7 ■ **NUCLEAR HAZARDS**

Radioactive substances are present in nature. They undergo natural radioactive decay in which unstable isotopes spontaneously give out fast moving particles, high energy radiations or both, at a fixed rate until a new stable isotope is formed. (Fig. 2.5.7)

The isotopes release energy either in the form of gamma rays (high energy electromagnetic radiation) or ionization particles i.e. alpha particles and beta particles. The alpha particles are fast moving positively charged particles whereas beta particles are high speed negatively charged electrons. These ionization radiations have variable penetration power. (Fig. 5.5)

Sources of Radioactivity

Various sources of radioactivity can be grouped into (*i*) Natural sources and (*ii*) Anthropogenic (man made) sources.

(*i*) **Natural Sources**: Sources of natural radioactivity include cosmic rays from outer space, radioactive radon-222, soil, rocks, air, water and food, which contain one or more radioactive substances.

(*ii*) **Anthropogenic sources**: These sources are nuclear power plants, nuclear accidents, X-rays, diagnostic kits, test laboratories etc. where radioactive substances are used.

Effects of Radiations

Ionisation radiations can affect living organisms by causing harmful changes in the body cells and also changes at genetic level.

(*i*) **Genetic damage** is caused by radiations, which induce mutations in the DNA, thereby affecting genes and chromosomes. The damage is often seen in the offsprings and may be transmitted upto several generations.

(*ii*) **Somatic damage** includes burns, miscarriages, eye cataract and cancer of bone, thyroid, breast, lungs and skin.

Damage caused by different types of radiations depends on the penetration power and the presence of the source inside or outside the body. Alpha particles lack penetration power but they have more energy than beta. They will be, therefore, dangerous when they enter the body by inhalation or through food. Alpha particles cannot penetrate the skin to reach internal organs whereas beta particles can damage the internal organs. Greater threat is posed by radioisotopes with intermediate half-lives as they have long time to find entry inside the human body.

Control of Nuclear Pollution

(*i*) Siting of nuclear power plants should be carefully done after studying long term and short term effects.

(*ii*) Proper disposal of wastes from laboratory involving the use of radioisotopes should be done.

■ SOLID WASTE MANAGEMENT

Higher standards of living of ever increasing population has resulted in an increase in the quantity and variety of waste generated. It is now realized that if waste generation continues indiscriminately then very soon it would be beyond rectification. Management of solid waste has, therefore, become very important in order to minimize the adverse effects of solid wastes. Solid waste (waste other than liquid or gaseous) can be classified as municipal, industrial, agricultural, medical, mining waste and sewage sludge.

Sources of Urban and Industrial Wastes

Urban waste consists of medical waste from hospitals; municipal solid wastes from homes, offices, markets (commercial waste) small cottage units, and horticulture waste from parks, gardens, orchards etc.

- **Waste from homes (Domestic waste)** contains a variety of discarded materials like polyethylene bags, empty metal and aluminium cans, scrap metals, glass bottles, waste paper, diapers, cloth/rags, food waste etc.
- **Waste from shops** mainly consists of waste paper, packaging material, cans, bottles, polyethylene bags, peanut shells, eggshells, tea leaves etc.
- **Biomedical waste** includes anatomical wastes, pathological wastes, infectious wastes etc.
- **Construction/demolition waste** includes debris and rubbles, wood, concrete etc.
- **Horticulture waste and waste from slaughter houses** include vegetable parts, residues and remains of slaughtered animals, respectively.

The urban solid waste materials that can be degraded by micro-organisms are called **biodegradable wastes**. Examples of this type of waste are vegetable wastes, stale food, tea leaves, egg shells, peanut shells, dry leaves etc. Wastes that cannot be degraded by micro-organisms are called **non-biodegradable wastes**. For example, polyethylene bags, scrap metal, glass bottles etc.

- **Industrial waste:** Industrial waste consists of a large number of materials including factory rubbish, packaging material, organic wastes, acids, alkalis and metals etc. During some industrial processing large quantities of hazardous and toxic materials are also produced. The main sources of industrial wastes are chemical industries, metal and mineral processing industries. Radioactive wastes are generated by nuclear power plants. Thermal power plants produce fly ash in large quantities. Solid wastes from other types of industries include scrap metal, rubber, plastic, paper, glass, wood, oils, paints, asphalt, tars, dyes, scrap leather, ceramics, abrasives, slag, heavy metals, asbestos, batteries. In Europe and North America the environmental laws and safety laws are becoming more stringent due to which disposal of hazardous wastes is becoming a problem. Cost of disposal of such wastes is increasing. Therefore, these wastes are being exported to developing countries which do not even have sufficient knowledge or technique for their disposal.

Effects of Solid Wastes

Municipal solid wastes heap up on the roads due to improper disposal system. People clean their own houses and litter their immediate surroundings which affects the community including themselves. This type of dumping allows biodegradable materials to decompose under uncontrolled and unhygienic conditions. This produces foul smell and breeds various types of insects and infectious organisms besides spoiling the aesthetics of the site.

Management of Solid Waste: For waste management we stress on 'three R's'-Reduce, reuse and recycle before destruction and safe storage of wastes.

(*i*) **Reduction in use of raw materials:** Reduction in the use of raw materials will correspondingly decrease the production of waste. Reduced demand for any metallic product will decrease the mining of their metal and cause less production of waste.

(*ii*) **Reuse of waste materials:** The refillable containers which are discarded after use can be reused. Villagers make casseroles and silos from waste paper and other waste materials. Making rubber rings from the discarded cycle tubes which are used by the newspaper vendors, instead of rubber bands, reduces the waste generation during manufacturing of rubber bands. Because of financial constraints poor people reuse their materials to the maximum.

(*iii*) **Recycling of materials:** Recycling is the reprocessing of discarded materials into new useful products.

(*i*) Formation of some old type products e.g. old aluminium cans and glass bottles are melted and recast into new cans and bottles.

(*ii*) Formation of new products: Preparation of cellulose insulation from paper, preparation of fuel pellets from kitchen waste. Preparation of automobiles and construction materials from steel cans.

The process of reducing, reusing and recycling saves money, energy, raw materials, land space and also reduces pollution. Recycling of paper will reduce cutting of trees for making fresh paper. Reuse of metals will reduce mining and melting of ores for recovery of metals from ores and prevent pollution.

For **discarding wastes** the following methods can be adopted:

(*i*) **Sanitary landfill**: In a sanitary landfill, garbage is spread out in thin layers, compacted and covered with clay or plastic foam.

In the modern landfills the bottom is covered with an impermeable liner, usually several layers of clay, thick plastic and sand. The liner protects the ground water from being contaminated due to percolation of leachate. Leachate from bottom is pumped and sent for treatment. When landfill is full it is covered with clay, sand, gravel and top soil to prevent seepage of water. Several wells are drilled near the landfill site to monitor if any leakage is contaminating ground water. Methane produced by anaerobic decomposition is collected and burnt to produce electricity or heat.

(*ii*) **Composting**: Due to shortage of space for landfill in bigger cities, the biodegradable yard waste (kept separate from the municipal

waste) is allowed to degrade or decompose in an oxygen rich medium. A good quality nutrient rich and environmental friendly manure is formed which improves the soil conditions and fertility.

(*iii*) **Incineration**: Incinerators are burning plants capable of burning a large amount of materials at high temperature. The initial cost is very high. During incineration high levels of dioxins, furans, lead and cadmium may be emitted with the fly ash of incinerator. Dioxin level may reach many times more than in the ambient environment. For incineration of materials, it is better to remove batteries containing heavy metals and plastic containing chlorine before burning the material. Prior removal of plastics will reduce emissions of dioxins and polychlorinated biphenyls (PCBs)

■ ROLE OF AN INDIVIDUAL IN PREVENTION OF POLLUTION

The role of every individual in preventing pollution is of paramount importance because if every individual contributes substantially the effect will be visible not only at the community, city, state or national level but also at the global level as environment has no boundaries. It is the responsibility of the human race which has occupied the commanding position on this earth to protect the earth and provide conducive environment for itself and innumerable other species which evolved on this earth. A small effort made by each individual at his own place will have pronounced effect at the global level. It is aptly said, *"Think globally act locally"*.

Each individual should change his or her life style in such a way as to reduce environmental pollution. It can be done by following some of the following suggestions.

- Help more in pollution prevention than pollution control.
- Use ecofriendly products.
- Cut down the use of chlorofluorocarbons (CFCs) as they destroy the ozone layer. Do not use polystyrene cups that have chlorofluorocarbon (CFC) molecules in them which destroy ozone layer.
- Use the chemicals derived from peaches and plums to clean computer chips and circuit boards instead of CFCs.
- Use CFC free refrigerators.

The manufacture and operation of such devices should be encouraged that don't pollute. If they cost more then their higher prices may be offset by including environmental and the social costs of pollution in the price of such products which pollute environment.

Air pollution can be prevented by using really clean fuel i.e. hydrogen fuel. Hydrogen for that matter should not be produced by passing current in water as for generation of this current, again the environment will be polluted. So solar powered hydrogen fuel is the need of the hour.

- Reduce your dependency on fossil fuel especially coal or oil.
- Save electricity by not wasting it when not required because electricity saved is electricity generated without polluting the environment. Put on warm clothes rather than switching on a heater.
- Adopt and popularize renewable energy sources.
- Improve energy efficiency. This will reduce the amount of waste energy, i.e. more is achieved with less energy.
- Promote reuse and recycling wherever possible and reduce the production of wastes.
- Use mass transport system. For short-visits use bicycle or go on foot. Decrease the use of automobiles.
- Use pesticides only when absolutely necessary and that too in right amounts. Wherever possible integrated pest management, including alternate pest control methods (biological control), should be used.
- Use rechargeable batteries. Rechargeable batteries will reduce metal pollution.
- Use less hazardous chemicals wherever their application can be afforded. Baking soda, vinegar and borax can help in cleaning, bleaching and softening. Baking soda can replace modern deodorants.
- The solid waste generated during one manufacturing process can be used as a raw material for some other processes.
- Use low phosphate, phosphate-free or biodegradable dish washing liquid, laundry detergent and shampoo. This will reduce eutrophication of water bodies.
- Use organic manure instead of commercial inorganic fertilizers.
- Do not put pesticides, paints, solvents, oils or other harmful chemicals into the drain or ground water.
- Use only the minimum required amount of water for various activities. This will prevent fresh water from pollution.

- When building a home, save (don't cut) as many trees as possible in the area.
- Plant more trees, as trees can absorb many toxic gases and can purify the air by releasing oxygen
- Check population growth so that demand of materials is under control.