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Patenting Techniques for Soil Pollution Reduction

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Abstract

A chemical or substance that is out of place, existing in the soil at a higher quantity than normal, and has negative effects on any organism that is not the target is referred to as "soil pollution." Soil pollution is a hidden threat since it is frequently difficult to gauge or see. One of the biggest soil concerns harming the world's soils and the ecosystem services they provide is soil pollution, according to the Status of the World's Soil Resources Report (SWSR). In every location, worries about soil pollution are expanding. In a recent resolution, the United Nations Environmental Assembly (UNEA-3) called for swifter action and increased cooperation to address and control soil pollution. This agreement, reached by more than 170 nations, demonstrates the significance of this issue on a global scale. Chemicals used in or created as a result of industrial processes, household, animal, and municipal wastes (including wastewater), agrochemicals, and petroleum-derived products are the main anthropogenic sources of soil pollution. Intentional releases of these chemicals into the environment include the use of fertilisers and pesticides, irrigation with untreated wastewater, and land application of sewage sludge. Accidental releases include oil spills and landfill leaching. In addition to incomplete combustion of various compounds, smelting, transportation, spray drift from pesticide applications, radionuclide deposition from air weapons testing, and nuclear accidents all contribute to soil pollution.

Keywords: Soil pollution • Reduction • Patenting techniques

Introduction

According to scientific research, soil pollution can seriously impair the crucial ecological functions that soil provides. Because of the hazardous amounts of toxins present, soil contamination decreases crop yields and makes crops grown on contaminated soils unsafe for both human and animal use. The movement of several contaminants, including significant nutrients like nitrogen and phosphorus, from the soil to surface and ground waters results in eutrophication, which harms the environment and directly affects human health through contaminated drinking water. Additionally, pollutants cause direct harm to larger soil-dwelling organisms and soil microorganisms, which have an impact on soil biodiversity and the functions of the impacted organisms [1].

The outcomes of scientific studies show that human health is directly impacted by soil pollution. Polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs), organic compounds like arsenic, lead, and cadmium, as well as medications likes antibiotics, all poses risks to human health. Many people will always remember the health risks brought on by the widespread radionuclide contamination of the soil following the Chernobyl disaster in 1986. Thermal desorption and soil replacement methods are the two fundamental components of physical remediation. In order to reduce the pollutant concentration, improve the soil's environmental capability, and subsequently remediate the soil, soil replacement refers to the use of clean soil to replace or partially replace the contaminated soil. Three categories of soil replacement exist: soil replacement, soil spading, and fresh soil imports. Replacing polluted soil with fresh soil is known as soil replacement. This approach is appropriate for small areas of contaminated soil. Additionally, the replacement soil needs to be managed effectively to avoid causing a second pollution. Soil spading is the process of deeply excavating contaminated soil to disseminate the pollutant into deep areas with the intention of dilution [2].

Description

It is crucial to clean up polluted soils, and new, scientific remediation techniques are always being developed. There are a number of measures that must be performed to determine if natural or man-made pollutants are causing soil pollution, as well as the amount to which that pollution poses a risk to the environment and to human health. These risk assessment methodologies are comparable around the world. Science-based biological solutions like accelerated microbial decomposition or phytoremediation are replacing increasingly expensive physical remediation techniques like chemical inactivation or sequestration in landfills. This book aims to provide an overview of the state-of-the-art in soil pollution, as well as a list of the major pollutants and their sources that have an impact on both human health and the environment. It pays particular attention to pollutants that are present in agricultural systems and get into human systems through the food chain. The best methods now available for determining and remediating polluted soils are discussed in selected case studies towards the end. This publication, which was created as part of the Global Symposium on Soil Contamination (GSOP18), identifies the most significant knowledge gaps regarding soil pollution globally and provides a framework for upcoming debates [3].

Persistent organic pollutants (POPs) are synthetic carbon-based molecules derived from industrial and agrochemical products that typically biodegrade very slowly and will bioaccumulate in animals' tissues. Pesticides, as well as polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons, are some POPs (PAHs). The top layer of the Earth's crust that has undergone changes due to weathering, physical, chemical, and biological activities is known as soil. It is made up of living things arranged in genetic soil horizons, organic matter, mineral particles, water, and air (ISO, 2013). The value of soils to people and the environment is described in terms of the functions of the soil ecosystem [4].

The ability of the soil to continue functioning as a vital living system, within ecological and land-use constraints, to preserve biological productivity, improve the quality of the air and water environments, and uphold plant, animal, and human health is known as soil health. The ability of natural processes and elements to offer commodities and services that directly or indirectly

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meet human needs is known as the "soil ecosystem services". Food supply availability, accessibility, use, and stability are all considered to be aspects of food security. When a chemical or material is present in a higher concentration than would normally occur, it is said to be contaminated soil (this volume). An unnatural or present chemical or material is referred to as "soil contamination."

Man-made nanoparticles (MNPs) and treatment by-products are two more significant categories of developing pollutants. Over a thousand products contain MNPs as additives, including paints, cosmetics, textiles, papers, plastics, and food. The number of products containing or requiring MNPs has significantly expanded in recent decades. They are additionally utilised in textiles to create clothing that is abrasion, UV, and self-cleaning as well as water and dirt repellent and anti-microbial. In order to lessen the effects of both organic and inorganic contaminants, manufactured nanoparticles are applied specifically to soil remediation. However, they are also mistakenly introduced into the soil through a number of different mechanisms [5].

Conclusion

Based on the pollutant's volatility, thermal desorption heats the contaminated soil using steam, microwaves, and infrared radiation to make the pollutant (for example, Hg, as) volatile. The heavy metals are subsequently removed by collecting the volatile heavy metals using a vacuum, negative pressure, or carrier gas. Traditional thermal desorption can be divided into low temperature desorption (90-320°C) and high temperature desorption (320-560°C) based on the temperatures. This method has the benefits of a straightforward process, mobile devices, and reusing remedied soil. This technology was employed for in-situ clean-up by a mercury collecting and service company in the USA, who also created a commercial service. However, its application is constrained by a number of variables, including costly equipment and a lengthy desorption period.

Acknowledgement

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Conflict of Interest

None.

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