MODULE 8 – DEALING WITH INDUSTRIAL WASTE

OBJECTIVES

By the end of this session students will be able to:

1. Know about how industrial and hazardous waste is dealt with.

2. Know how industrial waste can be reduced, reused , recycled and composted.

3. Learn about chemical, physical, thermal and biological treatment processes for industrial waste.

4. Know about land filling of hazardous industrial waste.

SUMMARY

There are two ways of dealing with industrial solid and hazardous waste:
1. Waste management, &,
2. Prevention of pollution and waste.

In 'waste management' we produce large amount of waste and then try to manage it so as to reduce environmental harm, while 'preventing pollution and waste' is to produce less waste in the first place and then utilizing the waste as potential resource which can be recycled, reused or composted.

For reducing waste and pollution, industries need to redesign manufacturing processes and products. Also there is a need to decrease demand and consumption of products. Green designing, life cycle assessment and industrial symbiosis are new concepts which are yet to be implemented so as to achieve a zero waste society.

Industrial wastes containing metals and salts can be reused to recover these resources. Used solvents can be purified and reused and metal based products can be recycled indefinitely, while paper and plastics can be recycled only a few times before they loose their quality. Reusing a product is more close to pollution prevention than recycling.

Industrial wastes are treated to reduce their volume and toxicity through several different types of treatment. This includes chemical treatments, thermal treatments, physical treatments and biological treatments. Various processes are designed for these treatments.

Waste which cannot be reduced, recycled or composted is disposed by dumping in landfills or deep underground wells. But these alternatives are not very safe and may damage the environment and humans. Developed countries export their waste to get rid of it. In the last few years a new kind of waste – e-waste (electronic waste) is also produced in large amounts. It is highly hazardous and toxic. Safe disposal or e-waste is yet to be designed.

To develop a zero-waste society we have to adopt green design concept & strict environmental norms.

TRANSCRIPTION

Introduction

There are two ways of dealing with industrial solid and hazardous waste:

(i) Waste management, &,
(ii) Prevention of pollution and waste

Waste Management: In the first way of waste management we produce large amount of waste, which is an unavoidable part of industrial and economic growth, and then try to manage the waste either by reducing it by burying or burning or land-filling it.
While, Preventing pollution and waste: is to produce less waste in the first place and then to utilize waste as potential resource through several methods of recycling, reusing and reducing. In this approach the economic system is used to discourage waste production. It, rather, encourages the prevention of waste and use of energy and matter resources in a proper way so as to reduce unnecessary consumption. This approach gives more emphasis on:

(a) Reduce waste and pollution
(b) Reuse as many things as possible
(c) Recycle and compost;

And less emphasis is given to:

(a) Chemical and biological treatment & incineration of waste that cannot be reduced, &,
(b) Burning waste in landfills or above-ground vaults.

According to scientific estimates, in a low waste society 60-80% of waste could be eliminated through reduction, reuse and recycling. Remaining 20-40% of waste could be treated to reduce the toxicity and the remnants could be burned or buried.
The present approach of most countries is that of high waste production to achieve faster economic growth and a low cost of production, and then to manage the waste somehow. But slowly the approach of a many small industries and corporate sector is changing because these companies, they have learnt that reduction of waste and pollution can be good for corporate growth, safety and health of workers & consumers and the environment as a whole.

Reducing Waste & Pollution:

One way of reducing waste and pollution is to reduce the consumption of the particular product only using it when it becomes necessary and that too in the smallest quantity.
The other way to reduce waste and pollution is redesigning. For example to redesign manufacturing processes in such a way that ***less material is used***. Today's new generation cars, for example, are lightweight because most of their steel parts are slowly replaced with aluminum and plastic based parts.
To design products that ***produce less pollution and consume fewer resources*** when used is also a way or reducing waste and pollution. For example, to design more energy efficient lights, auto vehicles and other appliances.
Manufacturing processes can also be redesigned to ***produce less waste and pollution.*** For example, most toxic organic solvents can be replaced by water-based or

citrus-based products; and hydrogen peroxide (H_2O_2) can be used in the place of Chlorine (Cl_2) which is generally used for the bleaching of paper, textile and many such products.

The ***Green design concept and life-cycle assessment*** is also a way by which the waste can be reduced or pollution can be reduced. For example, some European car companies have designed their cars in such a way that they could be easily dissembled and the parts can be repaired, reused or recycled. Similarly, tyres have now been designed in such a way that their lifecycle is 97,000 kms, but scientists and researchers feel that it could be increased to 1,60,000 kms., by remanufacturing and redesigning the product.

Eliminating unnecessary packaging is also an important part reducing waste and pollution.

Ecoindustrial Revolution and Clean Production:

Ecoindustrial revolution is a new concept in which all the industrial products and processes are designed in such a way that they become an integrated part of a closed system of material flow and cycling. In this concept one company's waste becomes the resource of another company. Besides, the companies take back packaging and used products so that they can reuse, recycle, remanufacture and even compost the products. This is also known as 'Industrial Symbiosis'.

One such example of industrial symbiosis has been established in Kalundborg of Denmark, where an oil refinery, a thermal power project, , a municipal heating system, a sulfuric acid plant and a biotechnology company, a few farms, a fish farm, some greenhouses, one sheet rock plant, and some other business groups work together and each company's waste is a resource for the other company. Such eco-industrial parks are in the planning stages in many countries, including US.

Scientists and economists believe that this shift from dirty to cleaner technology can be accelerated and can be achieved in next 20-40 yrs.

Recycling & Reuse:

Reuse is also a way of waste reduction, through which we can keep high quality matter resource from being wasted into a low-quality matter waste. It reduces energy consumption, extends resource supplies and reduces pollution.

Industrial wastes such as metal or salt based waste cannot be destroyed and if improperly disposed, t can be a hazard to the people and the environment. These wastes have potential economic value and can be reused. Many precious metals like gold, platinum, antimony, tungsten and cobalt are routinely mined from their waste which has significant amounts of these elements. However, few of the elements of less value like iron and aluminium cannot be recovered because their waste is of low value. A valuable element like silver can be recovered from photographic waste.

Industrial waste high in solvents can be recycled after use, be purified, and reused. For example acetone, chloroform, benzene, xylene and hexane can be reused.

Industrial wastes containing high amounts of organic carbon forms have large quantities of stored energy & these wastes, such as organic liquids, woody materials, resins and oils can be used in incinerators and electric generators for recovery of energy. However, this type of reuse is not very eco-friendly and is rgoverned by high air emission standards by Air Pollution (Prevention & Control) Act.

Other industrial wastes such as mine tailings can be used for fills and earthworks. Or, Oil fields waste, if made salt-free, can be used for earthworks. Similarly, coal-burning waste such as fly ash can be used for earthwork and in mixing the soil & it can also be used for the making of bricks.

Besides, many industries like soft-drink, dairies and distilleries can make reuse of their pet & glass bottles, so as to save energy and matter.

Another big problem of solid-waste is that of used tyres. Tyre dumps are fire hazards and breeding grounds for mosquitoes. Tyre waste is reused in US for foundations and wall making in low-cost housing.

Recycling: Many of us are very familiar with recycling of common materials like glass, aluminum and paper.

Recycling of aluminum is a good example because it produces 95% less air pollution, 97% less water pollution. Besides, it saves around 95% of energy as compared to that which is needed for the mining of aluminum.

There are several other examples of industrial recycling and reuse:

For example, an oil refinery can refine motor vehicle oil & reuse it.

- A paint manufacturer can process waste & household paint.
- A paper industry can recycle the reused paper, although it is a bit difficult process because large amount of paper which is produced now-a-days is coated with plastic or some other material.
- Recycling of metal and glass can be continued indefinitely, but recycling of plastics is not possible because after several uses it loses its quality.

  However, reuse is more eco-friendly and causes less pollution as compared to recycling.

Industrial Waste Treatment: Chemical & Thermal

Industrial waste can be treated to achieve two major goals:

(i) To reduce the volume of waste, &,

(ii) To reduce toxicity of waste

Waste treatment can be done through four major processes, which are –

(a) Chemical Treatment

(b) Thermal Treatment

(c) Physical Treatment

(d) Biological Treatment

(a) Chemical Treatment: This includes the treatments like neutralization, precipitation, oxidation, etc.

Neutralization is a process in which the acidic and basic wastes are treated so as to make them neutralized and to make them non-hazardous and non-reactive.

Precipitation is a process which is often used for waste water and slurried sludges which contain metal. In this process a substance is added to these wastes so that the metals become insoluble and it precipitates out.

Oxidation is often used to detoxify and destroy organic pollutants of carbon-based waste streams. It is of two types – (i) thermal oxidation or incineration (ii) chemical oxidation.

(b) Thermal Treatment: Thermal Treatment includes Incineration and stabilization

Incineration or thermal oxidation is burning of waste at high temperature. Solid or liquid organic containing wastes which have high energy value and low water content can be good example of treating the waste in this way. But this method is hazardous because in this method a lot of hazardous air pollutants are produced and toxic ash is also produced.

Stabilization is a process which is used for the metal based waste. In this process the waste is chemically or physically treated before its final disposal. In thermal stabilization waste is heated to a high temperature and melted. After it cools it is converted into a hard mass in which it is difficult for metals to leach out. Thus it can be safely disposed into landfills.

Industrial Waste Treatment: Physical & Biological

(a) Physical Treatment: This includes treatments such as filtration, dewatering and drying, and distillation.

In *Filtration* a liquid is separated from the solid through a membrane.

Dewatering and Drying is a popular method for treatment of slurry & wastewaters. There are several options available for dewatering and drying such as air drying, particle filtration, sedimentation and decanting.

Distillation is used to separate mixture of liquids, through various temperatures. In this method resource recovery is done and it is used to reduce volume of waste.

(b) Biological Treatment: It is also known as ***bio-remediation***. Here micro-organisms are used to convert hazardous toxic material wastes into the less hazardous andnon-toxic waste. The micro-organisms – they use this material as their nutrients, & sometimes even they change the toxic metal waste into the less hazardous or non toxic metal wastes. When plants are used for this purpose it is called ***phytoremediation.*** In this process many microbes and plants are used and even genetically engineered microbes are being used successfully for bio-remediation.

Disposal of Industrial Waste:

Disposal is the last step in management of industrial waste. Industrial wastes that have low metal content and low economic value are disposed through ***land fills***. But before dumping these wastes it is necessary to neutralize and stabilize them so that toxic metals do not leach out. Similarly, wastes high in salt content can be dumped into special landfills.

Another method which is used in developed countries is ***injecting waste into deep underground wells***, within well understood geological formations. Generally liquid wastes of oil refineries, the brines, metal-containing waste, wastewaters and wastewater containing high concentrations of organic toxic metals can be dumped through this process. This includes pesticides, radioactive material and chlorinated hydrocarbons which are disposed of by this method.

These methods of industrial waste disposal are not very safe and if there is a leakage or seepage they then pollute the groundwater and other resources for at least 10,000 years. Therefore, complex and costly regulations, in addition to potential liability, limit such disposal. Besides, identifying a site for disposal of industrial hazardous waste needs a lot of regulating and investigation. Continuous monitoring is required of dumping site even after the disposal of waste, so that there is no harmful effect on man and environment.

Exporting Waste:

Today's developed countries have evolved a new method of getting rid of their waste and that is to export waste to the less developed countries and poor countries. More often, the whole process is done to escape the strict regulations and the local opposition of the people and to save money. Most of it is exported to Asian countries and the European countries, including Russia. In recent years a large amount of ***electronic waste (e-waste)*** has also been dumped in these countries. This e-waste is highly hazardous and its disposal is not safe.

Conclusion:

It is evident from this discussion that most of our industrial processes are not safe and we have to redesign them, so as to produce less pollution and environmental safety. Also, there is an urgent need to address our present model of our economic growth in which least attention is given to human health and environment issues. To achieve a zero or low waste society, it is necessary that we use green technology, which is environment friendly and long lasting.

Glossary

1. **Solvent**: A solvent is a liquid, solid, or gas that dissolves another solid, liquid, or gaseous solute, resulting in a solution that is soluble in a certain volume of solvent at a specified temperature.

2. **Pesticide**: Pesticides are substances or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. A pesticide may be a chemical substance, biological agent (such as a virus or bacterium), antimicrobial, disinfectant or device used against any pest. Pests include insects, plant pathogens, weeds, mollusks, birds, mammals, fish, nematodes (roundworms), and microbes that destroy property, spread disease or are a vector for disease or cause a nuisance.

3. **Industrial waste**: Industrial waste is a type of waste produced by industrial activity, such as that of factories, mills and mines. It has existed since the outset of the industrial revolution.

4. **Organic Chemicals:** An organic chemical, also referred to as an organic compound, is defined as being constructed of molecules that possess carbon-based atoms. Specifically, it is composed of carbon atoms attached to hydrogen atoms, together with a variety of other elements from functional groups, such as oxygen, nitrogen, sulfur, etc. an organic chemical exists naturally, albeit in a vast variety of combinations. In fact, they occur in all living organisms and form the core of all biological processes. However, organic compounds also govern numerous organic chemical reactions.

5. **Toxic**: A Toxic substance is one that is capable of causing injury or damage to a living organism.

6. **Metal**: A **metal** is a chemical element that is a good conductor of both electricity and heat and forms ionic bonds with non-metals.

7. **Environment**: In general, environment refers to the surroundings of an object. Environment may refer to (a)The natural environment, that is, all living and non-living things that occur naturally on Earth (b) Built environment, or constructed surroundings that provide the setting for human activity, ranging from the large-scale civic surroundings to the personal places (c) Biophysical Environment or the physical and biological factors along with their chemical interactions that affect an organism, and (d) Environment systems, meaning the surroundings of a physical system that may interact with the system by exchanging mass, energy, or other properties.

8. **Pollution**: Pollution is the introduction of contaminants into a natural environment that causes instability, disorder, harm or discomfort to the ecosystem i.e. physical systems or living organisms. Pollution can take the form of chemical substances or energy, such as noise, heat, or light.

9. **Hazardous waste**: Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludges. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes.

10. **Landfill**: A **landfill site** (also known as **tip**, **dump** or **rubbish dump** and historically as a **midden**), is a site for the disposal of waste materials by burial and is the oldest form of waste treatment. Historically, landfills have been the most common methods of organized waste disposal and remain so in many places around the world. Landfills may include internal waste disposal sites (where a producer of waste carries out their own waste disposal at the place of production) as well as sites used by many producers. Many landfills are also used for waste management purposes, such as the temporary storage, consolidation and transfer, or processing of waste material (sorting, treatment, or recycling).

11. **Recycling**: Recycling is processing used materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from landfilling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to virgin production.

12. **Reuse**: To reuse is to use an item more than once. This includes conventional reuse where the item is used again for the same function and new-life reuse where it is used for a new function.

13. **Reduce**: To reduce is to bring down waste production to a smaller extent, size, amount, number, etc.

14. **Waste water**: Wastewater is any water that has been adversely affected in quality by anthropogenic influence. It comprises liquid waste discharged by domestic residences, commercial properties, industry, and/or agriculture and can encompass a wide range of potential contaminants and concentrations. In the most common usage, it refers to the municipal wastewater that contains a broad spectrum of contaminants resulting from the mixing of wastewaters from different sources. Sewage is correctly the subset of wastewater that is contaminated with feces or urine, but is often used to mean any waste water. "Sewage" includes domestic, municipal, or

industrial liquid waste products disposed of, usually via a pipe or sewer or similar structure, sometimes in a cesspool emptier.

15. **Leaching**: In general, leaching is the extraction of certain materials from a carrier into a liquid (usually, but not always a solvent).

16. **Mine tailings**: Tailings, also called slimes, **t**ails, leach residue, or slickens are the materials left overafter the process of separating the valuable fraction from the uneconomic fraction (gangue) of an ore. Tailings are distinct from overburden or waste rock, which are the materials overlying an ore or mineral bodies that are displaced during mining without being processed.

17. **Composting**: Biological decomposition of organic waste by bacteria, fungi, worms and other organisms under controlled aerobic (occurring in presence of oxygen) conditions.

18. **Incineration**: A high temperature waste treatment that involves burning of organic substances present in waste materials. It converts waste into ash, gases and heat.

19. **Vaults**: A reinforced room or compartment where waste can be stored.

20. **Redesign**: Any or all stages in the design process repeated (with corrections made) at any time before, during, or after production.

21. **Green design**: Also called environmental design, it is the philosophy of designing physical objects, the built environment and services to comply with the principles of economic, social and ecological sustainability.
    It is also a product design philosophy that treats environmental attributes as design objectives and not as constraints. It aims at incorporating those attributes without compromising performance, quality, functionality and useful life of the item.
22. **Remanufacturing**: Rebuilding, repairing and restoring an equipment or instrument to meet or exceed original equipment manufacturer's performance specifications.
    The process of creating 'like new' products using cores or discarded products as the primary raw material through the processes of dis-assembly, cleaning, refurbishing, reassembly, at a cost which is typically 40-50% of the 'new' product price. Remanufacturing saves energy, raw materials, reduces solid wastes and labour.
23. **Dissemble/ Dis-assemble**: To disconnect the pieces of (something), e.g. dis-assemble an engine.
    To come apart/to take apart.
    (synonyms: breakdown/demount/dismantle/dismember/ knock down/ strike/ take down).

24. **Cleaner production**: It is a preventive, company specific environmental protection initiative. It is intended to minimize waste and emissions and maximize product output.

25. **Eco-industrial Park**: An eco-industrial park (EIP) is an industrial park in which businesses cooperate with each other and with the local community in an attempt to reduce waste and pollution, efficiently share resources and help achieve sustainable development.

26. **Resource "Recovery"**: It is the collecting and separating of certain waste materials for processing into new forms, which will ultimately be marketed as raw materials for new products. It reduces the amount of waste, saves space in landfills and is more energy efficient than burning materials and conserves natural resources.

27. **Eco-friendly**: Also 'environment friendly', are terms used to refer to goods and services, laws, guidelines and policies claimed to cause minimal or no harm to the environment.

28. **Earth works**: Civil engineering work involving moving quantities of soil.

29. **Foundation**: The portion of a building's structure that transfers the weight of the building into the ground strata.

30. **Detoxify**: To remove toxic substances

31. **Stabilization/Solidification**: These processes are used to treat solid inorganic materials including heavy metals such as chromium, vanadium, lead, cadmium and arsenic - wastes that requires effective treatment to prevent migration into the environment. They are also used to treat solid residuals produced by other Treatment Centre processes, such as ash or slag from incineration or precipitates from Physical/Chemical Treatment. Solid inorganic wastes contaminated with trace metals and other toxic compounds are chemically and physically stabilized using specific recipes.

    Material destined for the Stabilization and Solidification Facility may be subjected to either stabilization or solidification or both, depending on the chemical and physical characteristics of the waste. Waste is first sampled and characterized in the laboratory to determine a treatment recipe. Waste is then reduced to a particulate size of less that one cubic centimetre in the crushing mill. Soluble salts can be removed and disposed of by deep-well injection.

    Stabilization involves addition of binders and additives to prevent hazardous contaminates from leaching into the surrounding environment. This is achieved by chemically immobilizing contaminates.

Solidification uses pozzolanic reagents such as Portland cement, lime or fly ash to form solid, inert material suitable for landfill. The process is used on solid or semisolid waste.

After a leachate test to ensure they are no longer hazardous, stabilization and solidified materials are placed in a secure landfill cell.

32. **Sedimentation**: It is the tendency for particles in suspension to settle out of fluid in which they are entrained and come to rest against a barrier, due to forces like gravity, centrifugal acceleration or electromagnetism.

33. **Decanting (or decantation)**: Process for the separation of immiscible liquids. This is achieved by carefully pouring a solution from a contained in order to leave the precipitate (sediments) in the bottom of the original container.

34. **Disposal**: Systematic destruction especially destruction or transformation of waste or garbage.

35. **Brine**: Water saturated with common salt/ a strong saline solution (as of calcium chloride).

36. **Seepage**: The slow escape of a liquid or gas through porous material or small holes.
37. **E-waste/Electronic waste**: Discarded computers, office electronic equipments, entertainment devices such as mobile phones, TV sets and refrigerators. It is kept in 'Hazardous waste' category because it may contain contaminants such as lead, cadmium, beryllium, mercury and brominated flame retardants.

FAQs

1. How many ways are there to deal with industrial and hazardous waste?

Ans: Broadly speaking, there are two ways of dealing with industrial and hazardous waste (a) waste management, and (b) prevention of pollution and waste.

2. What is 'waste management'?

Ans: 'Waste Management' means producing high amount of waste and then attempting to manage it so as to reduce environmental harm, mostly by burying or burning or shipping it off to other countries.

3. How can industrial waste be dealt with through 'prevention of waste and pollution'?

Ans: ‘Prevention of waste and pollution’ means producing less waste in the first place and then utilizing the waste as a potential resource by recycling, reusing, reducing or composting it.

4. Why is ‘prevention of pollution and waste’ a better way of dealing with industrial waste, as compared with ‘waste management’?

Ans: Because in this system the economic system is used to discourage waste production. It also encourages waste prevention and efficient use of energy and material resources, by reducing unnecessary consumption.

5. How much waste could be eliminated through ‘prevention of waste and pollution’, in a low waste society?

Ans: According to a scientific estimate, in a low waste society 60-80% of solid and hazardous waste can eb eliminated through reduction, reuse and recycling.

6. What are the ways of reducing waste?

Ans: There are several ways to reduce waste:

(a) By decreasing consumption of a product
(b) Redesigning manufacturing process so that it produces less waste
(c) Redesigning products so that they produce less pollution and consume fewer resources when used
(d) Introducing green design concept
(e) Eliminating unnecessary packaging

7. How can life-cycle assessment be used to reduce waste?

Ans: life-cycle assessment can be used to develop products so that they have longer life and are easy to repair, reuse, recycle and remanufacture.

8. Explain the concept of eco-industrial revolution and clean production.

Ans: ‘Eco-industrial revolution’ is a new concept in which all industrial products and processes are redesigned and integrated into a closed system of recycling material flows so that one company’s waste becomes another company’s resource or raw material.

9. In how many years can the target of clean production be achieved?

Ans: According to scientists and economists the target of clean production an be largely achieved in the next 20-40 years.

10. What is the concept of ‘reuse’?

Ans: ’Reuse’ is a form of waste reduction by which we can save unnecessary consumption of matter resource, reduce energy consumption, extend resource supplies and reduce pollution by reusing the product. This includes conventional reuse where the item is used again for the same function and new-life reuse where it is used for a new function.

11. What is ‘recycling’?

Ans: Recycling is processing used materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from land filling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to virgin production.

12. What are the major goals of industrial waste treatment?
Ans: Industrial waste is treated to achieve two major goals:
    (a) To reduce the volume of waste, and,
    (b) To reduce the toxicity of the waste

13. What are the types of waste treatment are used by industries?
Ans: There are four types of waste treatment are used by industries:
    (a) Chemical treatment
    (b) Thermal treatment
    (c) Physical treatment
    (d) Biological treatment

14. What are the processes used under ‘chemical treatment’?
Ans: The processes used under ‘chemical treatment’ are:
    (a) Neutralization
    (b) Precipitation
    (c) Oxidation, including thermal oxidation and chemical oxidation

15. What are the ‘thermal treatment’ processes?
Ans: The processes used for ‘thermal treatment’ are:
    (a) Incineration
    (b) Stabilization

16. What are the ‘physical treatment’ processes for industrial waste treatment?
Ans: The ‘physical treatment’ processes for industrial waste treatment include:
    (a) Filteration
    (b) Dewatering & Drying
    (c) Distillation

17. What is ‘Biological treatment’?
Ans: In ‘bioloogical treament’, micro-organisms and/or plants are used to degrade organic hazardous wastes, using them as nutrients, or changing the toxic metals into less toxic forms. The process is also known as ‘bio-remediation’.

18. Which type of industrial waste is disposed by land filling?
Ans: Industrial wastes that contain very little amount of metals, or any other resource, of which recovery is not economical, are disposed by land filling.

19. What kind of treatment is done to waste before disposing in a landfill and why?

Ans: Before dumping waste in a landfill it is neutralized and stabilized so that the leaching of toxic substances does not take place.

20. Which other method is used for dumping toxic industrial waste in developed countries?

Ans: In developed countries another method used for dumping toxic industrial waste is by injecting it into deep underground wells.

21. How do developed countries at times get rid of their hazardous and industrial waste?

Ans: Today's developed countries have evolved a new way to get rid of their hazardous and industrial waste by exporting it to the poor and less developed countries.