Al-Mustaqbal University

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Environmental Pollution

3th Lecture

Soil Pollution

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Soil pollution refers to the contamination of soil with harmful substances that negatively affect the natural environment, human health, and living organisms. Soil is a vital component of the ecosystem because it supports plant growth, stores water, and plays a key role in nutrient cycling. When soil becomes polluted, these functions are disrupted, leading to environmental and health problems.

Sources of Soil Pollution

Soil pollution originates from both natural and human-made (anthropogenic) sources. However, human activities are the main contributors.

1-Industrial Activities

Industries release a wide range of pollutants into the environment, including heavy metals such as lead (Pb), mercury (Hg), cadmium (Cd), and arsenic (As). These substances can settle on soil surfaces or be discharged directly as solid or liquid waste. Some industries also release radioactive materials that contaminate surrounding soils.

2-Agricultural Activities

The excessive use of chemical fertilizers, pesticides, and herbicides is a major cause of soil pollution. These chemicals may improve crop yield in the short term but accumulate in soil over time, reducing soil fertility and contaminating groundwater.

3-Domestic and Municipal Waste

Improper disposal of household waste, sewage sludge, and landfill leakage introduces organic pollutants, plastics, and pathogenic microorganisms into the soil. Open dumping is a serious problem in many developing regions

Types of Soil Pollutants

1- Heavy Metals

Heavy metals are persistent pollutants that do not degrade easily. They accumulate in soil and enter the food chain. Chronic exposure can cause serious health problems such as kidney damage, neurological disorders, and cancer.

2-Organic Pollutants

These include pesticides, petroleum hydrocarbons, solvents, and industrial chemicals. Many organic pollutants are toxic, carcinogenic, or endocrine-disrupting substances.

3-Biological Pollutants

Biological contamination includes bacteria, viruses, and parasites originating from sewage and animal waste. These pollutants increase the risk of infectious diseases.

4- Radioactive Pollutants

Radioactive soil contamination may occur due to nuclear accidents, improper disposal of radioactive waste, or natural radionuclides such as radon. This type of pollution is especially relevant to medical physics.

Effects of Soil Pollution

1-Environmental Effects

Soil pollution reduces soil fertility, affects plant growth, and destroys soil microorganisms. Polluted soil can no longer support healthy ecosystems, leading to loss of biodiversity.

2-Effects on Human Health

Humans are exposed to soil pollutants through ingestion of contaminated food, drinking polluted water, inhalation of dust, or skin contact. Health effects include:

- Respiratory problems
- Gastrointestinal diseases
- Neurological disorders
- Increased cancer risk

3-Effects on the Food Chain

Pollutants in soil are absorbed by plants and transferred to animals and humans. This process is known as bioaccumulation and biomagnification, leading to higher concentrations of toxins at higher trophic levels.

Soil Pollution and Medical Physics

Medical physics plays an important role in studying and controlling soil pollution, especially radioactive contamination.

1-Radioactive Soil Contamination

Radioactive elements such as cesium-137, strontium-90, and radon can contaminate soil. These radionuclides emit ionizing radiation, which can damage biological tissues and DNA.

2- Health Risk Assessment

Medical physicists use radiation measurements, dosimetry, and risk models to assess the health effects of contaminated soil on populations. This helps in planning protective measures and medical monitoring.

3- Environmental Radiation Monitoring

Techniques such as gamma spectroscopy and radiation detectors are used to measure radioactive contamination in soil. These methods are essential for environmental safety and public health protection.

Prevention and Control of Soil Pollution

1- Pollution Prevention

- Reducing the use of chemical fertilizers and pesticides
- Proper treatment and disposal of industrial and medical waste
- Promoting sustainable agricultural practices

2- Soil Remediation Techniques

- Physical methods: soil removal, isolation, or containment
- Chemical methods: stabilization or neutralization of pollutants
- Biological methods (bioremediation): using microorganisms or plants to remove contaminants