



Practical Chemical Management Toolkit for your Company

Module 3 – Hazardous Waste Management

General information on the GIZ Convention Project Chemical Safety

Chemistry plays an important role in modern society and therefore in development and development co-operation. There are both dangers and benefits in dealing with chemicals. The GIZ Convention Project Chemical Safety was launched on behalf of the **German Ministry for Economic Cooperation and Development (BMZ)** in 1997.

The main aims are to assist developing countries and companies in developing countries with the treatment and final disposal of hazardous chemicals (primarily persistent organic pollutants), especially in the form of pesticides, and to assist with the implementation of the concepts of chemical safety and chemical management as well as to improve work safety, competitiveness and cleaner production processes in small and medium size enterprises (SMEs).

Activities today focus on strengthening local capacities and public and private sector levels for hazardous waste disposal (consulting, execution and capacity building), sound chemicals management (e.g. development and implementation of training) as well as supporting the German Federal Ministry for Economic Cooperation and Development (BMZ) in developing concepts for international development cooperation in the context of cleaner production, resource efficiency

and international conventions and agreements (Stockholm, Rotterdam, Basel, SAICM etc.).

Practical Chemical Management Toolkit for your Company

**Module 1 – Inventory and Risk Assessment
under the Umbrella of Resource Efficiency
and Cleaner Production**

**Module 2 – Managing the chemical risks in
your company – control measures and gap
analysis**

Module 3 – Hazardous Waste Management

This toolkit has been developed for companies particularly in developing countries to translate the requirements under the various international chemical conventions and agreements into practical steps. It provides managers, supervisors as well as workers involved in the various aspects of managing chemicals with a ready reference to address the challenges of handling chemicals substances in a sound and responsible manner. It refers to a number of practical measures that they can undertake on their own to implement a practical and successful chemical management in their operations.

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For further **information** and **additional materials** (such as **Annexes**, **Trainer Manuals** and **Powerpoint Presentations** for teaching, as well as **calculations** and **figures**) or if you have any further queries, please refer to the GIZ Convention Project on Chemical Safety website



www.gtz.de/chemical-safety

and do not hesitate to contact us directly. We can offer our experience and advice as well as trainers and the opportunity for co-operation.

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1. Introduction to module 3 Hazardous waste and SMEs

The majority of small and medium sized enterprises (SMEs) generate hazardous wastes as part of their operating procedure and this may pose a threat to human health and to the environment. In India, for example, estimates indicate that nearly 50% of the hazardous waste has its origin in SMEs. Furthermore, SMEs dealing with hazardous materials may not have full knowledge of the best management practices for such materials. Some SMEs may not even be fully aware of the quantities and types of hazardous materials / wastes on their premises. On the other hand, SMEs are required to comply with regulations to implement the safe management and control of hazardous materials. This is often a difficult task for SMEs as many of them lack the necessary knowledge and/or resources.

Many emerging countries lack adequate infrastructure for hazardous waste management facilities and hazardous waste legislative frameworks are not in place, not well known and not implemented by SMEs.

This module intends to be a helpful tool for enterprises, especially SMEs, to be able to identify, quantify and manage hazardous materials and hazardous waste in an environmentally sound manner.

Also in this module we used the **NPO-concept (Non-Product Outputs)** as the starting point for implementing waste management. NPOs are wastes and our aim is to reduce these NPOs to a minimum.-The NPO concept is complemented in this module with simple ‘Good Housekeeping’ habits to further achieve NPO reductions. Figure 1 below gives an overview over the activities dealing with waste management during the implementation of our three modules and the NPOs mitigation aspects treated in each module. The key activity in this module will be the separation of hazardous from non hazardous wastes (see figure 8).

Module	Activity	Aim
1	Chemical inventory and risk assessment Identification of hot spots and sources of NPOs	NPOs identified and quantified
2	Implementation of measures to eliminate hot spots and reduce NPOs	Introducción of Good Housekeeping practices NPO costs made visible
	Substitution of hazardous chemicals	Reduces risks and NPO costs
	Purchase and storage procedures and practices	Engineering and administrative controls Maintenance
3	Waste inventory, classification, separation, segregation and collection	Separation of NPOs in hazardous and non hazardous, safety storage of wastes, 3R, pre-treatment, transport and final NPO disposal

Figure 1 – GIZ modules on practical chemical management are based on NPOs as a starting point for improvement

The starting point will always be the NPO(s)

„Good housekeeping¹ refers to a number of practical measures based on common sense that organizations can undertake to improve their productivity, obtain cost savings and reduce the environmental impact of their operations. Good housekeeping is more of a habit than a technique and is aimed at:

- Rationalizing the use of raw materials, water and energy inputs
- Reducing the volume and/or toxicity of waste, wastewater and emissions related to production
- Conserving material and energy
- Improving working conditions and occupational safety.

The implementation of these good housekeeping practices is relatively easy and the cost is usually low. Thus, they can be readily implemented by SMEs. ‘Good Housekeeping’ practices can provide a real economic asset and advantage for a company in terms of minimizing waste, as well as the use of raw materials and energy. Minimizing waste can enable enterprises to reduce the loss of valuable material inputs and therefore reduce operational costs.”

This module will support to manage (reduce/reuse/recycle) the wastes your enterprise generate. Also at the end you will be able to conduct an internal waste audit.

2. Rounding off the chemical management in your company

During implementation of GIZ modules 1 and 2 on practical chemical management, you have prepared a floor map in which you might have indicated the locations and movements of chemicals in your company. As you have noticed from your flow diagram as well as on-site assessment of production processes, in chemical handling practices not all inputs end up in the final product, some portion of these inputs become **non-product outputs**. With the help of the different improvement measures you may have been able to gradually reduce the amount of these NPOs. However, despite all efforts you will still end up with a certain amount of NPOs. In Module 3 you will continue with the further separation, quantification, classification and reduction of the remaining NPOs. If you can make the NPO costs visible to the management, this will accelerate their mitigation. This will be reflected in becoming more competitive.

These non-product outputs, mostly in the form of liquid and solid wastes, will require careful management as well, in order to eliminate or reduce the risks of adverse effects on health, safety and the environment.

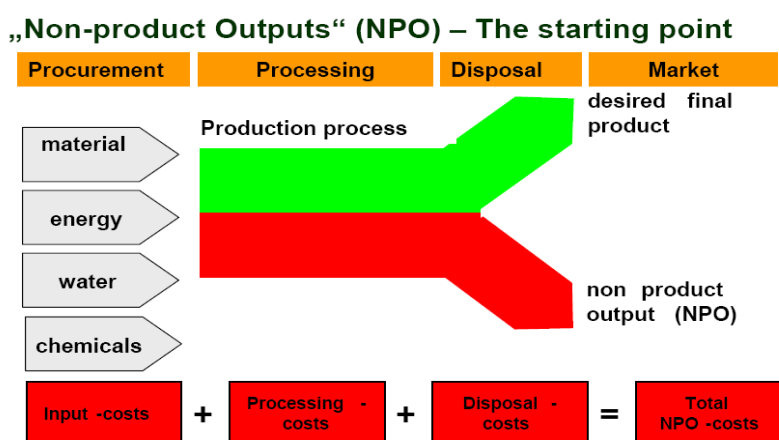


Figure 2 – The NPO concept as starting point for chemical management in your company

¹ GTZ Guide ‘Good Housekeeping’ at: [Download Good Housekeeping](#) and APO Green Productivity Manual at: [Download Green Productivity Manual](#)

Possible sources of chemical waste in your company
Off-specification, unwanted or spilt raw material (e.g. raw material which has exceeded “shelf life”, chemicals spilt in storage etc.)
Raw materials or items which are used in a process but not consumed by that process (e.g. oil filters, dust filters, used oil, expired batteries etc.)
Materials resulting from process start-ups (e.g. solvent washings of reaction vessels/pipe work)
Unwanted by-products from a process (e.g. dross/slugs/slurry/scoria/casting sand from foundry processes, contaminated rinse waters/solvents, etc.)
Results of process malfunctions / poor control (e.g. off-specification batch of product, partially reacted materials, etc.)
Material resulting from process shut down (e.g. residues from reaction vessels / pipe work, washings from vessels/pipe work)
Materials resulting from routine in-situ maintenance of the process equipment (defective components, used oil, filters, cleaning materials, solvents etc.)
Sludges from waste water treatment plants and air emissions control residues

Table 1 – Possible sources of chemical waste in your company

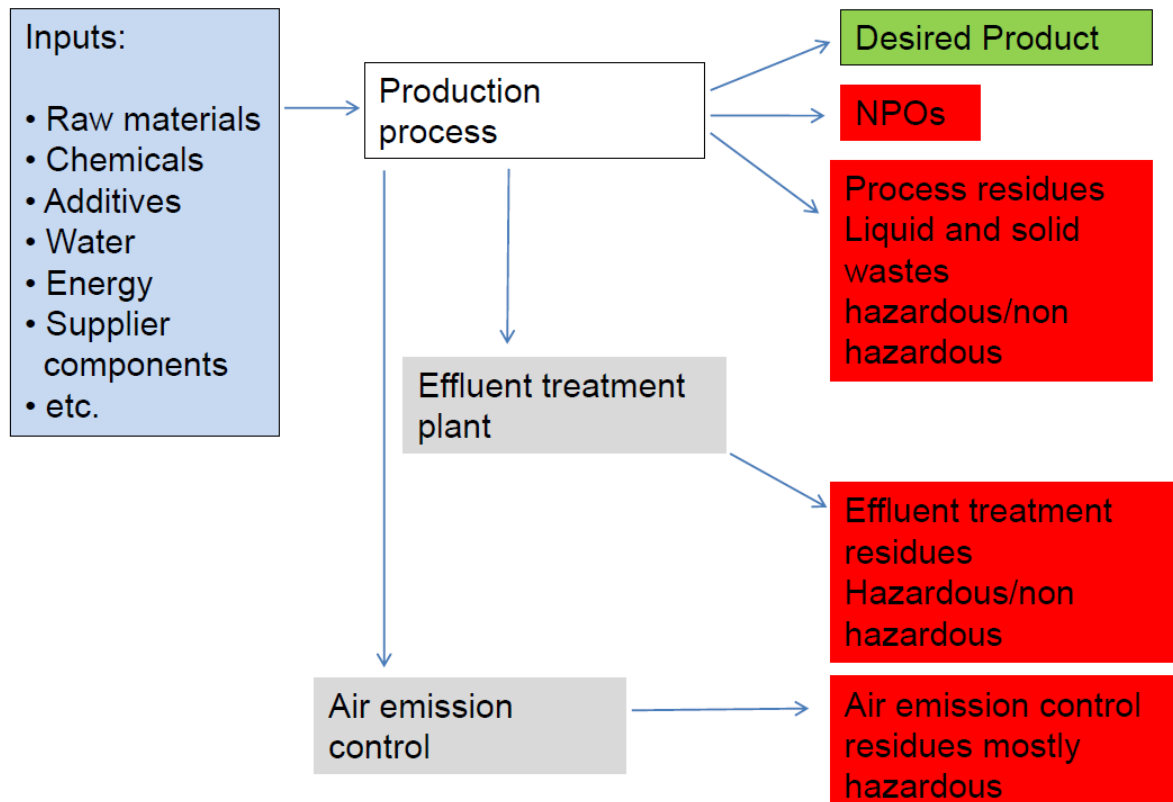


Figure 3 – Overview of inputs in blue, desired product in green and production related wastes (NPOs) in red

If you quickly want to find out where your company stands with regard to the management of

hazardous wastes, just go through the following self-check:

Indicators for Hazardous Waste Management	Yes	Partly	No
All hazardous wastes in your company are identified, separated from non-hazardous ones and quantified			
You can see from the flow diagram where your hazardous wastes are produced			
You know the composition of all hazardous wastes produced			
You know and utilise the hazardous waste classification system existing in your country			
All relevant data related to hazardous waste is compiled			
You meet local legal requirements on hazardous waste			
You have signed a contract with a local HW service provider			

Table 2 – Indicators for Hazardous Waste Management

This module will guide you through different steps to ensure that you will handle the hazardous

waste you generated in your company in a safe and sound way. You will:

<input checked="" type="checkbox"/>	Systematically identify and quantify all chemical wastes (NPOs) in your company and make their costs visible
<input checked="" type="checkbox"/>	Identify, separate and classify the hazardous wastes
<input checked="" type="checkbox"/>	Create a waste inventory table
<input checked="" type="checkbox"/>	Select and plan for waste management measures to: <ul style="list-style-type: none"> • correctly separate waste at generation point • have an internal report on wastes • arrange for safe on-site collection, labelling and storage of wastes • carry out preliminary treatment on-site • arrange for further off-site treatment and disposal

Table 3 – Steps in handling hazardous waste

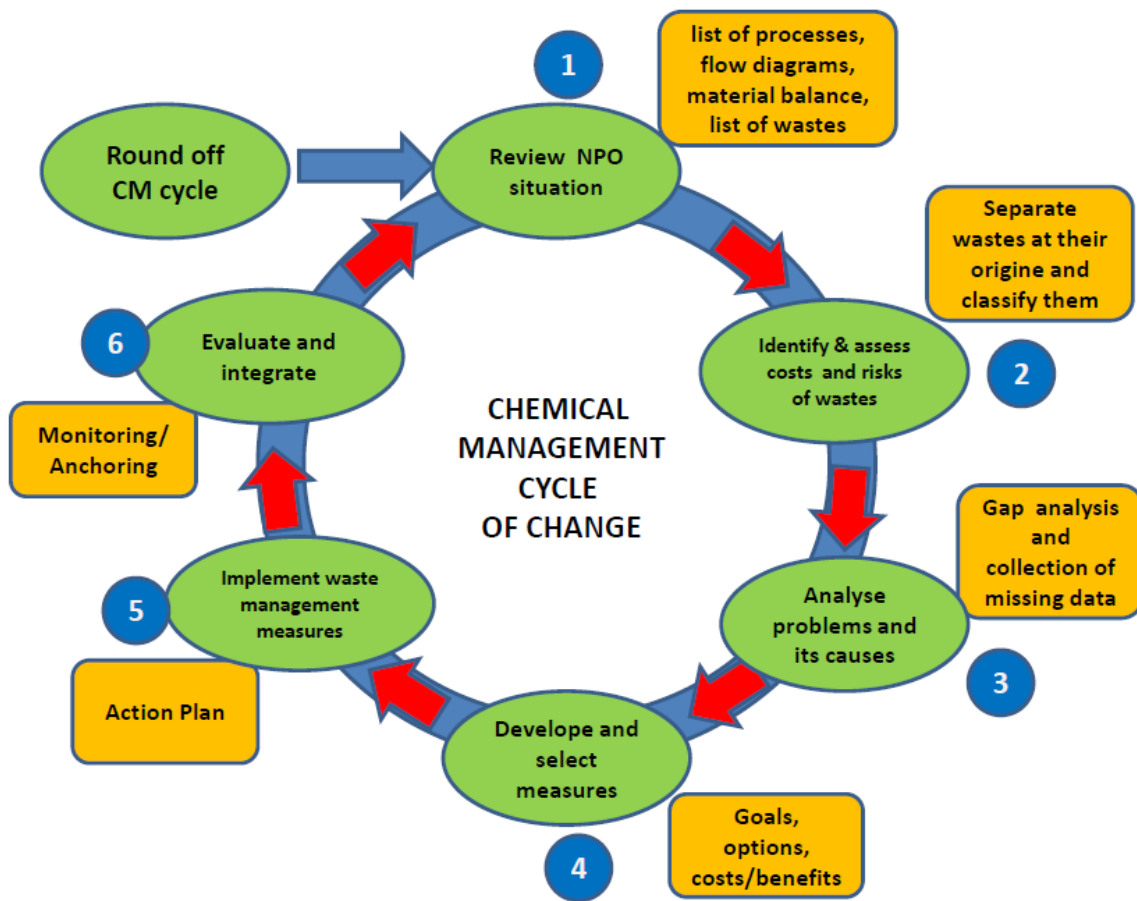


Figure 4 – Steps of the chemical management cycle of change in your company to be completed during the implementation of this module

3. Identify and quantify remaining chemical wastes in your company

In order to complete this step, take another look at the process flow diagram (example in figure 5) and list of NPOs which you have identified earlier.

As you have by now already implemented or initiated various improvement measures, the process flow diagram will facilitate the establishment of balances between input materials such as raw materials, additives, water etc. and the output in terms of products, by-products, residues, wastewater, and emissions needs to be reviewed and possibly adjusted.

This will require further on-site work and data collection.



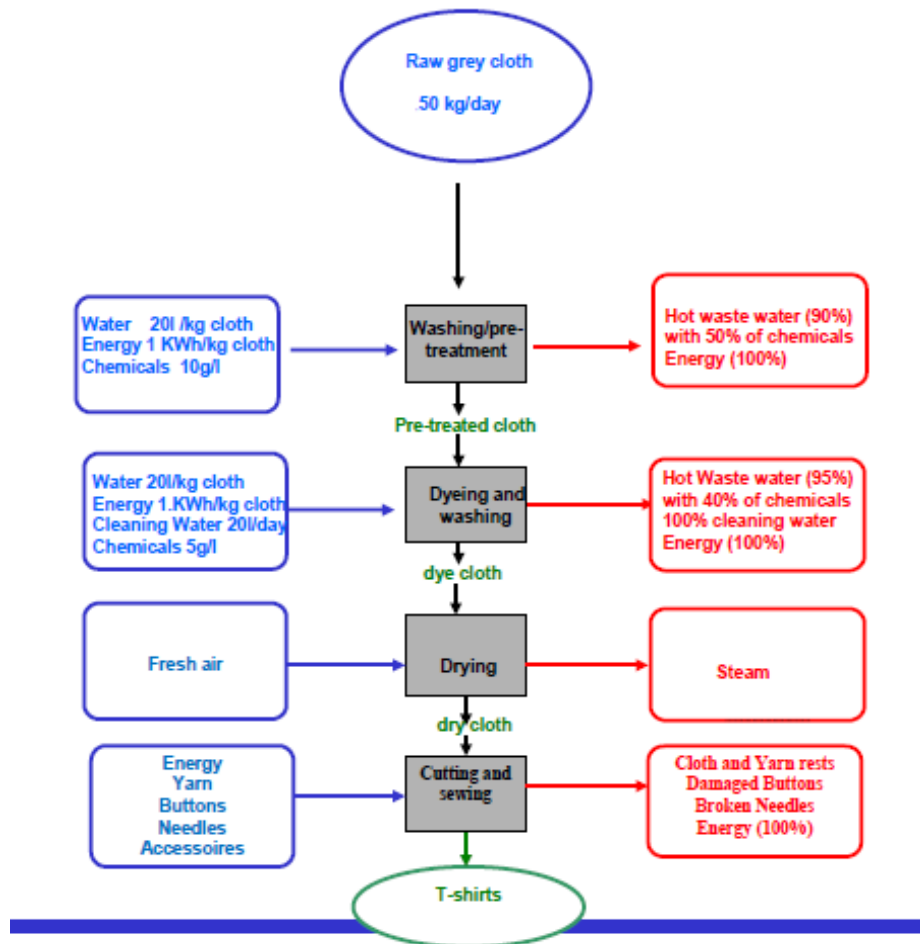


Figure 5 – Process flow diagram drawing from module 1

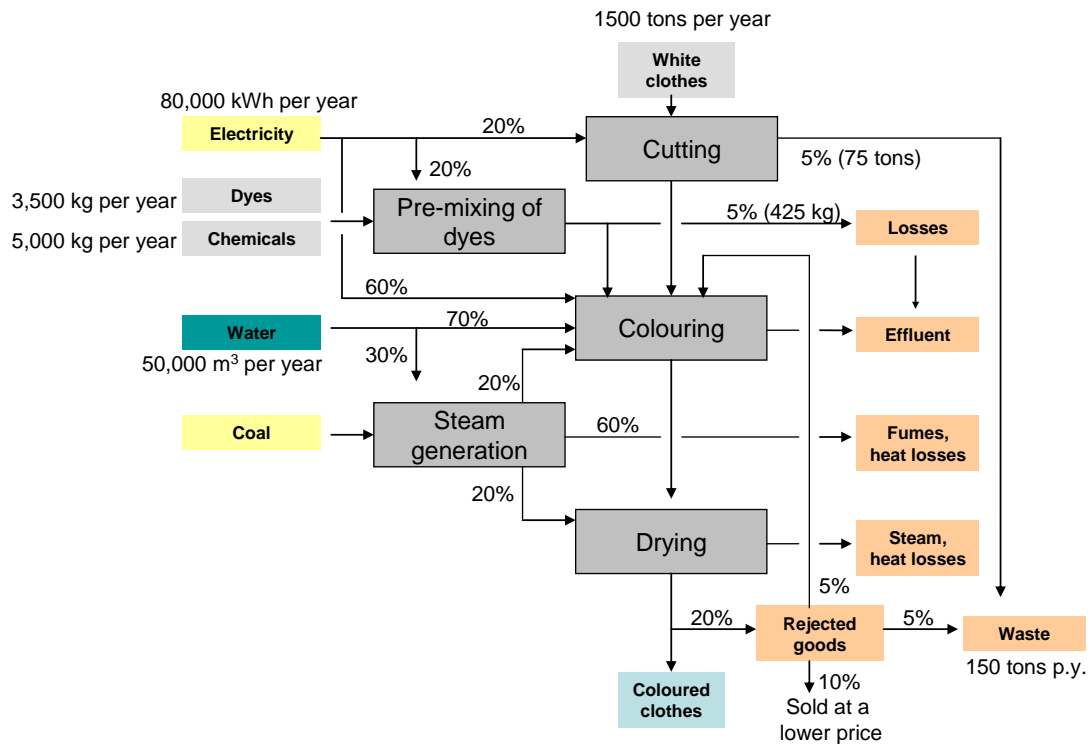


Figure 6 – Process flow diagram quantification from module 2

Eventually, you will identify/quantify all the wastes in your company in module 3. During this step, also observe and verify how these non-product outputs/wastes are further handled, stored, transported, treated or disposed of. At the end of this module you will have a more comprehensive and quantified flow diagram of your whole process.

The objectives are to become more aware with the intention of applying cleaner production principles, and thus **to become more competitive**, to reduce emissions and wastes, to improve productivity and to have a broader view of the waste problem complex. By going through this exercise you will reflect on what can be improved in your production process, which inputs should be substituted by less hazardous ones, how to reduce waste, etc.

Let us start this exercise with an on-site inspection. During this on-site waste audit you should collect information to determine:

- Who has which responsibilities for waste management in your company and how is it regulated (e.g. work instructions and procedures, job description, designated person)?
- What different kinds of waste are generated, in what quantities and with what frequencies?
- Where and how do wastes move from their point of generation?
- Are wastes separated in hazardous and non hazardous wastes?

What measures are in place to avoid / minimise waste generation?

- How are the wastes handled / managed on-site
 - Where and how are they stored?
 - How much is currently stored? Location, storage together with other waste, outside...
 - Is there any on-site pre-treatment (waste water treatment plant)?
- Knowledge of your end of pipe technology and their costs (end of pipe technology is an approach to pollution control which concentrates upon effluent treatment or filtration prior to discharge into the environment, as opposed to making changes in the process giving rise to the wastes)
- If the wastes are transferred off-site:
 - Who is hired /employed to collect and transport the waste from your company?
 - Where are the wastes taken to?
 - How is the waste managed once it has left the premises?

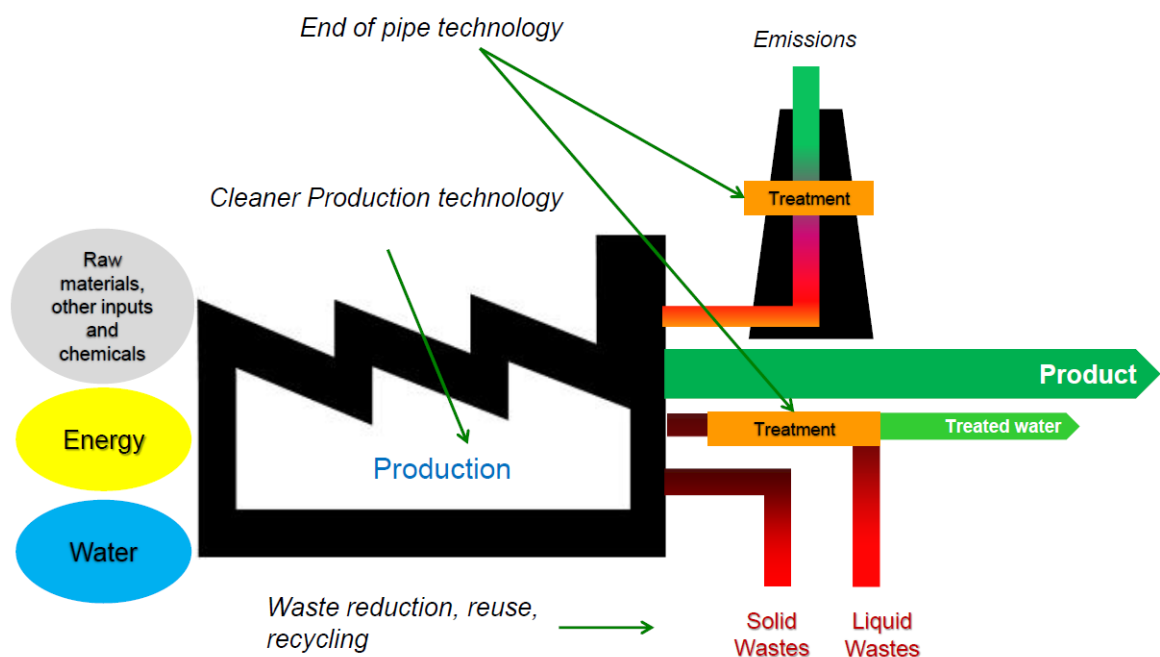


Figure 7: Cleaner production vs End of pipe

For the preparation of improving of waste management measures for your company you will then need to verify the following information:

- Physical characteristic of your waste: liquid, sludge, solid, liquid/sludge etc.
- Principal component of waste => remember what went into the process
- Quantities used in all your main processes
- Composition of waste (if possible)
- Frequency of generation (continuous / periodic / twice a month etc.)
- Quantity generated on each occasion or on average

During the on-site visit you will be able to conduct an internal waste audit. The waste audit is a based investigation procedure for assessing pollutant emissions from industrial sites. It focuses on the actual processes within the enterprise under consideration. The objective of a waste audit however is not only to identify, characterize and quantify all wastes generated by a particular enterprise but also to discover how those waste are currently being managed.

The waste audit ideally should also identify the real situation including any “hidden” wastes – for example wastes which, instead of being separated, are being generated but are being allowed to mix with waste-waters or general solid wastes and be discharged as effluents or dumped. Identification of all wastes is of utmost importance for improving the waste management situation; **only hazardous wastes correctly identified at the point of generation are visible and are able to be separated and managed.** After the on-site visit you will also be better prepared for any official waste control that could come in the future.

The Cleaner Production Concept

Cleaner Production in small and medium sized enterprises (SMEs) means the continuous application of an integrated, preventative environmental strategy to processes, production and services to increase resource efficiency and reduce risks to humans and the environment. It is a broad term that encompasses terms such as resource efficiency, pollution prevention and green productivity. In essence, applying Cleaner Production protects the environment, the consumer and the worker while improving resource efficiency, profitability and competitiveness.

SMEs should be aware of the key aspects of cleaner production, especially of the need to reduce the dispersion of toxic substances. A concrete example of Cleaner Production activities at SME level would be the implementation of sound hazardous waste management



For more details about concepts such as cleaner production, resource efficiency, cycle economy, green economy etc. refer to our [contact details](#) given above.

4. Assess hazards / risks and gaps in handling waste

The objective of proper hazardous waste management is to prevent harm to the environment and human health arising from such waste as part of the overall chemicals management in your company. While this is relevant for all the people working in your company, this applies even more to the staff involved in handling hazardous waste on-site before it is handed over to a hazardous waste transporter.

This can only be achieved if all staff (from executive board to workers) is provided with comprehensive information and appropriate equipment for the safe handling of any kind of hazardous waste generated in the plant.

For a first reference to decide whether you are dealing with hazardous or non-hazardous waste, check with your list of identified wastes. If the input chemical is hazardous, so may be its waste. The safety data sheets (SDS) provide an indication of the way in which wastes of the respective substance ought to be handled.

But be aware that even non-hazardous inputs can lead to hazardous waste output. During the different processes in your company different input chemicals might get intermixed as well as react with each other.²

First differentiate between hazardous and non-hazardous waste using the available information (from SDS, from knowledge of used input materials, hazardous properties of these materials). This first differentiation (hazardous/non-hazardous) will help you to separate hazardous wastes from non hazardous as early as possible in your production and will save you unnecessary costs in the future.

Typical hazardous wastes are, for example, asbestos, strong acids (usually with $\text{pH} \leq 2$) and alkalis (usually with $\text{pH} \geq 12.5$), galvanic sludges, used lead-acid batteries, used Ni-Cd batteries, wastes containing high amounts or specific compounds of arsenic, cadmium, hexavalent chromium, cyanide, mercury, polychlorinated biphenyls (PCBs), other Persistent Organic Pollutants (POPs), peroxides, certain pesticides³, organic solvents, halogenated hydrocarbons like dichloromethane (DCM)⁴ and tetrachloroethylene.

² Example: In a tannery, liquid waste streams from different production steps usually end up in the same drainage. Mixing of acidic and sulphide-containing waste waters might result in the generation of hydrogen sulphide gas, which can result in temporary impairment of health but also fatal effects if inhaled at a higher concentration.

³ http://www.pan-germany.org/gbr/project_work/highly_hazardous_pesticides.html

⁴ DCM is internationally categorized as 'water polluting substance'

For the correct waste identification, the following sources of information must be considered:

- waste constituents, from SDS if available
- hazardous properties of wastes
- chemical and physical characteristics of the material
- manner of waste generation – process conditions

In order to identify possible gaps in the safe handling of chemical wastes and the situation in your company, you can use a checklist.



For a Checklist on Waste Management, refer to our [contact details](#) given above.

5. Hazardous and non-hazardous waste

To distinguish hazardous from non-hazardous waste, regulators of most countries have adopted generic hazardous waste lists comprising common hazardous waste types that are known to exceed minimum hazardous characteristics thresholds. Waste types specified in these lists are defined as hazardous.

Complementary to these hazardous waste lists, regulators have defined a series of hazardous characteristics that render wastes hazardous (when exhibiting these characteristics). US-EPA defines four hazard characteristics (ignitability / flammability, corrosivity, reactivity and toxicity), whereas the EU, using a more detailed approach, defines 15 hazard characteristics (H1-H15). The Basel Convention defines 13 hazard characteristics, very similar to that of the EU.

Ignitability/ flammability	Ignitable wastes can create fires under certain conditions or are spontaneously combustible. Examples include waste oils and used solvents.
Corrosivity	Corrosive wastes are acids or bases that are capable of corroding metal and damage human skin, like storage tanks, containers, drums, and barrels. Battery acid is a good example.
Reactivity	Reactive wastes are unstable under “normal” conditions. They can cause explosions, toxic fumes, gases, or vapors when mixed with water. Examples include lithium-sulfur batteries and explosives.
Toxicity	Toxic wastes are harmful or fatal when ingested or absorbed. When toxic wastes are disposed of on land, contaminated liquid may drain (leach) from the waste material and pollute ground water. Certain chemicals (POPs, PCBs) and heavy metals are examples of potential toxic wastes.

Table 4 – Criteria that render wastes hazardous according to the US, EPA Regulation

Code	Designation	Note
H 1	Explosive	Substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene.
H 2	Oxidising	Substances and preparations which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances.
H 3A	Highly Flammable	<ul style="list-style-type: none"> • Liquid substances (including extremely flammable liquids) and preparations having a flashpoint of below 21°C, or • Substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any application of energy, or • Solid substances and preparations which may readily catch fire after brief contact with a source of ignition and which continue to burn or to be consumed after removal of the source of ignition, or • Gaseous substances and preparations which are flammable in air at normal pressure, or • Substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities.
H 3B	Flammable	Liquid substances and preparations having a flashpoint equal to or greater than 21°C and less than or equal to 55°C.
H 4	Irritant	Non-corrosive substances and preparations which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation.
H 5	Harmful	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks.
H 6	Toxic	Substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin, may involve serious, acute or chronic health risks and even death.
H 7	Carcinogenic	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce cancer or increase its incidence.
H 8	Corrosive	Substances and preparations which may destroy living tissue on contact.
H 9	Infectious	Substances containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms.
H 10	Toxic for reproduction	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may produce or increase the incidence of non-heritable adverse effects in the progeny and/or of male or female reproductive functions or capacity.
H 11	Mutagenic	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce hereditary genetic defects or increase their incidence.
H 12	-	Substances and preparations which release toxic or very toxic gases in contact with water, air or an acid.
H 13	Sensitizing	Substances and preparations which, if they are inhaled or if they penetrate the skin, are capable of eliciting a reaction of hyper-sensitization such that on further exposure to the substance or preparation, characteristic adverse effects are produced.
H 14	Ecotoxic	Substances and preparations which present or may present immediate or delayed risks for one or more sectors of the environment.
H 15	-	Substances and preparations capable by any means, after disposal, of yielding another substance, e.g. a leachate, which possesses any of the characteristics listed above.

Table 5 – Criteria that render wastes hazardous according to European Waste Regulation following [Directive 91/689/EEC Appendix 3](#)

To determine the possible risk to health & safety and the environment, you can follow a similar control banding procedure as applied during the assessment of hazards and risks of hazardous chemicals described in modules 1 and 2.

6. Classify your waste using an official Waste List

Any waste generated in a workplace must be clearly identifiable. When classifying waste, you can follow a logical assessment flow and use existing lists. Examples are lists existing in your country or the Y-code list (for the transboundary HW movement according to the Basle Convention) or the US lists (F, K, P, U) or the European waste list (EWL) or the OECD amber list.

Using these lists of standard classification will help you to connect with an existing national or local waste management system at a later stage when you are planning on sending your hazardous waste on for further treatment or final disposal off-site.

With a good waste list at hand, it should be possible to refer to the list and to check if the waste under consideration is listed as hazardous or not.

In case reference to the waste list provides exhaustive information, no further efforts are required.



For reference on the European Waste List and the Basel Convention Y-codes, use our [contact information](#).

Even when referring to other waste classification systems, the question „Hazardous or non-hazardous?“ cannot always be answered by a waste list as the hazardous nature of a waste is sometimes subject to the **concentration** of hazardous substances in the waste. Therefore, in most cases a combined approach is required. At the outset it is always wise to refer first to the waste list.

In reality, in many cases the question of whether hazardous waste or non-hazardous waste becomes a question of:

- Which hazardous substances are contained in the waste?
- What are the hazardous properties of those substances?
- What are the threshold concentrations of those substances for making a waste hazardous?

Therefore, it is very important that you know the input materials used in the process. You can then derive the composition of your wastes more easily starting from the input materials.

For differentiating between hazardous and non-hazardous waste, expert panels of the EU have defined concentration threshold limits for hazardous substances contained in waste materials with respect to hazardous properties H1 - H15 and with reference to the ‘Categories of Danger’ and Risk-Phrases.

Since wastes normally are mixtures of different substances, it is important that you know the concentration of the substances in your specific waste mixture. Also, it is important that you know the chemicals used in the process that produced that waste mixture in order to find out the H-code.

Knowing all these parameters will facilitate the classification of wastes as hazardous or non-hazardous.

Also consider concentration limits and hazard codes (H1–H15) during wastes classification

Categories of danger	Flash point Concentration limits	Hazardous properties
Flammable	Flash point ≤ 55 °C	H3
Irritant R36, R37, R38	Total concentration of $\geq 20\%$ of one or more substances	H4
Irritant R41	Total concentration of $\geq 10\%$ of one or more substances	H5
Harmful	Total concentration of $\geq 25\%$ of one or more substances	H5
Very toxic	Total concentration of $\geq 0.1\%$ of one or more substances	H6
Toxic	Total concentration of $\geq 3\%$ of one or more substances	H6
Carcinogenic (Cat. 1 or 2)	Concentration of $\geq 0.1\%$ of one substance	H7
Carcinogenic (Cat. 3)	Concentration of $\geq 1\%$ of one substance	H7
Corrosive R34	Total concentration of $\geq 5\%$ of one or more substances	H8
Corrosive R35	Total concentration of $\geq 1\%$ of one or more substances	
Toxic for reproduction (Cat. 1 or 2, R60 or R61)	Concentration of $\geq 0.5\%$ of one substance	H10
Toxic for reproduction (Cat. 3, R62 or R63)	Concentration of $\geq 5\%$ of one substance	H10
Mutagenic (Cat. 1 or 2, R46)	Concentration of $\geq 0.1\%$ of one substance	H11
Mutagenic (Cat. 3, R40)	Concentration of $\geq 1\%$ of one substance	H11
Eco toxic with R phrases R50-53	total concentration of $\geq 0.25\%$ of one or more substances.	H14
Eco toxic with R phrases R51-53	total concentration of $\geq 2.5\%$ of one or more substances.	H14
Eco toxic with R phrases R52-53	total concentration of $\geq 25\%$ of one or more substances.	H14
Eco toxic with R phrase R59	total concentration of $\geq 0.1\%$ of one or more substances.	H14

Table 6 shows the relationship between Risk phrases, hazard codes (H1-H15), flash points and concentration limits when classifying a waste

7. Select and plan waste management measures

Based on the information collected, the company should be able to identify major areas of improvement taking the avoidance of NPOs into account as a guiding principle

Your action plan for addressing the management of chemical waste in your company will follow the same principles as the one you have prepared in module 2.

An action plan should contain at least the following information:

- Measures for improving the situation in the company
- Persons in charge
- Time frame

- Waste generation data still needed to be collected
- Investment (capital) and running cost
- Expected environmental benefits/result (for monitoring and later evaluation)

Assign clear responsibilities

The overall responsibility to use chemicals safely rests with the owner and/or management of your company. The same applies to the management and disposal of the hazardous chemical waste. Depending on where your company is located, there might be some specific legal requirements regarding the assignment of employees dedicated to the management of hazardous wastes. Even if such requirements do not exist in your country, it is helpful to assign the operational responsibility of hazardous waste management to a suitable person or team.

Example from Germany: WMO

In Germany, in order to obtain a valid operating permission for a company generating hazardous waste, one of the pre-requisites is that a person responsible for internal hazardous waste management is nominated. The law further requires that any establishment generating hazardous waste must nominate its own officer: a waste manager officer (WMO). This person is often simultaneously responsible for pollution prevention and occupational safety and health. The WMO must be reliable, qualified and competent. This may be proven through training record / evidence of education in the field of “maintenance and disposal”, or through documentation of long-term practical experience.

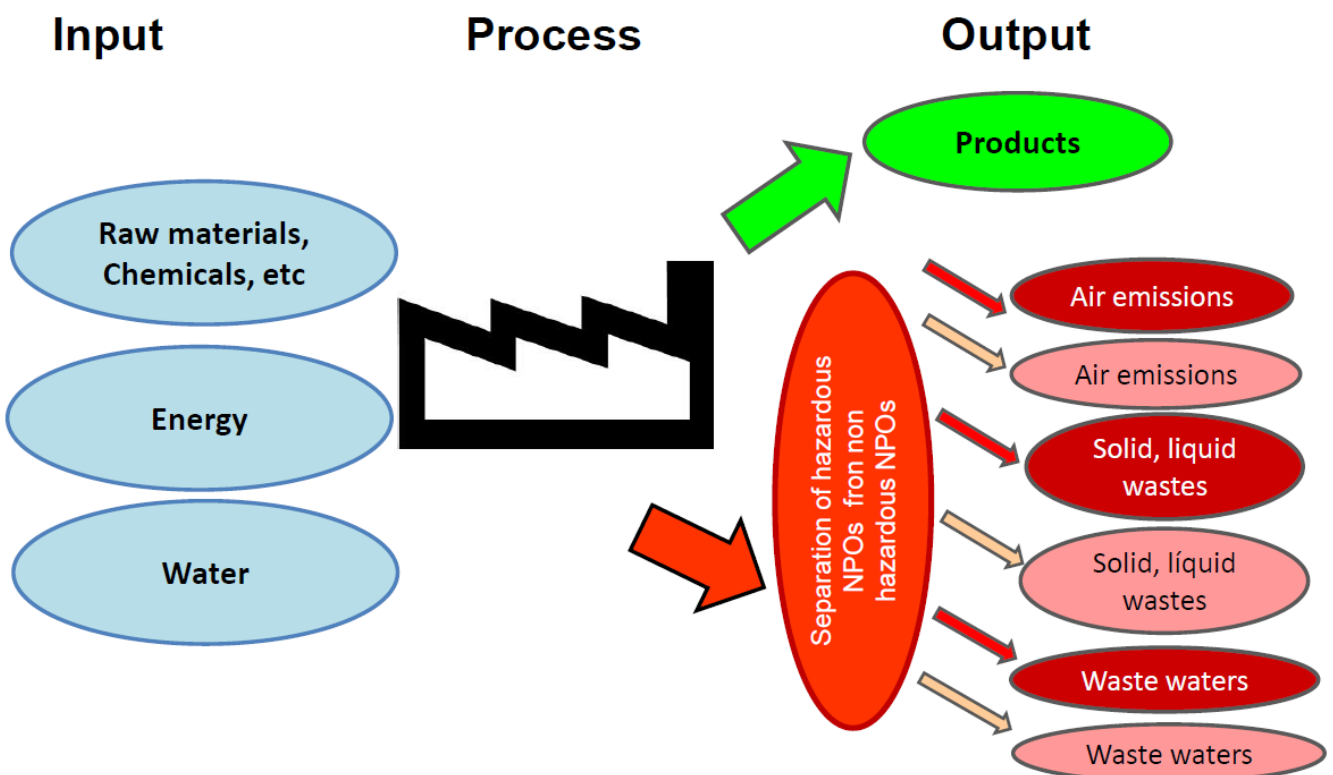
Train and qualify personnel involved in handling hazardous waste

Personnel involved in the handling or management of hazardous waste must be trained to ensure that they are able to respond effectively to emergency situations. All facility personnel working on production lines and processes generating hazardous wastes should be provided with initial training and annual refresher training covering the following aspects:

- presence of the specific materials
- potential physical and health hazards associated with these materials
- proper procedures for handling and use of these materials, including the use of personal protective equipment (i.e. gloves and protective goggles)
- location and appropriate use of the chemical Safety Data Sheets
- procedures to be followed in the event of an emergency situation

Separation of hazardous from non-hazardous waste as soon as possible

The separation and interim storage of hazardous and non-hazardous waste is the first important aspect in waste management. Hazardous waste is usually costlier to treat and dispose of. When hazardous and non-hazardous wastes get mixed all of the resulting waste may have to be considered as hazardous waste, resulting in an increase of your treatment and disposal costs.



Segregation is of utmost importance for waste management in your company

Figures 8 – NPOs contain hazardous (red) and non hazardous wastes (pink). Important activities during this module are the separation of hazardous from non hazardous wastes at the generation point and the segregation of compatible from incompatible wastes during storage

























Segregation of compatible from non-compatible wastes during storage

At the same time, hazardous wastes of different nature and composition must not be mixed either. As in the case of incompatible chemicals, different types of incompatible chemical wastes can react with each other as well and generate equally or more hazardous reaction products, or result in an explosion. Also segregate liquid hazardous waste from solid hazardous waste.

The following table guides you to check the compatibilities of the different types of waste. This table should also be used when storing hazardous chemicals in your company.

The green fields in figure 9 indicate that these hazardous chemicals/wastes can be stored together.

Further, the different types of waste must be put into appropriate containers made of material compatible with the content – e.g. plastic containers for acids and bases, metal drums or other metal containers for organic solvents. You have to train your personnel in the appropriate use of the different containers for hazardous wastes.

			C	Xi, Xn	T, T+	F, F+	O	E
								
								
C			✓	✓	o	x	x	x
Xi Xn			✓	✓	✓	✓	o	x
T, T+			o	✓	✓	o	x	x
F, F+			x	✓	o	✓	x	x
O			x	o	x	x	✓	x
E			x	x	x	x	x	✓

Key to the figure 9




C	Corrosive		Are allowed to be stored together
Xi	Irritant		
Xn	Harmful		
T, T+	toxic, highly toxic		
F, F+	flammable, highly flammable		
O	Oxidizing		Are allowed to be stored together, subject to special precautions
E	Explosive		Are not allowed to be stored together

Figure 9 – Compatibility check for hazardous substances



Figure 10 – Sample of a hazardous waste label



For an editable word version of a label, please [contact us](#).

Ensure labelling and hazard communication

Any container you use for hazardous waste must be labelled and marked clearly and unambiguously. These labels should contain the following information:

- the warning “hazardous waste”
- description of the contents, **also in layman’s terms**
- indication of the hazardous properties – e.g. “flammable”, “corrosive”, “toxic”, “explosive”. Similar labels and pictograms are used when working with hazardous chemicals
- department/section where the waste has been generated
- name and telephone number of the employee responsible for internal hazardous waste management
- date of filling of the container

Organise on-site storage of hazardous waste

Depending on the situation in your location, it may not be possible to dispose of hazardous waste off-site immediately. Often the hazardous waste may need to be stored on-site until it can be transported to a location for its final treatment and disposal.

The on-site interim storage must be organized in such a manner that

- subsequent off-site treatment will not be hampered and
- no danger for staff or the environment will arise from the waste during its interim storage on-site.

The first aspect can be achieved / safeguarded by making sure that the different types of hazardous wastes are already identified and separated at their place/source of generation. To do so, you will have to

- inform, train and instruct your staff on how to identify, separate and store the hazardous waste
- provide for appropriate containers in sufficient numbers to collect the waste at the place of generation and transport to an interim on-site storage area
- respect the incompatibilities of wastes during the entire period of storage

Using clearly marked containers - maybe even of different colors-facilitates the separation of different types of waste at the point of generation.

For example:

- red containers for flammable halogen-free solvents
- blue containers for halogenated hydrocarbons such as dichloromethane, trichloroethylene or tetrachloroethylene.

Make sure to only select and use containers that are made of, or lined with, material that is compatible with the hazardous waste to be stored in them.

Provide a separate on-site hazardous waste storage area

In small and medium-sized enterprises, hazardous wastes are often generated only in small quantities. Therefore, on-site collection and interim storage is necessary until quantities large enough for

shipment by a licensed hazardous waste transporter are accumulated.

Designate one suitable area in your company for on-site storage of hazardous waste. When identifying this area, keep in mind that

- the area needs to be big enough to hold the quantities of hazardous waste generated between the usual pick-up dates or further scheduled times of disposal for the hazardous waste
- different types of hazardous waste need to be stored separately
- the area needs to be protected from sun and rain. Excessive heat might trigger a fire or explosion, while rain water might mix with residue of leaked chemical wastes and effuse/flow out, contaminating soil and groundwater
- the storage area must have provisions to contain any leakage or spillage. The floor needs to be made of impermeable material or plastic sheets or lined with sheets as well as having provisions for containment / dyking

Once you have identified and prepared the storage area, also ensure that the area is clearly marked and access is/can be limited to authorized personnel only. Display warning signs describing precautionary and preventive measures.

In the case of intermediate storage of flammable and explosive liquids, the safety precautions to be observed are the same as for the storage and handling of chemicals – i.e. installation of explosion-proof electric and electronic equipment and fire-extinguishing features in the area of intermediate storage. Further emergency provisions should be available for the hazardous waste storage area for containing leakages and spillages (e.g. spill absorbing material and special additional waste containers).

Ensure good waste handling practices

An excellent method of informing your staff is to draw up a plant-specific waste guide that lists any waste generated in the plant and indicates how to proceed with and handle it.

Some good practices which you and your staff should follow are:

☑	Keep storage area clean
☑	Maintain the containers in good condition and immediately replace leaking ones
☑	Keep the hazardous waste containers closed at all times except when removing wastes
☑	Never fill to the line any container containing liquid hazardous waste, and allow at least 5 cm of air space near the top to control vapor pressure inside
☑	Follow working procedures and instructions regarding the safe handling and emergency response
☑	Use the designated personal protective equipment

Hazardous waste services providers offer for example

- General advice on waste/hazardous waste management
- Help with classification and labelling
- Guidance on packing and recommendations for containers and volumes
- Rent, delivery and collection of containers
- Safe transport of containers to treatment facilities
- Preparations for safe transport and labeling
- Special advice in the form of an external consultant acting as an outsourced waste manager officer for the company



To read more about **hazardous waste service providers**, please refer to our [contact information](#).

Arrange for off-site transport of hazardous waste

Enterprises consigning their hazardous waste to a licensed carrier for transport to an external utilization or disposal facility have the following responsibilities:

- To classify their hazardous waste according to the regulations for dangerous goods
- To use packages/containers in compliance with the package specifications on the respective dangerous goods class and quantity
- To place the respective danger labels on the packages
- To ensure that the carrier has a license for the transport of dangerous goods
- To check the equipment and the suitability of the truck sent by the carrier for transporting dangerous goods (IDG)
- To ensure proper tie-down of the cargo load
- To supply the driver with the necessary documentation such as consignment notes, copies of the “Records of Proper Waste Management” and “Transport Emergency Cards” relating to the wastes and their dangerous good classes

Violations of these duties may have repercussions in case of traffic accidents.

Enterprises that are consignors of dangerous goods are moreover obliged to appoint an “officer for the prevention of the risks inherent in the carriage of dangerous goods”. Subject to the total quantity of dangerous goods shipped per annum, this obligation can be transferred to a third party. A convenient solution might be outsourcing this function to the carrier and including a respective clause in the transportation contract.

PRACTICAL TIP

▶ Contact the company which handles your final disposal of waste for further guidance. In Germany, as common practice hazardous waste management facilities offer advice and additional services to their customers, i.e. the hazardous waste producers, e.g. on recommended packaging and volumes. Depending on regulations and practices in a country, it might be advisable to contact the transporter and disposal company for other reasons, for example to ensure that they transport or dispose of the hazardous waste according to national or international regulations. This may be something that a company is required to safeguard and therefore a certificate or similar guarantee should be sought by the producing company and provided by the transport or disposal company.

Duties of the Hazardous Waste Transporter

The waste producer's responsibility for the hazardous waste does not end with the handing over of the waste to the transporter. In EU Member States, any carrier transporting hazardous wastes needs an approval of the relevant competent authority. The waste producer is obliged to verify whether the carrier in charge of the transport of waste to the waste management facility has obtained and holds a valid approval.

Example from Germany

With regard to the technical competence of persons responsible for managing and supervising such hazardous waste transport operations, the German Ordinance on Transport Licenses requires the following:

The persons responsible for managing and supervising a company for the collection and transport of waste for disposal of hazardous waste shall possess the technical competence required for their tasks.

Such competence includes the following:

1. Technically proper and competent collection and transport of waste, with a special emphasis on proper waste transport techniques and proper labelling of vehicles and containers
2. Knowledge of the harmful environmental impacts, other hazards, significant impairments and nuisances that may be caused by the waste, and measures to prevent or remedy such problems
3. Knowledge of the type and nature of the hazardous waste
4. Knowledge of the provisions of waste-management laws and of other environmental legislation applicable to the specific collection and transport activities
5. Knowledge of the references to legislation on goods transport and the transport of hazardous goods
6. Knowledge of the provisions pertaining to company liability.

8. Off-site Waste Management options

Off-site waste management deals with the further treatment and final disposal of the waste removed from your company. In many countries you still have a responsibility towards your waste even when it has left your company. Therefore, it is important to select the right option of disposal of your waste.

These treatment and disposal operation have to be carried out in an environmentally sound way to meet all regulations, etc. As the off-site treatment and disposal of waste, particularly of hazardous waste, can be rather expensive, avoiding waste and, if this is not possible, then reducing these wastes are preferable options. The latter also includes the minimisation of hazardous waste as such.

The on- or off-site treatment options also include the recovery and reuse of valuable materials contained in the waste, which can be reprocessed as secondary raw material (circular economy), either by your company or off-site by another company.



To read more about the reuse and recycling of material and energy, please make use of our [contact information](#).

9. Evaluation and integration into the company structure

At this point, you have successfully “rounded off” the chemical management in your company. During the previous modules, you have looked into the efficient management of chemicals at the different stages, starting with procurement, storage, production and disposal. The complexity and costs for managing the remaining waste is closely connected to the way (1) you select and procure chemicals and (2) you store and handle these during the production.

Reducing the cost of treatment and disposal of non-product output starts at the very beginning of the flow of the chemicals into and through your company. In this module you have taken steps to

☑	Identify and quantify all remaining chemical wastes (NPOs) in your company
☑	Identify, classify and segregate the hazardous wastes
☑	Establish a waste inventory table as an information and management tool in your company
☑	Ensure that different types of wastes can be clearly identified
☑	Assign clear responsibilities and provide instructions and training
☑	Organize the safe on-site collection and storage of wastes
☑	Arrange for further off-site treatment, transport and disposal
☑	Carry out a waste audit in your company



For further information and examples of different containers used for collection and storage just [contact us](#).

10. Other waste management related topics

Corporate Social Responsibility (CSR)

The European Commission's definition of CSR is: "A concept whereby companies integrate

social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis"

CSR is about enterprises deciding to go beyond minimum legal requirements and obligations stemming from collective agreements in order to address societal needs. Through CSR, enterprises of all sizes, together with their stakeholders, can help to reconcile economic, social and environmental ambitions. CSR has become an increasingly important concept, and part of the debate about globalisation, competitiveness and sustainability.

In the general context of sustainable development and, in particular, of sustainable production and consumption, environmental issues should be managed along all stages of the product life cycle. This contributes to minimize the overall negative environmental effects of products and their manufacturing. Environmental concerns, however, cannot be regarded in isolation and must be integrated alongside other aspects of products such as performance, quality and safety.

Life-cycle thinking

All stages of the life cycle of products need to be addressed, e.g. design, raw materials utilized, production process, transport / distribution, use / consumption, and waste/ disposal phases. For example, enterprises should take into consideration the use and waste phases when designing a product so as to minimize the overall environmental impact (including pollution).

Together with life-cycle thinking approaches, enterprises must also implement eco-efficiency strategies, as these have immediate positive effects notably in terms of reducing energy and resources consumption, minimizing waste generation, etc.



For additional material on CSR and waste management, please [contact us](#).

Precautionary principle, Duty of care (Responsibility for downstream HW utilization & disposal), Polluter pays' principle, Waste hierarchy principle, life-cycle thinking.

11. Useful references

General principles of Hazardous Waste Management

GIZ Manual on Industrial Hazardous Waste Management for competent authorities in Low and Middle Income Economies



[Download GIZ Manual on Industrial Hazardous Waste](#)

The aim of this manual is to serve as ready information tool for decision-makers, government authorities, the private sector, journalists and NGOs in low and middle income economies on the salient features of an efficient hazardous waste management based mainly on the European Union's and OECD experiences up to 2011.

Waste Management and Cleaner Production

PRE-SME: Promoting Resource Efficiency in Small and Medium sized Enterprises an industrial training handbook



[Download UNEP PRE-SME Training Handbook](#)

“Promoting Resource Efficiency in SMEs” (PRE-SME) is an effort to upscale the results of the National Cleaner Production Centres programme. The overarching goal of PRE-SME is to enhance the capacities of developing countries to assist SMEs develop and implement cleaner, safer and resource efficient production programmes that will result in reduced manufacturing costs, lower pollution and improved health and safety performance. This training handbook is an excellent compendium of updated tables, methods and topics of RE, 2010.

See Videos about: stuff consumption, extended producer responsibility, precautionary principle, “toxics in toxics out” at:

“The Story of Stuff” is a short video that tells us where our stuff comes from and where it goes when we throw it away:



www.storyofstuff.org/

The “Story of Electronics” is a short video that tells us why “products designed for the dump” are toxic for the people and for the planet:



[Story of stuff – electronics](#)

The “Story of Cosmetics” is a short video that tell us the ugly truth of “toxics in toxics out”:



[Story of stuff – cosmetics](#)

Where to get information on classification of hazardous substances?

The “International Chemical Safety Cards” (English version), ICSCs, comprise some 1300 chemicals in 18 different languages.



[Website: International Chemical Safety Cards](#)

The most comprehensive source is the EU Directive on “Classification, Packaging & Labelling of Dangerous Substances”, **CLP - Annex VI**, which provides classifications of more than 7.000 chemicals. The annex is regularly updated.



[Website: Classification, Packaging & Labelling of Dangerous Substances](#)

The valuable information provided on the Safety Data Sheet (SDS) can be used to optimize chemical use and improve workplace health & safety standards.

Selection of SDS internet sites:



[MSDS Solution Centre](#)



[NC State University MSDS Management System](#)

Alternatively, you can just type “MSDS” followed by the name of the chemical in question into a search engine.



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