MODULE 5

APPLICATIONS

5.1 APPLICATIONS OF EMS

- Environmental Management System is a tool for managing the impacts of an organisation's activities on the environment.
- It provides a structured approach to planning and implementing environment protection measures.
- EMS monitors environmental performance
- EMS integrates environmental management into a company's daily operations, long term planning and other quality management systems.
- Application of Environmental management system (EMS) in urban environment provides a city with orderliness, regularity, quietness and freshness environment.
- It contributes to the sustainable development and optimization in life level index of the city.
- Where malfunctions in manufacturing systems and other activities of a company may lead to environmental damage, procedures must be instituted to identify such malfunctions promptly and instigate remedial action

5.1.1 COMPONENTS OF EMS

1. Environmental Policy
2. Environmental Impact Identification
3. Objectives and targets
4. Consultations
5. Operational and Emergency procedures
6. Environmental Management Plan
7. Documentation
8. Responsibilities and Reporting Structure
9. Training
10. Review Audits and Monitoring Compliance
11. Continual Improvement

5.1.2 BENEFITS OF EMS

An EMS can assist a company in the following ways:

1. Minimize Environmental liabilities
2. Maximize the efficient use of resources
3. Reduce waste
4. Demonstrate a good corporate image
5. Build awareness of environmental concern among employees
6. Gain a better understanding of the environmental impacts of business activities.
7. Increase profit, improving environmental performance, through more efficient operations

5.2 WASTE AUDITS

- Waste Audit is a physical analysis of waste composition to provide a detailed understanding of problems, identify potential opportunities and give a detailed analysis of the waste composition.
- Establish baseline or benchmark data
- Characterise and quantify waste streams.
- Verify waste pathways
- Identify Waste diversion opportunities
- Access effectiveness and determine ways to improve efficiency of current waste management systems.

5.2.1 STEPS IN WASTE AUDITS

1. Background information

- Production processes, facility layout, waste stream generation, waste management costs.
- Source, type, quantity and concentration of waste

2. Plant Survey

- Verify and fill gaps in background data.
- Identify additional waste streams
- Actual operation data and manufacturing practices

3. Sampling

- Identify type of waste and point of origin.
- Determine fate (e.g., waste treatment, storm sewer, and atmosphere).

- Determine rate produced or emissions factors (amount produced per hour, per production unit)
- Determine variability (potential shock loading).

4. Plant Survey Methods and Procedures

- To identify missing or inaccurate information, a preliminary review of the data should be done during, or immediately following, the survey.

5. Evaluation and Selection of Waste Reduction Techniques

- List waste streams
- Identify potential waste reduction techniques for each waste stream
- Evaluate the technical and economic aspects of each technique
- Select the most cost effective waste reduction techniques for each waste stream

6. Waste Minimization Program Implementation and Monitoring

- Keeping employees informed.
- Maintaining records and data
- Corporate Commitment.

WASTEWATER MINIMIZATION

1) Process change: Process changes can reduce the inherent demand for water. An example is the replacement of wet cooling towers by dry air coolers.

2) Water reuse: Wastewater can be reused directly in other water using operations when the level of previous contamination does not interfere with the water using operation. This reduces both freshwater and wastewater volumes but leave the mass load of contaminant essentially unchanged.

3) Regeneration reuse: Wastewater can be regenerated by partial or total treatment to remove the contaminants that would otherwise prevent reuse. The regeneration is any operation that removes the contaminants that prevent reuse and could be filtration, pH adjustment, carbon adsorption, and other processes. Regeneration reduces both freshwater and wastewater volumes and decreases the mass load of contaminant.

4) Regeneration recycle: Wastewater can be regenerated to remove contaminants and then the water recycled. In this case, regenerated water may enter the water using operations in which the water stream has already been used. Also, recycle can sometimes create a buildup of undesired contaminants not removed in the regeneration process.

WASTEWATER REUSE INTO THREE WAYS AS FOLLOWS

1) Internal wastewaters recycle: Depending on the manufacturing process, water consumption can be cut down between 50% to 90% by adopting appropriate water recycling techniques.

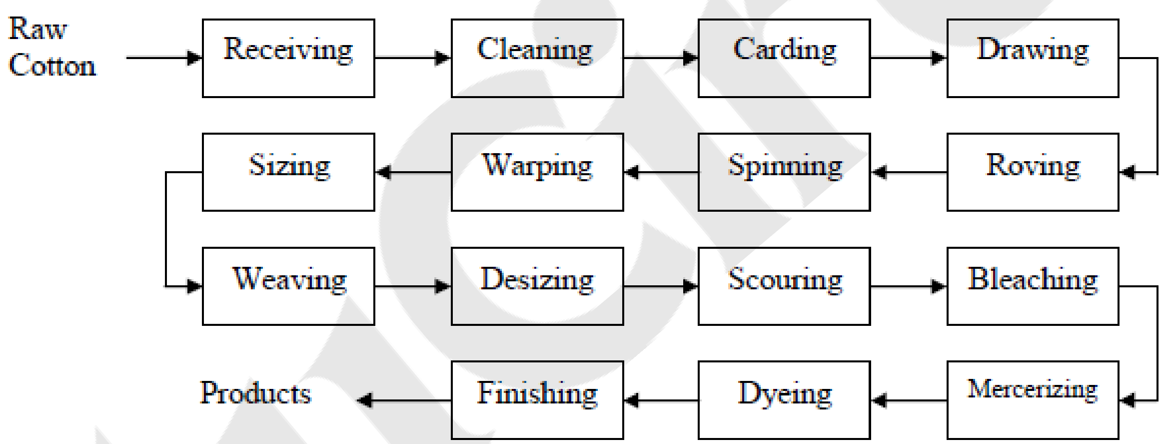
2) Reuse of treated industrial wastewater.

3) Reuse of treated wastewater for other activities such as irrigation, fire protection, dual system etc.

5.3 POLLUTION PREVENTION IN VARIOUS INDUSTRIES

5.3.1 TEXTILE INDUSTRY

Production Process



5.3.1.1 SOURCES OF WASTEWATER AND ITS CHARACTERISTICS

1. Sizing wastewater results from the cleaning of sizing boxes, rolls, size mixer, sizing area and the drainage of sizing solution. Its volume is low but, depending on the recipe used, can contain high levels of BOD, COD and TSS.
2. Desizing effluent results from additives used in the size technique, surfactants, enzymes, and acids or alkaline as well as the sizes themselves. The generated wastewater can be the largest contributor to the BOD and TSS.
3. Scouring wastewater characteristic is an organic and alkaline, contain fabric fragment starch and sizing materials, caustic soda and chemicals used. It generates very high BOD concentrations.

4. Bleaching wastewater usually has high solids content with low to moderate BOD levels include alkaline and contain bleaching agents.
5. Mercerizing wastewater has low BOD and total solids levels but are highly alkaline prior to neutralization. The low BOD content arises from surfactants and penetrating agents used as auxiliary chemicals.
6. Dyeing wastewater depend upon the dyes used. It contributes high volume, color, low BOD, high COD, high temperature and is sometimes toxic.

5.3.1.2 POLLUTION PREVENTION

Pollution prevention programs should focus on reduction of water use and on more efficient use of process chemicals. Process changes might include the following:

- Match process variables to type and weight of fabric (reduces wastes by 10–20%).
- Manage batches to minimize waste at the end of cycles.
- Avoid nondegradable or less degradable surfactants (for washing and scouring) and spinning oils.
- Avoid the use, or at least the discharge, of alkylphenol ethoxylates. Ozone-depleting substances should not be used, and the use of organic solvents should be minimized.
- Use transfer printing for synthetics (reduces water consumption from 250 l/kg to 2 l/kg of material and also reduces dye consumption).
- Use water-based printing pastes, when feasible.
- Use pad batch dyeing (saves up to 80% of energy requirements and 90% of water consumption and reduces dye and salt usage). For knitted goods, exhaust dyeing is preferred.
- Use jet dyers, with a liquid-to-fabric ratio of 4:1 to 8:1, instead of winch dyers, with a ratio of 15:1, where feasible.
- Avoid benzidine-based azo dyes and dyes containing cadmium and other heavy metals. Do not use chlorine-based dyes.

5.3.1.3 CLEANER PRODUCTION OPPORTUNITIES

1) Good housekeeping: Good housekeeping in textile industries is a program of maintenance, inspection, and evaluation of production practices should be established.

2) Reduction in water use-

- Minimizing leaks and spills
- Maintaining production equipment properly
- Identifying unnecessary washing of both fabric and equipment, and
- Training employees on the importance of water conservation.

3) Reuse in mercerizing: On the mercerizing range, the scope for water conservation and reuse lies in adopting a countercurrent flow pattern.

The water requirement can be reduced, if most of this water can be recovered as steam condensate from the multiple effect evaporators of the caustic recovery plant provided suction in the evaporations is carefully controlled to avoid boiling overflow.

4) Reuse in dyeing*:* Small saving can be affected if running washes are replaced by static ones wherever possible. Further, the batching or wetting water need not be drained out. It can be retained for use in the next operation like dyeing.

5) Reuse in printing and finishing: Uses water for various cooling and washing operation and reuse steam condensates in boilers.

6) Reuse of soaper wastewater: The colored wastewater from the soaping operation can be reused at the buckeye washer, which does not require water of a very high quality. Alternatively, the wastewater can be used for cleaning floors and equipment in the print and color shop

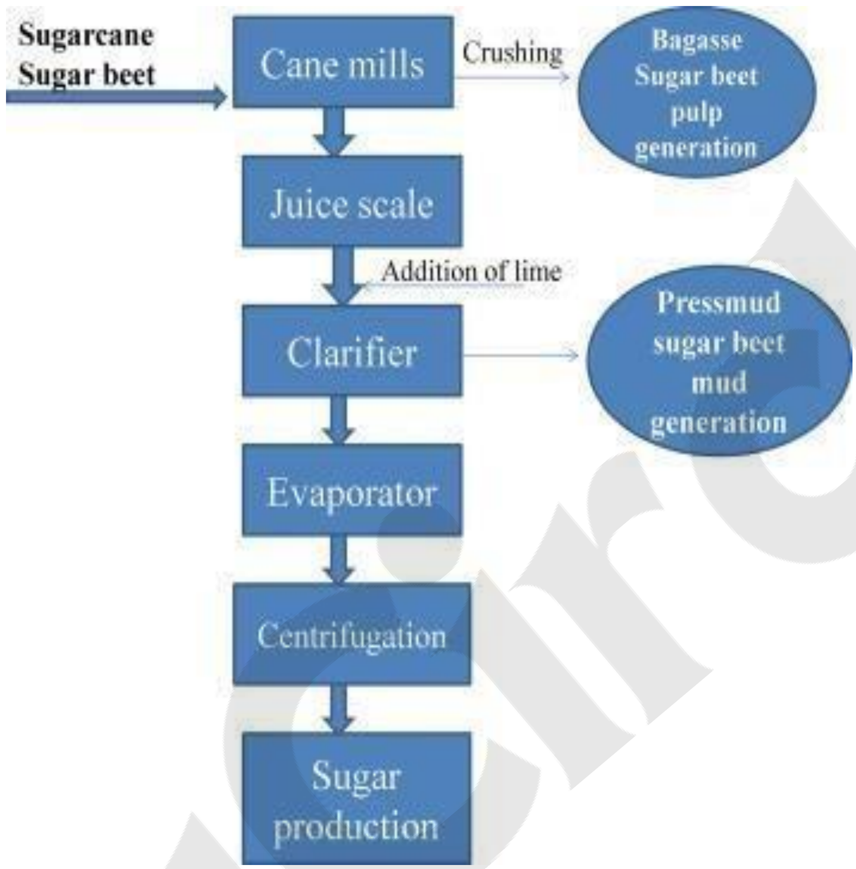
8) Counter current washing: Counter current washing is an employed frequently on continuous preparation and dye range. It can be applied at desire washers, scour washers, mercerizing washers, bleach washers, dye ranges, and print house soaper range.

9) Use of automatic shut-off valves: An automatic shut-off valve set to time, level, or temperature will control the flow of water into a process unit. One plant estimated that a reduction in water use of up to 20% could be achieved with thermally controlled shut-off valves.

10) Use of flow control valves: A flow or pressure reduction valve can significantly reduce the quantity of water used in a wash or clean-up step. These valves are particularly useful in cleaning areas where operators are not always aware of the need for water conservation.

5.3.2 SUGAR INDUSTRY

Production Process



5.3.2.1 SOURCES OF POLLUTANTS AND ITS CHARACTERISTICS

- The main air emissions from sugar processing and refining result primarily from the combustion of bagasse (the fiber residue of sugar cane), fuel oil, or coal.
- Other air emission sources include juice fermentation units, evaporators, and sulfidation units.
- Approximately 5.5 kilograms of fly ash per metric ton (kg/t) of cane processed (or 4,500 mg/m3 of fly ash) are present in the flue gases from the combustion of bagasse.
- Sugar manufacturing effluents typically have biochemical oxygen demand (BOD) of 1,700–6,600 milligrams per liter (mg/l) in untreated effluent from cane processing and 4,000–7,000 mg/l from beet processing; chemical oxygen demand (COD) of 2,300–8,000 mg/l from cane processing and up to 10,000 mg/l from beet processing; total suspended solids of up to 5,000 mg/l; and high ammonium content.

5.3.2.2 POLLUTION PREVENTION AND CONTROL

- Reduce product losses to less than 10% by better production control. Perform sugar auditing.
- Discourage spraying of molasses on the ground for disposal.
- Minimize storage time for juice and other intermediate products to reduce product losses and discharge of product into the wastewater stream.
- Give preference to less polluting clarification processes such as those using bentonite instead of sulfite for the manufacture of white sugar
- Collect waste product for use in other industries—for example, bagasse for use in paper mills and as fuel. Cogeneration systems for large sugar mills generate electricity for sale. Beet chips can be used as animal feed.
- Optimize the use of water and cleaning chemicals. Procure cane washed in the field. Prefer the use of dry cleaning methods.
- Recirculate cooling waters.

5.3.2.3 AUDIT APPROACH

The typical audit comprises of three steps as Pre-Audit, onsite Audit and Post Audit.

Pre-Audit: The Pre-Audit is conducted to get the background information and making the survey by using the questionnaires. The pre audit is useful to get familiar with the company and to save time requirement for the onsite audit.

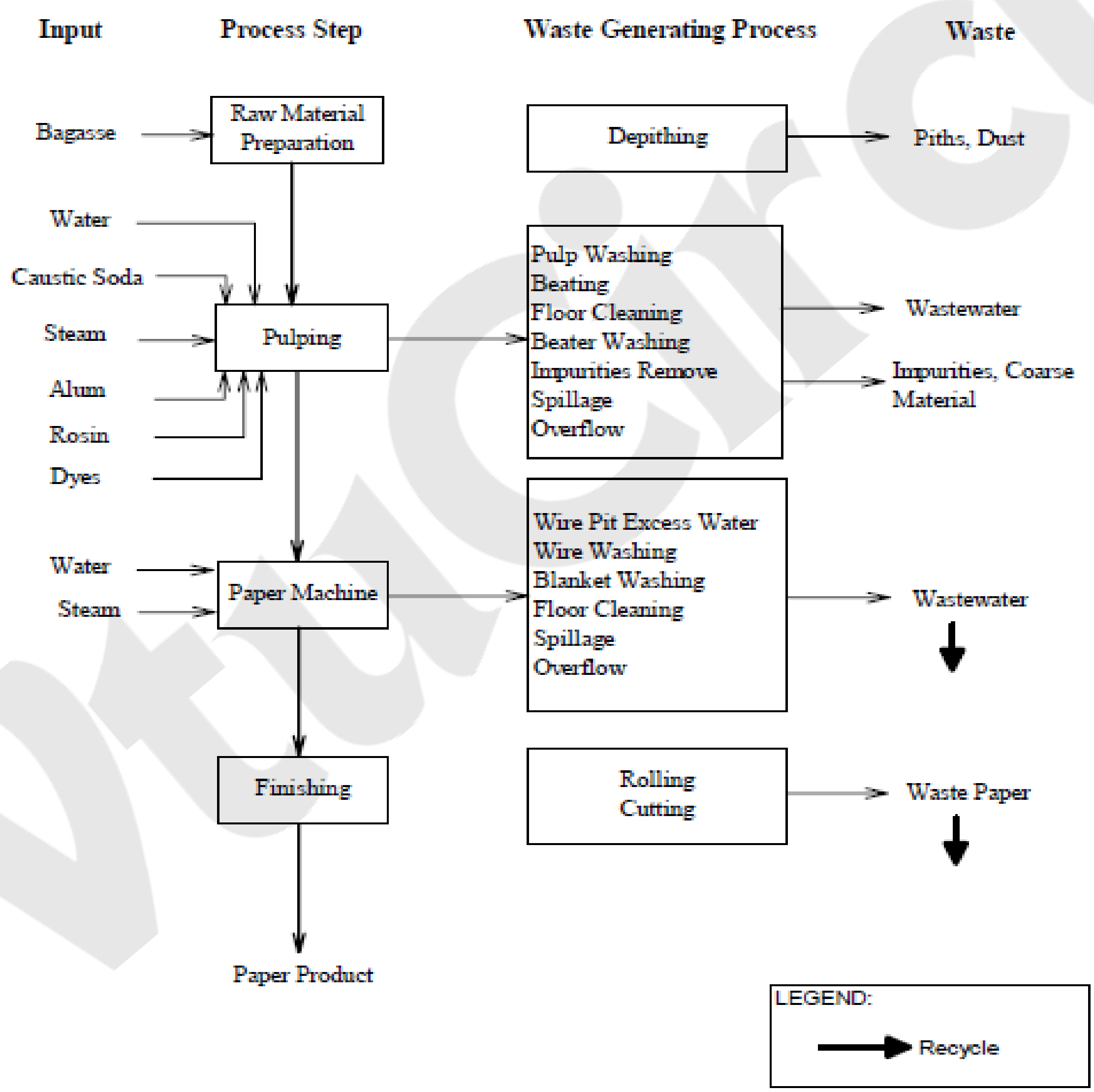
Onsite Audit: The onsite audit means to identify the water usage, raw material consumption, by product produced, wastewater produced, solid waste, hazardous waste generated and also analysis report is produced for all this waste as well as air, noise and sound. The water used for all the purpose within the industry is also taken into account.

Post Audit: The final draft is prepared for raw material, water and energy consumption and also the waste generated on the action plan the recommendation are given.

The wastewater is generated in a sugar factory from processing, domestic purposes and some number of spent lees which is coming from distillery. All these wastewaters treated in ETP of sugar factory treatment process. To achieve BOD reduction from 1000 mg/lit i.e. 92% treatment efficiency. There is two stage biological treatment plants. The first stage will comprises of an aerobic lagoon equipped with surface aerator and second stage is provided with conventional complete mix activated sludge process. The aerated lagoon in first phase is expected to reduce BOD by 50 %. The second stage is activated sludge process which further provides 90% reduction in BOD resulting into an effluent. An oil and grease trap are incorporated to remove all free and floatable material.

5.3.3 PULP AND PAPER MILL/ INDUSTRY

Production Process



5.3.3.1 SOURCES OF POLLUTANTS AND ITS CHARACTERISTICS

Source	Major Pollutants
Chemical Pulping Process	VOCs (terpenes, alcohols, phenols, methanol, acetone, chloroform, methyl ethyl ketone [MEK])
	Reduced sulfur compounds (TRS)
	Organo-chlorine compounds
Bleaching	VOCs (acetone, methylene chloride, chloroform, MEK, chloromethane, trichloroethane)
Wastewater Treatment Plant	VOCs (terpenes, alcohols, phenols, methanol, acetone, chloroform, MEK)
Power Boiler	SO2, Nox, fly ash, coarse particulates
Evaporator	Evaporator noncondensibles (TRS, volatile organic compounds: alcohols, terpenes, phenols)
Recovery Furnace	Fine particulates, TRS, SO2, Nox
Calcining (Lime Kiln)	Fine and coarse particulates

5.3.3.2 POLLUTION PREVENTION AND CONTROL

- Prefer dry debarking processes.
- Prevent and control spills of black liquor.
- Prefer total chlorine-free processes, but at a minimum, use elemental chlorine-free bleaching systems.
- Reduce the use of hazardous bleaching chemicals by extended cooking and oxygen delignification.
- Aim for zero-effluent discharge where feasible. Reduce wastewater discharges to the extent feasible.
- Incinerate liquid effluents from the pulping and bleaching processes.
- Reduce the odor from reduced sulfur emissions by collection and incineration and by using modern, low-odor recovery boilers fired at over 75% concentration of black liquor.
- Dewater and properly manage sludges.
- Where wood is used as a raw material to the process, encourage plantation of trees to ensure sustainability of forest

5.3.3.3 WASTE AUDITING OF THE MILL

Unit Operation of The Mill

1. Main processing sections consuming water are washing, diluting pulp before pumped to beaters, beating and paper making.
2. Beating unit operation is the process combining beating and washing.
3. Wastewater from office section

Solid Waste Generation from Production Process

1. Piths generated from depithing unit operation.
2. The amount of pith separated is accounted for 20% of the bagasse amount.
3. Cinder generated from coal burning from the steam boiler.
4. It is estimated that the cinder amount is accounted for 30% of the amount of coal consumed.
5. Waste paper (low quality product) come from finishing and cutting.
6. At present, this waste paper amount is about 15% of total paper amount from paper machine.
7. The amount of waste paper here seems to be high.
8. The reason leading this might be that the rolls in the paper machines were not clean resulting in paper is broken.
9. Another reason might be the edge for cutting too large.

Water Consumption

- River water from sedimentation unit is pumped to the production area of the mill.
- A part of the raw water is pumped to a tank where alum is added.

This water is used for two purposes:

1. Domestic use including staff housing and office consuming.
2. Steam boiler use after adding chemical to soften the water.

Evaluating Material Balance

1. A material balance of the input and output across the two sections of the paper production was made.
2. This difference was due to beside the washing wastewater there was the black liquor remain from cooking discharging.

3. In pulp and paper industry the useful component balances are : water balance, solid balance and COD balance.
4. These balances give a direct indication of the efficiency of utilization of fibrous raw material, chemical and water. It gives the relative importance of different waste streams in term of quantity of loss

Energy Audit of the Mill

The two major energy forms consuming in the mill are steam and electricity.

1. Coal is used to produce steam.
2. team supply to the cooking and drying process is produced by a steam boiler

5.3.3.4 IDENTIFICATION FOR CLEANER PRODUCTION OPPORTUNITIES

5.3.3.4.1 Causes of Waste Generation

1) Poor Housekeeping

- It was seen the spillage of the bagasse from the belt conveyors when transferring the bagasse from the depither to a digestor.
- The leaking and overflow of water taps in the mill leading to water consumption amount was increased.
- The insulation of steam pipeline has been in bad condition.

2) Poor Raw Material Quality

- It was easy to recognize when surveying the mill that depithed bagasse was still mixed with fine piths after depithing process.
- Hence the input material contains amount of non-fibrous material leading to consume more chemicals and energy.

3) Poor process and equipment design

- The concentrated black liquor from cooking operation have not been separated and collected.
- The spillage of pulp in washing pulp operation was seen due to inadequate size of the potcher (the tanks below the digestors)
- Time of beating was found to be too long (more than 2 hours).
- It was seen that edge cutter was too large.
- Consistency indicator was absence.

- Fiber recovery unit using for wastewater from paper machine was absence

5.3.3.4.2 Cleaner Production

Good housekeeping

1. Installation of a screen to separate fine piths and dust in the depithed bagasse.
2. Repairing the belt conveyor to prevent the bagasse spillage.
3. Replacing another type of water tap to avoid water leaking.
4. Installation of self-closing valves for the pressurized raw water to minimize water wastage
5. Insulation of the steam pipeline
6. Insulation of the digestors.
7. Cleaning the roll in the paper machines to avoid broke paper

Better Process Control

1. Segregation of initial concentrated black liquor
2. Installation of consistency indicator.
3. Adjustment of edge cutter to reduce side trimming loss
4. Use of soft water as boiler feed water.
5. Installation fiber recovery unit (saveall) for whitewater from paper machines.
6. Reduce beating time
7. Multiple loading of digestor

Recycling

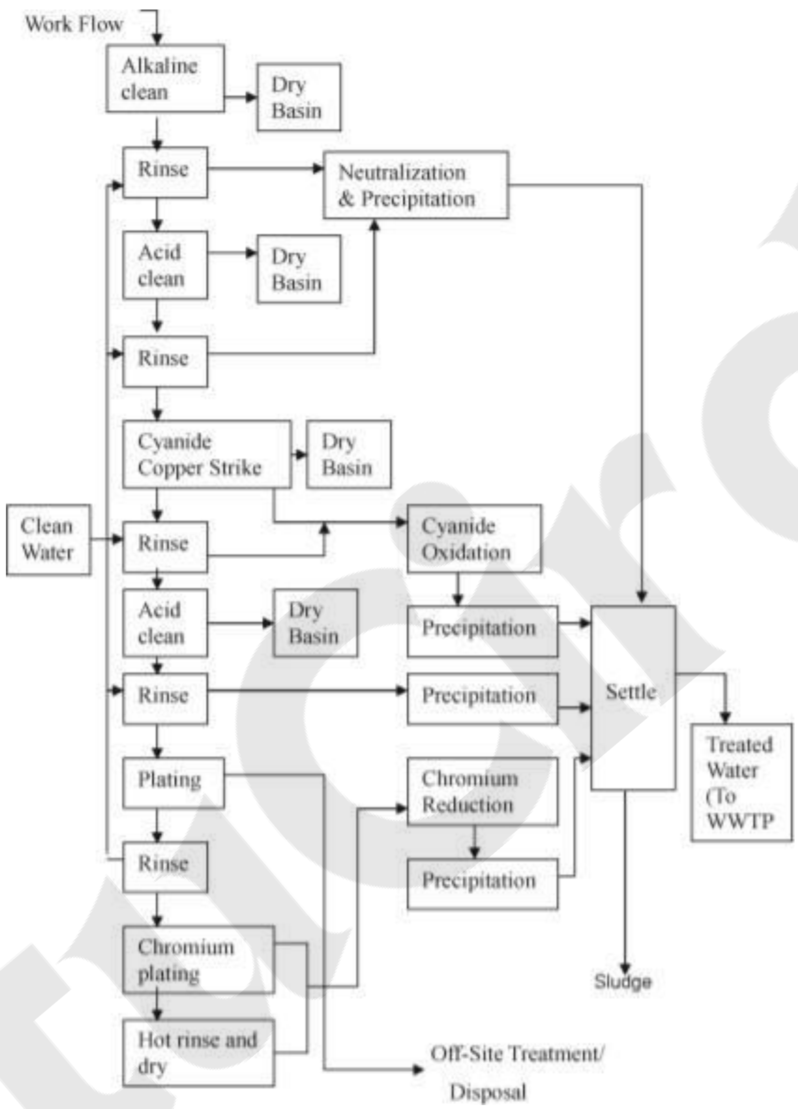
- Recovery of concentrated black liquor for use as construction material additive.

5.3.4 ELECTROPLATING INDUSTRY

- Electroplating involves the deposition of a thin protective layer (usually metallic) onto a prepared metal surface, using electrochemical processes.
- The process involves pretreatment (cleaning, degreasing, and other preparation steps), plating, rinsing, passivating, and drying

The cleaning and pretreatment stages involve a variety of solvents (often chlorinated hydrocarbons, whose use is discouraged) and surface stripping agents, including caustic soda and a range of strong acids, depending on the metal surface to be plated. The use of halogenated hydrocarbons for degreasing is not necessary, as water-based systems are available. In the plating process, the object to be plated is usually used as the cathode in an electrolytic bath. Plating solutions are acid or alkaline and may contain complexing agents such as cyanides.

Production Process



5.3.4.1 SOURCES OF POLLUTANTS AND ITS CHARACTERISTICS

- Any or all of the substances used in electroplating (such as acidic solutions, toxic metals, solvents, and cyanides) can be found in the wastewater, either via rinsing of the product or from spillage and dumping of process baths

- Solvents and vapors from hot plating baths result in elevated levels of volatile organic compounds (VOCs) and, in some cases, volatile metal compounds, which may contain chromates.
- Approximately 30% of the solvents and degreasing agents used can be released as VOCs when baths are not regenerated.

5.3.4.2 POLLUTION PREVENTION AND CONTROL

1. **Changes in Process**

- Replace cadmium with high-quality, corrosion-resistant zinc plating. Use cyanide-free systems for zinc plating where appropriate. Where cadmium plating is necessary, use bright chloride, high-alkaline baths, or other alternatives. Note, however, that use of some alternatives to cyanides may lead to the release of heavy metals and cause problems in wastewater treatment.
- Use trivalent chrome instead of hexavalent chrome; acceptance of the change in finish needs to be promoted.
- Give preference to water-based surface-cleaning agents, where feasible, instead of organic cleaning agents, some of which are considered toxic.
- Regenerate acids and other process ingredients whenever feasible.

2. **Reduction in Dragout and Wastage**
    - Minimize dragout through effective draining of bath solutions from the plated part, by, for example, making drain holes in bucket-type pieces, if necessary
    - Allow dripping time of at least 10 to 20 seconds before rinsing.
    - Use fog spraying of parts while dripping.
    - Maintain the density, viscosity, and temperature of the baths to minimize dragout.
    - Place recovery tanks before the rinse tanks (also yielding makeup for the process tanks). The recovery tank provides for static rinsing with high dragout recovery.

3. **Minimizing Water Consumption in Rinsing Systems**

- It is possible to design rinsing systems to achieve 50–99% reduction in traditional water usage. Testing is required to determine the optimum method for any specific process, but proven approaches include:
- Agitation of rinse water or work pieces to increase rinsing efficiency
- Multiple countercurrent rinses
- Spray rinses (especially for barrel loads).

4. Management of Process Solutions

- Recycle process baths after concentration and filtration. Spent bath solutions should be sent for recovery and regeneration of plating chemicals, not discharged into wastewater treatment units.
- Recycle rinse waters (after filtration).
- Regularly analyze and regenerate process solutions to maximize useful life.
- Clean racks between baths to minimize contamination.
- Cover degreasing baths containing chlorinated solvents when not in operation to reduce losses. Spent solvents should be sent to solvent recyclers and the residue from solvent recovery properly managed (e.g., blended with fuel and burned in a combustion unit with proper controls for toxic metals)

5.3.4.3 Practices That Will Lead to Compliance with Emissions Guidelines

1. Use cyanide-free systems.
2. Avoid cadmium plating.
3. Use trivalent chrome instead of hexavalent chrome.
4. Prefer water-based surface cleaning agents where feasible, instead of organic cleaning agents, some of which are considered toxic.
5. Minimize dragout.
6. Use countercurrent rinsing systems; recycle rinse waters to the process after treatment.
7. Regenerate and recycle process baths and rinse waters after treatment.
8. Recycle solvent collected from air pollution control systems.
9. Send spent solvents for recovery.
10. Do not use ozone-depleting substances.

11. Manage sludges as hazardous waste
12. Reuse sludges to the extent feasible but without releasing toxics to the environment

5.3.4.4 ENERGY CONSERVATION

- Replace lighting with energy efficient bulbs.
- Set up an energy audit for the facility and institute recommendations for energy efficiency.
- Turn off equipment after finish using it.
- Manage information electronically.
- When replacing equipment, check for energy saving features and train employees in energy-wise practices.

5.3.5 TANNING INDUSTRY

Tanneries and The Environment

- When auditing an industrial site or tannery, it is important first to know the quality and quantity of pollutants being released into the environment and second the type and proximity of receptors, in order to established a pollution prevention strategy to lower or eliminate the impact on them.

Environmental Impact

- Environmental impact of tanneries might vary depending on the quality and quantity of generated pollution and the proximity of contaminant effluents to “receptors” (humans, plants, animals or ecosystems exposed to pollutants).
- Sensitive receptors include, for example, hospitals, schools, daycare facilities, elderly housing and convalescent facilities as well as ecosystems.
- These are areas more susceptible to the adverse effects of exposure to toxic chemicals, pesticides, and other pollutants.

Water Consumption

- Water consumption in the tanning sector includes process water, and also technical water which is needed for cleaning, energy use, waste water treatment, and sanitary purposes.
- Process water consumption varies greatly from tannery to tannery, depending on used technology, processes involved, raw material used, and manufactured products, but

accounts for about 80% of the total water consumption. Technical water accounts about for the other 20% of total water consumption.

Impact on waste management systems

- By-products and waste generated during leather production might include trimmings from raw hides, lime fleshing, lime split and pelt trimmings, chromium shavings, chromium split, chromium leather trimmings, buffing dust, finishing chemicals, sludge from wastewater treatment, packaging, salt, organic solvents, residues of process chemicals and auxiliaries, fats from degreasing, finishing sludge, residues from air abatement other than buffing dust, such as activated carbon filters and sludge from wet scrubbers, and residues from waste treatment.

Minimum recommendations for proper environmental management

- Chemicals and hazardous waste - All chemicals, hazardous waste and fossil fuels should be stored on a covered and paved area with secondary spill containment with at least equal capacity to the stored quantity, in order to prevent soil and groundwater contamination.
- Hazardous waste - should be stored to a maximum of 6 months and then properly manage for final elimination or recycling (and complying with local legislation).

Chemicals, by-products and waste.

- No chemicals, hazardous waste, nonhazardous waste and by-products should be dumped, burned or buried anywhere.
- These hazardous materials should be sent to authorized landfills or handed to authorized waste management companies.

Wastewater

- Wastewater- Before discharging any wastewater into the municipal sewer system or any other location, a previous characterization of the wastewater stream and continuous monitoring must be implemented to comply with local environmental legislation
- No untreated or highly contaminated wastewater should be discharged in close rivers, water canals, groundwater and land, to avoid high environmental, economic and social impact.

By-products and waste

- All potentially hazardous waste must be characterized (analyzed) in order to know if the waste can be classified as hazardous or nonhazardous, and implement appropriate management and recycling for each type of waste.

- An environmentally sound management and recycling plan of every generated by-product and waste should be developed collaborating with the local public administration.

Odors

- In order to prevent odors, it is necessary the correct management of accumulated wastes, cured and stored hides processes and the wastewater treatment plant.

Emissions

- All air emissions should be characterized (analyzed) setting limited emission values according to local environmental legislation and health and safety standards.
- If possible, the use of renewable energy should be implemented to avoid greenhouse and other harmful emissions while lowering.

5.3.5.1 POLLUTION PREVENTION AND CONTROL

1. Removal of Salt

- Desalting of raw stock reduces TDS level in the composite tannery wastewater by about 15%.
- Practically, it has been seen that TDS in the composite effluent of a tannery processing salted raw hides/skins to semi-finished leather is reduced from 12,000-18,000 mg/L to 10,500-15,700 mg/L on account of desalting of raw stock, collection and proper disposal of the dusted salt,
- No commercially viable technology for removing salts from the tannery has been developed to date

3. Enzymatic Unhairing

- Separation of the hair from the epidermis by the addition of enzymatic products, avoiding the use of sulphide.

Environmental benefits

- Lower environmental impact in the wastewater given that sulphides are not used
- Hair is removed in solid form so the level of wastewater pollution (COD) is reduced
- Reduction of the consumption of water (less washes than using sulphide)
- Toxicity of wastewater is reduced.

3. Increasing the Efficiency of Chromium Tanning

- It is relevant to optimize the parameters of the process to increase the proportion of the conventional chrome-tanning agent taken up by the hides or skins.

Measures for ensuring high efficiency in the process

- The chromium input must be optimized during conventional chrome tanning to reduce the possible waste (lowest possible quantity of chromium should be used).
- Use of short floats for reducing the chromium input, combining a low chromium input with a high chromium concentration.

Environmental benefits & Driving forces

- Lower consumption of water and tanning agents
- Lower volume of wastewater
- Lower amount of chromium contained in waste and effluents
- Lower amount of chromium in the sludge generated during wastewater treatment

4. Substitution Of Nitrogenous Compounds In Post- Tanning

• • Substitution of amino resins in the retanning stage (urea-formaldehyde and melamine formaldehyde) and ammonia, used as a dye penetrator

Environmental benefits & Driving forces

- The substitution of amino resins with other filling agents for improving the leather fullness avoids the possibility that traces of free formaldehyde may appear in leather.
- The substitution of ammonia as a penetrating agent avoids the possibility that traces of hexavalent chromium may be formed in leather

5. Non-Spraying Curtain or Roller Coating

- The leather to be finished is fed into the machine through a curtain of liquid or by impregnated rollers.

Environmental benefits & Driving forces

- Reduced amounts of waste and solvent emissions to air are the main environmental benefits.
- The avoidance of the mist and solid particulate emissions associated with spraying is also beneficial.
- Roller coating wastage rates of 3-5% are reported as opposed to 40% for conventional spraying.

6. Mechanical and Physio-Chemical Treatment

These operations include several operations as screening of gross solids, skimming of fats, oils, and greases and removal of solids by sedimentation, sulphide oxidation and suspended solids, chromium and COD removal by coagulation/ flocculation and precipitation.

- Pollutants contained in effluents are converted into sludge which is easier to dispose of.

Environmental benefits & Driving forces

- Up to 30-40% of gross suspended solids in the raw waste stream can be removed by properly designed screens.
- Mechanical treatment and by means of a preliminary settling operation, it is possible to remove up to 30% COD, thus saving flocculating chemicals in the next stage and reducing the overall quantity of the sludge generated.
- With the subsequent physico-chemical treatment, it is possible to achieve a reduction of up to 55-75% in the COD.
- A significant reduction of the concentration of substances in the wastewater, particularly chromium (up to 95%) and sulphides (up to 95%) can also be achieved.
- Preparation of wastewater for biological treatment.

7. Water-Based Chemicals for Coating

- Use of finishing products which are dispersed in water rather than in solvent

Environmental benefits & Driving forces

- In the finishing operations, emissions from solvents impose a workplace health problem.
- It would be quite feasible for tanneries to apply aqueous finishes for base and middle finish coats and to apply aqueous nitrocellulose with polyurethane or polyacrylate top coats.
- Environmentally friendly crosslinking agents or self-crosslinking reactive polymers could also be incorporated.
- Benefits are felt from the reduction of VOCs in the workplace. If efficient technology and controlled operations are used, these emissions would be avoided.

8. Organic Waste Fractions and By-Products

- The reduction of waste production inside installations is essential for an optimized waste treatment system

Environmental benefits & Driving forces

- The reduction of wastes sent for disposal is the main reason for using these techniques, as well as obtaining useful by-products and the production of energy.

Ex: 1) Sheep wool can be used by the textile industry, i.e., in carpet manufacture

2) Gelatin and glue can be produced from untanned materials

9. Process Water Management

- A good process water management reduces the global environmental impact

Environmental benefits & Driving forces

- If the tannery implements efficient technical control and good housekeeping, a water consumption of approximately 12-25 m3/t can be achieved, versus 40 m3/t commonly employed.
- The economic feasibility of a change in consumption depends greatly on the cost of water consumption.
- Economizing in the use of water does not in itself reduce the pollution load, but it nevertheless has a number of beneficial effects:
- Saving of energy as a consequence of saving hot water
- Improved uptake of chemicals and consequently savings of chemicals result from the use of shorter floats
- Use of batch washing makes better control possible.
- Additionally, and importantly, the lower effluent volume makes it possible to construct a wastewater treatment plant with smaller capacity

5.4 HAZARDOUS WASTE MANAGEMENT

5.4.1 WHAT IS A HAZARDOUS WASTE?

Hazardous Waste substance is a solid, semi solid or non-aqueous liquid which because of its quality, concentration, or characteristics in terms of physical, chemical, infectious quality:

- Can cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitate reversible illness, or
- Pose a substantial present or potential hazard to humans or the Environment when it is improperly treated, stored, transported, disposed of or otherwise managed.

5.4.2 HAZARDOUS WASTE CHARACTERISTICS

Any waste is hazardous if it exhibits whether alone or when in contact with other wastes or substances, any of the identified characteristics below:

1. Corrosivity
2. Reactivity
3. Ignitability
4. Acute toxicity
5. Infectious property.

CORROSIVITY

A waste exhibits the characteristics of corrosivity if a representative sample of the waste has either of the following properties:

- Any liquid which has pH less or equal to 4 or greater than or equal to 12.5 as determined by the standard test procedure, or
- A waste, which can corrode steel at a rate greater than 6.35 mm per year at a temperature of 55 degree C as determined by standard testing procedures.

REACTIVITY

- Unstable and undergoes violent change without detonation
- Violent reaction with water
- Potential explosive mixture with water
- Toxic gases, vapors or fumes generation of CN or S wastes
- Explosive

IGNITABILITY

- Waste with flash point < 60 degree C

TOXICITY

- A solid waste exhibits the characteristics of toxicity if the leachate from the representative sample.

5.4.3 STORAGE OF HAZARDOUS WASTE

In a large establishment where a number of wastes are being generated, an area be designated as a storage area known as central hazardous waste accumulation area. This is an area where hazardous wastes are accumulated prior to being picked up for treatment, recycling or disposal. Requirements for these areas include:

- The accumulation area must be locked or protected from unauthorized entry. A fence around the area is not required if it is in an area that is already restricted from unauthorized personnel.
- Containers must be labeled with the appropriate hazardous waste label.
- There must be appropriate signage identifying the area as hazardous waste storage, and a "No Smoking" signage.
- Weekly inspections must be conducted at these areas using the weekly inspection checklist.
- There must be sufficient aisle space to allow unobstructed movement of personnel, fire protection equipment, spill control equipment, a n d decontamination equipment to any area of the operation.

EPA-Designated Hazardous Wastes

- The EPA lists contain numerous examples of hazardous wastes that require careful handling and treatment in a cradle-to-grave management system. Three lists of specific hazardous wastes have been promulgated by EPA

1. Nonspecific source wastes: These are generic wastes, commonly produced by manufacturing and industrial processes. Examples from this list include spent halogenated solvents used in degreasing and wastewater treatment sludge from electroplating processes.
2. Specific source wastes: this list consists of wastes from specifically identified industries such as wood preserving, petroleum refining, and organic chemical manufacturing. These wastes typically include sludge, still bottoms, wastewaters, spent catalysts, and residues, e.g., wastewater treatment sludge from the production of pigments.
3. Commercial chemical products: the third list consists of specific commercial products or manufacturing chemical intermediates. This list includes chemicals such as chloroform and creosote, acids such as sulfuric acid and hydrochloric acid, and pesticides such as DDT and Kepone.

5.4.4 TREATMENT OF HAZARDOUS WASTE

The various treatment procedures can be classified as:

1. Physical.
2. Chemical.
3. Biological.
4. Thermal.
5. Incineration

5.4.4.1 PHYSICAL TREATMENT PROCESS

- Physical treatment of hazardous waste includes a number of separation processes commonly used in industry.
- It is of first importance where waste containing liquids and solids are separated to reduce cost.

Few Physical treatment processes are:

- Reverse osmosis
- Flocculation
- Filtration
- Sedimentation
- Carbon Adsorption
- Distillation

5.4.4.2 CHEMICAL TREATMENT

- Chemical treatment transforms waste into less hazardous substances using such techniques as pH neutralization, oxidation or reduction, and precipitation.
- These procedures involve the use of chemical reactions with the help of various chemicals to convert hazardous waste into less hazardous substances.
- The chemical treatment produces useful by-products and some-times residual effluent that are environmentally acceptable.
- Chemical reactions, either reduce the volume of the waste or convert the wastes to a less hazardous form.

Chemical treatment process

- Solubility
- Neutralization
- Precipitation
- Coagulation and flocculation
- Oxidation and reduction
- Ion exchange methods

5.4.4.3 BIOLOGICAL TREATMENT

- Biological treatment uses microorganisms to degrade organic compounds in the waste stream
- It is an effective, efficient and cost-effective way to treat remove hazardous substances from wastewater through biological agents.
- Hazardous waste materials are toxic to some of the microorganism. But a substance, which is toxic to one group of organisms, may act as valuable source of food for another group.
- Bio-treatment is required in ideal conditions for better growth of bio agents and hence is a limitation factor also.
- These involve the use of microorganisms under optimized conditions to mineralize hazardous organic substances e.g. the use of pseudomonas under aerobic conditions break down phenols.

Biological treatment process

- Bioremediation
- Metal uptake through plant species
- Composting
- Bacterial culture

5.4.4.4 THERMAL TREATMENT

- These are the treatment processes which involve the application of heat to convert the waste into less hazardous forms.
- It also reduces the volume and allows opportunities for the recovery of energy from the waste.

5.4.4.5 INCINERATION

- In incineration, in general, waste is destroyed or reduced to CO_2 , H_2O and other inorganic substances and these substances are harmless.
- The only limitation with this treatment process is generation of effluent or emission which is rather secondary pollution.
- Incineration is the controlled combustion process which can be used to degrade organic substances. In practice, complete combustion is difficult if not impossible to achieve but for hazardous waste 99.99% or greater destruction or removal is required for the process to be generally acceptable

5.4.5 DISPOSAL OF HAZARDOUS WASTE

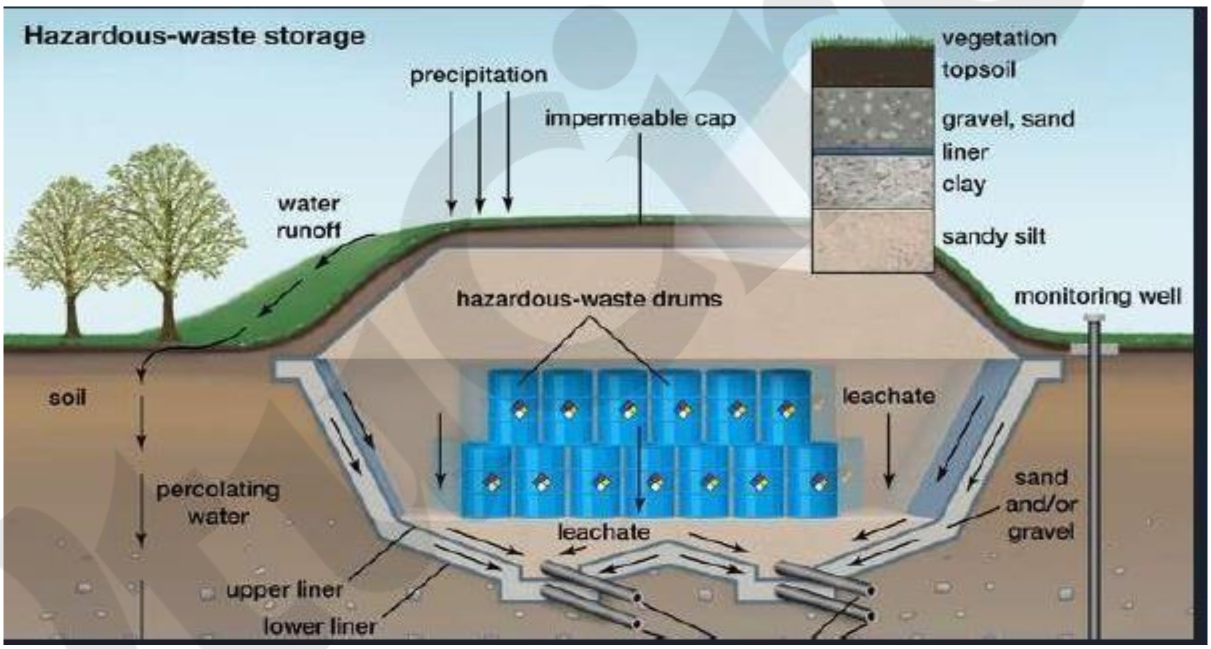
For Hazardous wastes, land disposal is the ultimate destination, although it is not an attractive practice, because of the inherent environmental risks involved.

- Two basic methods of land disposal include **landfilling** and **underground injection**.
- Prior to land disposal, surface storage or containment systems are often employed as a temporary method.

5.4.5.1 SECURE LANDFILLS

- Landfilling of hazardous solid or containerized waste is regulated more stringently than landfilling of municipal solid waste.

- Hazardous wastes must be deposited in so-called secure landfills, which provide at least 3 meters (10 feet) of separation between the bottom of the landfill and the underlying bedrock or groundwater table.
- A secure hazardous-waste landfill must have two impermeable liners and leachate collection systems.
- The double leachate collection system consists of a network of perforated pipes placed above each liner.
- The upper system prevents the accumulation of leachate trapped in the fill, and the lower serves as a backup.
- Collected leachate is pumped to a treatment plant.
- In order to reduce the amount of leachate in the fill and minimize the potential for environmental damage, an impermeable cap or cover is placed over a finished landfill.

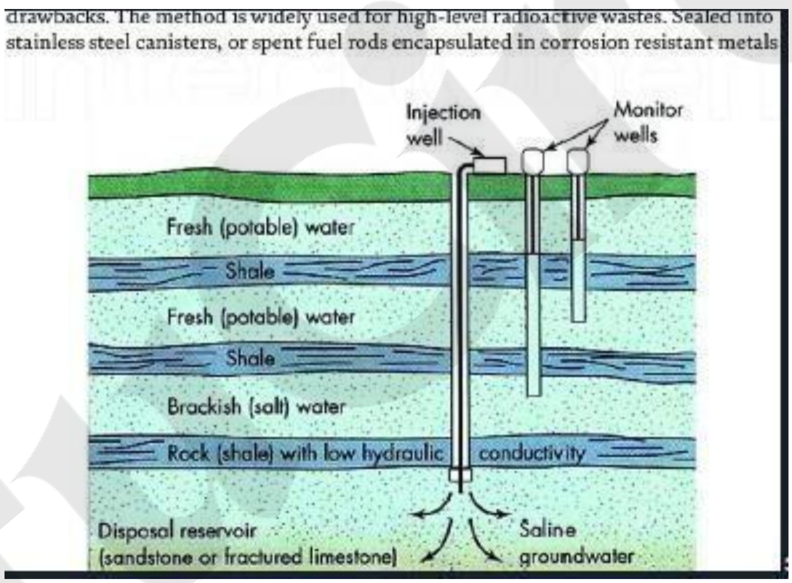


A groundwater monitoring system that includes a series of deep wells drilled in and around the site is also required.

- The wells allow a routine program of sampling and testing to detect any leaks or groundwater contamination.
- If a leak does occur, the wells can be pumped to intercept the polluted water and bring it to the surface for treatment.

5.4.5.2 DEEP-WELL INJECTION

- One option for the disposal of liquid hazardous waste is deep-well injection, a procedure that involves pumping liquid waste through a steel casing into a porous layer of limestone or sandstone.
- High pressures are applied to force the liquid into the pores and fissures of the rock, where it is to be permanently stored.
- The injection zone must lie below a layer of impervious rock or clay, and it may extend more than 0.8 km (0.5 mile) below the surface.
- Deep-well injection is relatively inexpensive and requires little or no pretreatment of the waste, but it poses a danger of leaking hazardous waste and eventually polluting subsurface water supplies.



5.5 TRANSBOUNDARY MOVEMENT

- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted in 1989 and it came into force in 1992.
- It is the most comprehensive global environmental agreement on hazardous wastes and other wastes. With 175 Parties (as at 31 March 2011), it has nearly universal membership. The Convention aims to protect human health and the environment against the adverse

effects resulting from the generation, transboundary movements and management of hazardous wastes and other wastes.

- **Transboundary Movement means** any movement of hazardous wastes or other wastes from an area under the national jurisdiction of one State to or through an area under the national jurisdiction of another state or to or through an area not under the national jurisdiction of any state, provided at least two states are involved in the movement.

5.5.1 CONDITIONS FOR TRANSBOUNDARY MOVEMENT

Parties are under an obligation to take the appropriate measures to ensure that TBM of hazardous wastes and other wastes are only allowed if one of the three following conditions is met:

- The State of export does not have the technical capacity and the necessary facilities, capacity or suitable disposal sites in order to dispose of the wastes in an "environmentally sound manner"; or the wastes are required as raw material for recycling or recovery industries in the State of import; or
- the TBM in question is in accordance with other criteria decided by the Parties (such criteria will normally be found in the decisions adopted by the Conference of the Parties).
- In all cases, the Convention requires that the standard of "Environmentally sound management" (ESM) of hazardous wastes or other wastes is met.

ESM means taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes.

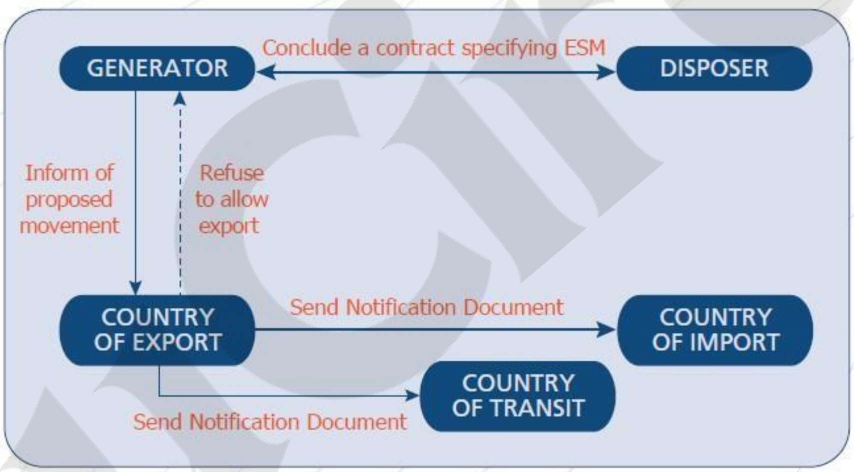
5.5. PROCEDURES FOR TRANSBOUNDARY MOVEMENT

The Basel Convention contains a detailed Prior Informed Consent (PIC) procedure with strict requirements for TBM of hazardous wastes and other wastes. The procedures form the heart of the Basel Convention control system and are based on four key stages

i. Notification
ii. Consent and issuance of movement document
iii. Transboundary movement
iv. Confirmation of disposal.

Stage 1: Notification

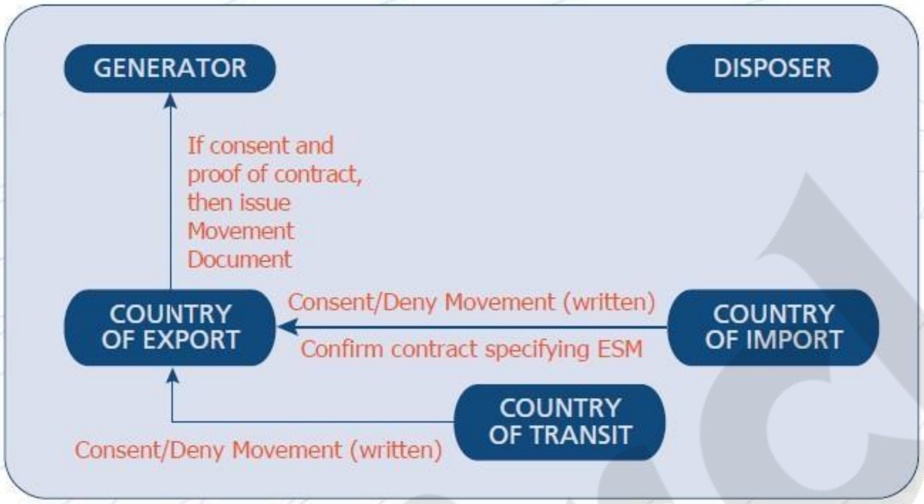
- The purpose of notification is for the exporter to properly inform the importer of a proposed transboundary movement of hazardous wastes or other wastes.
- The exporter/generator of the wastes must inform the Competent Authority (CA) of the State of export of a proposed shipment of hazardous or other wastes.
- Before the shipment can be allowed to start the generator and the disposer conclude a contract for the disposal of the waste. Under the Convention this contract must ensure that the disposal is conducted in an environmentally sound manner.
- If the CA of the State of export has no objection to the export, they inform - or requires the generator/exporter to inform, the CA of the States concerned (State of import and State of transit) of the proposed movement of hazardous wastes or other wastes by means of a "notification document".



Stage 2: Consent & Issuance of Movement Document

- The purpose of stage 2 is to ensure that the importer agrees to the proposed transboundary movement and accompanies the shipment of hazardous wastes or other wastes.
- On receipt of the notification document, the CA of the country of import must provide its written consent or denial.
- The CA of any country of transit must acknowledge promptly receipt and may provide its written consent to the country of export or denial within 60 days.

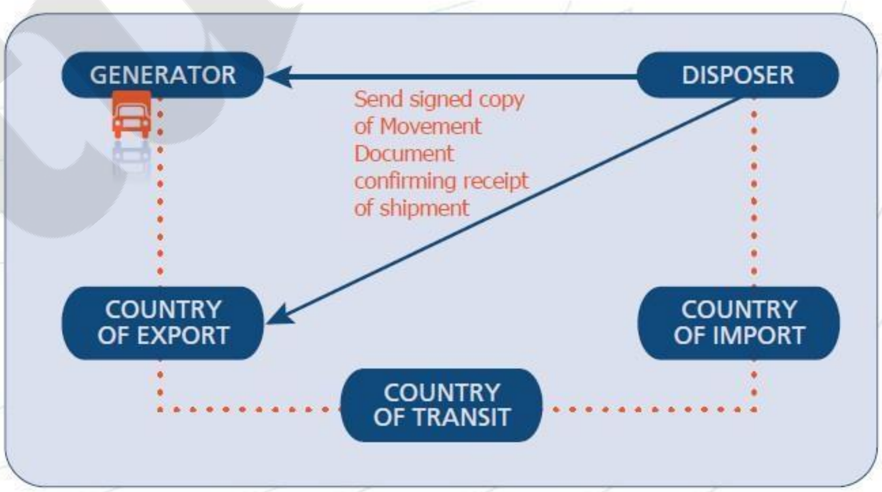
- Once the relevant CAs have established that all the requirements of the Convention have been met and have agreed to the movement, the CA of the country of export can proceed with the issuance of the movement document and authorize the shipment to start.



Stage 3: <u>Transboundary Movement</u>

- Stage 3 illustrates the various steps that need to be followed once the transboundary movement has been initiated and until the wastes have been received by the disposer.

- The movement document provides relevant information on a particular consignment, for example, on all carriers of the consignment, which customs officers it has to pass through, the type of waste and how it is packaged. It should also provide accurate information on the authorizations by the CAs for the proposed movements of wastes.



Stage 4: <u>Confirmation of Disposal</u>

- The purpose of stage 4, the final stage in the TBM procedure, is for the generator and country of export to receive confirmation that the wastes moved across borders have been disposed of by the disposer as planned and in an environmentally sound manner.
- The Convention requires a confirmation from the disposer when the disposal has taken place, according to the terms of the contract, as specified in the notification document. If the CA of the country of export has not received the confirmation that disposal has been completed, it must inform the CA of the country of import accordingly.