SOIL POLLUTION

What Is Soil Pollution?

All soils, whether polluted or unpolluted, contain a variety of compounds (contaminants) which are naturally present.
Such contaminants include metals, inorganic ions and salts (e.g. phosphates, carbonates, sulfates, nitrates), and many organic compounds (such as lipids, proteins, DNA, fatty acids, hydrocarbons, PAHs, alcohols, etc.).
These compounds are mainly formed through soil microbial activity and decomposition of organisms (e.g., plants and animals).
Additionally, various compounds get into the soil from the atmosphere, for instance with precipitation water, as well as by wind activity or other types of soil disturbances, and from surface water bodies and shallow groundwater flow.

When the amounts of soil contaminants exceed natural levels (what is naturally present in various soils), pollution is generated

Soil pollution also called soil contamination, is caused by the presence of xenobiotics* (human-made), by the presence of toxic chemicals (pollutants or contaminants), by their unnatural high concentrations, (exceeding the levels that should naturally be present), their unnatural existence, or

other alteration in the natural soil environment, that pose a risk to human health and/or the ecosystem.

It is typically caused by industrial activity, agricultural chemicals or improper disposal of waste.

Good to know

The Soil has many components and can be tested for various reasons, to name a few:

1. The soil's nutrient content, composition, and other characteristics such as the acidity or pH level usually used for plantation and agriculture studies (The soil composition of vineyards is one of the most important viticultural considerations when planting grape vines.)

2. Soil mechanics for agricultural engineering, hydrology and soil physics, it provides the theoretical basis for analysis in geotechnical engineering. (Example applications are building and bridge foundations, retaining walls, dams, and buried pipeline systems).

3. Soil chemistry is the study of the chemical characteristics of soil. A knowledge of environmental soil chemistry is paramount to predicting the fate of contaminants, this enables us to better predict the fate and toxicity of contaminants and provide the knowledge to develop scientifically correct, and cost-effective remediation strategies.

**A xenobiotic is a chemical substance found within an organism that is not naturally produced or expected to be present within the organism. It can also cover substances that are present in much higher concentrations than are usual. Natural compounds can also become xenobiotics if they are taken up by another organism, such as the uptake of natural human hormones by fish found downstream of sewage treatment plant outfalls, or the chemical defenses produced by some organisms as protection against predators.*

The Effects of Soil Pollution

Soil pollution affects plants, animals and humans alike.
Soil pollution may enter our bodies directly - through the inhalation of soil dust or soil particles, or through skin contact, or indirectly - through the consumption of food, especially vegetables grown in contaminated soil, or by inhaling the toxic vapors of volatile chemicals polluting the soil.

Land pollution touches essentially every area of the living world, including:

- Water that isn't safe to drink
- Polluted soil, which leads to a loss of fertile land for agriculture
- Climate change, which causes an onslaught of disastrous problems, including flash floods and irregular rainfalls
- The endangerment and extinction of species in wildlife
- Habitat shifting, where some animals are forced to flee where they live in order to survive
- An increase in wildfires, due to polluted areas often becoming very dry
- Increased air pollution, which burning waste contributes to

Direct Exposure
Soil pollution effects may vary based on age, general health status and other factors, such as the type of pollutant or contaminant inhaled or ingested. However, children are usually more susceptible to exposure to contaminants, because they come in close contact with the soil by playing in the ground; combined with lower thresholds for disease, this triggers higher risks than for adults.

Agriculture
Crops or plants grown on such contaminated soil absorbs toxic material from the soil and will decrease the agricultural output of a land. When animals or human beings consume these crops or plants the toxic material can pass into their body.

Toxic gases
Humans can be affected by soil pollution through the inhalation of gases emitted from soils moving upward, or through the inhalation of matter that is disturbed and transported by the wind because of the various human activities on the ground.

Diseases
Soil pollution may cause a variety of health problems, starting with short terms problems:

- headaches
- nausea
- fatigue
- skin rash
- eye irritation

Long term diseases due to the inhalation of soil particulate matter and the ingestion of contaminated food can potentially result in serious conditions, of which the most common include:

- *Cancer, including leukemia* – caused by the contact with soils contaminated with chemicals (e.g. gasoline, benzene)
- Asthma and bronchitis
- *Nervous system damage* – caused especially by the presence of lead (Pb) in soil, and affecting especially children
- *Neuromuscular blockage and depression of the central nervous system*
- *Kidney and liver damage* – caused by chemicals such as mercury (Hg)

What are Soil Pollution Causes?

There are two main cause for soil pollution

1. **Anthropogenic (man-made) causes**
2. **Natural causes**

1- Man-Made Pollutants

Anthropogenic (man-made) soil pollution originates in several types of processes, some deliberate (industrial) and some accidental. Human-caused soil pollution can work in conjunction with natural processes to increase the toxic contamination levels in the soil.

- Accidental spills and leaks during storage, transport or use of chemicals (e.g. leaks and spills of gasoline and diesel at gas stations);
- Foundry activities and manufacturing processes that involve furnaces or other processes resulting in the possible dispersion of contaminants in the environment;
- Mining activities involving the crushing and processing of raw materials, for instance, heavy metals, emitting toxic substances;
- Construction activities : Urbanization and Construction
  While urbanization is not in itself littering, large quantities of people living, producing trash and littering in a dense area does inevitably lead to land pollution. To accommodate this increased population, construction activities also occur, which result in large waste materials, such as metal, plastic, wood, and bricks. When these materials are not properly disposed of, it contributes to the land pollution of that area.
  To help reduce the environmental impact of construction sites, it's important to work with partners that offer comprehensive builder solutions to achieve cost-effective construction recycling and waste disposal plans.
- Agricultural activities involving the diffusion of herbicides, pesticides and/or insecticides and fertilizers;
- Transportation activities, releasing toxic vehicle emissions
- Chemical waste dumping, whether accidental or deliberate – such as illegal dumping;
- The storage of waste in landfills, as the waste products may leak into groundwater or generate polluted vapors
- Cracked paint chips falling from building walls, especially lead-based paint.

Construction sites are the most important triggers of soil pollution in urban areas, due to their almost ubiquitous nature. Almost any chemical substance handled at construction sites may pollute the soil. However, the higher risk comes from those chemicals that can travel more easily through the air as fine particulate matter. The chemicals that travel as particulate matter are more resistant to degradation and bioaccumulate in living organisms, such as PAHs.
Additionally, construction dust may easily spread around through the air and is especially dangerous because of its lower particle size (less than 10 microns). Such construction dust can trigger respiratory illnesses such as asthma and bronchitis, and even cancer. Moreover, the sites that involve the demolition of older buildings can release asbestos, a toxic mineral that can act as a poison in soil. Asbestos particles can be redistributed by the wind.

2- Natural Pollutants

Apart from the rare cases when a natural accumulation of chemicals leads to soil pollution, natural processes may also have an influence on the human released toxic chemicals into the soil, overall decreasing or increasing the pollutant toxicity and/or the level of contamination of the soil. This is possible due to the complex soil environment, involving the presence of other chemicals and natural conditions which may interact with the released pollutants.
Natural processes leading to soil pollution:

- **Natural accumulation of compounds** in soil due to imbalances between atmospheric deposition and leaking away with precipitation water (e.g., concentration and accumulation of perchlorate in soils in arid environments)
- **Natural production** in soil under certain environmental conditions (e.g., natural formation of perchlorate in soil in the presence of a chlorine source, metallic object and using the energy generated by a thunderstorm)
- **Leaks from sewer lines** into subsurface (e.g., adding chlorine which could generate trihalomethanes such as chloroform).

The pollutants may enter the soil/land via:

- waste disposal (e.g. landfills);
- air deposition, either dry (e.g. from mining and smelting activities, foundries etc.) or wet (e.g. acid rain);
- contact with contaminated surface or ground waters.

Soil pollutants, including chemicals and pathogens, have interchangeable liquid, solid or gaseous forms that mix until an equilibrium is reached between the three. The solid forms are absorbed or mixed with soil particles, liquids fill the voids made of pores between soil particles, and the gaseous forms surround the air between soil particles. This means that we can be exposed to gaseous, liquid and solid forms of soil pollution separately or together at the same time.

Types of Pollution

Soil pollution consists of pollutants and contaminants. The main pollutants of the soil are the biological agents and some of the human activities. Soil contaminants are all products of soil pollutants that contaminate the soil. Human activities that pollute the soil range from agricultural practices that infest the crops with pesticide chemicals to urban or industrial wastes or radioactive emissions that contaminate the soil with various toxic substances.

- **Biological Agents:** Biological agents work inside the soil to introduce manures and digested sludge (coming from the human, bird and animal excreta) into the soil.
- **Agricultural Practices:** The soil of the crops is polluted to a large extent with pesticides, fertilizers, herbicides, slurry, debris, and manure.
- **Radioactive Pollutants:** Radioactive substances such as Radium, Thorium, Uranium, Nitrogen, etc. can infiltrate the soil and create toxic effects.
- **Urban Waste:** Urban waste consists of garbage and rubbish materials, dried sludge and sewage from domestic and commercial waste.
- **Industrial Waste:** Steel, pesticides, textiles, drugs, glass, cement, petroleum, etc. are produced by paper mills, oil refineries, sugar factories, petroleum industries and others as such.

Tiny amounts of contaminants accumulate in the soil and - depending on the environmental conditions (including soil types) and the degradability of the released contaminant - can reach high levels and pollute the soil. If the soil is contaminated, home-grown vegetables and fruits may become polluted too.

We can also categorize pollution as per the frequency:

- Continuous pollution
- Occasional pollution
- Accidental pollution

What are Soil Pollution Examples

Examples of Soil Contaminants
There is a large variety of pollutants that could poison the soil. Examples of the most common and problematic soil pollutants can be found below.

- Lead (Pb): Potential sources: lead paint, mining, foundry activities, vehicle exhaust, construction activities, agriculture activities.
- Copper (Cu): Potential sources: mining, foundry activities; construction activities
- Zinc (Zn): Potential sources: mining; foundry activities; construction activities
- Arsenic (As): Potential sources: mining, coal-fired power plants, lumber facilities, electronics industry, foundry activities, agriculture, natural accumulation
- Herbicides/Insecticides: Potential sources: agricultural activities; gardening
- PAHs (polyaromatic hydrocarbons): Potential sources: coal burning, vehicle emissions, accumulation in plants & vegetables grown on polluted soils; cigarette smoke; wildfires, agricultural burning; wood burning, constructions

On an individual level, waste and litter are the main reason for soil pollution.

It wasn't until the mid-20th century that solid wastes were collected with the environment in mind. Prior to that, waste was typically left on top of the ground in "open dumps," which resulted in rats, mosquitoes, and other disease infestations, as well as foul smells and windblown debris. Yet, while there are now significantly safer practices for disposing of waste, there are still many other factors contributing to and worsening the situation.

How to Prevent Land Pollution on a personal level

Given the disastrous effects of land pollution, taking preventive measures to reduce its impact moving forward is crucial.

- **Using Fewer Pesticides and Chemicals in Gardening**
  Given that the use of pesticides and chemicals in gardening, farming and agriculture greatly contribute to land pollution, finding alternatives will help to reduce the environmental impact. Farmers, for instance, can use natural ingredients by switching from bio-fertilizers to manure.
  On the individual level, supporting environmentally-conscious, local farmers at your closest farmer's market or local grocery store can help to build up business for farmers with more sustainable farming practices. Another option is to contribute to or volunteer in an urban garden in your neighborhood.

- **Reduce, Reuse and Recycle**
  At the individual level, there are many things we can do to reduce our contribution to land pollution. One of the simplest ways to do this is to reuse or recycle items so that you aren't creating waste out of a material or item that still has a purpose. With the growing awareness around what can be recycled and an increase in recycling bins in many cities, it has never been easier to recycle.
- **Reforestation activities**
  Reforestation involves replanting an area with trees. This can be needed for areas that have experienced wildfires, for instance, or where trees had been chopped down and milled. This process helps to bind the soil, which helps to protect it from land pollution and prevents soil erosion and flooding.

Sources:
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