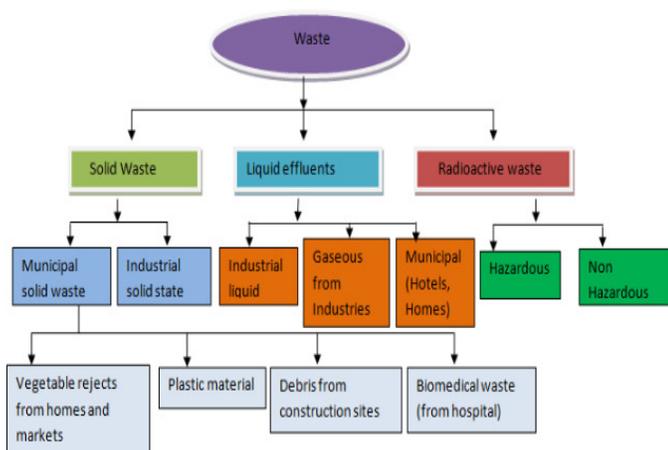


## 22. CLEANER TECHNOLOGY

- Industrial revolution took place in mid-eighteenth century. Once industries began to provide goods and services, life became much easier and comfortable. But the negative aspect of industrialization was generation of lot of waste material.
- Waste accumulated to pollute air, water and land and impacted biodiversity.
- Use of cleaner technologies deals with - improved methods of manufacturing goods by using less energy and raw material and produce good quality goods and such "Eco friendly technology" keeps environment pollution free.
- Waste is an unwanted or discarded material that cannot be used in its present form.
- Waste can be of three types i.e. solid waste, liquid effluent and radioactive waste

Types of WASTE



### 1. Industrial Solid waste

- Coal ash/fly ash from thermal and power plants. Blast furnace slag from iron, steel mill.
- Red mud and tailings from Al, Cu, and Zn producers. Lime mud from Fertilizers industries. Gypsum producing Pulp and paper industries.
- Hospitals producing bio-medical waste.
- Fertilizer and allied industries producing gypsum.

2. The major producers of liquid effluents	<ul style="list-style-type: none"> <li>• Cement, thermal power plants, iron and steel, fertilizer, zinc, copper and aluminum smelters, oil refineries, distilleries, pulp and paper, pharmaceuticals, dye industries, pesticides, petrochemical, tanneries, sugar and basic drugs</li> </ul>
3. Municipal waste	<ul style="list-style-type: none"> <li>• Vegetable rejects from domestic units and vegetable markets, plastic material, building debris, bio-medical wastes etc.</li> </ul>
4. Industrial liquid waste	<ul style="list-style-type: none"> <li>• Liquid waste from industries are after thrown into water bodies like rivers and streams without any treatment.</li> <li>• As a result, these effluents pollute river that adversely affects aquatic life and the river ecology. The industrial waste water often contain valuable materials that can be recovered</li> </ul>
5. Municipal liquid waste	<ul style="list-style-type: none"> <li>• Comes from hotels and residential colonies in the form of sewage.</li> </ul>
6. Gaseous waste	<ul style="list-style-type: none"> <li>• Various gases are emitted from industrial installations that have potential use but are not being utilized.</li> <li>• These gases can be converted into methanol and petrol.</li> <li>• <b>Recoverable from liquid and gaseous waste</b></li> </ul> <p>Municipal sewage - Treat and convert to usable water.</p> <p><b>Gaseous Sewage</b></p> <ol style="list-style-type: none"> <li>1. CO<sub>2</sub> convert into CaCO<sub>3</sub></li> <li>2. SO<sub>2</sub> convert into gypsum or S</li> <li>3. Hot gases suitable use</li> </ol>
7. Recoverable from liquid and gaseous waste	<ul style="list-style-type: none"> <li>• Comes mostly from Nuclear Power plants.</li> <li>• Hazardous because radioactive substances emit harmful radiations.</li> <li>• Radioactive waste should be disposed off carefully to save physical environment and living beings from exposure to radiation. Waste, are categorized into hazardous waste and Non-hazardous waste</li> </ul>

• **Concept of Cleaner Technology**

- Cleaner technology is using technology in industries in such a way that environment is protected from harmful effects of waste accumulation and the resulting pollution.
- The aim of cleaner technology is to make industrial manufacturing processes cleaner and more sustainable by redesigning them taking clues from nature, that is, how nature deals with wastes.
- In nature, waste or the leftover of one organism becomes food of another organism, so that nutrients of the earth are endlessly recycled.

**So the problems and solutions are:**

Problems	Solutions
<ul style="list-style-type: none"> <li>• Improper disposal of waste causes pollution.</li> <li>• Pollution causes damage to physical environment and health-hazards for plants, animals and humans.</li> <li>• But industries are needed for development.</li> </ul>	<p>Devise/cleaner manufacturing technologies for-</p> <ul style="list-style-type: none"> <li>• Less waste generation</li> <li>• Better methods of waste disposal and detoxification them.</li> <li>• Indulge in Reduce, Reuse, Recycle</li> <li>• Encourage 'Resource Exchange' i.e., use waste of one industry as raw material for another.</li> <li>• Discard "Throw away" economy as it is wasteful economy and causes pollution due to accumulation of waste.</li> </ul>

- **Waste Management** means planning and implementing ways and means of safe disposal by avoiding incineration or burning waste which is commonly used but releases the green house gas carbon dioxide into the environment causing global warming and climate change .

- The slogan for waste management are use of 3Rs



- The three Rs strategy of waste management involves **reduce, reuse and recycle**. If these 3Rs are used to manage waste, negligible waste will remain.

• **How to reduce waste:**

- Reduce consumption
- Redesign manufacturing process so that less material and energy is needed.
- Make repairable products.
- Make long- lasting products.
- Reduce on packaging or use recyclable packaging.

• **How to Reuse:**

- Product reuse reduces waste of resources and pollution.
- A well made product is long lasting, repairable and reusable.
- Do not junk everything. For example - recover and reuse automobile parts, bricks, doors, steel frames from broken down houses in new construction.
- Believe in handing down clothes, glass, crockery, utensils.
- **Use cotton and jute-** made bags and metal and material for long use and biodegradable waste rather than the non-degradable plastic.
- Be careful in handling waste from TV, Computers, Mobile phones and other electronic waste (e-waste).
- Dismantling them leaves scrap of heavy metals like Lead, Mercury and Cadmium. Do not burn them to prevent exposure to fumes of dioxins.

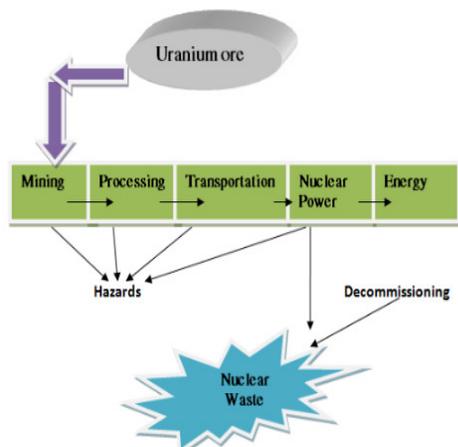
• **How to Recycle:**

- Design and mould discarded material into new products and artifacts. e.g. use old newspapers and magazines and one sided written paper.
- Glass, aluminum and steel may also be remolded. So also plastic can be recycled.
- Make manure, compost and vermicompost from kitchen waste and use for growing your plants.

- When waste is recycled to make same products e.g. old plastic bags into new plastic garbage bags, it is
- **Primary Cycling:** When waste makes new product - e.g. rubber tyres into rubber bands, paper pulp fibres into cardboards, it is termed **Secondary Cycling**.
- Our priority to tackle the problem of waste management should be in the order as follows:

First Priority	Second priority	Last Priority
<b>Waste Prevention</b>	<b>Reuse and Recycle</b>	<b>Waste management</b>
<ul style="list-style-type: none"> <li>• Change in manufacturing process to stop production of harmful chemicals.</li> <li>• Use less of harmful resources or materials</li> <li>• Reduce packaging materials in products</li> <li>• Make products that last longer and are easy to repair</li> </ul>	<ul style="list-style-type: none"> <li>• Reuse products</li> <li>• Repair products</li> <li>• Recycle</li> <li>• Compost (biodegradable)</li> <li>• Reassembled/ products</li> <li>• Recyclable</li> </ul>	<ul style="list-style-type: none"> <li>• Treat waste material to reduce toxicity</li> <li>• Bury waste in landfills.</li> <li>• Incinerate waste</li> <li>• Release waste into the environment for dispersal and dilution.</li> </ul>

- Nuclear energy is atomic energy. Atoms are the smallest parts or units of elements. Atoms have a nucleus. When the nucleus of radioactive elements like Thorium or Uranium splits (nuclear fission) or fuses with another nucleus (nuclear fusion), a lot of energy is released. Nuclear power plants capture such nuclear energy for use by humans.
- Nuclear “fuel cycle” begins with-



- Mining of uranium ore from the underground mines. Each step of the ‘fuel cycle, (mining,

processing, transportation, nuclear power and energy production) poses a potential threat or hazard which is dangerous for life on earth.

- Apart from heat, many new radioactive elements (Strontium-90 and Plutonium-239) are also produced. These are unwanted and dangerous by products or “radioactive waste”.
- Uranium ore and mill waste remain heaped in deserts because there is no place to store them. They blow around with wind and wash with rain giving out radioactive gas for thousands of years in future.
- People are concerned about the safety of nuclear power plants that are currently operating.
- Radiations can be released from them and nuclear contamination can occur at other points.
- 3-mile Island, USA in 14<sup>th</sup> March, 1979 and Chernobyl in Ukraine on 25<sup>th</sup> April 1986 are the some example of nuclear disaster.
- Prevention and Control of Nuclear disaster:
  - In such cases immediate manual shut down of reactor necessary. Redesigned reactor with automatic shut down.
  - In nuclear power plants, only one third heat used for generating electricity, two-third lost as waste heat redesigning necessary.
  - Instead of installing expensive cooling operation, constant reactor near lakes, rivers, ocean to draw lot of water and return after cooling is over.
- **Safe Disposal of Nuclear Waste**
  - Radioactive waste may be low level (LLW) or high level (HLW) .
  - LLW include waste from use of radionuclides in laboratories, hospital and industries.
  - HLW results from spent nuclear fuel rods and absolute nuclear weapons.
- Nuclear waste may be disposed safely as-
  - Bury it deep underground in insulated containers.
  - Shoot it into the space or into the sun. The cost would be very high
  - Bury it under the ice sheet of Antarctica or Greenland ice cap.

- Change it into harmless or less harmful isotopes.
- Dump it into deep oceans by keeping the waste into glass and steel cases.
- **Life Cycle Analysis**
  - Society has become concerned about issues of natural resources depletion and environmental degradation.
  - Many industries have started using “clean technology” processes to provide “greener” products.  
Many industries are actually using pollution prevention methods to check and improve their environmental performance.
  - Life Cycle Assessment (LCA) is actually a concept which considers the entire life cycle of a product.
  - The term “life cycle” refers to the major activities in the course of products life span from acquiring the raw material to its manufacture, use, maintenance and final disposal.
- **Life Cycle Assessment (LCA) is done in a systematic manner:**
  1. **Aim or goal** i.e. define or describe the product, process or activity.
  2. **Inventory analysis** i.e. identify and quantify energy, water, material used and environmental releases (e.g. air emissions, solid waste disposal and waste water discharge)
  3. **Impact assessment** i.e. assesses the human and ecological effects of energy, water and material usage and the environmental releases identified in the inventory analysis.
  4. **Interpretation** i.e. evaluates the results inventory analysis and impact assessment to select the preferred product or service.
- **Benefits of Life Cycle Analysis**
  - Becomes easier to select product or process vis-a-vis environmental impact.
  - Identifies environmental impact from one medium (Air emissions) to another (discarding liquid effluents).
  - Impact of each stage on human and ecological effects of material consumption can be assessed.
- **Ecolabelling**
  - When 'Labels' are put on eco- friendly products, it is called **Ecolabelling**. For example, if you see the picture of "earthen pot" on a product you can buy the product because it refers to the slogan "no harm to environment product".
- **Objectives of Ecolabelling**
  - Protect environment
  - Spread awareness about environmental issues.
  - Encourage efficient management of renewable and non renewable resources.
  - Protect ecosystem and species diversity.
  - Prevent pollution.
- In India, **ecolabelling scheme** is of Indian government which supports cleaner technologies for manufacturing Eco friendly products .e.g. soaps, detergents architecture, paper etc.
- The idea of earthen pot is to show that it is made of soil to serve the purpose. Once broken, it mixes with soil so no harm to environment. Such labels are called **Eco Labels**.
- Presently the scheme is limited to household and some consumer products to meet certain environment criteria alongwith quality requirements of Indian standards. The label is known as “Eco mark” and issued by CPCB.
- An ‘**earthen pot**’ indicating that the product is not harmful to the environment.
- There is a growing need to apply scientific knowledge and methods to develop cleaner technology for efficiently and judicious use of natural resources.



### Check Yourself

1. What is the end product of pulp and paper industry?
  - a. Lime mud
  - b. Fly ash
  - c. Gypsum
  - d. Red mud
2. What is the recoverable matter from textile industry?
  - a. Sodium salt
  - b. Phenol
  - c. Caustic soda
  - d. Fluoride
3. Bacteria and enzymes help to destroy toxic hazardous substance in harmless compounds, this process is known as:
  - a. Cryopreservation
  - b. Smelting
  - c. Fermentation
  - d. Bioremediation
4. Which authority does issue eco label in India?
  - a. FASSAI
  - b. CPCB
  - c. MOEF
  - d. SPCB
5. What is the symbol of eco-level
  - a. An earthen pot
  - b. Fish
  - c. Rose flower
  - d. Tiger

Ans: 1.a      2.c      3.d      4.b      5.a



### Stretch Yourself

1. Define the concept of cleaner technology
2. What is the main objective of ecolabelling?
3. Name recoverable matter from industries belongs to pulp and paper, textile, fertilizer and distillery.
4. What is bioremediation?
5. Define background radiation.



### Test Yourself

1. How does fuel cycle work? Explain in brief
2. Mention the role of 3Rs (Reduce, Reuse and Recycle) in waste management?
3. Why do you think that safe disposal of nuclear waste is necessary to prevent any disaster?
4. Describe the procedure of Life Cycle Analysis (LCA) or Assessment.
5. Mention the advantages of conducting LCA