PUC Ist year - Semester – II

Unit VII: Environmental issues: Causes,effects and control measures

Module No 38. Thermal pollution and Nuclear hazards

Increase or decrease in the temperature of water, air and land by human activity is called Thermal pollution.

Temperature is one of the most vital environmental factors for organisms. Temperature fluctuation influences all metabolic process for organisms. Heated effluents, either from natural or man made sources, contaminated with water supplies may be harmful to life because of their toxicity, reduction in normal oxygen level of water, aesthetically unsuitable and spread diseases. Thermal pollution reduces the number of aquatic species and destroys the balance of life in streams.

Sources of Thermal pollution:

Following sources contribute to thermal pollution

1. Electric power plants and nuclear power stations use water as a coolant. These units release hot water to the original source of water such as River, Lake, Sea etc., raising its temperature. Such hot effluents kill both plants and animals resulting in decreased primary production.
2. Some thermal power plants utilize coal as fuel. Coal-fired power plants constitute the major source of thermal pollutants. Their condenser coils are cooled with water from near by lake or river and discharge the hot water back to the stream increasing the temperature of near by water.
3. The municipal sewage normally has a higher temperature than the receiving water. This discharged sewage not only raises the stream temperature but also creates numerous deleterious effects on aquatic biota.

4. In addition to electric power industries, various factories with cooling requirement contribute to thermal pollution.

Effects of Thermal pollution:

1. A rise in temperature changes the physical and chemical properties of water. Concentration of dissolved oxygen decreases with increase in temperature, which seriously affect the aquatic organisms.
2. The rising temperature increases the toxicity of the poison present in water.
3. Increase of temperature interfere with the biological activity of the aquatic organisms. Temperature is considered to be vital significance to physiology, metabolism and bio chemical process in controlling respiratory rates, digestion, excretion and over all development of aquatic organisms. The temperature changes totally disrupt the entire ecosystem.
4. Activities of several pathogenic micro organisms are accelerated by higher temperature.
5. High water temperatures promote blue-green algal blooms which disrupt the aquatic food chain.
6. High temperature of water may induce increase in activity, which exhausts the organism and shorten its life.

Control of Thermal Pollution:

1. Factories and power stations should have provisions for storing and cooling hot water. The hot water should not be released into rivers directly. They should be stored in cooling towers and spray ponds for reuse.

Nuclear Hazards

Radio active pollution poses a serious threat to the environment and future generation. A number of nuclear explosions have already been made during recent past in different parts of world. During atmospheric nuclear explosion tests, a large quantity of long-lived radio nuclides are released to the atmosphere which get distributed all over the world. Generally the test including nuclear fission and fusion processes uses uranium (U^{235}) and Plutonium (Pu^{239}) as fission material. A study reveals that radio nuclides formed in explosion test include fission fragments such as Strontium (Sr-90), Caesium (Cs-137), Barium (Ba-141) and Iodine (I-131) along with unused explosives and activation products. The radio active dust that falls to the earth after atomic explosion is called radio active fallout. Nuclear weapons testing had added greatly to radio activity.

There are two main radio-active elements in the nuclear fallout – Iodine-131 and Strontium-90. Since Iodine participates in the formation of Thyroxine, so it is an essential requirement in animals for the proper functioning of their Thyroid glands. Plants contain little Iodine and animals obtain their iodine requirement through plants. The normal stable iodine – 127 and its unstable radio isotope I – 131, are chemically indistinguishable by biological system. There fore I – 131 is taken by the organisms indiscriminately. Thus I – 131 gets entry into the food chain. Man being the top consumer, gets I – 131 in his body. In man it can damage WBC, bone marrow, spleen, lymph nodes, thyroid gland, and can induce lung tumours and sterility.

Strontium – 90 can replace calcium in plants and animals. Plants require calcium for the formation of cell wall where the animal calcium is used in bone formation. Radio-active strontium enters the human body through food chain and gets concentrated in human beings. Sr – 90 reaches daily products through

vegetation and the use of it by cattle, then to man by consumption of contaminated food, meat, milk, dairy products. In humans, most strontium becomes concentrated in bones, where damage to bone cells and marrow-blood cell-producing tissues occurs. It can cause bone cancer and tissue degeneration in man and animals.

The radio active wastes from nuclear plants may be in the form of gases, liquids or solids. The power plants are designed in a way that there is no leakage of radio active materials in any form. However, no nuclear plant is contamination proof. Leakage from several points may result in wastes that are radio active. Three Mile Island nuclear power plant leakage in USA in 1979, and “melt down” of Chernobyl nuclear power plant in USSR in 1986 are the examples of nuclear plant accidents causing escape of radio nuclides in atmosphere. Dissolved and suspended materials enter water bodies and contaminate them. These substances eventually are conveyed to humans from water supplies to food chain. Dissolved radio active substances in the waste water also enter the atmosphere. Thus radio active wastes in the effluent from nuclear power plants can eventually become widely distributed in air, water, soil, plants, animals and humans.

Radio active substances are among the most toxic substances known. The harmful effect of radiation upon human beings is due to its ability to ionize and ultimately destroy the organic molecules of which body cells are composed of.

The radiation destroys the body’s immune response. Delayed effects of radiation include eye cataracts, leukemia, malignant tumors, cardio vascular disorders premature ageing, mental retardation, congenital malformation, retarded growth, and reduced life span. Radiation can also produce mutations in plants and animals by bringing about changes in chromosomes.

Radiation pollution can be controlled by strict enforcement of safety measures during mining, transport and use of radio active substances. Ban on

tests of nuclear weapons is a must, to check radiation pollution. Peaceful uses of atomic energy or nuclear energy for electricity, treatment of diseases, agricultural and industrial purposes may be essential but its use for war purposes will finish life on this planet. Radio active wastes should be dumped in deep sea in sealed stainless steal container surrounded by concrete. Regular monitoring through frequent sampling and quantitative analysis has been ensured in the risk areas. Nuclear devices should never be exploded in air. Production of radio isotopes should be minimized. Minimum number of nuclear installations should be commissioned. Extreme care should be exercised in the disposal of industrial wastes contaminated with radio nuclides.

MCQ:

1. Which of the following contribute to thermal pollution
   A. Nuclear power plants
   B. Coal fired power plants
   C. Industrial effluents
   D. All the above
2. Which of the following is the major source of thermal pollution
   A. Coal fired power plants
   B. Domestic sewage
   C. Automobiles
   D. All the above
3. With the increase in temperature of receiving water
   A. Dissolved oxygen content decreases
   B. Dissolved oxygen content increases
   C. Physical and chemical properties will not alter
   D. Decreases the toxicity of the poison present in water
4. The ionizing radiation can cause

A. Leukemia
B. Malignant tumors
C. Cardio vascular problems
D. **All the above**

5. Important nuclear fuels used in nuclear reactor are

   A. U^{235} B. Sr – 90 C. Pu^{239} **D. A and C**

6. Chernobyl, the world's worst nuclear disaster took place in the year

   A. 1982 B. 1979 **C. 1986** D. 1983

7. Radio nuclides formed in explosion tests include

   A. Sr – 90 B. Cs – 137 C. I – 131 **D. All**

8. In humans strontium – 90 can cause

   A. Bone cancer
   B. Tissue degeneration
   C. Damage bone cells
   D. All

Short answer questions:

1. What is thermal pollution
2. How to control thermal pollution
3. Describe the effect of strontium – 90 on man
4. How Iodine – 131 effect the human beings

Long answer questions:

1. What is thermal pollution? Describe the sources and effects of Thermal pollution
2. Describe various nuclear hazards?