



# Put chemical management into practice

## **MANAGING CHEMICAL WASTE**

# Managing chemical waste

## In this session

- ZDHC CMS references and requirements
- Waste inventory and classification
- Good practices in on-site handling and storage chemical wastes
- Preparing for off-site treatment and disposal



# ZDHC CMS references and requirements



## ZDHC CMS 3.5.11 - Waste and disposal

- Generating waste that cannot be discharged to air, water or soil but needs to be collected and disposed of as chemical waste in accordance with local regulations.

## ZDHC Waste water guideline

- XXX

# ZDHC CMS references and requirements

## Checkpoints



- Waste storage areas reflect in factory plan
  - Chemical waste storage areas
  - Wastewater storage
  - Non-chemical waste storage areas
- Waste/waste streams reflected in Chemical Material Flow Diagrams
- Cost clearly assigned to the different wastes
- Plans available for how and where to safely store chemical waste, where it is generated and how it Will be Disposed
- Necessary permits available for collection, transportation, storage and disposal of all wastes such as chemical, chemical hazardous waste and recycled wastes?

# ZDHC CMS references and requirements

## Checkpoints



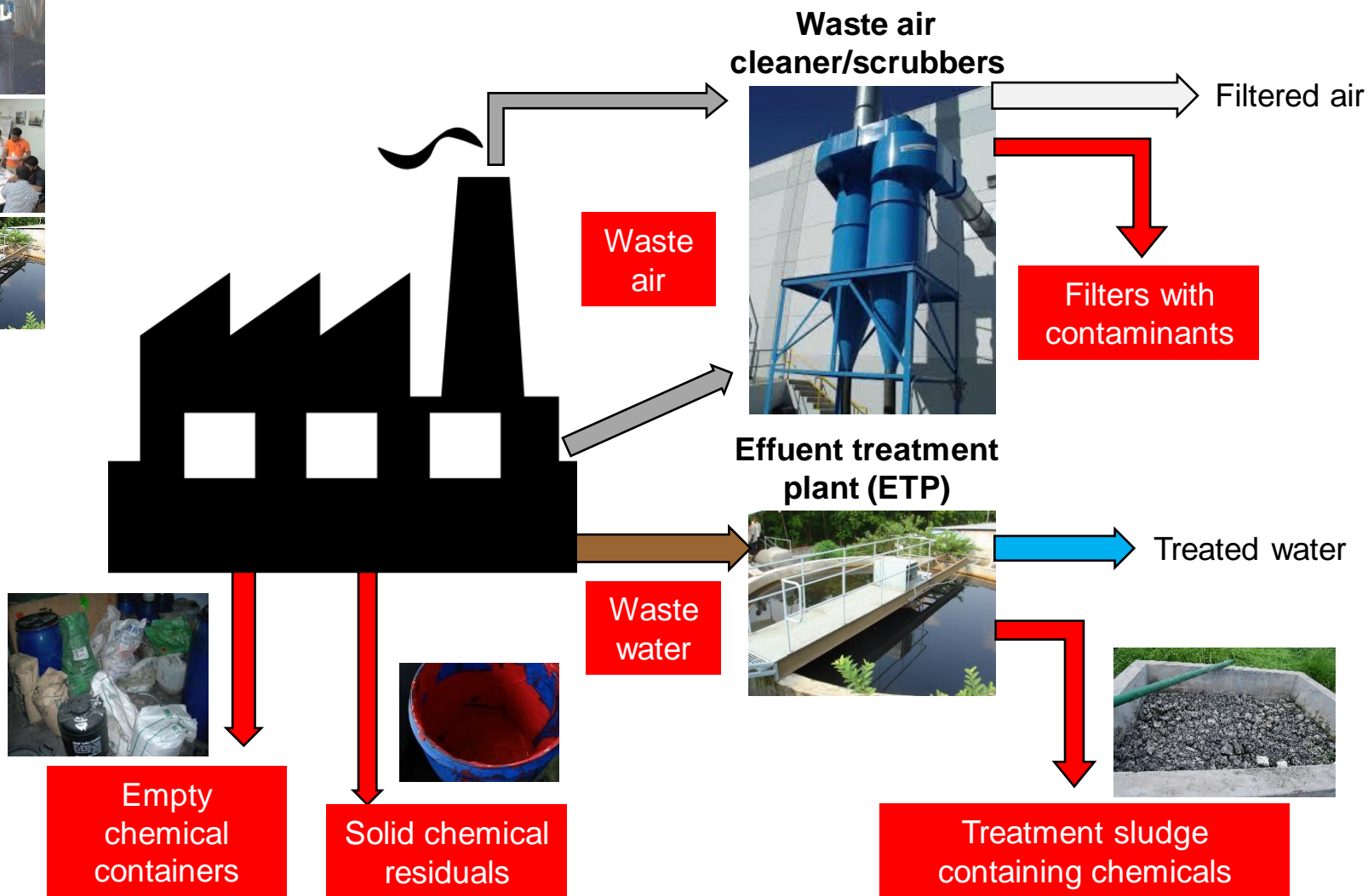
- Purchase decision considering whether chemical or its end products require disposal as hazardous waste
- Process/plan for reducing environmental impacts e.g. by assigning clear roles and responsibilities for management of wastes
- Organisation set goals to reduce chemical wastes or discharges.
- Organisation created waste action plan
- Standard labelling procedure for waste established
- Procedure for proper waste collection, handling, storing and disposal available and followed

# Steps in managing hazardous waste

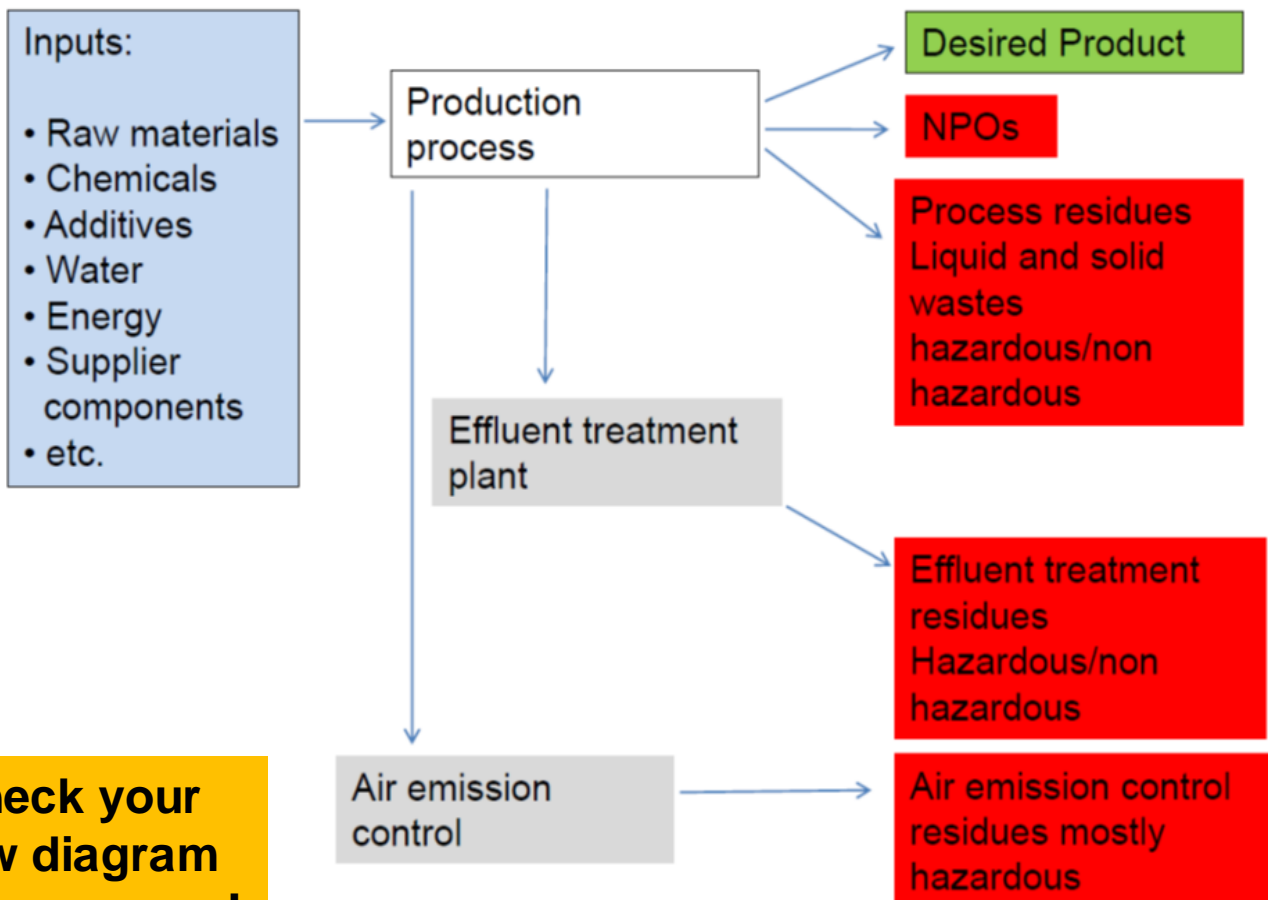
- Systematically identify and quantify all chemical wastes (NPOs) in your company and make their costs visible
- Identify, separate and classify hazardous wastes
- Create a waste inventory table further off-site treatment and disposal
- Select and plan for waste management measures to:
  - correctly separate waste at generation point
  - have an internal report on wastes
  - arrange for safe on-site collection, labeling and storage of wastes
  - carry out preliminary treatment on-site
  - arrange for off-site treatment and disposal



# Chemical waste flows in your company



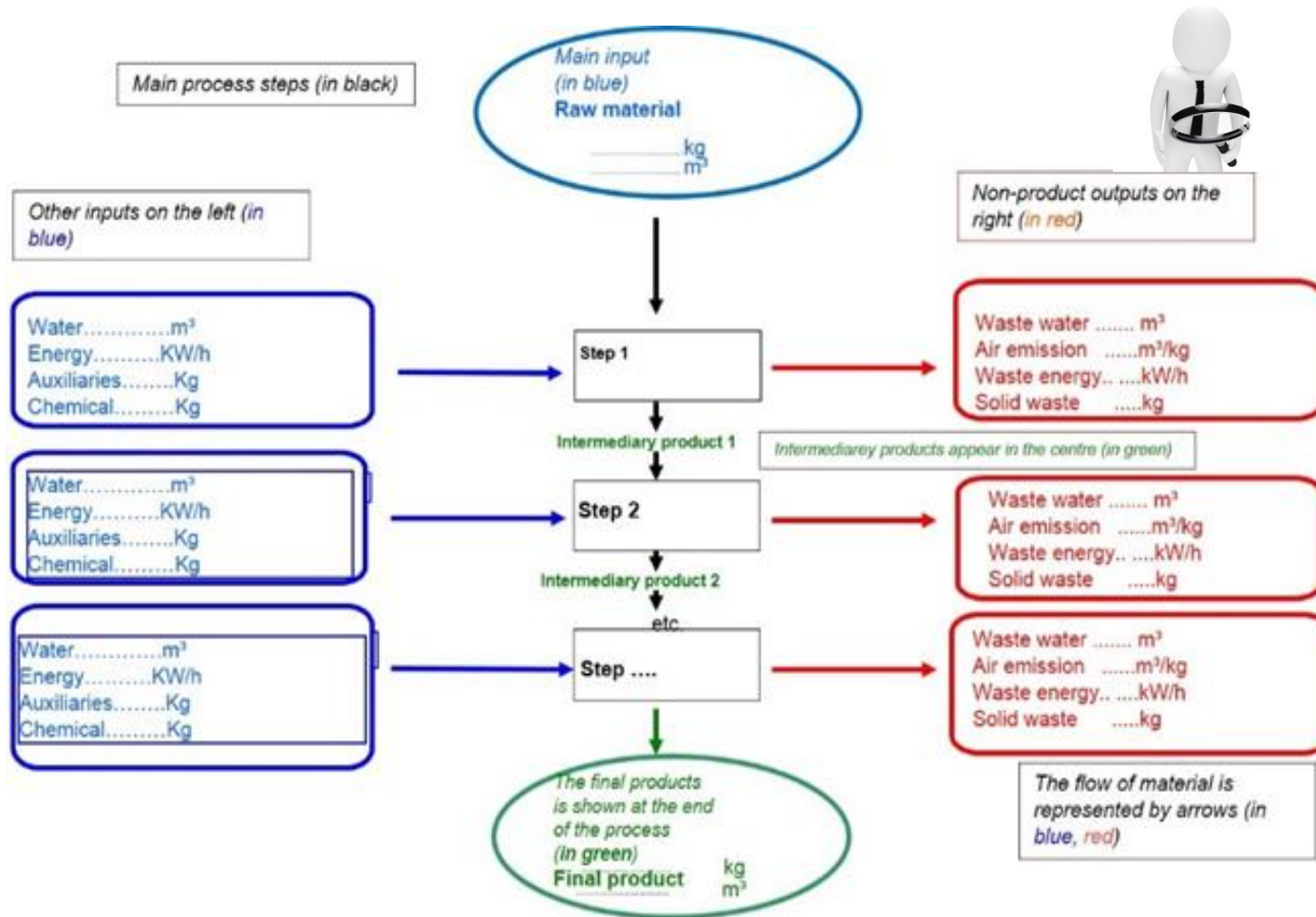
# Sources and types of chemical waste



**Check your  
flow diagram  
and eco-maps!**



# Does the company systematically identify and quantify all chemical wastes?



# Sources and types of chemical waste (textile)



Waste in need of	General waste	Textile industry specific waste
No control	Waste glass, paper, paper board, wood, iron scrap (pipes, old machines), electric cables, plastic drums (clean), metal drums (clean), non-contaminated plastic wrap	Waste yarn, waste fabric (spoilt works, trials, selvedge cuttings), wastes from shearing and raising, textile dust
General control	Waste oil, oil-contaminated cloths, non-halogenated organic solvents, soot from oil incinerators, glue and adhesive agents, contaminated packages	Dyes and pigments, residual padding dyeing liquors, residual printing pastes, residual padding finishing liquors, oil-containing condensates from off-gas treatment (stenters), sludge from process waste water treatment
High control	Waste from oil/water separators, halogenated organic solvents, PCB-containing condensers	

Source: BREF/BAT Textile 2003

# Sources and types of chemical waste



- 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. 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, printing screens)
- 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

# Does the company maintain a waste inventory table further off-site treatment and disposal?

As per GIZ REMC Toolkit

Waste Name	Category / Type	Source Process	Storage Area	Yearly Quantity	Associated Hazards	Disposal Method (actual/recommended)	Waste Disposal Vendor Address	License Number	License Validity Time

# Waste inventory

Identifying and classifying hazardous and non-hazardous waste

- Hazardous substances contained in the waste identified?
- Hazardous properties of those substances known ?
- Threshold concentrations of those substances for making waste hazardous verified?

## Use of official waste classification

- Classifying wastes using the Y codes list of the Basel Convention (BC)
- European Waste List and its equivalences with Y code lists and H characteristics
- US lists (F, K, P, U)
- ....

## Concept:

- Use of specific identification code for type of waste (e.g. EWL code)
- Refer to standardized hazard codes



# Example: European Waste List (EWL)



Code	Designation	Note
H 1	<b>Explosive</b>	Substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene.
H 2	<b>Oxidizing</b>	Substances and preparations which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances.
H 3A	<b>Highly Flammable</b>	<ul style="list-style-type: none"> <li>Liquid substances (including extremely flammable liquids) and preparations having a flashpoint of below 21°C, or</li> <li>Substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any application of energy, or</li> <li>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</li> <li>Gaseous substances and preparations which are flammable in air at normal pressure, or</li> <li>Substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities.</li> </ul>
H 3B	<b>Flammable</b>	Liquid substances and preparations having a flashpoint equal to or greater than 21°C and less than or equal to 55°C.
H 4	<b>Irritant</b>	Non-corrosive substances and preparations which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation.
H 5	<b>Harmful</b>	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks.
H 6	<b>Toxic</b>	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	<b>Carcinogenic</b>	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	<b>Corrosive</b>	Substances and preparations which may destroy living tissue on contact.
H 9	<b>Infectious</b>	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	<b>Toxic for reproduction</b>	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	<b>Mutagenic</b>	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	<b>Sensitizing</b>	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	<b>Ecotoxic</b>	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.

Criteria that render wastes hazardous according to European Waste Regulation



# Example: Classification of waste from textile industry



EWL Code	European waste list (EWL) Classification	H	H	Y
		(EU)	(Basel)	(Basel)
<b>04 02</b>	<b>Wastes from the textile industry</b>			
04 02 09	Wastes from composite Mats (impregnated textile, elastomer, plastomer)			
04 02 10	Organic matter from natural products (for example grease, wax)			
04 02 14*	Wastes from finishing containing organic solvents	H3, H5	H3, H4.1	Y42
04 02 15	Wastes from finishing other than those mentioned in 04 02 14			
04 02 16*	Dyestuffs and pigments containing dangerous substances	H7, H3, H5, H8	H3, H11, H4.1	Y12
04 02 17	Dyestuffs and pigments other than those mentioned in 04 02 16			
04 02 19	Sludges from on-site effluent treatment containing dangerous substances	H4, H7, H10, H6	(H11, H6.1)	<b>Art. 1 (1) b</b>
04 02 20	Sludges from on-site effluent treatment other than those mentioned in 04 02 19			
04 02 21	Wastes from unprocessed textile fibres			
04 02 22	Wastes from processed textile fibres			
04 02 99	Wastes not otherwise mentioned			

# Example: Classification of waste from leather industry

EWL Code	European waste list (EWL) Classification	H	H	Y
		(EU)	(Basel)	(Basel)
<b>04 01</b>	<b>Wastes from the leather and fur industry</b>			
04 01 01	Fleshings and lime split wastes			
04 01 02	Liming Waste			
04 01 03*	Degreasing wastes containing solvents without a liquid phase	H3, H6, H7	H4.1, H6.1, H11	Y6, Y9, Y42
04 01 04	Tanning liquor containing chromium			
04 01 05	Tanning liquor free of chromium			
04 01 06	Sludges, in particular from on-site effluent treatment containing chromium			
04 01 07	Sludges, in particular from on-site treatment free of chromium			
04 01 08	Waste tanned leather (blue sheetings, shavings, cuttings, buffing dust) containing chromium			
04 01 09	Wastes from dressing and finishing			
04 01 99	Wastes not otherwise specified			



# Waste inventory

Identifying and classifying hazardous and non-hazardous waste

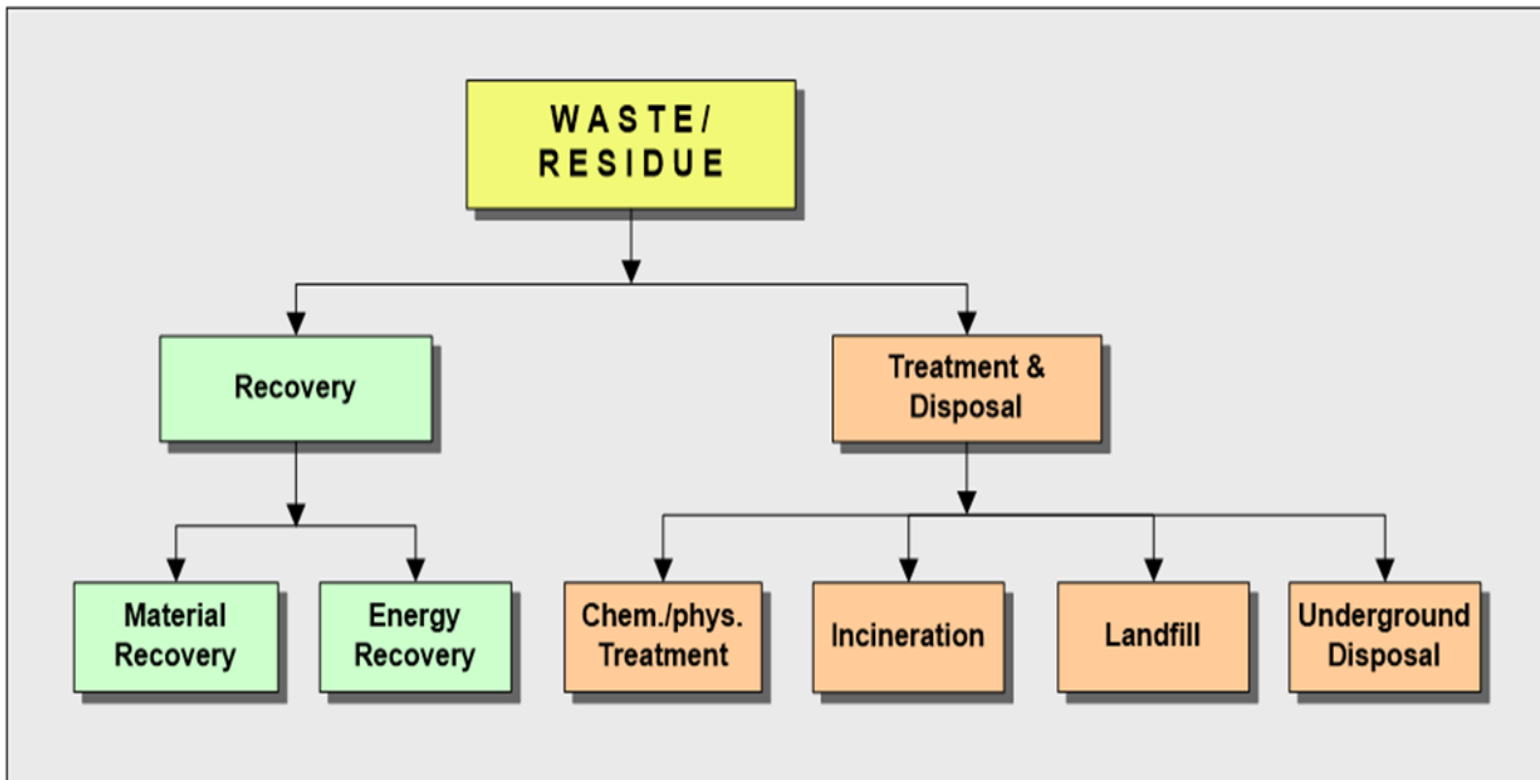
Example: European Waste List

Color code used

- **RED** “Absolute Entries\*” – Hazardous waste regardless of any threshold concentrations (A)
- **BLUE** “Mirror Entries\*” – Hazardous waste only if dangerous substances are present above threshold concentrations (M)
- **BLACK** “Non-hazardous Entries” – Non Hazardous wastes



# Solid waste treatment and disposal option



**Substitution of hazardous chemicals and application of BATs will help you to reduce the hazard levels of your treatment sludge and waste, reducing the cost for their treatment and disposal.**

Source: UNIDO

# Avoid burning of chemical waste in your factory!

- Open uncontrolled burning of mixed chemical waste
  - Inadvertent source of persistent organic pollutants (refer to Stockholm Convention on Persistent Organic Pollutants) => long-term effects
  - Release of toxic by-products of burning process (consult SDS on such by-products) with environmental health effects on immediate surroundings , apart from smoke and unpleasant odours



# Good practices in on-site handling and storage chemical wastes

## Labelling of waste containers showing



**HAZARDOUS  
WASTE**

Contents: Paint and Varnish Sludge (08 01 13\*)

Hazardous property: Flammable!

Department: ABC Date: 01/12/2008

**HANDLE WITH CARE!**

CONTAINS HAZARDOUS OR TOXIC WASTE

Contact: Dep. HAZ or [hazwaste@company.de](mailto:hazwaste@company.de) for disposal

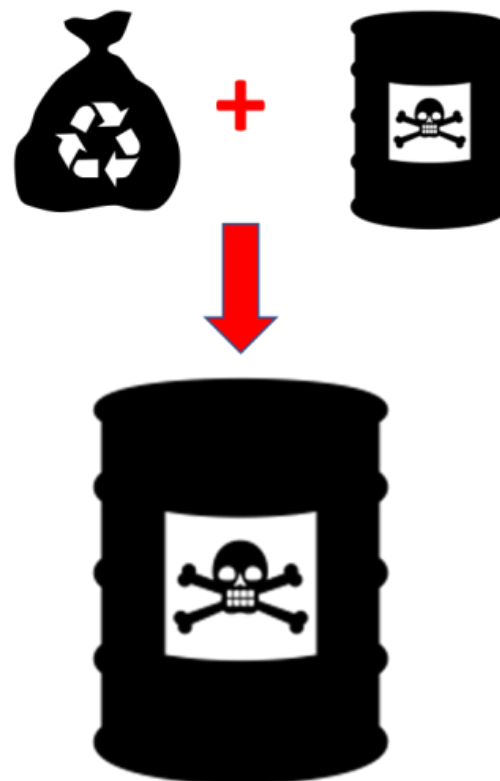
- warning “hazardous waste”
- description of contents, also in layman’s terms
- indication of hazard properties – e.g. “flammable”, “corrosive”, “toxic”, “explosive” - similar to labels and pictograms used for hazardous chemicals
- department/section where the waste has been generated
- name and telephone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

# Good practices in on-site handling and storage chemical wastes

## Separate hazardous and non-hazardous waste

Keep hazardous and non-hazardous chemical wastes apart => Combined waste considered hazardous

- Ensure separation during collection, storage and selection of disposal routes



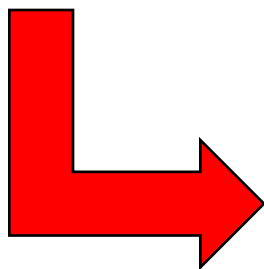
# Good practices in on-site handling and storage chemical wastes



	1	2	3	4	5	6	7	8	9	10	11	12	
Chemical hazard Mechanical hazard													
Explosives	1.1 Explosive	1.2 Explosive	1.3 Explosive	1.4 Explosive	1.5 Explosive	1.6 Explosive	1.7 Explosive	1.8 Explosive	1.9 Explosive	1.10 Explosive	1.11 Explosive	1.12 Explosive	
Compressed gases	2.1 Flammable	2.2 Non-flammable, non-toxic	2.3 Toxic	2.4 Corrosive	2.5 Corrosive	2.6 Corrosive	2.7 Corrosive	2.8 Corrosive	2.9 Corrosive	2.10 Corrosive	2.11 Corrosive	2.12 Corrosive	
Flammable liquids	3.1 Flammable	3.2 Flammable	3.3 Flammable	3.4 Flammable	3.5 Flammable	3.6 Flammable	3.7 Flammable	3.8 Flammable	3.9 Flammable	3.10 Flammable	3.11 Flammable	3.12 Flammable	
Flammable solids	4.1 Flammable	4.2 Flammable	4.3 Flammable	4.4 Flammable	4.5 Flammable	4.6 Flammable	4.7 Flammable	4.8 Flammable	4.9 Flammable	4.10 Flammable	4.11 Flammable	4.12 Flammable	
Oxidizing substances	5.1 Oxidizing	5.2 Oxidizing	5.3 Oxidizing	5.4 Oxidizing	5.5 Oxidizing	5.6 Oxidizing	5.7 Oxidizing	5.8 Oxidizing	5.9 Oxidizing	5.10 Oxidizing	5.11 Oxidizing	5.12 Oxidizing	
Toxic	6.1 Toxic	6.2 Toxic	6.3 Toxic	6.4 Toxic	6.5 Toxic	6.6 Toxic	6.7 Toxic	6.8 Toxic	6.9 Toxic	6.10 Toxic	6.11 Toxic	6.12 Toxic	
Corrosive	7.1 Corrosive	7.2 Corrosive	7.3 Corrosive	7.4 Corrosive	7.5 Corrosive	7.6 Corrosive	7.7 Corrosive	7.8 Corrosive	7.9 Corrosive	7.10 Corrosive	7.11 Corrosive	7.12 Corrosive	

Segregate incompatible hazardous waste to prevent possible emergencies (e.g. chemical reactions)

- Use of different waste containers
- Separation of waste containers



# Good practices in on-site handling and storage chemical wastes



## Provide on-site hazardous waste storage area

- large enough to hold quantities of hazardous waste generated between the usual pick-up dates or further scheduled times of disposal for the hazardous waste
- separately store different types of hazardous waste
- 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
- provisions to contain any leakage or spillage => floor made of impermeable material or plastic sheets or lined with sheets as well as having provisions for containment / dyking



**No access  
for unauthorised  
personnel**



# Good practices in on-site handling and storage chemical wastes



- Waste storage area kept clean
- Containers maintained in good condition and leaking ones immediately replaced
- Hazardous waste containers kept closed at all times except when removing wastes
- Any container containing liquid hazardous waste never filled to the line, and at least 5 cm of air space allowed near the top to control vapor pressure inside
- Working procedures and instructions regarding the safe handling and emergency response available
- Designated personal protective equipment provided and used (in line with requirements of MSDS)



# Good practices in on-site handling and storage chemical wastes



## Handling of empty chemical containers

- Are the chemical containers cleaned before storage and disposal (with wash water sent to effluent treatment plant)?
- Does the company engage a registered waste service provider for final disposal?
- Does the company verify that the hazardous chemical containers are not reused for storage of food items?
- Have you explored the possibility of return system of chemical containers to your chemical supplier?

# Good practices in on-site handling and storage chemical wastes

## Waste action plan created

- Names of persons in charge
- What waste generation data to be collected
- Investment (capital) and running cost associated with waste
- Measures for reducing waste
- Timeframe to reduce waste
- Expected environmental benefits/results (for monitoring and later evaluation)
- How to train and qualify personnel involved in handling hazardous waste about:
  - 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 PPE (e.g., gloves and protective goggles)
  - Location and appropriate use of the chemical SDSs
- Procedures to be followed in the event of an emergency



# Off-site transport and disposal of hazardous (chemical) waste

## Engaging external waste service providers

- Establish procedure and criteria for selection of your waste service providers
  - Licensing/permit requirements in your country for collection, transport, treatment and disposal
- Consider extended responsibility for managing and disposal of chemical waste
  - Ensuring safe packaging and transport (condition of vehicle, qualification of driver)
  - Avoidance of environmental impacts e.g. safe storage facilities, control and treatment of leachate, control and treatment of air emissions)



# Off-site transport and disposal of hazardous (chemical) waste

## Checkpoints – Example Transport of waste

- Classify their hazardous waste according to regulations for transport of dangerous goods
- Use packages/containers in compliance with package specifications on the respective dangerous goods class and quantity
- Place respective danger labels on waste packages
- Ensure that carrier has a license for the transport of dangerous goods
- Check equipment and the suitability of truck sent by carrier for transporting dangerous goods (TDG)
- Ensure proper tie-down of cargo load
- Supply driver with the necessary documentation (in EU 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)
- ....

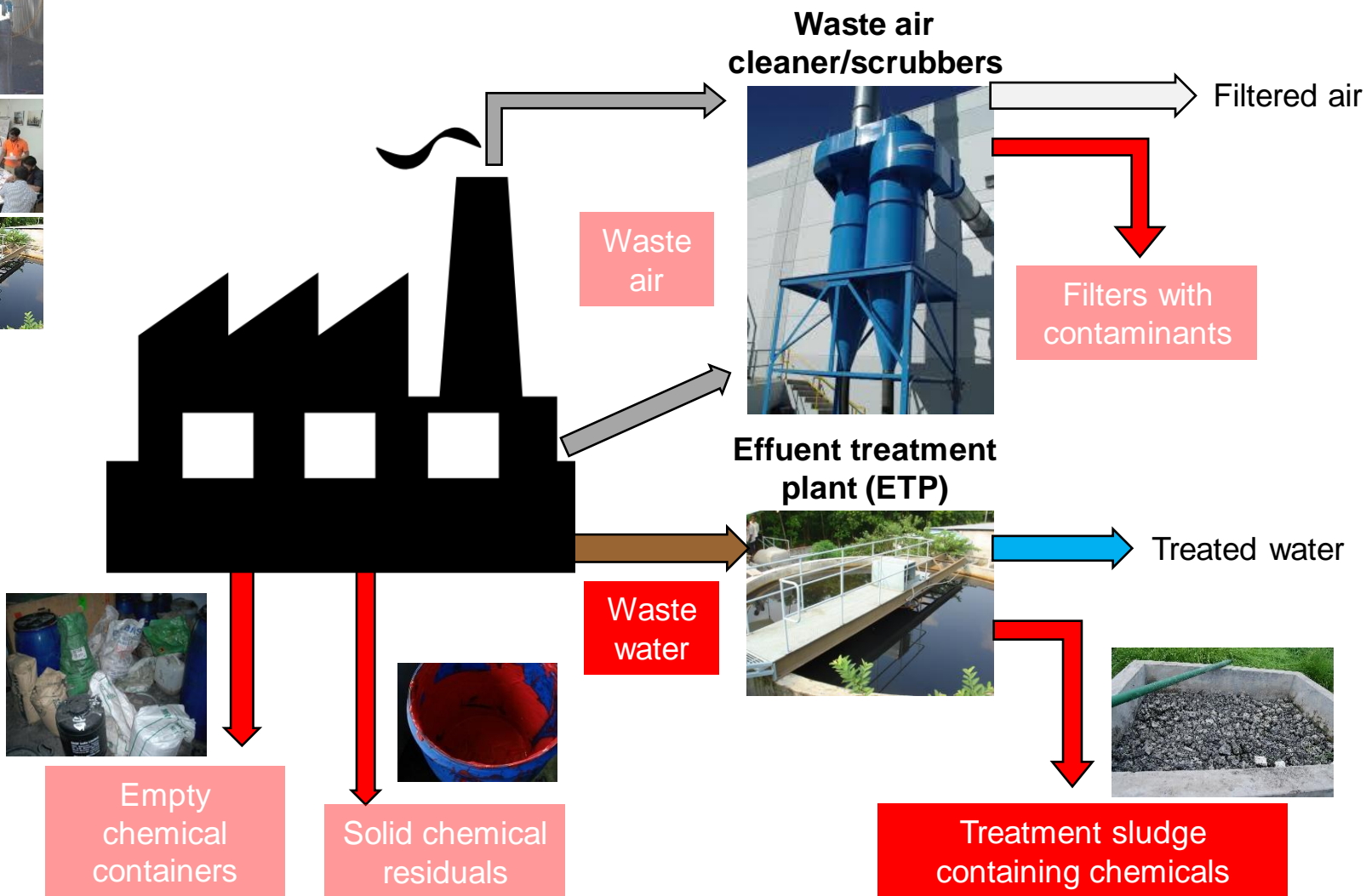


# Off-site transport and disposal of hazardous (chemical) waste

Checkpoints – Example Controlled landfill



# Treatment of waste water and sludge





# General Checkpoints – Waste water treatment

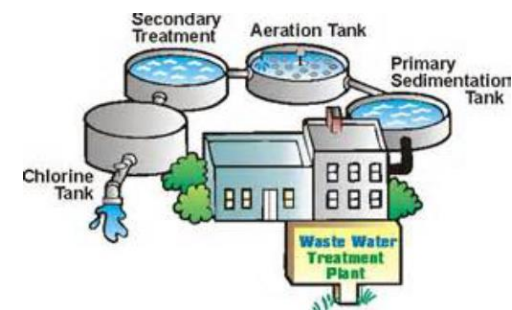
- Does your company have an in-house effluent treatment plant (ETP) or is connected to an external one e.g. common effluent treatment plant (CETP)?
- Does your company have a valid environmental license to operate?
- Does the ETP/CETP comply consistently with wastewater discharge permits at all times?
- Is the ETP operated by designated and qualified personnel?
- Does your company have an approved treatment sludge management plan?



# Treatment of waste water and sludge



Waste water quantity benchmarks in textile industry	L/kg
Wool scouring	2 - 6
Yarn finishing (wool)	35 - 45
Yarn finishing (cotton)	100 - 120
Yarn finishing (synthetic fibres)	65 - 85
Finishing of knitted fabrics (wool)	60 - 70
Finishing of knitted fabrics (cotton)	60 - 136
Finishing of knitted fabrics (synthetic fibres)	35 - 80
Finishing of woven fabric (wool)	70 - 140
Finishing of woven fabric (cotton)	50 - 70
Finishing of woven fabric (synthetic fibres)	100 - 180



Source: BREF BAT/Textile, 2003



# Treatment of waste water and sludge



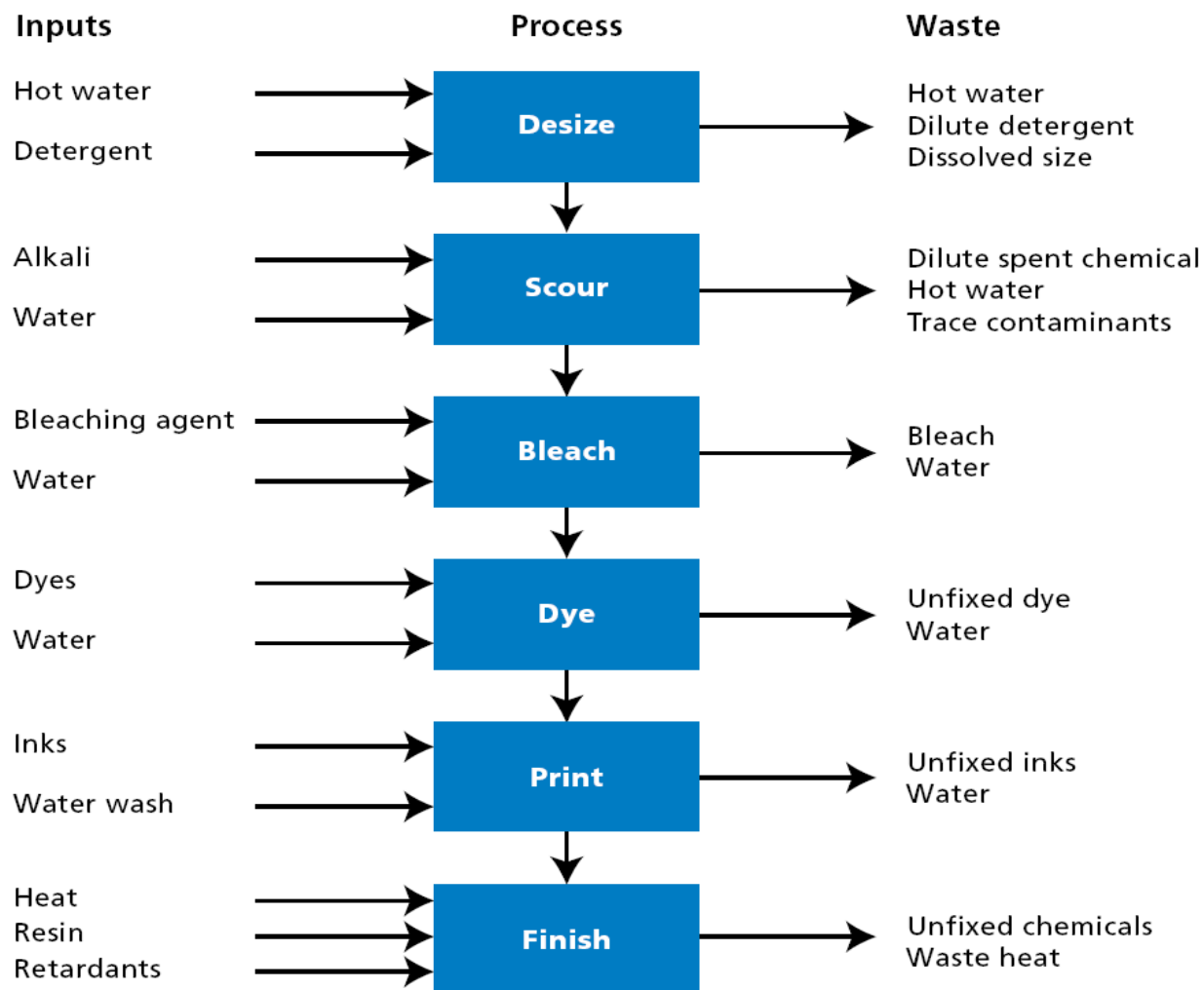
Waste water quantity benchmarks in leather industry	L/kg
Bovine leather (from raw to finished)	12 -30
Pig skin leather (from raw to finished)	32 - 69
Sheep/goat skin leather (from raw to finished)	110 – 265 per skin
Wool-on sheep skin leather (from raw to finished)	360 per fell



Source: BREF BAT/Leather, 2013

# Treatment of waste water and sludge

## Example - Woven fabrics



# Treatment of waste water and sludge

## Good practices

### Linking resource efficiency and waste water management

- 20 - 50% chemical reduction possible by simply reviewing recipes and chemical use
- Re-use of dye solutions from the dye bath
- Recovery of caustic after the mercerizing process
- Replacing hazardous chemicals with less hazardous chemicals, some examples
  - Bi-reactive dyes in place of mono-reactive
  - Switch from APOE to biodegradable
  - Replace metal-containing dyes
  - Starch-based sizes with synthetic sizes



# Treatment of waste water and sludge

## Good practices

### Increase cost effectiveness of waste water treatment

- Segregate toxic from less or non toxic effluent streams
- Segregate effluent containing non-biodegradable material
- Separate streams to multi-cell equalization tank
- Rinse water collection tank for reuse in process where low-grade rinse water is acceptable



# Treatment of waste water and sludge

## What is sludge

- residual **semi-solid material** left as by-product from industrial and municipal wastewater treatment
- **residues of effluent treatment plants** (ETP) independent of applied treatment:
  - Physio-chemical effluent treatment
  - Biological effluent treatment
  - Chemical-biological effluent treatment



# Treatment of waste water and sludge

## Sludge categories – Example Bangladesh

Increasing hazardousness  
for human health and environment

### Category A: Municipal sludge

- only domestic or urban waste waters
- comparable to domestic or urban waste waters

### Category B: Sludge from industry

- including sludge from CETP\*

### Category C: Sludge from industry belonging to the category of hazardous waste

- including sludge from CETP, exhibit one or more hazardous characteristics such as high flammability, explosive property, oxidizing property, poisonous, infectious etc.
- If the sludge or the wastewater are from hazardous labelled industry or contain any chemical recognized as hazardous

\*Central Effluent Treatment Plant

Resource Efficient Management of Chemicals (REMC)





# Treatment of waste water and sludge

## Sludge categories – Example Bangladesh

### Treatment and disposal options

Management Option	Sludge category		
	A	B	C
Anaerobic Digestion (Co-Fermentation)	X <sup>1</sup>	X <sup>1</sup>	**
Aerobic Digestion (Composting)	X <sup>1</sup>		
Agricultural Use	X		
Controlled Landfill*	X	X	X
Thermal incineration	X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>
Land application (filling material, e.g. for flood prevention)	X	X <sup>2</sup>	**
Recycling in brick, cement or asphalt manuf.	X	X <sup>3</sup>	**

# Use cleaner production approaches for cost-effective sludge management

- Reduce quantity of sludge generation
  - Segregation of waste flow from dyeing
  - with appropriate wastewater treatment technologies with low sludge production
  - with proper operation and maintenance in the plant. Monitor pH, dosing of chemicals, aeration level, retention time etc.
  - efficiency of the existing ETP needed to be evaluated
- Reduce volume of sludge
  - By reducing moisture content in the sludge
  - By using techniques such as filter press, vacuum technique, centrifuge etc.
- Reduce the burden of chemical/hazardous load from processing
  - ZDHC approach on MRSL: the use of less hazardous chemicals results in less hazardous sludge
  - Know your raw materials
  - Know your Dyes/Chemicals
  - Substitution of dyes/chemicals:
  - Process approach
  - New Technology





# Special requirements as per ZDHC

Refer to ZDHC Wastewater Guidelines ([www.roadmaptozero.com](http://www.roadmaptozero.com))

- Valid license to operate
- Comply consistently with wastewater discharge permits at all times.
  - For industrial wastewater and any domestic wastewater discharges
  - No bypasses around ETP unless permitted by authorities
- Generally-accepted process engineering best practices applied
- Not dilute wastewater discharge with incoming water as a means to achieve compliance
- Properly classification of treatment sludge
- Sludge hauling and disposal contract out to licensed/ permitted and qualified third parties have appropriate facilities (e.g. no impact on environment from sludge, leacheate,..)

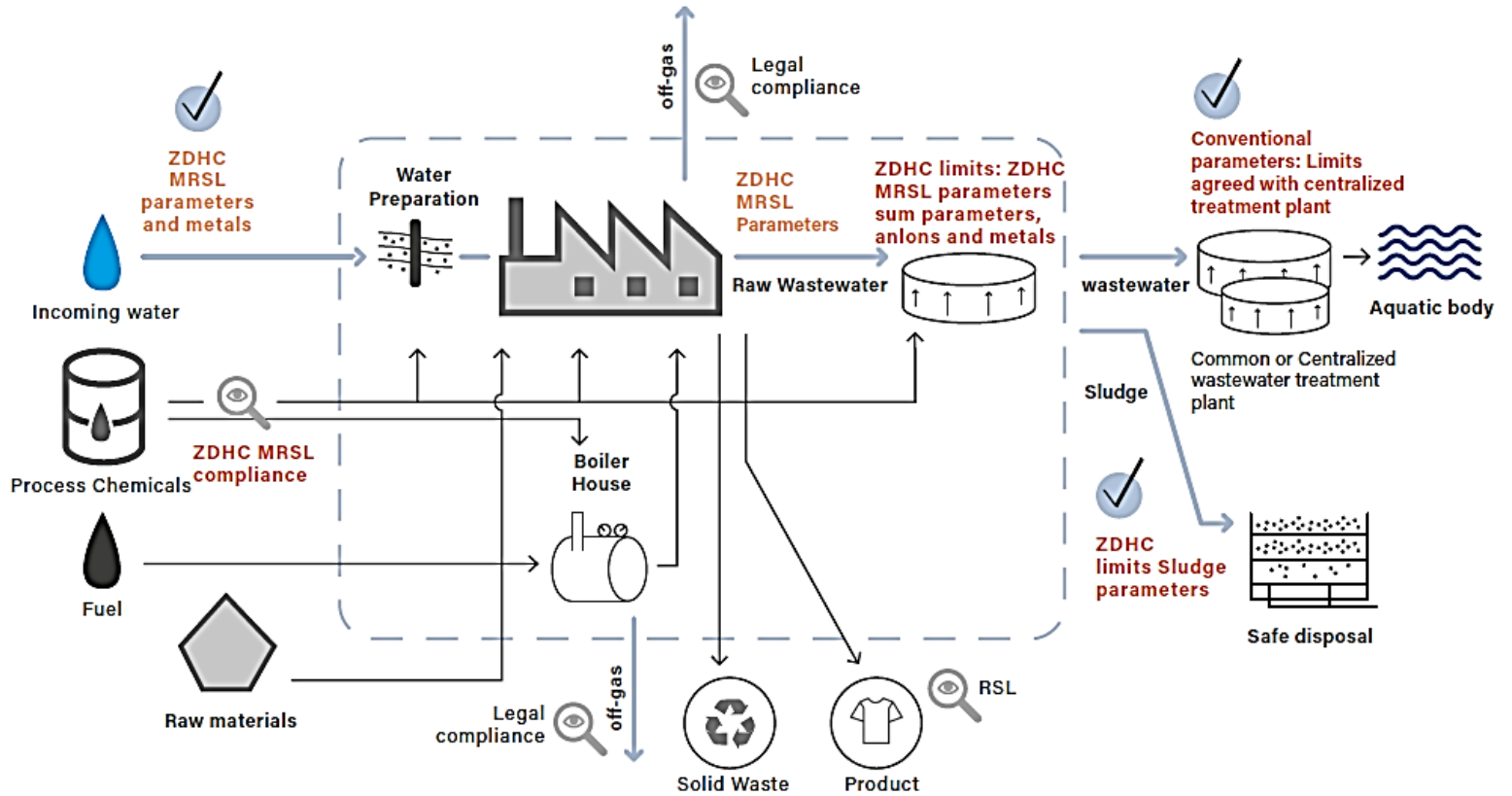




# Special requirements as per ZDHC

Refer to ZDHC Wastewater Guidelines  
([www.roadmaptozero.com](http://www.roadmaptozero.com))

- Each facility expected to develop written procedures clearly identifying and documenting the sampling point/s, sampling methodologies and reporting frequency, for
  - Discharged Wastewater
  - Untreated Wastewater
  - Input water
  - Sludge
- Following sampling methodology
- Adhere to testing and reporting frequency (at least twice a year)

# Special requirements as per ZDHC



-  Check point
-  Measuring point

# For further information and training



- ZDHC Wastewater Guidelines ([www.roadmaptozero.com](http://www.roadmaptozero.com) )
- In Bangladesh
  - IUBAT training on operation of effluent treatment plants
  - DOE Sludge management guidelines
  - Handbook on sludge management in textile industry