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# SOIL CONTAMINATION

Methods of soil remediation from industrial contaminants  
and possible use of phytoremediation or other  
bioremediation technologies in those processes

**Lithuania-4.2**



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In this essay, we will analyse soil contamination, its effects on the environment and methods of remediation. To start with, people tend to think that soil pollution and soil contamination are the same, when really they are two different things.

Contamination is the presence of a substance that is normally not present; that substance does not need to be harmful to be considered as a contaminant. On the other hand, pollution is when a certain substance is considered as harmful in all instances; the substance is contemplated as a pollutant even if it is a substance that is normally present there, but when it surpasses harmless limits, that is when the term pollution is used.

Professor Mamdouh F. Abdel-Sabour used an easy way to explain this by saying that “the air in the room is contaminated by smoke cigarette while the air in a city is polluted by flue gas emissions”. Soil contamination is a form of land degradation brought by the spillage, migration, or burying of dangerous contaminants to the soil ecosystem from unbothered industrial effluents, manufacturing wastes, local waste and other man-made substances or activities.

The term soil contamination is the occurrence of pollutants in soil above a certain level causing a decay or loss of one or more soil functions. In locations with high population density, soil contamination is greatly caused by human activities. Some examples include manufacturing, industrial dumping, land development, local waste disposal, and excessive pesticide or fertilizer use.



<https://www.soiladvocates.ca/soil-contamination-and-remediation/>

In 2006 a mapping of geochemical contamination was carried out by Gregorauskienė, V. revealing that the soil contamination with heavy metals was estimated according to the highest allowable concentrations (HAC) and the total contamination index Z<sub>d</sub> which is associated to standards of human health.

A portion of geochemical background and contamination data is publicized in Geochemical Atlas of Lithuania. The purpose of soil remediation works in most cases to reduce contaminants to levels which are 'suitable for use', meaning you can use your area without environmental risks. It refers to processes of stopping or reversing environmental damage.

In addition, soil remediation is the application of proven technologies to manage risks from contaminated soils that could be harmful to human health and the environment. There are two types of remediation: Ex-situ – having the ground dug out and treated; and In-situ – treatment while the soil remains within the subsurface. Methods of soil remediation will be mentioned and talked about in depth in the upcoming paragraphs.



Contaminated soil can cause a number of problems some of which include the release of pollutant gases, pollution of drinking water sources, increased salinity, health problems, clogging of drains.

Soil contaminants can reach humans through soil, dust, air, water or food. All of the listed ways can occur separately or simultaneously. When young children play in bare soil, since they play close to the ground, it is likely that they might breathe in dust particles that are naturally spread over a wide area.

Children can also ingest them, because they have a tendency to place items, including their fingers, in their mouths. Contaminated soil dust can also affect our food supply.

For instance, contaminated soil could be found on produce. If a vegetable like lettuce is grown in soil with contaminants, the leaves could be coated. So washing it is very important. Root crops usually have soil on them in the store. It is important to wash them well too. Construction and poor landscaping efforts can make soil dust. Breathing in contaminated dust could cause physical or chemical damage to humans. For example, asbestos fibres can puncture the lungs.

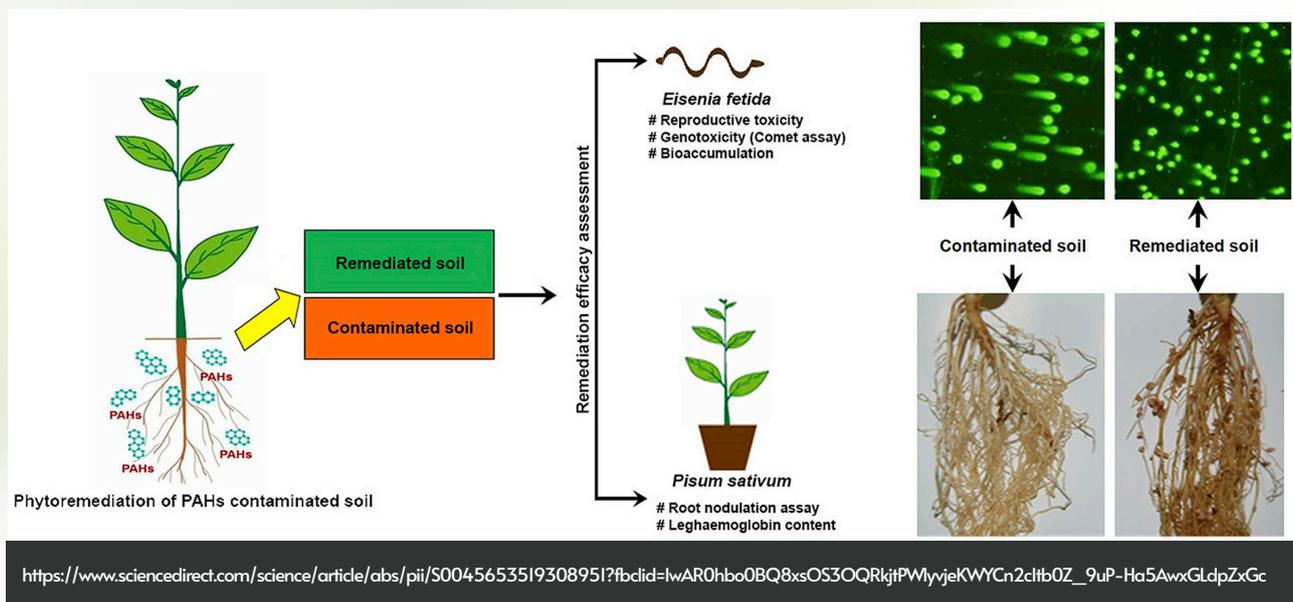


[https://en.m.wikipedia.org/wiki/Soil\\_contamination](https://en.m.wikipedia.org/wiki/Soil_contamination)

Chemicals can hurt the nervous system, including the brain. Other health problems consist of eye irritation, respiratory disorders, pulmonary disease, and an increased risk of lung and skin cancer. Contaminated soils can leak harmful chemicals into nearby ground or surface waters, where these materials can be taken up by plants and animals, contaminate a human drinking water supply.

This can cause diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio. Also gastrointestinal illnesses, nervous system or reproductive effects, and chronic diseases such as cancer. Soil dust can build up and contribute to and cause clogs in drains.

This can lead to unpleasant odour, slow drainage, can attract mould and pest since they thrive in moist areas, flooding, leaks and leaked home structure. Costly repairs could be needed, which is not ideal. A noteworthy amount of antibiotics, used broadly in agriculture and human healthcare, are released into the environment after being eliminated from the organism to which they were provided. These antibiotics can seep into our soils and advance throughout the environment that we live in. This creates antimicrobial resistant bacteria, which reduces the effectiveness of antibiotics.



Each year around 700 000 deaths are due to antimicrobial resistant bacteria. By 2050, if this problem is not solved, it will kill more people than cancer and cost more than the size of the current global economy.

Now to consider ways to concur the following problems. The most common type of soil remediation is bioremediation. Bioremediation uses biological processes to transform or all together remove contaminants from soil and water.

This action depends on microorganisms including bacteria and fungi, which use the contaminant as a food source. After the bacteria absorbs every single bit of the pollutant, the bacteria naturally die off, leaving behind a healthier and safer environment. Not only can bioremediation help the land we live on but also so can phytoremediation.

This is the use of plants to clean up contaminated conditions. There are five main types of phytoremediation, which include rhizofiltration, phytoextraction, phytotransformation, phytostabilization and phytostimulation. Phytoextraction is the process by which plants accumulate, in other words collect, pollutants in their roots, shoots, or leaves above ground.

Phytotransformation is the transformation of organic pollutants from soil, sediments, or water into a more stable and less hazardous form. Phytostabilization is a process where plants limit contaminated soil movement.



Rhizofiltration is a method of removing damaging chemicals and overabundance nutrients from water by filtering it through a mass of roots. Phytostimulation is a technique that can be used to remediate area contaminated with herbicides. An advantage for this technique is that it uses plants and natural resources and is generally less costly. The remediation is done in place, saving transportation charges.

<https://www.soilutions.co.uk/services/soil-remediation/>

It is thought to be an environmentally friendly approach as it limits pollution exposure to the environment and ecosystem. This method has easy disposal and can be applied over a large-scale of land. A few disadvantages consist of limited scope, phytoremediation can only occur on the surface area and depth occupied by the roots.

It is also impossible to fully avoid pollutants from leaching into groundwater using plant-based remediation techniques. Another disadvantage is that it is not a fast process, long-term commitment is required. Likewise, thermal desorption is a further remediation technique that is the most proven and successful for hydrocarbon contamination.

Thermal desorption typically consists of two main processes. Firstly, contaminated solids are heated to the boiling point of the contaminants.

The dehumidified contaminants are then transferred to the second part of the process, where the vapour is either destroyed by a thermal oxidizer or liquefied in a vapour recovery unit (VRU). This is an efficient, environmentally beneficial process. Removal of hazardous chemicals and hydrocarbons from our planet protects the health of the environment and the population.



<https://www.soilutions.co.uk/services/soil-remediation/>

To sum up soil contamination is a consequential problem that should be taken more seriously to prevent unchangeable factors in the future. There is thought to be as many as 2.5 million potentially contaminated sites across Europe.

Roughly, one third of these sites have already been identified and just about 15 % have been remediated. We should keep in mind that landfills, junkyards and waste disposal sites pose high risk of soil contamination. It is possible for the whole ecosystem to change due to these pollutants. They contain a large mix of toxic types like lead, arsenic, and petroleum products.

Company's need to consider that these problems are mainly caused by their toxic waste releases. Human activities play a big part in it too. Contaminated soils can leak harmful chemicals into nearby ground or surface waters, where these materials can be absorbed by plants and animals, harm a human drinking water supply.

To be on the safe side, if you have doubt about the condition of the soil near your home, it is best to have a soil test done to eliminate worries. Instead of risking developing health problems including harmed nervous system, eye irritation, respiratory disorders, pulmonary disease, and an increased risk of lung and skin cancer, we should encourage a more eco-friendly technology for industry, farming and stockbreeding, and other economic activities.



Children should also be taken into consideration since they tend to play in soil and touch their faces with filthy hands. This is the easiest way for them to get sick. Soil remediations are used for these problems but are not always as affective as they should be.

Even though phytoremediation is not a very fast and instant process, it is widely accepted as a cost-effective environmental restoration technology and reduces the concentrations or toxic effects of contaminants in the environment.



There are five types of phytoremediation which are phytostabilization, phytodegradation, rhizofiltration, phytoextraction and phytovolatilization. In addition, bioremediation removes contaminants from soil and water with microorganisms. An advantage for using this method is that it causes little to no threat to the environment since natural organisms degrade contaminants into simple compounds.

It is important to find solutions for this matter because even for a small leak, oil can remain in soil for decades, typically 20-30 years. In the future, it can become harder to find sustainable land for food. Countries with high mineral resources will be most affected, especially developing countries.



<https://www.fao.org/global-soil-partnership/resources/highlights/detail/es/c/1127426/>



# BIBLIOGRAPHY

Adachi K. 1981. Mass fragmentographic determination of polymethylbiphenyl in foods contaminated with petroleum products. Bull Environ Contam Toxicol

“The nation that destroys its soil destroys itself.” – Franklin D. Roosevelt

“The roots of all goodness lie in the soil of appreciation or goodness.” – Dalai Lama

“The air in the room is contaminated by smoke cigarette while the air in a city is polluted by flue gas emissions” – Professor Mamdouh F. Abdel-Sabour

## GROUP

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