Commentary
Volume 7:4, 2022

Journal of Nanosciences: Current Research

ISSN: 2572-0813

Open Access

Supportable Utilization of Nano Helped Remediation for Relief of Weighty Metals and Mine Spills

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Description

The environment has changed as a result of increasing globalization over the past two decades; As a result, there has been a growing trend in the demand for environmentally friendly remediation methods. The application of chemical fertilizers and pesticides, industrial discharge, and transformed products of these accumulated chemical residues are among the various sources of soil pollution. The composition and ecosystem of the soil may be harmed by these processes. To address this issue, a variety of approaches, including physical, chemical, and biological ones, have been utilized. Nanotechnology has been extensively used to treat and remove contaminants over the past ten years. The study of nanomaterials (NMs) has added a new dimension to the remediation of polluted soils. In addition to remediating contaminated sites, the use of engineered NMs has proven useful in preventing the release of soil pollutants. They have set the stage for environmentally friendly methods for finding pollutants and restoring polluted sites to their early stages, which will also help increase soil fertility. To produce the desired results, nano-enabled remediation mechanisms necessitate extensive field and target-specific research [1].

The purpose of this review was to understand the need for an interdisciplinary approach in order to use nanotechnology in multitasking remediation strategies involving a variety of contaminants. It also emphasized the areas in need of improvement. A major cause of public health concern is the growing accumulation of heavy metals (HMs) in the food and water supply chain. From the smallest organisms, such as microbes, all the way up to the most complex ones, such as humans and animals, the soil serves as an essential sink for the various lifeforms that inhabit the planet. Numerous undesirable components, such as HMs, have accumulated in the soil as a result of the natural cycle of nutrients being disrupted by the invasion of natural flora by various anthropogenic sources. In light of the current state of soil pollution, sustainable development cannot be achieved. Soil conservation should be a top priority in today's society, which is facing a challenging situation of decreasing land area and a lack of food and shelter due to rising populations. Thermal treatment, filtration, adsorption, chemical abstraction, membrane bound separation, microbial degradation, and other methods are some of the options for dealing with this situation. Weighty metal evacuation can likewise be proficiently achieved by utilizing methylene phosphonic corrosive (DTPMP) phosphate intercalated with layered twofold hydroxide. According to the findings of another study, an adsorption mechanism was used to remove Pb (II) from wastewater when lysine was intercalated with montmorillonite. A single treatment strategy is at the heart of the processes described above. Although these treatments have been effective, they suffer from a number of drawbacks, including inefficiency, high costs, and inability to scale up. Acid mine drainage, or AMD, is a type of pollution brought on by drainage water leaking into water bodies from sulphur-bearing sites. Sulphide minerals are exposed to the environment during mining, resulting in the production of an excessive amount of acid, which has the potential to harm the environment both now and in the future. Corrosion of mining machinery and equipment, deterioration of soil quality, and groundwater contamination as a result of the leaching of HMs from mine and drainage water are some of the adverse effects of AMD [2,3].

By oxidizing mineral sulphides, iron disulphide or iron pyrite produces acid mine drainage in water or air. Sulphuric acid and metal sulphates are produced when oxygen and water react with metal sulphides. Acidity rises as a result of the metals' subsequent oxidation. When ferrous sulphide (pyrite) reacts with water and oxygen to produce ferrous sulphate and sulphuric acid, it undergoes oxidation. Ferric sulphate is made when ferrous sulfate oxidizes even more to form ferric sulfate. Certain bacteria, like Acidithiobacillus ferroxidans, can speed up this reaction even more. Additionally, ferric sulfate reacts with water to produce ferric hydroxide, releasing hydrogen ions that raise water's acidity. More acid is produced when the ferric hydroxide that results is further reacted with pyrite. The amount of oxidized iron determines the amount of acid produced. Fresh water enters the mine as rainwater or water utilized in mining operations for drilling, dust control, or other purposes. Underground mines may allow ground water to enter through cracks and fractures. Sulfide minerals produce oxidized products that flow into the surrounding aqueous environment and reach nearby rivers and other water bodies. As pyritic sulphur responds with water and oxygen, sulphuric corrosive is created, and iron sulphate is shaped. Consequently, acidophilic bacteria like Acidithiobacillus ferroxidans flourish and expand in coal mine-created acidic environments. Consequently, the bacteria are the catalysts for the acid production reaction, which proceeds more quickly than chemical oxidation. The hydrolysis of oxidized pyrite products and the production of sulphuric acid are the primary causes of the acidity found in mine drainage water [4].

The type and nature of the contaminant, its concentration, its form (simpler or complex), the goal and time frame for treatment, the cost, and the impact on the environment all influence the choice of any remediation method used to remove HMs. In addition, depending on the nature and location of the site, the degree of contamination, and the treatment strategy to be implemented, treatment methods are divided into in situ and ex situ categories. The first type is the most popular because it treats soil in its natural environment with air, water, microbes, and plants. The latter, on the other hand, is based on digging contaminated soil into a fermenter so that it can be treated, which makes it more complicated and ultimately costs more. Cost, time, and the release of by products are among the disadvantages of all conventional methods currently in use, making post-treatment challenges involving environmental contamination inevitable. Demands for environmentally friendly technology have increased as a result of the growing accumulation of contaminants across all levels of the environment. NMs hold a promising future toward this path inferable from their latency, eco-accommodating nature, high productivity, and size adaptability, which gives them an edge over customary procedures. They can be effectively applied across various lattices, i.e. soil, surface, or ground water as remediation apparatuses. NMs' high adsorption capabilities and reusability, which are unaffected by rapid changes in temperature and pH, make them suitable for highly acidic acid mine treatment and make them a preferred method of decontamination. There are some drawbacks and potential dangers associated with the use of NMs given that research on them is still in its infancy. Accumulation and toxicity are the main drawbacks of using NMs because of

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Date of Submission: 02 July 2022, Manuscript No. jncr-22-82695; **Editor assigned:** 04 July 2022, PreQC No. P-82695; **Reviewed:** 16 July 2022, QC No. Q-82695; **Revised:** 21 July 2022, Manuscript No. R-82695; **Published:** 28 July 2022, DOI: 10.37421/2572-0813.2022.7.156

the possibility that they will interact with elements in the environment, making it harder for researchers to use them as decontaminants. NMs are easy to mobilize, so they can spread out over long distances. Because of this, they may be hard to track and could cause ecotoxicity by bioaccumulating in non-target species. When NMs come into contact with microorganisms and a variety of environmental factors, they may further become oxidized, resulting in the production of reactive oxygen species, which may be harmful to plants and other living things. In order to establish their utility in harmony with nature and to obtain sustainable solutions for environmental remediation, in-depth studies are required to ascertain the precise fate of NPs in the environment [5].

Acknowledgement

None.

Conflict of interest

No potential conflict of interest was reported by the authors.

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How to cite this article: Claridge, Shelley. "Supportable Utilization of Nano Helped Remediation for Relief of Weighty Metals and Mine Spills." J Nanosci Curr Res 07 (2022): 156.