as well as with the aid of various Internet search engines (AltaVista, Infoseek etc.)

#### **Companies**

Six companies working with flat gaskets made of ceramic materials were contacted. Three of the companies purchase and use components in manufacturing different products. Two of the companies import and sell gaskets. One of the companies is a Swedish sales office for ceramic products in a Group with its own production of flat gasket components, although not in Sweden.

The companies have good knowledge of the main constituents in gaskets. One reason is because the product consists of a relatively simple mixture of chemical substances. Another reason is the fact that different manufacturing materials give the ceramic components different properties. Some of the companies therefore have an interest in acquiring knowledge of the manufacturing materials. The companies importing and selling flat gaskets often have a consulting sideline forcing them to have knowledge about contents and even the manufacturing process to some extent.

Companies in groups manufacturing ceramic flat gaskets supplied the most detailed information. A factor facilitating the transfer of information!

Companies using flat gaskets in their business obtain information on contents from product safety data sheets. The companies also contact the Swedish Ceramic Institute for information on ceramic materials.

Obtaining information on complete contents can be difficult, according to some companies. One explanation is that there are no manufacturers in the country. To some extent, it is also because manufacturers are reluctant to report entire contents for secrecy reasons.

#### **Trade organisations and research institutes**

The ceramics business is not as highly structured as more traditional business sectors, such as the forestry industry. None of the companies offering ceramic flat gaskets is a member of the trade-oriented Swedish Ceramic Society. One company is a member of the trade research institute the Swedish Ceramic Institute which, in close collaboration with the Swedish Ceramic Society, strives to develop and increase the use of ceramic materials.

No coordinated environmental work is pursued, and there are no sector-specific rules on the products' chemical composition.

However, these two organisations both possess extensive knowledge of the chemical content of ceramic products. The Swedish Ceramic Society can be asked to perform an assay, for a price, of the chemical constituents of structural ceramics.

The Swedish Ceramic Institute conducts research in the ceramics field and has knowledge of manufacturing processes and the contents of structural ceramics. Some basic information on use and contents is available at its website.

#### *1.5.4 Product group contents*

According to the companies, flat gaskets are usually made of aluminium oxide or silicon carbide as the main ingredient. They often make up more than 90% of the contents. The rest of the product consists of substances added to give the gasket different properties or to make the structure completely moisture-resistant.

Quartz and easily liquefied type of glass, in the form of lithium oxide or magnesium oxide, can be used as a binder in both types of gaskets. Silicon carbide gaskets often contain free silicon, which fills the pores and makes the structure impervious to moisture. Resin can also be used as filler in manufacturing at times. Sodium oxide, calcium oxide and iron oxide can also be used in aluminium oxide gaskets.

Organic binders, such as polyvinyl alcohol, polyethylene glycol or latex may be added in the manufacturing process. However, they burn up when the ceramic is heated (sintered) in the fabrication process and is of no interest to any investigation of contents.

## 1.6 Food packaging for prepared meat products

### Summary

Legislation on materials intended for contact with food is comprehensive. A manufacturer should therefore know exactly which substances are in the food packaging.

However, information on additives in plastic food packaging is regarded as a trade secret and is very hard to obtain. Companies only share such information when confidentially agreements exist. *Normpack*, which has such agreements with companies, has extensive and detailed information on materials and chemicals contained in food packaging. They do not release this information.

The secrecy problem in gathering information occurs throughout the business sector.

### 1.6.1 Description of the product

The National Food Administration has divided food packaging into different groups. One group is “plastic packaging for prepared food products” (ham, salami, bacon etc.), and we chose to describe the packaging of interest in this way in our contacts with companies. This type of packaging is often a laminate, made of many layers welded along the edges. Vacuum packaging is often used.

### 1.6.2 Description of the business sector

The chemical contents of food packaging is strictly regulated. The existing legislation is the Swedish Food Act, the Food Ordinance and the National Food Administration’s notification with regulations and general advice on materials and products intended for contact with food. The EU directives in the field have been incorporated into Swedish legislation. Producer responsibility (regulation 1997:185, directive 94/62/EG) also applies to packaging.

*Packforsk* is a trade organisation and a trade research institute in the packaging field. *Normpack*, a part of *Packforsk*, is a Swedish standard for materials and products intended for contact with food. All the major producers are affiliated to *Normpack*, and a number of supermarket chains demand that the packaging they buy complies with the *Normpack* standard. Related trade organisations are the Association of Retail Grocers, the Federation of Swedish Food Industries, the Swedish Plastics and Chemicals Suppliers’ Association, the Swedish Plastics Industry Association and the Association of Swedish Chemical Industries. In addition to *Packforsk*, several universities have departments for polymer engineering at which research in the field can be conducted.

Plastic food packing is manufactured in Sweden, but some is also imported. A few major companies probably dominate the manufacture of this kind of packaging. However, *Normpack’s* register lists about 60 companies with *Normpack* certification (1999-2000) for packaging for prepared meat products.

According to the Packaging Act, 70% of plastic packaging is to be collected 1 July 2001. At least 30% must be recycled and the energy recovered from the remainder, i.e. by incineration with energy recovery. The task of the materials company *Plastkretsen AB* is to provide a system for collecting and recycling plastic packaging according to stipulations in the Packaging Act. Materials companies for metals, plastics, corrugated board and Paper/cardboard have founded a joint subsidiary – *Reparegistrert AB* (REPA), to which packaging fees are paid. Soft plastics from which the packaging is often made are part of the packaging collected by a few municipalities only and subjected to energy recovery. In most municipalities, packaging made of soft plastics is included in household refuse. No extensive eco-labelling of plastic packaging occurs, but the material is often stated.

### 1.6.3 Who knows what?

#### Literature

There is considerable research literature on food packaging, but determining what a certain type of packaging usually contains is difficult. *ToxNet* contains examples of substances hazardous to health found in food packaging. A number of relevant legal texts and regulations can be found on the Internet via e.g. *Rättsnätet* or *Rixlex*. The EG Commission's directives list additives allowed in food packaging. *Packforsk's* website holds extensive information on packaging and packaging materials. However, additives are not addressed to any great extent.

#### Manufacturers

All 10 companies, manufacturers and importers contacted replied to the questionnaire. However, five of them replied that they neither manufacture nor import the packaging in question. The other companies only reported the plastic materials in the packaging but not the chemicals. This is mainly because that information is a trade secret and because the actual contents are not interesting to e.g. an importer when the packaging is known to comply with the *Normpack* standard. When a new plastic material is to be used in food packaging, a very thorough toxicological investigation must be performed to ensure that it complies with legal requirements and that the packing does not release any substances harmful to health.

The three questionnaire replies from manufacturers concerned packaging for meatballs and liver pâté. They replied with the information available at the company. The manufacturers used materials from 2-5 sub-contractors per packaging. One comment was that the specified information should be available from *Normpack*.

#### Importers

Two questionnaire replies were received from importing companies. They both concerned laminates from vacuum packaging of prepared meat products. They reported the constituent plastics but no additives. Both importers also replied that the packaging did not contain any of the substances listed in Appendix 2. One importer also identified a large number of substances not used in the product and reported a few examples of stabilisers which might be found in the packaging.

Both importers contacted the manufacturer/supplier and found it relatively easy to obtain information from them on the product, but the process can take time. One factor facilitating information retrieval was product compliance with international rules and the *Normpack* standard. Recipe secrecy was a factor impeding information retrieval. One of the importers was told by the manufacturer that they could not disclose product recipes to customers but they could possibly submit them directly to the authorities if they could reach a confidentiality agreement.

One view was that the questionnaire was "an example of needless paper work for companies" and that an apparently simple questionnaire still requires a relatively large amount of work.

Requesting the names of importers of food packaging from the Swedish Customs was problematical, as the Customs tariff number makes no distinction between packaging for food and packaging materials for some other use. Instead, we contacted a few large food chains, KF and ICA which import packaging and its contents.

They require that all packaging complies with the *Normpack* standard or the equivalent if the product is imported. They have limited knowledge of the contents of the packaging they import, especially as regards additives, and rely to a great degree on *Normpack's* work. They know somewhat more about the packaging used for their own brands, as each product has product specifications indicating e.g. the printing inks, which may be used on the packaging. KF's *Signum* and *Ånglamark* brands have materials labelling and *Normpack's* symbol on packaging.

Companies have seldom asked any specific questions about packaging contents. However, KF, within the framework of *Normpack*, has contacted its sub-contractors for information on lacquers on the inside of food tins and PVC contents. This proved to be a useful way of obtaining information.

### **Trade organisations**

*Normpack*, part of the trade organisation/research institute *Packforsk*, has ‘recipes’ on file for all packaging certified by *Normpack*. The information is detailed and contains e.g. target values for additives. There is no information on residual chemicals, such as residual monomers. *Normpack* has a confidentiality agreement with the packaging companies. Information may therefore not be disclosed, a practice strictly observed.

The *Normpack* standard focuses on food safety, not the environment. It is based on Swedish and European legislation, and, when this is insufficient to cover all substances, even on Dutch, German and U.S. legislation as well as some additional regulations. There are currently about 400 *Normpack* certificates. A certificate usually covers a group of products of the same type. The starting point is a kind of ‘worst case scenario’, i.e. packaging presenting the greatest risk of migration; this is the thickest packaging. One company can e.g. have 30 of its 2,000 packages analysed and then guarantee the safety of packaging made from the same materials in a thinner version.

The Food Companies Association (Li), a merger of the Food Industry Employers’ Association (LAF) and the Federation of Swedish Food Industries (LI), accounts for virtually all of the food trade’s sales and staff numbers. The Food Companies Association is familiar with legislation on food packaging but does not possess any detailed knowledge. They can envisage turning to their member companies for an investigation of the contents in packaging. However, they are doubtful that the results would be useful, as packaging manufacturers are anxious to keep the entire list of contents secret. However, it should be possible to ask them whether any specific substances are found in packaging. Many of the members should also be able to report whether or not the packaging is certified by *Normpack*.

### **Recycling companies**

The REPAR register contains information on all the different packaging companies and e.g. the materials used in the packaging they manufacture. However, the register does not state whether packaging is made of hard plastic or soft plastic, the type of plastic involved nor the constituent chemicals used. The information is classified, and the register does not show which company makes which type of packaging (e.g. food packaging or other packaging.)

#### **1.6.4 Product group contents**

A laminate for vacuum packaging for prepared meat products, such as cold cuts, usually contains mainly polyethylene and polyamide (nylon) and is made from 17-18 different layers. Other materials found are PET (polyethylene terephthalate) and polyurethane glue. One packaging examined might contain stabilizers, the only example of an additive used. These are phosphite, phenol, polyol, calcium salt and zinc salt stabilizers.

## 1.7 Costume jewellery necklaces

### Summary

Importers and manufacturers have limited knowledge about the contents of costume jewellery (made of non-precious materials). The companies do not receive any detailed list of contents from suppliers who are often small manufacturers, often located in countries pursuing limited environmental work. Moreover, the number of suppliers is often large, thereby further reducing the possibility for importers to procure information on contents.

There are a large number of actors on the Swedish market, and the absence of any trade organisation or trade research means that there is no coordinating function and no common source of knowledge.

The regulation of nickel content introduced in the E.U. has contributed to increased awareness of the contents of costume jewellery. The demand for knowledge is another factor contributing to an increase in the actors' knowledge of the contents of jewellery.

The National Testing and Research Institute probably has the greatest knowledge about contents derived from chemical analyses made on costume jewellery.

### 1.7.1 Description of the product

Costume jewellery necklaces (made from non-precious materials) can be made of many different materials, such as plastic, metal, wood and textiles. They are sold in clothing shops, department stores, jewellery shops and street markets.

Costume jewellery necklaces were selected, as they are a product which can be made from many different materials. They also belong to a poorly regulated product group in which knowledge of chemical contents is poor. The market has many actors but no trade organisation.

### 1.7.2 Description of the business sector

Sweden imports about 5 times as much costume jewellery as it exports (the Swedish Customs – 93). The market has many actors but no coordinating organisation. The two closest trade organisations are the Association of Swedish Jewellers and Goldsmiths and the Goldsmiths Suppliers' Association. Most of their members are importers and sellers of precious metals.

No legislation specifically governs the contents of costume jewellery necklaces. One EU directive<sup>5</sup> regulates the presence of and release of nickel in e.g. jewellery. No eco-labelling occurs for the product group, and chemistry know-how is limited.

The precious metal control for which the National Testing and Research institute is responsible hallmarks jewellery made of precious metals with the Cat Paw as a guarantee of the jewellery's content of precious metal. They can also conduct analyses of costume jewellery.

### 1.7.3 Who knows what?

#### Literature

Books on jewellery were found in *Libris*. It contained many examples of materials used in costume jewellery. Examples of allergenic substances were found in *ToxNet*. The Precious Metal Control has an Internet listing containing some information on the contents of costume jewellery.

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<sup>5</sup> Directive 76/769/EEG

## **Manufacturers**

Costume jewellery necklaces sold in Sweden are almost exclusively imported. However, some small businesses also make the product. One such business replied to the questionnaire. The manufactured necklace consists of braided leather, which can be composed with stones or glass. The manufacturer is small and has no knowledge of the product's chemical contents. The only chemical the product could conceivably contain is chromium introduced during the leather's chrome tanning.

## **Importers**

A questionnaire was sent to 11 importers of jewellery and costume jewellery (a collective designation for jewellery made of non-precious materials). Customs' information on importing companies served as the basis for our choice of companies to contact. The contact list also contained companies with varying import volumes.

The fact that most of the manufacturing takes place in some other country often limits the possibility of obtaining information on contents. It is also difficult for the importing companies to obtain their own knowledge about manufacturing methods and materials when articles are imported from many different countries. Costume jewellery necklaces are subject to trends, and the materials in the jewellery is constantly changing, thereby making it more difficult for importing companies to investigate and identify content. Another factor making it harder to obtain declarations of contents for articles is that many suppliers are small, There is also often a large number of suppliers. One contacted company has 76 suppliers in Hong Kong alone.

Product declarations, listing the necklace materials, are found to some extent. Only the material group is usually specified (e.g. wood, plastic and metal) and not which specific materials. The metal is sometimes identified. e.g. stainless steel or brass.

Costume jewellery may not contain excessive levels of lead and nickel. EU standards on the nickel content of metal jewellery have heightened awareness about nickel content. The standards have also led to a switch to other metals.

For businesses, customer demands also influence the metals to be avoided. Metal jewellery is sometimes sent to the National Testing Institute for an analysis of its nickel content. This is mainly the case for large orders. The quantity purchased is frequently too small for analysis to be considered.

*Hennes & Mauritz* is a company at the forefront of changes made in the use of substances harmful to the environment and health in costume jewellery.

Companies receive information on product contents exclusively from suppliers.

## **Trade organisations and trade research**

There is actually no single trade organisation for businesses importing and selling costume jewellery. In this study, we contacted trade organisations for companies in related lines of business.

The Swedish Association of Jewellers and Goldsmiths only works with companies dealing with articles made from precious metals and were unable to supply any information on costume jewellery.

Nor was the Goldsmiths Suppliers' Association able to provide any information on costume jewellery.

There is no trade organisation possessing knowledge of the contents of costume jewellery. However, the National Testing Institute is one source of some information, derived from its chemical assays of costume jewellery, on what this jewellery can contain.

### **Chemical analysis**

One necklace was sent off to a company for chemical analysis. Beads and metal parts were analysed with a scanning electron microscope connected to an EDS in order to identify elements with atomic numbers higher than neon's. The beads were then examined with infrared spectroscopy (FT-IR) in order to identify organic substances in the specimens, compared to the known spectra of organic substances. Both methods were primarily qualitative. The analysis report did not state exact concentrations. Chromatographic analysis could have been used for more reliable identification of the presence of organic substances in the necklace.

#### ***1.7.4 Product group contents***

The basic material used in metal jewellery is often brass or steel. The surface finish, often with a gold or silver colour, can contain small amounts of lead. According to one company contacted, the lead content is to be removed and has also declined in recent years. Nickel alloys are often used to "glue" a surface material to the basic material. Since the introduction of regulations on nickel content, different copper alloys are being tested instead of "layers of glue" containing nickel.

Information supplied by the companies reported the following constituent substances:

- Lead
- Cadmium compounds
- Copper
- Zinc
- Iron

The metal parts in the analysed necklace were made of an alloy of copper and silver. The beads proved to be made of a silicate containing the elements silicon, potassium, calcium and sodium. Small amounts of aliphatic phthalic acid polyester were also found in extracts from purple beads in the necklace.

## Appendix 2 – Questionnaires

### 2.1 Example: Questionnaire on the chemical contents of costume jewellery necklaces

- 1) Do you manufacture or import costume jewellery necklaces?  
 Yes, we manufacture the product  
 Yes, we import the product  
 No, we neither manufacture nor import the product
  
- 2) How many versions of costume jewellery necklaces do you move in a year?  
.....
  
- 3) If you manufacture/import many different costume jewellery necklaces, select the one sold in the largest volume on the Swedish market and describe it (product name, appearance, colour, approximate weight etc.)  
.....  
.....
  
- 4) About how many of the necklaces described above do you sell on the Swedish market each year?  
.....
  
- 5) If you manufacture the necklace in question: From how many sub-contractors do you receive parts/materials used in the necklace?  
.....
  
- 6) What materials and chemicals does the necklace contain? See **Appendix !**
  
- 7) Does the necklace contain any of the following? See **Appendix !**
  
- 8) If you import the jewellery: Is it hard or easy to get information on the product from the supplier?  
.....  
  - 8.1) Are there any special factors making it easy to obtain information?  
.....
  
  - 8.2) Which factors make it hard to obtain information?  
.....

9) How long did it take you to find the required information and fill in this questionnaire?

.....

10) Where did you get the information from (supplier, environmental declaration, chemical analysis etc.)?

.....

11) Whom may we contact if we have any further questions (name, E-mail address and telephone number)?

.....

12) Do you have any comments on this questionnaire?

.....

## What materials and chemicals does the necklace contain?

<b>1. Plastics</b>	%
How much of the total product consists of <i>plastics</i> ?	
Which <i>plastics</i> are used and in what amounts (% of the total product)?	%
Plastic 1:	
Plastic 3:	
Plastic 2:	
Other plastics:	
Which chemicals do the different <i>plastics</i> contain and in what amounts?	
Plastic 1:	
Plastic 2:	
Plastic 3:	
Other plastics:	
<b>2. Metals</b>	%
How much of the total product consists of <i>metallic materials</i> ?	
Which <i>metallic materials</i> are used and in what amounts (% of the total product)?	%
Material 1:	
Material 2:	
Material 3:	
Other metallic materials:	
Which substances do the different <i>metallic materials</i> contain and in what amounts?	
Material 1:	
Material 2:	
Material 3:	
Other metallic materials:	
<b>3. Ceramic materials (incl. glass)</b>	%
How much of the total product consists of <i>ceramic materials</i> ?	
Which <i>ceramic materials</i> are used and in what amounts (% of the total product)?	%
Material 1:	
Material 2:	
Material 3:	
Other materials:	
Which oxides do the different <i>ceramic materials</i> contain and in what amounts?	

Material 1:	
Material 2:	
Material 3:	
Other materials:	
<b>4. Wood</b>	%
How much of the total product consists of <i>wood</i> ?	
Which <i>kinds of wood</i> are used and in what amounts (% of the total product)?	%
Wood 1:	
Wood 2:	
Wood 3:	
Other kinds of wood:	
Which chemicals has the wood been treated with and in what amounts?	
Wood 1:	
Wood 2:	
Wood 3:	
Other kinds of wood	
<b>5. Other materials (e.g. paper, stone, textiles, leather)</b>	%
How much of the total product consists of <i>other materials</i> ?	
Which <i>other materials</i> are used and in what amounts (% of the total product)?	%
Material 1:	
Material 2:	
Material 3:	
Other materials:	
Which chemicals do the different <i>materials</i> contain and in what amounts?	
Material 1:	
Material 2:	
Material 3:	
Other materials:	
<b>6. Residual chemicals</b>	
Chemicals left over from the manufacturing process sometimes remain in the finished product. Which residual chemicals could conceivably be found in this necklace?	

**Does the necklace contain any of the following?**

<b>Substance</b>	<b>Yes</b>	<b>No</b>	<b>Concentration</b>
Lead compounds			
Nickel			
Cadmium compounds			
Chromium			
Butyl hydroxytoluene (BHT)			

## 2.2 Questionnaire on the chemical content of newsprint

In the questionnaire one question was if certain substances were present in the product. Which chemicals we asked about for the different articles are shown below.

### Newsprint

AOX (Absorbable organic halogens, total concentration of chlorine bound to organic compounds)

EOX (Extractable organic halogens)

Butylbenzylphthalate

Dibutylphthalate

Dioxins

Epichlorohydrin

Formaldehyde

Fufurol

Fufuryl alcohol

Chorophenols

Chromium compounds

2-methyl-4-isothiazolin-3-on

Ethoxilated nonylphenols

Polychlorinated biphenyls (PCB)

Organic tin compounds

### Stretch trousers

Formaldehyde

Azo dyes

Dyes containing chromium

Dyes containing cadmium

Disperse Blue 3

Brominated flame retardants

Diethylhexylphthalate (DEHP)

Nickel

### Cameras

Lead

Nickel

Cadmium

Mercury

Arsenic

Beryllium

Bismuth

Chromium

Diethylhexylphthalate

Brominated flame retardants

### **Aircraft engines**

Cadmium  
Chromium  
Nickel  
Nickel sulphate  
Nickel oxide  
Lead  
Mercury  
Arsenic  
Copper  
PVC

### **Ceramic flat gaskets**

Cadmium  
Chromium  
Nickel  
Yttrium  
Lead oxide  
Beryllium oxide  
Thorium oxide  
Mercury  
Polyaromatic hydrocarbons (PAH)

### **Plastic food packaging**

Lead compounds  
Tin compounds  
Diethylhexylphthalate (DEHP)  
Dibutylphthalate  
Butylhydroxytoluene (BHT)  
Bisphenol A

**KEMI** 

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