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Remediation of Soil Pollution and the Use of Artificial Intelligence

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Abstract

Soil – '*the soul of infinite lives*' is the ultimate medium for plant growth. It not only supports the plant growth but also provides the optimum nutrients and water required by plants and also regulates the aeration and temperature of it. In brief it is the store-house of nutrients. It is said that –' if you want to have food, conserve the soil'—but in recent days due to many reasons, mostly of anthropogenic activities such as urbanization, removal of trees(deforestation), mining and the overuse of nutrients are seemed to be the reasons of soil degradation. Soil pollution is one of the type of such soil degradation only. Soil pollution not only reduces the soil fertility or ultimate production of crops, but it is also hazardous to human health. In this article I have tried to show the different remediation of such soil pollution that the scientists have already worked on and also have tried to drag the reader's attention to some future aspects including the use of artificial intelligence.

Keywords: soil pollution; remediation; biochar; artificial intelligence

Introduction

In Trams Frams words—"*DON'T SPOIL THE SOIL, IT WILL SPOIL YOU ONE DAY*". No doubt, soil is a very important part of our lives. It is called the mother from which we are all born. But now we are the one who is responsible for the degradation of this soil. Soil pollution is the contamination of soil by some heavy metals, fertilizers, pesticides, industrial waste, the leakage oil spills and many more. These contaminants remain in the soil for a long period of time and deplete its physical, chemical and biological properties. As a result of it, soil losses its fertility and crop yield declines. Important to note that this pollutants present in the soil may enter in human body through the food chain and may result into the different types of diseases. Hence remediation of such soil is very important. Remediation is the removal or the degradation of soil pollutants including the heavy metals present in our soil. This can be achieved widely by two ways----

(i) *In situ remediation*--- In this type of remediation the soil is treated in its original place itself which prevents the destruction of its structure, soil organic moisture and its aggregation. In situ remediation process mainly includes—bioremediation, where living microbes are used to reduce the contamination; biosparging, where the pollutants such as aromatic compounds are treated; mycoremediation, which is the process of bioremediation by the use of fungi only and phytoremediation where plants like mangroves are used to remediate the soil.

(ii) *Ex situ remediation*--- In this type of remediation the soil to be treated is excavated and then treated elsewhere. Here, the structure of soil, soil organic matter and its other properties are disturbed and also a costlier one. It includes- biopiling, a technique where the excavated soil is pumped with oxygen, nutrients and moisture; soil washing, a technique where the polluted soil is washed with some chemicals and thermal treatments, where the contaminants are removed by the process of heating etc.

The another type of classification of soil remediation is—

(i) Physical remediation---
   (a) *Soil washing*: As already mentioned, in this type of remediation the polluted soil is excavated and then washed to remove its contaminants.
   (b) *Thermal desorption*: In this process the soil is heated to a very high temperature to evaporate the soil contaminants from it.

(ii) Chemical remediation----
   (a) *Soil washing by using chemicals*: In this process, the contaminated soil is being washed with some chemicals to remove the pollutants.
   (b) *Immobilization*: This remediation mainly involves the processes like stabilization, vitrification, electro kinetic etc. In these methods, oxidation and reduction of soil pollutants is done which changes these toxic substances into non toxic substances.

(iii) Biological remediation----
   (a) *Phytoremediation*: In phytoremediation as the name suggest, plants are mainly used to remediate the contaminated soil and does not involve any others substances.
   (b) *Bioremediation*: Again in bioremediation, the living microbial organisms are used to degrade the toxic substances into non toxic form.
   (c) *Mycoremediation*: Mycoremediation is a type of bioremediation where only fungi are used to treat the polluted soil.
   (d) *Phytovolatilization*: Here, plants are used in such a way so that they absorb the heavy metals present in the soil and release them directly into the atmosphere.
   (e) *Bioaugmentation*: This is a process that involves the microorganisms to break down the contaminants present in the soil.

Many scientists have already performed some experiments to find the different remediation of soil pollution. Jiang et al. in 2023 used some chemical methods such as solidification to immobilize the contaminants. Wang and Zhang experimented on the influence of vegetation and soil properties on heavy metals contamination in Hangzhou. Some researchers have focused on the physical remediation also. Liu et al. 2018, involved physical removal, washing and electro kinetic extraction to remove the contaminants from the soil. Huang el al. produced three kinds of biochars each having different characteristics and then tested with Cassia alata in heavy metal contaminated soil. Furthermore, Zhang et al. and Xu et al. also studied the contribution of biochar as a soil amendment to remove the cadmium (Cd) from soil.

A review by Song et al. and the studies conducted by Duan et al. and Dong et al. further showed to the world how the bioremediation that means the use of different microbes can also help to remediate the polluted soil.

Future aspects

As mentioned above, already many works have been done in this field. But still some scope is left where the scientists can work on. One of such is the use of artificial intelligence in soil pollution control. Intelligence is the ability to gain knowledge and when an artificial entity is able to do this then its called artificial intelligence. In the 21st century where we are standing now, the use of AI tools is gaining importance in every single field. It is not only cost effective but also accurate. Though to use these AI tools minimum training is needed, but the less time consumption of these tools cannot be ignored. We all know that one of the reasons of soil contamination is the overuse of fertilizers and pesticides in the crop field. So for this purpose we should promote the use of AI to find the accurate amount of the chemicals to be supplied depending on the crops. Moreover these tools also help us to find the highly contaminated soil area. Next, heating is one of the widely used methods to remediate soil pollution. But we must consider the fact that above a particular heat or temperature supplying from the outside, the population of microbes may get affected, which will ultimately hamper our soil fertility. Hence the exact temperature to be used considering the soil microbes should also be noted.

Conclusion

Soil pollution is not a territorial problem. It is a problem facing by all the countries across the world. Somewhere we are not considering this problem as a serious one and hence we are still lacking to develop an easily applicable technology to solve this problem. Today's generation must know that the healthy life is possible only by healthy food and healthy food will come from a healthy soil. So it's our responsibility to control soil pollution by developing the proper knowledge of the input used in its cultivation.

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