Beyond Compliance. Environmental Management and Toxics Reduction in Practice
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Chapter 6

Toxics reduction in 10 large companies, why and how.


keywords: toxics, environmental management, toxics use reduction, company, release, supplier.
Abstract

Environmental management can be directed at the various aspects of environmental performance. One of these aspects is the reduction of toxics. To address the problems caused by toxic chemical pollution especially in the USA toxics reduction programs have been developed focusing on pollution prevention and toxics use reduction. Pollution prevention aims at reducing the amount of any hazardous substance, pollutant or contaminant entering any waste stream or otherwise released into the environment (prior to recycling, treatment or disposal). Toxic Use Reduction (TUR) reduces, avoids or eliminates the use of toxic or hazardous substances. Both techniques may also reduce the risks to the health of workers and consumers. Pollution prevention may include TUR.

The aim of this survey is to find out why and how companies are reducing the toxics (releases and use). To address these issues investigations were carried out using structured interviews in ten large internationally operating companies from a wide range of industries that were known to have performed toxics reduction. The interview comprised also questions about the involvement of the purchasing department.

All but one of the studied companies mentioned compliance as one of the reasons for toxics reduction, product (safety) was mentioned by 4 companies and the working environment was mentioned twice.

Six of the studied companies have substantial programs for toxics reduction. Most of the programs are directed to toxic release reduction but three programs also to toxic use reduction. As to toxics reduction measures most companies mentioned more measures than process related ones. For toxics release and use reduction the measures taken were very different in complexity, varying from a black list to the execution of a complex program. Most companies are far from using the whole potential for activities relevant to toxics reduction within the company, which should consist of a comprehensive policy with clear targets, a comprehensive program for toxics reduction (including TUR) and a monitoring system extending to the corporate level. Only one company was found that met these requirements. Three companies specified requirements about toxics to their suppliers. Companies can do more in this field using requirements for excluding or limiting toxics in supplies.
Introduction

Environmental management can be directed to the various aspects of environmental performance (1). One of these aspects is the reduction of toxics, substances that may cause harm to people and other organisms by interference with vital processes.

By the 1970s it became clear in the USA and Europe that the regulatory mechanisms for dealing with toxics emissions (water, air) and waste were inadequate. Concerning chemical production the regulatory activities were exclusively focused on the end point of the cycle, which caused a virtually unrestricted flow of chemicals onto the market. In practice thus the efforts to reduce the toxic pollution were mainly focused on pollution control (end of pipe measures) to limit present and future environmental contamination (2). An American survey (3) executed in the early 1970s in 516 large companies showed that somewhat over 85 % of the companies said they operated a pollution control program (air, water). The same survey showed that the pollution control programs were heavily related to production (77 %), but included also materials selection and to a lesser degree product design, choice of suppliers, and product use and disposability. The pollution control programs up to the 1970s were hardly effective for toxics reduction and the reduction of toxics dispersed into the environment by transportation and commercial products (4). The regulatory response to the shortcomings in toxics reduction emerged in new legislation a.o. the Toxics Substances Control Act (TSCA 1976).

Pollution prevention

In 1990 the USA introduced the Pollution Prevention Act in which pollution prevention is defined as a ‘source reduction’. Pollution prevention aims at reducing the amount of any hazardous substance, pollutant or contaminant entering any waste stream or otherwise released into the environment (prior to recycling, treatment or disposal). Recycling outside the production site and treatment were specifically excluded from the definition of pollution prevention. Furthermore over 150 countries participated in ‘Agenda 21’ (5) which addresses prevention of pollution at the source.

Toxic Use Reduction reduces, avoids or eliminates the use of toxic or hazar-
drous substances. Pollution prevention may include Toxic Use Reduction. In the early 1990s pollution prevention programs such as the voluntary EPA (Environmental Protection Agency, USA) 33/50 program were started. The 33/50 program aimed at the reduction of the release of 17 high use toxic chemicals: 33 % reduction in 1992 and 50 % reduction in 1995. The 17 chemicals accounted for 22 % of the release reported to TRI (Toxic Release Inventory). The TRI monitors the releases of manufacturing facilities with 10 or more employees that meets certain thresholds for processing one or more of the 329 identified toxic chemicals. Fifteen percent of the companies invited to participate in the 33/50 EPA program did participate. The reduction in releases was predominantly reached by end-of-pipe treatment and on-site recycling (2).

The prevention programs and regulations in the USA however ignored occupational problems and have not dealt directly with product-based problems caused by toxic chemicals.

**Toxics and the work environment**

Toxics handled by industry not only have an impact on the open environment but also on the work environment (6,7,8). In many countries policies as to environmental problems are separated from policies concerning the work environment. In the USA for example the Occupational Safety and Health Administration (OSHA) has until now given little attention to pollution prevention issues (4). The OSHA however has developed a generic hazard communication standard to provide information on the hazards of the chemicals to the workers. The same holds for the European Union. Unfortunately the information provided in the form of Material Safety Data Sheets (MSDS) is often incomplete and incorrect (9).

**Toxics and consumer products**

Toxics may be present in products. Data of the State of New Jersey (1990) indicate that 55 to 99 % of industrial inputs of five toxic heavy metals (mercury, lead, cadmium, chromium, and nickel) was converted into products. Toxic constituents in consumer products may cause problems among users, consumers and on disposal (10). Potential toxic hazards may also be caused by products used by industry. Product reformulation and substitution of toxic constituents can help to address these problems (11).
Toxics use and release reduction

The reduction of toxic use or releases can be achieved externally by legal and regulatory requirements. Morrison (12) showed as to 'the factors reflected in environmental policy making' (of US companies) that the necessity to stay within the limits of the law was more than twice (69%) as important as a social responsibility (32%), with liability pressures (21%) coming third. Morrison also showed 'the key issues' of company concern. According to this study toxic air pollution, toxic waste disposal and worker health and safety head the list of the (35) issues. Morrison's (12) list concerning 'the primary elements of corporations environmental strategies' is headed by installation of and improving new pollution control devices and complying with environmental regulations. Internal factors are also important in the reduction of toxics. The findings of a study (13) as to the effect of employee participation on source reduction (based on the 1991 - 1992 TRI database) showed three formal employee participation practices: internal pollution prevention opportunity audits, participative team management and formal employee recommendation procedures. A combination of these practices tripled the reduction in emissions (reduction of toxic waste at the source) compared to manufacturers using none of these practices.

The reduction of toxic use or releases can be achieved internally by changing the production process, the products, re-use and (in process) recycling, end of pipe measures, applying input substitution and / or set requirements for the purchased products and raw materials (8,14,15). Ideally activities of companies aimed at toxics reduction should be comprehensive in addressing all these possibilities. They should be based on a policy with clear targets. Monitoring extended to the corporate level should be a part of the activities.

The aim of this survey is to find out why and how companies are reducing the toxics (releases and use). As the use of toxics may cause problems to both the open and the work environment we studied if the environmental department is integrated with the department of risk, safety and health. To answer how and why companies are reducing toxics (release and use) we studied the toxics reduction policy of the company, the reasons for toxics reduction, the implementation in the organisation and the results.
The interview comprised also questions about the involvement of the purchasing department. Because the purchasing department actually buys materials and products the purchasing department is in a strategic position to reduce the use of toxics by selecting less hazardous substances on a case by case basis and to set toxics related requirements for products and raw materials (15). To address these issues investigations were carried out using structured interviews in ten large internationally operating companies from a wide range of industries that were known to have performed toxics reduction.

**Method**

The study was carried out with structured interviews, from 1996 until March 1998. We selected ten large international companies (table 1). To select the companies we used the most recent corporate environmental reports. Criteria were: large international company, a well developed environmental management system and described toxic reduction results. The second criterion was to ensure that there was sufficient environmental expertise in the company. After the selection of the company a member of the management or the director of the environmental department was informed about the research project by phone. Afterwards the questions of the interview were faxed and the company was asked to select one or more experts on the subject. All approached companies co-operated.

In most of the time employees or managers (eight) working at the corporate environmental department were interviewed. One interview was executed with the purchasing manager and the manager regulatory affairs, another interview separate with the environmental manager and a senior consultant Product Design & Engineering. When present, written material was collected (company environmental report, purchasing procedures, LCAs procedures, supplier requirements). The interviews were executed at the company or by phone and took about one to two hours. In all cases more information was obtained by a second interview at the company or by phone. When needed the questions were asked in several ways to probe the subject of the question to the bottom and to be sure the answers were reliable. The interviews were recorded, transcribed into a written text and sent back for comment. The text of the interviews were sent back to be sure there
was no misunderstanding. The interview texts were finalised on the basis of these comments. Most comments were very minor. The interview was structured into three parts with open questions (table 2). The first part was intended to obtain insight into the environmental organisation and integration with department of risk, safety and health. The second part focused on the toxics reduction. The third part was to learn more about the purchasing department and toxics reduction.

\begin{table}
\centering
\caption{Participating Companies}
\begin{tabular}{ll}
1. & Cytec \\
2. & Merck & Co Inc. \\
3. & Volvo \\
4. & The Body Shop \\
5. & ICI \\
6. & Dow \\
7. & IBM \\
8. & Polaroid \\
9. & Océ \\
10. & Bristol-Myers Squibb \\
\end{tabular}
\end{table}

\begin{table}
\centering
\caption{Interview}
\begin{tabular}{ll}
\textbf{Environmental Organisation} & \\
1. & How is the environmental organisation set up; is the environmental department integrated with the department for risk, safety and health. \\
\textbf{Toxic Reduction} & \\
2. & Does the company has a policy to reduce the toxics, if so how and why. \\
3. & Has toxic reduction a place in the management system, if so how. \\
4. & Is there a reduction in the number and amount of toxics or toxics emissions, if so how did you reach it.
\end{tabular}
\end{table}
5 How is the purchasing department organised, what is bought and for which sites.
6 Is the purchasing department involved in the reduction of the toxics or toxics emissions, if so how.
7 Do suppliers have to comply with environmental and/or quality requirements regarding the toxics.

Results

The results from the interviews are given below. A summary is to be found in table 3.

Company 1 (Cytec, workforce 5000)
The company is part of the chemical industry and has 35 sites, most of the sites are located in the U.S.A. The information used was collected out of written material and from 2 interviews. Interviewed were the purchasing manager and the manager regulatory affairs at the site located in the Netherlands. This site is following the environmental policy dictated by headquarters in the U.S.A. The environmental-, risk-, health and safety activities are integrated in one department. Most of the products of the company are hazardous materials. Due to this reduction of the toxics use is not a goal for the company, compliance is the reason given for reducing the toxics emissions. The purchasing department of the site in the Netherlands buys most of the raw materials for the European sites, sometimes also for the American sites. The company is working on a supplier partnership. The number of suppliers is reduced according to the rule: one supplier for one raw material. The criteria used to reduce the number of suppliers are mainly based on quality and liability reasons. There are no criteria for the environmental performance of the suppliers, but there are environmental related criteria for the materials delivered by suppliers. These derive from requirements of customers as to the amount of heavy metals and halogenated hydrocarbons in the product. The requirements of customers resulted in demands for reduction of the heavy metals
and halogenated hydrocarbons in the raw materials supplied. Setting quality requirements for raw materials resulted in a substantial reduction of the hazardous waste generated by the company.

Company 2 (Merck & Co Inc., workforce 48000)
The company is a pharmaceutical manufacturer and has about 50 sites. Sixty percent of the employees are working in the United States. The information used is derived from written material and an interview with the vice-president of the corporate environmental department located in the United States. The corporate environmental department is integrated with the safety, risk and health corporate department. The company works with product stewardship, informing the product users about responsible use. The policy of the company is to reduce the release of toxics not the use of toxics. Air emissions of carcinogens have been reduced by more than 90% worldwide since 1987, the releases and transfers of SARA toxics (chemicals listed under section 313 of the Superfund Amendment and Reauthorisation) were reduced by 90% at the end of 1995. The reason for the toxic release reduction was compliance with requirements relevant to the Toxics Release Inventory (TRI); the company was also a participant of the EPA 33/50. To reduce the release of toxic chemicals methods such as new processes, recovery, substitution and 'end of pipe control' are used. The company did not measure whether the use of toxics is reduced.

The purchasing department is centrally organised and is buying (as much as possible), for quality and reliability reasons for all sites in the world. The company has no environmental requirements for raw materials. For quality reasons there are some requirements for toxic contaminants in raw materials, such as the amount of methanol in ethanol. The company does not use environmental requirements for suppliers, though a possibility to be considered for the future is the use of ISO 14000 as a criterion.

Company 3 (Volvo, workforce 72000)
The company is part of the automotive industry and has production facilities in 23 countries. The information used was collected from written material and interviews of the environmental manager at the headquarters and a senior consultant from the Product Design & Engineering site of Netherlands Car B.V. The
The company has a policy for toxics reduction using a grey and black list. The substances on the black list are to be excluded, the substances on the grey list have to be limited. The black list contains 10 groups of substances. The company states that the last types of cars are produced without the toxics on the black list. The company also states that the reduction of the number of toxics was also helped by using a data base. This data base, containing a register for the chemicals used is available worldwide. The reason for the toxics reduction is legislation and producer liability. The company is liable for the recycling of the post consumer-products (in 2002 up to 85 %). The company states recycling is easier without the toxics. The company has the strategy to buy as much as possible centrally, but the distance between the supplier and the production site is important in view of the just in time delivery. The company set environmental requirements for suppliers and contractors. The suppliers have to sign for the materials on the black and grey lists. The strategically important suppliers have to fulfill the requirements according to environmental systems as ISO 14001, EMAS or BS 7750 or have a time plan for fulfillment. The suppliers must be able to report on their environmental work, organisation, results and compliance. The environmental requirements and the requirements to deliver materials and/or products without the listed toxics can influence the environmental performance of the supplier and can lead to toxics reduction. The site in the Netherlands handles the requirements for suppliers in such a way that it makes suppliers aware of their environmental performance.

**Company 4 (The Body Shop, workforce 13000)**
The company is centrally organized and has production sites and shops in 45 countries. The information used is derived from written material and an interview with a member of the environmental department at the headquarters. The company has a corporate department, ‘Ethical Audit Department’, with environmental and other specialists. A ‘Global Supply Division’ with environmental and health and safety specialists and a ‘Retail Division’ with an environmental adviser. There are also part-time volunteer environmental advisers spread throughout the organisation. The company operates quality, health and safety and environmental
management systems. The various management systems operate independently, though integrated ethical audits are conducted. The company has a policy to minimize the risks of new products by screening new products for potential toxic impacts on the aquatic environment. Many of the raw materials have been tested also for potential toxic impacts on the aquatic environment. The results of the tests are used to set up a database, the information is used for developing new products.

The divisions / sites have their own purchasing departments but consistency in the various systems is maintained via the Strategic Purchasing area. The company developed an environmental rating scheme for suppliers. Toxics are not included in the rating scheme.

**Company 5 (ICI, workforce 64000)**
The company belongs to the chemical industry and has 200 sites in more than 30 countries. The information used is derived from written material and an interview with a senior process engineer of the environment group at the site in the Netherlands. The company is working with an environmental management system integrated with a health and safety system. The headquarters have a Safety, Health and Environmental (SHE) department. The sites have their own SHE departments. Audits are performed by members of the SHE group from another site. The company developed and introduced the Environmental Burden (EB) system (16,17) to assess the potential harm to the environment from chemical emissions, to improve the environmental management and reporting and to identify the most harmful wastes and reduce these first. Toxics are integrated in the EB system. At every site the emissions in water and air are measured. The air emissions measured are classified in five impact categories: acidity, hazardous air emissions, global warming, ozone depletion and photochemical ozone (smog) creation. The emissions in water are classified in three impact categories: acidity, aquatic oxygen demand and ecotoxicity to aquatic life. Some substances can be assigned to more than one impact category. The quantities measured in tons are multiplied by the so called potency factors for the specific substance. This will give the Environmental Burden of an individual substance. The EB of each environmental impact category can be calculated. The Environmental Burdens of the different impact categories are not aggregated because it is felt to be incorrect to add together the EB's
to find a total Environmental Burden until there is a method to aggregate the different environmental impacts. The company set the target to halve four of the environmental burdens of the operations worldwide in 2000, acidity in air and water, aquatic oxygen demand, ecotoxicity and potentially hazardous emissions (carcinogens) in air. The reduction targets are independent of the production quantities. The hazardous emissions to air are currently limited to those air emissions considered to have carcinogenic potential. The company states this is the beginning, the reduction of hazardous impacts has to be extended beyond the carcinogenics.

All the targeted impact categories have been reduced compared to 1995. In most of the cases the reduction was carried out by adaptations of production processes and in some cases by substitution. The company measures the impacts of the sites, not the impacts of a process. The company states: future developments in quantifying impacts should extend to the product supply chain ‘upstream’ and ‘downstream’. The company also states that the targets of the EB system determine the environmental strategy and emissions reduction programme, the environmental performance improvement is achieved by the SHE management systems and audits. The reason for the toxics emission reduction is compliance.

The purchasing departments are organised decentrally. All businesses buy for their own processes. The company produces more products out of one production chain. One of the quality requirements for the products supplied is a maximum yield in the next production step, this requirement can lead to a reduction in emissions and/or waste. There are no environmental requirements for outside suppliers.

**Company 6 (Dow, workforce 39,500)**
The company is a chemical company, organised in 15 business units and has 94 manufacturing sites in 30 countries all over the world. The information used is derived from written material and an interview with the vice president for environment, health and safety of the European part of the company and the head of the environmental department in the Netherlands.

The company has a corporate environmental policy. An environmental advisory council with experts from outside the company serves as adviser for the management on key environmental, health and safety issues (EH&S). Through
community advisory panels the company communicates with local citizens. An
EH&S committee of the Board develops the policy and steers the continuous
improvement of the EH&S performance. The company is working with a
'responsible care' program. One of the goals for 2005 is to incorporate principles
of sustainable development and eco-efficiency into business strategies.

The company is working on an emission reduction program of chemicals in
order to reduce the emissions to air and water, with an emphasis on substances
such as human carcinogens, chemicals that are persistent, toxic and bioaccumula-
tive (PTBs), selected ozone depletors and high volume toxic compounds. The
company selected 29 compounds (a number of the selected chemicals are the 17
EPA 33/50 chemicals) and wants to reduce the emissions (to water and air) of
these chemicals by 75% in 2005. The company wants to reduce the emissions
beyond current legislation anticipating a tighter legislation in the future. The com-
pany states the use of these PTB chemicals is reduced. Globally the emissions of
the 17 EPA 33/50 compounds are reduced by 65% compared to 1988. Also the
VOC emissions are reduced since 1988 by about 50%. The same applies for the
U.S. SARA 313 (TRI) compounds. Overall chemicals emissions have to be redu-
ced in 2005 by 50% and waste (including hazardous waste to landfill) indexed on
production by 50%. For the emission reductions of toxics process modification
is used as well as elimination of and substitution for toxics.

The company works in Europe with a priority list including 58 chemicals. This
European list includes chemicals considered (by the governemt) as priority for
voluntary reduction programs. The European part of the company reduced the
emissions of these 58 chemicals to air and water by 50%. The total amount of
hazardous waste (not indexed on the increased production) in Europe increased
but also the waste sent for external processing increased.

In the Netherlands the company calculated the impact of the emissions in
categories using the eco-indicator (18). For the human toxicology only the impact
of the carcinogenic chemicals is calculated. The goal is to reduce the total impact
of the emissions as measured by the eco-indicator with 17% in 2000.

The company has a corporate purchasing department, which is buying the
major items globally. The questionnaire for the responsible care programme is used
when the company buys from outside companies. The questionnaire also compri-
ses environmental questions. Questions about toxics are not present.
Company 7 (IBM, workforce 225,300)
The company is part of the electronic industry and has business units in Asia, Europe, Middle East, Africa, Latin America and North America. The information used is derived from written material and an interview with a program manager of the corporate environmental affairs department at the headquarters.

The corporate environmental affairs department is responsible for the company's worldwide environmental strategy and provides advice and counsel in process and product safety, energy and environmental programs. The management of a site is responsible for the environmental performance of the site. The Environmental Master Plan is the major planning and reporting document. It concentrates on performance in such areas as chemical emissions and use, waste and recycling of all the manufacturing, development and research sites. The corporate health and safety department is no longer integrated with the environmental department, but the departments are working very closely together.

The company has a strategy to reduce the generation of hazardous waste. The hazardous waste generation is indexed to the production. In 1996 hazardous waste generation declined by 9.7%. The 1995 hazardous waste generation was 24 percent lower compared to 1994. The percent of hazardous waste recycled remained constant in 1996 at 78%. For hazardous waste the company follows the U.S. definition for the production units in the U.S. In the European countries the European hazardous waste definition is followed, and so on. Hazardous materials used in large quantities but not subject to legal requirements are also considered for reduction.

The company has environmental impact assessment (EIA) programs for products and processes. The main issues for the process EIA are the work and safety issues and the impact on the environment. On the basis of the product EIA a product profile is made. This considers the energy used, undesirable chemicals (PBB's), the materials used and the possibilities of recycling etc. An EIA is performed for every product. The company wants to ease the dismantling of products and to increase the ability to recycle. The company has 19 reutilization and materials recovery centers around the world.

The company has eliminated the use of ethylene glycolether in all processes to improve the working environment and eliminated cadmium, mercury and lead from packaging materials. Compliance was one of the reasons for toxics reduc-
tion. In 1996 there was a 14.4% reduction in released chemicals (14.8% outside the U.S.) compared to the year before, defined by the U.S. Sara section 313. The releases of the EPA 33/50 chemicals have been reduced by 90.7% in 1996 compared to 1988.

The purchasing is centrally organised, worldwide. The units make the specification for the materials required. Beyond the reduction of costs, the company has in this way more influence on the suppliers. There are only a few procedures in the purchase contracts to preclude toxics, one is to preclude parts processed with CFCs. The company states that the company routinely works with its vendors and suppliers on a wide range of environmental improvement opportunities.

**Company 8 (Polaroid, workforce 12000)**

The company manufactures primarily in instant imaging recording fields and has its headquarters in the U.S.A. The company is organised in business units. There are 24 operating units in the U.S.A., the Netherlands, Mexico and Scotland. The company is a major participant in manufacturing joint ventures in China and Russia. The information used is derived from written material and an interview with an employee of the corporate Health, Safety and Environmental affairs. Forty-five environmental professionals are working in the companies facilities worldwide. The corporate office of Health, Safety and Environmental (HSE) Affairs includes a small staff of experts which provides support to HSE personnel. The environmental policy is a corporate policy with some differences between the countries and the states related to differences in law. All directors with operative responsibility sit on the Environmental Operating Committee. The company follows the Ceres (Coalition for Environmentally Responsible Economics) principles.

The company has a policy to reduce the overall use of chemicals and chemical waste. The program TUWR (toxic use and waste reduction) reduces the toxic use and the sources of waste per unit production. The program was started as a result of current legislation and legislation expected in the future. The environmental, accounting and reporting system (EARS) measures the divisions performances. EARS monitors and reports rates of toxic use and waste for 5 categories of materials. The categories are classified by the companies toxicologist. The system categorizes approximately 2000 chemicals both regulated and not regulated by law.
The strategy for the most toxic chemicals and wastes (category 1 and 2) is reduction of the use; for category 3 and 4, chemicals waste source reduction and recycling on/off site with reuse; for category 5, waste source reduction, recycling on/off site with reuse, vendor recycling and (beneficial) incineration. The company wants to improve in all 5 categories. If a chemical in category 2 has been substituted for instance by a chemical in category 4, the recycling and reuse in the category 4 has to be improved otherwise this category will be scoring worse after the substitution. The TUWR chemicals include the 17 chemicals targeted by EPA 33/50 so that substitution of another chemical, including equally toxic or more toxic cannot be counted as a reduction. The company follows quantitively the chemicals used from purchase through finished product. Usage and byproducts are reported at all levels, from individual process and product through site, divisional and corporate totals. The company wants to change the toxics reduction program. The program with 5 categories is in practice difficult to execute and does not correspond to the American governmental releases reduction programs. The company starts with a program aimed at use reduction of the most toxic materials with 5 % per year, a releases reduction program and reduction of the off-site transfers. The 5 % reduction program of the most toxic chemicals is a worldwide program. The results of the program are published in order to compare the scoring of the production sites.

From 1988 until 1993 the overall toxic use and waste per unit of production was reduced by 23 %. The use and waste reduction of the most toxic chemicals was higher. In 1994 there was an increase in chemical use and waste per unit of production. In 1995 compared to 1994 the toxic use and waste was reduced by 6 %. Since 1987 the company has reduced the releases of chemicals covered by the Superfund Amendment and Reauthorization Act (SARA) by approximately 3,3 million pounds (TRI, Toxic Release Inventory). For the EPA 33/50 chemicals a 66 % reduction was reached in air emissions (1995). There was a 99,9 % reduction in emissions to sewer and a 33 % reduction in off-site disposal. The company has an on line MSDS (Material Safety Data Sheet) data base containing more than 2000 chemicals. The company has a central purchasing department which buys the chemicals for the U.S. operating units and organises the hazardous waste disposal. The company has no procedures for precluding the purchase of toxic materials apart from benzene and mercury. All new chemicals are reviewed by a
toxicologist. The company has some problems with obtaining the right information from its suppliers.

**Company 9 (Océ, workforce 17,000)**

The company is active in the graphic technology and has business units in more than 30 countries. The information used is derived from written material and an interview with the manager of the safety and environmental department at the headquarters in the Netherlands. The company has no integrated corporate health, safety and environmental department but at the headquarters is a department for product safety and environment, and a department for the workplace safety and environment. The company has a corporate policy for health, safety and the environment. When developing a new product early in the project the raw materials are checked against a black list. The black list comprises the materials to be excluded by law (asbestos, cadmium, PCB’s, ozone depleting materials etc.) as well as materials the company wants to be excluded (materials likely to be excluded by law in the near future). The possibilities for dealing with the products in the post consumer stage (reuse and recycling) are considered. The company’s strategy is to design the products in such a way that the materials and parts can be reused and recycled. Hazardous materials are avoided if possible (the energy use has to be as low as possible). The company has its own recycling facility. The materials used during the development of the product in the R&D department are checked too. For example carcinogens are allowed only in R&D under controlled conditions. Glycolethers once used in the production process have been substituted by alcohol and aceton. The reasons stated for toxics reduction are compliance, consumer safety and safety of the working environment. The company has no corporate data about toxics emission reduction or toxics use reduction. In the Netherlands the emissions of toxics to the air and water are reduced due to new processes and the use of end of pipe technology, the hazardous waste increased mainly due to (one fraction) waste returned by customers. The company’s strategy for the maximum concentration of the toxics in the working environment is 20% of the MAC (Maximum allowable concentration).

The business units in the different countries have their own central purchasing department. Only articles with an article number can be bought directly. For other articles a procedure has to be started. Suppliers have also to provide product-
information about the compounds they supply. The materials on the black list are to be excluded. Suppliers have to sign for the product information provided. The reason for the supplier strategy is the product and post consumer product responsibility of the producer. For new products this product strategy is standard.

**Company 10 (Bristol-Myers Squibb, workforce 51,000)**

The company is a health and personal care company and operates worldwide in 32 countries on six continents. The company is organised in 4 business areas and has about 75 locations. The information used is derived from written material and an interview with an employee of the corporate Environmental, Occupational Health and Safety (EHS) department.

The corporate EHS department develops the corporate policy. The Corporate Issues Committee makes the major corporate decisions, several members of the committee sit on the Board of Directors. Each division within the company is represented on the Corporate EHS Steering group, this group helps to make the EHS policy. The company employs worldwide 150 people who spend at least half of their time on EHS management.

The EHS policy was started as a result of legislation. Due to considerations of costs the company wants to go further than complying with legislation. One of the company’s long term goals is zero pollution. The company states generating less waste will reduce the costs, because wastes represent losses of raw materials. Another goal is to complete Product Life Cycle (PLC) reviews of the major product lines and incorporate PLC criteria into new product development processes. The product lines are evaluated a.o. for waste reduction, higher efficiency and alternatives for toxics. The pharmaceutical business group is the major user of chemicals in the company (90%). The long term goals of the pharmaceutical business group for toxics are a 90% reduction in global toxic solvent releases and the elimination of known human carcinogens in manufacturing when feasible. Another goal is monitoring the environmental releases and employee exposures. The pharmaceutical business group is reducing chemical releases by modifying the processes and elimination and substitution of chemicals in product lines. The business group states that government requirements for pharmaceutical manufacturing have the unintended consequence of limiting EHS improvement. The releases of 10 high priority chemicals have decreased by 48% since 1988.
Expected is a decrease of 94% in 2000. The releases in the USA defined under SARA Section 313 decreased 70% from 1988 to 1995. The reduction of the USA EPA 33/50 chemicals decreased 60% in 1995 compared to 1988. A new process was started for penicillin that eliminates the use of a toxic solvent. The company states the medical devices business group succeeded in minimizing the use of toxics. Most divisions of this group have eliminated methyl chloroform and ethylene-oxide in processes.

The companies U.S. hazardous waste (goal is to collect hazardous waste data worldwide) increased in 1996 compared to the prior year. This increase is attributed partly to the shutdown of some research facilities, distribution centers and rising production at one facility.

The company has a group for ‘shared services’, they deal with purchasing of raw materials and chemicals. Care is taken that EHS impacts are considered when purchasing raw materials and equipment. In order to do so suppliers have to give information about the compounds in the raw materials. The company wants to reduce the toxicity of the raw materials. The company states in that way the negative impact of consumer use of the product is decreased.
### Table 3

Summary of the results, about the toxics reduction in 10 major companies.

<table>
<thead>
<tr>
<th>Company</th>
<th>env. dep. integ. H&amp;S</th>
<th>reason for toxics reduction</th>
<th>method used for toxics</th>
<th>comprehensive toxics reduction rel.</th>
<th>toxics reduction rel.</th>
<th>toxics requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cytec</td>
<td>+</td>
<td>*compliance</td>
<td>supplier partnership</td>
<td>-</td>
<td>-</td>
<td>+/-</td>
</tr>
<tr>
<td>Merck &amp; Co</td>
<td>+</td>
<td>compliance</td>
<td>*process related</td>
<td>-</td>
<td>+</td>
<td>+ ? +/-.</td>
</tr>
<tr>
<td>Volvo</td>
<td>-</td>
<td>*compliance</td>
<td>*black - and grey lists</td>
<td>-</td>
<td>+</td>
<td>+ + + +</td>
</tr>
<tr>
<td>Body shop</td>
<td>+</td>
<td>minimize risks products</td>
<td>*risk assessment</td>
<td>-</td>
<td>+</td>
<td>+ - - -</td>
</tr>
<tr>
<td>ICI</td>
<td>+</td>
<td>compliance</td>
<td>*Environmental Burden</td>
<td>-</td>
<td>+</td>
<td>+ + + -</td>
</tr>
<tr>
<td>Dow</td>
<td>+</td>
<td>compliance</td>
<td>*lists for emission reduction</td>
<td>-</td>
<td>+</td>
<td>+ + + -</td>
</tr>
</tbody>
</table>

+ = yes  
- = not  
? = unknown  
EIA = Environmental Impact  
+/− = few or very few assessment
### Summary of the results, about the use of life cycle methods in 7 major companies

<table>
<thead>
<tr>
<th>Company</th>
<th>env. dep. integ. H&amp;S</th>
<th>reason for toxics reduction</th>
<th>method used for toxics</th>
<th>comprehe n sive</th>
<th>toxics reduction rel.</th>
<th>toxics reduction rel.</th>
<th>toxic s requi re ments</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM</td>
<td>more or less</td>
<td>*compliance</td>
<td>*process related</td>
<td>-</td>
<td>+</td>
<td>+/-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*working environment</td>
<td>*EIA products and processes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*strategy reduction of hazardous waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polaroid</td>
<td>+</td>
<td>compliance</td>
<td>TUWR program</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td>Oce</td>
<td>more or less</td>
<td>*compliance</td>
<td>*process related</td>
<td>-</td>
<td>+</td>
<td>+/-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*working environment</td>
<td>*black list</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*product safety</td>
<td>*new processes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*product requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bristol-Meyers Squibb</td>
<td>+</td>
<td>*compliance</td>
<td>*process related</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*costs</td>
<td>*PLC review</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>*elimination and substitution</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

+ = yes  
- = not  
? = unknown  
EIA = Environmental Impact assessment  
PLC = Product Life Cycle

#### Discussion

In this study we tried to answer ‘why and how’ companies are reducing the toxics. In order to do so we selected the companies with a.o. the criteria of a well developed environmental management system and described toxics reduction results.
These criteria will influence the results of the study, as probably the selected companies will be leaders. To analyse differences in toxics reduction between the several industrial branches the studied sample is too small.

Toxics have an influence on the open and the work environment. In dealing with reduction of toxics (use and release) one should be aware of the negative effects of the toxics involved on the work environment. Ashford (19) stated that, the problems of the general and workplace environment are intimately connected and must be attacked together. Integrating the environmental management and the health and safety management (20) not only may improve the effectiveness of the environmental management but also may prevent a shift of the impact of toxics on the open environment to a risk for the working environment (21). Most of the studied companies had their departments for environment and health and safety integrated. Unfortunately the governmental policies in most countries in these two fields are separated (4).

Most companies are far from using the whole potential for toxics reduction, which should consist of a comprehensive policy with clear targets (air, water, waste, working environment, products), a program for toxics use and release reduction and a monitoring system also on a corporate level. Only company 8 (Polaroid) met the requirements.

The studied companies showed a large difference in policies aimed at toxics reduction. This survey confirms the findings of Morrison (12), who showed that the top factor reflected in environmental policy of companies is legislation, and of Berkhout (22) who states that regulation is the main driver for corporate environmental initiatives. All the studied companies mentioned compliance as one of the reasons for toxics reduction, product (safety) was mentioned by 4 companies and the improvement of the working environment was mentioned twice. Contrary to the findings of Morrison none of the companies mentioned social responsibility as a reason for toxics reduction, although an image problem is said to be one of the main reasons why the chemical industry, well represented in this survey, developed the Responsible Care program (23). The survey of Morrison (12) showed also that toxics are a main concern of companies. This is in our survey reflected in the policies of 6 of the studied companies. These companies have substantial programs for toxics reduction. Most of the programs are directed to toxics release reduction, but the programs of Volvo, Polaroid and to a lesser
extent Océ also to toxics use reduction. Seven of the companies were active in pollution prevention.

As to toxics reduction measures, most companies mentioned more measures than process related measures. This is in accordance with the findings of Lund (3) and Morrison (12). The measures to reduce toxics release and use were very different in complexity, varying from a black list to the highly complex program of Polaroid. The latter is actually replaced by another program due to its complexity. Compliance with the American programs SARA and EPA 33/50 operational in 5 companies relates to reduction of toxic releases. The EPA 33/50 chemicals are not only selected for toxicity, so it is possible to substitute the 33/50 chemicals by more toxic chemicals (24). Two companies have methods to prevent the substitution of chemicals by more toxic chemicals. Polaroid prevents the substitution of less toxic by more toxic chemicals by adding the EPA 33/50 chemicals to their own toxics use reduction program comprising 2000 chemicals which are categorized in 5 toxicity categories. Substitution can also give a shift in the environmental impact from one impact category to another. The methodology developed by ICI can be helpful to limit this problem. ICI calculates the emission reductions in quantity of impact per impact category.

Two companies are using a data base containing Material Safety Data Sheets about chemicals for on line use. This may stimulate employee participation in source reduction. None of the companies mentioned employees participation. Maybe the questions in the interview were not suitable to elicit responses on this subject.

For a sustainable industrialization environmental management should be extended beyond the own production chain (25). At every stage of production and consumption there are impacts upon the environment. In our survey supplier requirements about toxics in products and materials used are limited (table 3). Hale (26) states many companies specify environmental requirements for their suppliers. In our survey 5 companies did have such environmental requirements or worked with the suppliers for environmental improvement. Only 3 companies specified requirements about toxics. Quality requirements developed by Cytec resulted in a substantial reduction of the hazardous waste generated by the company. Obviously companies can do more in this field (15), using requirements for excluding or limiting toxics in supplies or setting requirements for raw materials resulting in less hazardous waste. But still most companies in the survey have a
long way to go before exploiting the whole potential for toxics reduction. All in all the findings in this survey are in agreement with Rossi (8) who states that toxics use reduction is emerging from behind the shadow of pollution control.

References


