6C – Background Material

Textbook 6C:
Sustainable Chemicals Management

Chemicals can harm humans and the environment

Chemicals provide society with a wide range of benefits, particularly increased agricultural and industrial productivity. On the other hand chemicals have the potential to cause considerable health and environmental problems throughout their life cycle, from production through to disposal.

Air pollutants can cause respiratory diseases in humans and have an impact on the environment, e.g. in the form of acid rain or the greenhouse effect. Chemicals discharged into water bodies can poison the organisms living in these ecosystems or lead to extreme algae growth, which is the case with nitrate. High nitrate levels in drinking water can also pose a special risk to humans, since the nitrate can be transformed into carcinogenic compounds and lead to colon cancer. Chemicals that are found in the soil can affect humans and the environment as well. Heavy metals in farmland, for instance, not only affect the organisms in the soil, but also humans who consume the crops grown on that soil.

To protect human health and the environment chemicals therefore have to be managed safely to prevent harm to humans or the environment. This approach is called sustainable chemicals management (SCM).

Companies should be proactive in planning for chemical safety

It is important for companies to recognize the importance of chemicals management as an integral part of their business operation and commit themselves to sustainability. In this regard, they should be proactive in planning for chemical safety and set objectives rather than solely responding to perceived problems.

In the first instance companies should identify the risks deriving from the manufacture and use of chemicals as part of their operations. By conducting chemical risk assessments they should identify the need of risk reduction. The dialogue on the chemical risks identified and the risk reduction measures (RRM) envisaged should be promoted within the business as well as with external audiences concerned. Beyond the communication of chemical safety issues it is recommended to enter actual partnerships for improved chemical safety. Partnerships with public authorities and other enterprises can provide the information and training needed to implement sustainable chemicals management practices. Especially SMEs should seek the assistance of public authorities and professional organizations.

6.C.1 Chemical risk assessment

Risk assessment is essential to determine the RRM required

Chemical substances can have adverse effects on the health of humans and on the environment. Harm that can be caused to human health by chemicals includes, for example, skin irritations, respiratory problems or even cancer. In the environment, chemicals can harm animal populations and disturb the natural functions of ecosystems. To determine which safety measures are necessary to prevent these impacts, the risks arising from chemicals need to be assessed. When new information on a chemical becomes available, the risk assessment should be reviewed and, where necessary, revised to ensure the maximum safety possible at all times. Other criteria for revisiting a risk assessment are the occurrence of incidents or the introduction of significant changes in the chemical process, the installations or the transport practices. Chemical risks can be assessed by the procedure outlined below.

6.C.1.1 Collecting information

Every assessment starts with a thorough information search

Before starting to assess chemical risks, certain information on the chemicals used, the kind of processes they are used in and the persons exposed needs to be gathered. Particular attention should be paid to those for whom chemical hazards may pose especially severe risks, such as pregnant women, children and elderly people. It is necessary to determine which process equipment (including protective measures), materials and processes are used and which tasks are performed (in which way and for how long they are performed). In addition, information on accidents, occupational diseases and other occurrences of ill health that have been reported has to be collected. In the same way information has to be collected on the legal requirements related to the use of chemicals.

The following sources can be used to obtain the information required for a chemical risk assessment:

- Safety data sheets of chemical substances;
- Labels attached to the chemicals packaging;
- Technical manuals of the equipment;
- Legal regulations and technical standards;
- Scientific and technical literature;
- Records of work accidents and occupational diseases;
- Interviews with workers.

6.C.1.2 Risk assessment

Probability and severity of harm determine the risk

If the information collected indicates that the chemical substances used are hazardous (classified as very toxic, toxic, harmful, corrosive, irritant, sensitizing, carcinogenic, mutagenic, toxic to reproduction, explosive, oxidizing, extremely flammable, highly flammable or flammable) the risks need to be assessed. It should also be considered that hazardous substances may be formed during a certain manufacturing process. Nitrogen oxide, for instance, is likely to occur during welding. But even if a process does not involve the use or input of hazardous substances, it can entail chemical risks, which should be assessed.

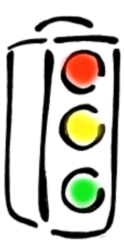
For each identified use or source of a hazardous substance, it has to be decided whether the risk is small, medium or high, taking into account the probability and severity of harm which can be caused by the hazard. The table below can be used to support the decision-making process.

Probability	Severity of consequences		
	Moderate harm	Medium harm	Extreme harm
Highly improbable	Small risk	Small risk	Medium risk
Probable	Small risk	Medium risk	High risk
Highly probable	Medium risk	High risk	High risk

Highly improbable harm should not occur during the entire occupational career of an employee. A source of harm can be considered probable if, it occurs only a few times during the occupational career of an employee. If, however, it materializes repeatedly during the occupational career of an employee, it should be regarded as highly probable.

The probability of harm can also be estimated by evaluating the physicochemical properties of a substance. The probability that a chemical may cause harm to human health, for instance, depends on how easily the substance is absorbed by the human body. In order for a substance to be absorbed, it must cross biological membranes. Most substances cross by passive diffusion. This process requires a substance to be soluble both in lipids and water. A useful parameter for the potential of a substance to diffuse across biological membranes is the octanol/water partition coefficient (Log P) value. Log P values above 0 indicate that the substance is more soluble in lipids than in water whereas negative values indicate that the substance is better soluble in water than in lipids. In general, Log P values between 0 and 4 are most favourable for absorption. The probability of a chemical causing harm to human health is therefore higher when the Log P value is within this range. Similarly the probability of inhalation and consequent respiratory harm can be estimated based on the particle size of a substance. Generally particles with diameters below 100 µm have the potential to be inhaled. Therefore any powder that contains particles with diameters below 100 µm entails a higher probability of harm.

Harm which does not cause prolonged distress, such as eye irritations or headaches, is considered to be moderate. Medium harm, by contrast, is characterized by non-acute, but prolonged or periodically recurring distress, such as second-degree burns on a limited body surface or a dermal allergy. If the use of a chemical potentially leads to accidents and illnesses such as cancer, causing grave and permanent distress and/or death, it is regarded as extremely harmful. Extreme harm also derives from persistent and bio-accumulative chemicals, since they cause long-term environmental damage.



Once the risk arising from a chemical hazard has been evaluated it has to be decided whether it is acceptable or unacceptable. In general, high risks are unacceptable, whereas small and medium risks are usually acceptable. However, risk assessments should always be carried out with the involvement of workers and other persons affected. When deciding on the acceptability of a chemical risk, gender, age and state of health of the persons affected has to be taken into account. Furthermore, legal requirements also have to be considered: If they are not complied with, the risk is not acceptable!

To document a chemical risk assessment Worksheet 6-5 "Risk assessment sheet" provided in the Worksheet section of the Toolkit can be used. In any case, basic information, such as company name, address, name(s) of the person(s) conducting the assessment and the date of the assessment should be recorded. For each chemical hazard identified, the results of the risk assessment have to be documented, including the preventive/protective measures to be implemented in order to reduce the risk.

6.C.2 Risk reduction measures

Hierarchy of RRM: elimination – substitution – control

If the risk arising from a chemical hazard is high and has been assessed as unacceptable, actions to reduce the level of chemical exposure need to be taken. But even if the risk is small and has been assessed as acceptable, it has to be ensured that the necessary risk reduction measures are in place to maintain exposure at the same level. The measures to prevent or reduce exposure to dangerous substances should be applied in the following order: **elimination – substitution – control**.

The best way to reduce the risks connected with dangerous chemicals is to eliminate these substances by changing the process or product in which the substance is used. If elimination is not possible, the substitution of the hazardous substance by a less dangerous one is the next best option. If a substance or process can neither be removed nor replaced, exposure should be prevented or reduced by one of the following measures:

- Enclosure of the emitting process;
- Control of the emission by better management of the processes;
- Technical solutions to minimize the concentration in the exposure zone;
- Organizational measures such as minimizing the number of exposed persons and the duration and intensity of exposure.
- The use of personal protective equipment should always be the last resort for risk reduction. However, none of these risk reduction measures should be regarded as a single, stand-alone tool, but should be implemented in combinations, for instance by combining technical measures with organizational changes.

6.C.2.1 Substitution of chemicals of concern

The use of dangerous substances involves hazards to human health and the environment. Therefore the use of these substances should be avoided where possible and chemicals of concern ought to be substituted by safer substances. Exchanging dangerous substances for safer ones benefits everyone involved in the process, since it can lead to:

- Reduced sickness absence, due to improved health of the workers;
- Reduced pollution of the environment;
- Reduced costs for control and protection measures.

First the chemicals of concern have to be identified. There are several reasons why a chemical can be of concern and should therefore be replaced. In general, substitution should be considered for substances that:

- Increase fire and explosion risks;
- Lead to high exposure of workers;
- Result in exposure of many workers;
- Are volatile, e.g. organic solvents;
- Are dispersed in the air (aerosols, dust);
- Present acute health risks, e.g. poisons, corrosives and irritants;
- Present chronic health risks, such as allergens;
- Have already caused problems in the company (health problems, accidents or other incidents);
- Cause occupational diseases;
- Can be absorbed through the skin;
- Require the use of personal protective equipment impairing workers (e.g. inhalation protection).

Especially chemicals of very high concern, such as carcinogenic, mutagenic and reprotoxic substances should be replaced. These substances are often covered by specific national regulations stipulating substitution insofar as technically possible. To determine whether a chemical is of concern the classification and labelling information of the safety data sheets supplied with the chemical should be checked. For substances where safety data sheets are not provided, information is usually available from other supplier sources, such as technical documents or instructions for use.

A substitution should be well reasoned

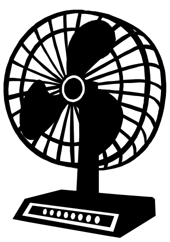
Changing from one substance to another is a three-stage process. First the available replacement substances have to be identified. If the substance to be replaced is used in a widely applied process, such as spray-painting or degreasing, the number of options available is likely to be higher. In a second step the alternatives identified have to be compared. A way of comparing different paints, adhesives and other chemical products intended to be applied on surfaces is the Danish Code Number Wizard MAL-KODE (for further information, please see Link section). This online tool calculates a code number representing the hazardousness of a product based on its chemical composition. By comparing these code numbers the least harmful product can be identified. When comparing different alternatives for substitution the relevant national legislation on occupational safety and health, as well as environmental and product safety legislation should also be checked to ensure that the options are legal. Finally a decision should be taken based on the regulatory requirements, technological possibilities, potential implications for the quality of the products, costs including the necessary investment and training for use of the new product.

6.C.2.2 Other substance-related measures

The risk of chemicals can also be reduced by limiting the concentration of a substance in a preparation or product. For example, if the concentration of a corrosive substance (marked with R34) in a preparation is reduced below 5%, there are usually neither corrosive nor irritant effects (unless the substance-specific individual limit is lower). In this case, no further risk reduction measures need to be taken to provide protection against irritant or corrosive effects.

The risk arising from a hazardous chemical can also be reduced by modifying its physical state. It is, for instance, much safer to handle solutions than powders. Chemicals in pellet or tablet form, or included in matrices are also safer to use. As important as the physical state of a chemical is its packaging. Chemicals should be stored and transported in closed and sufficiently resistant containers to prevent breaking or leakage. The volume of these containers should be limited to the amount of the chemical needed for the corresponding operation.

6.C.2.3 Technical measures



The most widespread technical risk reduction measure is ventilation. There are several types of ventilation systems such as natural ventilation, general mechanical ventilation and local exhaust ventilation. Natural ventilation, such as simply opening doors and windows, should never be relied on to control exposure to chemicals. General mechanical ventilation is suitable for only the most innocuous substances. This type of ventilation involves a fan extracting air from the building and an inlet sucking clean air back in. It merely dilutes the amount of chemicals in the air. To be effective, general ventilation needs to be carefully designed, otherwise there may be areas left where no air circulates (dead zones). By contrast, local exhaust ventilation (LEV) attempts to extract hazardous chemicals at the point where they are released, before they get into the atmosphere. There are many different types of LEV, including fume cupboards, booths and hoods. The exhaust air from any of these LEV systems needs to be properly treated to remove the chemicals, especially if the same air is recycled into the surroundings. Air treatment methods must be carefully chosen, depending on the type of chemicals involved. Ventilation systems must also be regularly checked and maintained.

Besides ventilation other technical risk management measures exist. Production and use processes can, for instance, be redesigned in a way that hazardous chemicals are contained in closed systems to avoid their release into the (workplace) environment. Separation techniques, such as filtration, sedimentation, oil-water separation or stripping, can be used to prevent releases into the environment. Apart from these physical techniques chemical treatment methods can also be applied, such as precipitation, oxidation or absorption. If waste water is treated on-site and the necessary facilities are available, biological treatment can also be an option for chemical risk reduction.

6.C.2.4 Communication in the chemical supply chain

An effective means of risk reduction is the communication of chemical safety information. The basic principle is that every person dealing with chemicals or products containing chemicals should have enough information to ensure their safe use and avoid negative effects on human health and the environment.

This information should be adapted to the needs of the specific group addressed, i.e. a factory worker will have to be informed in a different way than a consumer. Essentially, the safety depends on the quality and the comprehensibility of the information transmitted. Therefore the information has to be disseminated in a language appropriate to the target group. The degree of detail which the information should contain will also depend on the target group and the situation the chemical is applied in. These factors define also the kind of information to be communicated. Basically, the information can comprise:

- Information on the hazardous properties of a chemical;
- Information on the contents of hazardous chemicals in a product;
- Appropriate precautions and protective measures;
- Legislation regulating the use of the chemical;
- Relevant exposure limit values.

In general, information on chemicals relating to the health and safety of humans and the environment should not be regarded as confidential. However, if a supplier considers data demanded for safety reasons to be confidential, the use of ranges instead of exact data can be an alternative. This can help to protect trade secrets and reduce Confidential Business Information (CBI) claims.

Honesty is vital for obtaining credibility

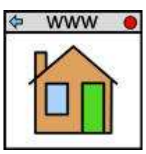
When communicating chemical risk and safety information, honesty is a vital condition for obtaining credibility. Honesty will not automatically be rewarded, but dishonesty will certainly create negative repercussions among the audience. The same effect will occur if relevant information is withheld or only one side of the story is told. If profits or other vested interests are obvious motives, it is better to address these issues and make it clear that such interests do not automatically preclude public interest or public welfare. An important argument in favour of reduction measures is that companies with an appropriate risk reduction and control programme are more likely to attract better qualified personnel, thus enhancing their corporate reputation and avoiding costly litigation.

If a company has nothing to hide, it should demonstrate this fact by being open to public scrutiny. Many chemical companies, for example, send their laboratory data or toxicological results directly to public interest groups and ask for their feedback. Even if one or the other group may misuse this open book policy, the net effect outweighs by far the potential damage. Some companies even publish their results in high-circulation journals, thus enhancing their credibility and demonstrating that they have nothing to hide.

Another way of demonstrating a company's commitment to product safety is to make the safety information on the label highly visible. Labels cautioning against a risk which are prominently displayed on the package do not deter loyal customers, but provide the information they need to protect themselves and shows that the company is committed to making the product as safe as possible.

Besides the product label, the main carrier of chemical safety information is the safety data sheet. Chemical suppliers are required to provide professional users with safety data sheets which include information on the properties of the substance, the dangers to health and the environment, hazards based on physicochemical properties as well as storage, handling, transport and disposal. Furthermore information on the protection of workers, appropriate fire fighting, measures to be taken following an accidental release and first aid measures are provided. For some products, such as pharmaceuticals (e.g. cytostatic drugs) or cosmetics (e.g. hairdressing products), safety data sheets normally do not have to be included.

To communicate potential health risks to large audiences, brochures and written leaflets can be used. The material should be designed in such a way as to correspond to the audience's needs, concerns and level of knowledge. Besides this adaptation to the users' needs it is also important to take the social and political context into account.



In addition to conventional written information, internet websites can also be used to communicate with the users of chemicals. In this case, however, it has to be considered that internet users expect routinely updated information, interesting graphical design and not too much accompanying text. Longer texts for downloading can be added, but these text elements should be clearly separated from the message section. The persons visiting the site should be able to voice their opinions, therefore at least an e-mail address should be included. Such feedback can provide important insights and contribute to establishing a productive dialogue with the audience of risk communication.

Personal contact and appearance is certainly more convincing than anonymously written information. Communicating chemical risk issues in lectures allows the audience to associate a human face with the message. Such lectures should explain the process of risk analysis and its role for balancing different risk management options. Besides the decision-making process, the past record of the company should also be included in the message. Thus people assign competence to the actors and get a better feeling for the trade-offs that are proposed or accepted by the communicator to meet the specific objective.

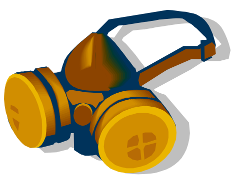
6.C.2.5 Other organizational measures

The communication of chemical risk and safety information is one type of organizational risk reduction measure. Other organizational measures are for example:

- Restriction of access to certain areas (e.g. only for specialists or authorized persons);
- Limiting the time of operating activities;
- Prohibition of eating/drinking/smoking.

These rules of conduct as well as the hazards they intend to prevent should be communicated to the persons affected at regular intervals, e.g. by means of safety briefings.

6.C.2.6 Personal protection measures



Personal protection measures should neither be the unique nor the first choice in risk management. Depending on the hazards arising from a chemical and the processing method, different personal protection equipment can be used, for example:

- Gas/dust filter masks;
- Independent air equipment;
- Protective glasses;
- Goggles/gloves;
- Protective clothing.

As a basic principle, respiratory equipment or full protection suits should never be used as permanent risk reduction measures, but only to prevent peak exposure levels.

6.C.2.7 Measures to reduce the risk of explosion and fire

Explosions occur when a sudden oxidation or decomposition reaction takes place, producing a temperature or pressure rise, or both simultaneously. Due to their virtually instantaneous nature, explosions usually have very severe effects on both persons and material assets. Therefore a series of measures to reduce the specific risks of explosions and fire are described below.

To prevent the outbreak of fires and explosions it is important to avoid ignition sources, including:

- Smoking;
- Operations involving a flame or sparks;
- Footwear with metal parts;
- Heat generated in exothermic reactions;
- Co-existence of chemically unstable or reactive products.

Machinery intended for use in potentially flammable or explosive atmospheres should be powered by safe energy (totally pneumatic or hydraulic control systems and components). If electrical equipment is used, it should be explosion-proof. Furthermore loading, unloading or transfer operations have to be carried out avoiding the generation of electrostatic charges and facilitating their elimination through the equipotential earth connection of all equipment and containers.

It is equally important to control the existence of flammable atmospheres (which may give rise to devastating explosions) by using instruments for their detection, such as explosion meters. The risk of fire and explosion in containers and equipment is controlled by reducing the concentration of the flammable component below the Lower Flammable Limit. This can be achieved, for instance, by using local extraction systems and adequate general ventilation of the work area. Wherever splashes or spillages of flammable chemicals may occur, the collection and drainage of these substances to a safe place under adequate ventilation conditions should be ensured. Equipment which has contained flammable material should always be cleaned prior to maintenance or hot repair operations.

6.C.3 Exposure monitoring

Inform yourself about current exposure limits

At many workplaces employees are exposed to hazardous substances. Exposure through skin contact and ingestion can be avoided without having to apply special protective measures. Conversely, inhalative exposure is more difficult to control and can easily lead to high intake rates with possible adverse effects. Therefore occupational safety authorities have established exposure limits to protect employees from overexposure to hazardous substances in the air. Basically the two following types of exposure limits are distinguished. Permissible Exposure Limits (PEL) are limits, which may be exceeded occasionally as long as the average exposure level of the whole workday (usually eight hours) remains lower. Short Term Exposure Limits (STEL), on the other hand, should not be exceeded at any time during a workday. If a compound with an exposure limit is used, areas with potential for exposure should be monitored. In case the exposure measured is higher than the prescribed limits, control measures and personal protective equipment must be evaluated to reduce the exposure to a level below the prescribed limits.

The monitoring process usually includes a sampling step and an analytical step. In this case an air sample from the workplace environment is collected in an adsorption tube. Inside the tube the contaminant is adsorbed onto a sorbent material, which is then analysed by an accredited laboratory to determine the amount of air contaminant present. However, sampling and analysis may also be performed by instruments such as real-time continuous monitoring systems or portable direct reading instruments which carry out the analysis internally. Another option are detector tubes, which are sealed glass tubes containing materials designed specifically for identifying and quantifying groups of chemicals. A colour change is often used to indicate the presence of air contaminants and the concentration detected. The manufacturer's instructions provide the user with information on how to collect a sample and interpret the tube's colour. These tubes are normally used for rapid detection and measurement of contaminants in the air. Because they contain reactive chemicals, they are sensitive to conditions that affect a chemical reaction such as temperature, humidity, the presence of other vapours and gases and the location of sampling. Therefore, results should be considered as a range rather than a single value. Irrespective of the chosen method, air samples must always be taken in the employee's breathing zone. This zone can generally be described as the ambient air within 30 cm of the worker's mouth.

Sampling systems can be further differentiated into active and passive sampling systems. Active sampling methods use small mechanical pumps to collect air samples, whereas passive sampling devices depend on air currents and diffusion to move contaminants into a tube. Passive sampling devices are generally easy to use and relatively inexpensive.

A monitoring programme may include both short and long term monitoring. Long term monitoring is carried out to determine the average employee exposure during a full shift (typically 8 hours), whereas short term monitoring is usually based on a sample collected over a 15 minute timeframe. In general, the samples collected should be representative of the actual exposure conditions in the monitoring area. How well a sample represents the conditions of a monitoring area depends on several factors. The most important factors are the employees' activity and plant operating conditions. Therefore, a chronological log of work-related events for each monitored employee is helpful when evaluating the results.

6.C.4 Non-regulatory industry initiatives on SCM

Regulatory measures can be avoided

Sustainable chemicals management can be based not only on official regulations, but also on non-regulatory initiatives, which have been voluntarily introduced by industry. Companies can join such voluntary initiatives for several reasons:

- The public perceives chemicals management as an important issue;
- A competitor who has participated in a non-regulatory initiative has gained a positive image;
- The proactive approach addressing environmental issues before the solution of problems is imposed externally;
- Problems can be resolved more rapidly than through regulatory approaches;
- Lower costs to achieve benefits for both the government and industry;
- Desire to be, and be seen as, responsible;
- A voluntary initiative is likely to address a problem with more flexibility, creativity and expertise than a regulatory approach;
- Industry is clearly interested in achieving cost-effective ways to implement SCM, while reducing the need for regulatory control and gaining the benefits of positive public recognition and credibility. Non-

regulatory programmes can help to implement SCM practices cost-effectively and often improve a company's market share. In addition, non-regulatory programmes can encourage technological innovations more effectively. Benefits are also derived from the faster response time of industry compared to regulatory bodies. In particular, small and medium-sized enterprises are likely to benefit from the potential transfer of technology and the sharing of information provided by a non-regulatory programme.

6.C.4.1 Responsible Care®

Managing risk has traditionally been addressed by individual companies working alone or together with their customers and suppliers to comply with regulatory requirements. The Responsible Care® initiative transforms the traditional form of risk management from an individual company activity to the responsibility of a group of like-minded companies representing significant segments of chemical production. This initiative has been adopted by chemicals associations in 52 countries to improve the health, safety and environmental performance of their companies' operations and products in a manner which is responsive to the concerns of the public. At the international level, the initiative is headed by the International Council of Chemical Associations (ICCA) through the Responsible Care® Leadership Group.

The participating companies commit themselves to adhere to the Responsible Care® Guiding Principles which state that a company will manage its activities to ensure that they represent an acceptable level of protection for the health and safety of employees, customers, the public and the environment. For companies the implementation of the initiative results in improved efficiency, lower costs for environmental, health and safety measures and improved relations with stakeholders. For the public, the successful implementation of the initiative ensures that the chemical industry will continually reduce its negative impacts on human health and the environment. To measure the performance and improvements achieved special indicators have been developed.

6.C.5 Chemical Leasing as a means of SCM

Traditionally, chemicals are sold to customers, who become owners of the substance and therefore responsible for its use and disposal. Their suppliers have a clear economic interest in increasing the amount of chemicals sold, which is usually related to negative releases to the environment.

The CL business model leads to a win-win situation

Compared to this approach, the concept of Chemical Leasing (CL) is much more service-oriented. In this business model the customer pays for the benefits obtained from the chemical, not for the substance itself. Such services can be, for instance, cooling and heating operations or the cleaning, greasing or degreasing of parts. Here the supplier remains the owner of the chemical and takes responsibility for its use and disposal. Consequently its economic success is not linked with product turnover anymore. The chemical consumption becomes a cost rather than a revenue factor for the chemicals supplier. It will try to optimize the use of the chemical and improve the conditions for recycling in order to reduce the amount consumed, which again reduces the environmental pollution. By reducing the ineffective use and over-consumption of chemicals, CL helps companies to enhance both their economic performance and their environmental record.

To achieve these targets the supplier of the chemical and its customer might have to collaborate with partners. Efficiency in the use of the chemical can best be increased if the producer of the chemical and the manufacturer of the equipment the chemical is used in combine their knowledge. Disposal companies, on the other hand, can provide important know-how on recycling opportunities for chemicals. For the successful implementation of this model additional partners such as NCPCs or consultancies can act as mediators between the different parties. Their involvement can make a considerable contribution towards adequate benefit sharing and proper monitoring of the CL project. The size of the different companies participating is secondary, since CL is applicable to large companies as well as to small and medium-sized enterprises.

UNIDO has defined the term of Chemical Leasing as follows:

"Chemical Leasing is a service-oriented business model that shifts the focus from increasing sales volumes of chemicals towards a value-added approach.

The producer mainly sells the functions performed by the chemical and functional units are the main basis for payment.

Within Chemical Leasing business models the responsibility of the producer and service provider is extended and may include the management of the entire life cycle.

Chemical Leasing is a win-win situation. It aims at increasing the efficient use of chemicals while reducing the risks of chemicals and protecting human health. It improves the economic and environmental performance of participating companies and enhances their access to new markets.

Key elements of successful Chemical Leasing business models are proper benefit sharing, high quality standards and mutual trust between participating companies."

The definition of the unit for payment is central for the implementation of a CL business model. The payment basis has to be directly related to the functions performed by a chemical, for instance, metal pieces degreased or cubic metres of water cleaned. A detailed cost benefit analysis (CBA) should be carried out to evaluate the expected environmental and economic savings of the CL business model. The CL contract formalizes the cooperation between the different partners. It is important to clearly state and define in the contract all the related financial, legal, technical, management, implementation and monitoring issues for the operation of the business model. Additionally, the responsibilities and tasks of each partner should be precisely identified. The contract should also consider the performance in terms of quality and environment.

6.C.6 International programmes

Sustainable chemicals management is on the agenda of several national and international organizations. The governmental initiatives promoting SCM range from regulatory measures to voluntary partnership programmes. Awareness of these programmes is important for companies in order to know the legal framework which applies to their activities and the funding opportunities they can benefit from.

6.C.6.1 REACH

REACH is an acronym for the new European chemicals legislation standing for "Registration, Evaluation and Authorization of Chemicals". This legislation is based on the principle that industry has to ensure the safety of chemicals before launching them on the market. As REACH is a regulation, it is (unlike European directives) directly applied in all EU member states, without having to be transposed into national legislation. Although they are not members of the EU, the EEA/EFTA-States (Iceland, Liechtenstein and Norway) have ratified REACH, which is thus also being applied in these countries. The implementation of REACH is supervised by the European Chemicals Agency in Helsinki (Finland).

European companies importing products from outside Europe face new obligations under REACH. In order to continue their import, the companies have to register the substances contained in those products. Registering a substance involves submitting a defined dataset to the European Chemicals Agency. The information to be submitted includes data on the physico-chemical properties of the substance, its toxicity and ecotoxicity.

However, not all substances in the products imported have to be registered. Substances imported in amounts less than 1 ton per year do not have to be registered. Other criteria based on which importers can be exempted from the duty to register depend on the type of product, the nature of the substance and its function in the product.

To fulfil their registration duties, importers first of all have to know which substances in the products they import are subject to the regulation. Once the product composition and the substances to be registered have been determined, the importers need information on their properties. In most cases European importers do not have all this information. Hence, they have to approach their suppliers outside Europe to enquire about the composition of the products they purchase and the properties of the substances in these products.

REACH indirectly affects non-EU companies

In consequence, even though REACH is a European piece of legislation, non-European companies might find themselves affected by REACH, due to their trading relations with Europe. Their European customers depend on the support and information they receive from their suppliers. Without this cooperation the European importers cannot fulfil their registration duties, and failure to register would mean that they would not be allowed to import the products concerned anymore.

A company outside Europe which receives a request for assistance in registration by a European customer has two options:

a) It provides its customer with the information on product composition and substance properties he requires. In this way the European customer can fulfil his registration duties.

- It appoints an "only representative" according to article 8 of the REACH-Regulation. This only representative then takes over the registration duties for the European customer, who is consequently relieved of his obligation to register.

An only representative has to be a natural or legal person established in the EU and must have sufficient background knowledge on the substance(s) he is supposed to register. An only representative can carry out the registration of one or more substances contained in the products the non-European company exports to Europe. The European customers purchasing these products do not have to register these substances themselves. Hence, they have to be informed by their non-European supplier about the appointment of an only representative.

The only representative is legally responsible for the registration of the substance. Nevertheless, in most cases, the exporter he represents provides him with all necessary data for registration. Besides carrying out the registration of substances, an only representative has further obligations. He has, for example, to provide and update information on the substance amounts exported to Europe as well as to keep a list of European customers of the exporter he represents. In addition he has to supply the necessary safety data sheets (SDS) to the European customers.

In conclusion, non-European companies have no immediate duties under REACH. The duties are placed on the European importer. However, the European importer may decide to continue trade relations with the non-European exporter only if the latter provides appropriate support. Otherwise he might switch to a European supplier of the same product. Hence, any company exporting to Europe should contact its European customers to clarify the need of cooperation regarding REACH. If necessary, the non-European exporter should support its European customer. The non-European company, however, is free to choose whether to appoint an only representative or to leave the registration duties to its European customers. By appointing an only representative, the exporting company gets more control over the registration process and avoids having to disclose potentially sensitive information to its European customers.

6.C.6.2 SAICM

SAICM is the international agenda for chemicals management

At the 2002 Johannesburg World Summit on Sustainable Development, the international community agreed on the goal of ensuring that, by the year 2020, chemicals are produced and used in ways that minimize significant adverse impacts on human health and the environment.

As a consequence, in 2003 the United Nations Environmental Programme (UNEP) decided to instigate the development of a Strategic Approach to International Chemicals Management (SAICM). For this purpose a multistakeholder and multi-sectoral preparatory committee was formed to analyse chemicals management practices around the world, identify deficits and determine the prerequisites for international action on chemical hazards. In 2006, at the International Conference on Chemicals Management (ICCM) in Dubai, the participating countries finally resolved upon SAICM by signing the **Dubai Declaration** on International Chemicals Management. The signing countries thereby committed themselves to promote the sound management of chemicals and hazardous waste at all levels. In addition to the Dubai Declaration, SAICM comprises two other core texts adopted by the ICCM. The **Overarching Policy Strategy** sets out the scope of SAICM, the needs it addresses, the objectives regarding risk reduction, knowledge and information, governance, capacity-building and technical cooperation and illegal international traffic, as well as the underlying principles and financial and institutional arrangements. The means to achieve these objectives recommended by the ICCM are described in the **Global Plan of Action**.

6.C.6.3 Green Chemistry Program

In 1991, the US Environmental Protection Agency (USEPA) launched the Green Chemistry Program. The aim of this programme is to promote the research, development and implementation of innovative chemical technologies that accomplish pollution prevention in a scientifically sound and cost-effective manner. These technologies are termed green chemistry technologies.

To accomplish its goals, the Green Chemistry Program supports fundamental research in the area of environmentally benign chemistry as well as a variety of educational activities, international initiatives, conferences and meetings, and green chemistry tools. The programme is composed of four major areas, including green chemistry research, the Presidential Green Chemistry Challenge, green chemistry education and scientific outreach.

The Green Chemistry Program funds basic research in green chemistry and awards grants to green chemistry research projects. These activities are covered by the programme area **Green Chemistry Research**.

The **Presidential Green Chemistry Challenge** recognizes outstanding accomplishments in green chemistry through an annual awards programme. The green chemical technologies recognized and supported by the Presidential Green Chemistry Challenge are scientifically sound, economically viable and directly reduce risks to human health and the environment by diminishing the hazards associated with the design, manufacture and use of chemicals.

For green chemistry to become widely adopted and practiced, chemists must be formally educated about green chemistry during both their academic and professional training. To accomplish this, the programme area **Green Chemistry Education** supports a variety of educational efforts that include the development of materials and courses to assist in the training of professional chemists in industry and education of students in academia.

The programme area **Scientific Outreach** supports a number of projects aiming at communicating the concept of green chemistry and results of green chemistry science. This includes organizing and participating in prominent meetings and conferences, publishing in scientific journals and books, and developing and disseminating computational tools and databases.