

Review on: Soil Washing Process to Remove Heavy Metals from Sludge

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Abstract— Soil is one of the most important components of the environment and proper management of land is very important to maintain its quality and sustained use. The soil contamination resulting from increasing release and accumulation of heavy metals in soil by industrial and other human activities cause serious threat to the functioning of components of ecosystem. Clean up or removal of pollutants from soil is very difficult task and time consuming, once contamination occurs. Soil washing is one of the few permanent treatment method to remove metal contamination from soil. Soil washing is a technology which is used to treat soils and sludges. Zinc ,chromium ,cadmium ,lead ,copper ,mercury ,nickel are considered as the most hazardous heavy metals .Soil washing provides a cost effective and environmentally proactive alternative to stabilization and land filling. This process not employed on soils that are contaminated with pesticides and volatile organic compound. Soil washing is a technique that uses liquids, usually water, to remove chemical pollutants from soil and sometimes water combined with chemical additives to scrub soils. This scrubbing cause removal of hazardous contaminants and concentrates them into smaller volume.

Key words: Contamination, Heavy Metals And Soil Washing

I. INTRODUCTION

Soil contamination is caused by presence of chemicals or other changes in the natural soil environment. It caused by industrial activity, agricultural, chemicals or improper waste disposal. Soil contamination can be caused by accidental spills, acid rain, intensive farming, nuclear wastes, industrial accidents, illegal dumping, oil and fuel dumping, electronic wastes and drainage of contaminated surface water into the soil. In varying concentration, heavy metals are toxic to plants, animals and human beings. Contaminated soil directly affects human health through direct contact or via inhalation of soil. Many herbicide and pesticides formulations can be carcinogenic that can cause chronic health conditions or congenital disorders. Movement of heavy metal down the soil strata imposes risk of ground water contamination and deterioration of water quality. There are a variety of remediation technologies involving physical, chemical, thermal and biological process for soil treatment. Decontamination can also be accomplished through soil washing process. Soil washing is a treatment process used for remediating both organic and inorganic chemical constituents from contaminated soils and sludges. High energy contact between an aqueous based washing solution and contaminated soils is involved in this process. Effectiveness of soil washing depends upon contaminants that it contains and the type of soil. This process is effective for removal of non halogenated volatiles and halogenated volatiles. An acidic or chelating agent is used to remove the heavy metals. Acidic aqueous solution includes carbonic acids, phosphoric acid, hydrochloric acid and nitric acid.

Oxidizing agents such as sodium hypochlorite and hydrogen peroxide .Some advantages of soil washing as a remediation technique are it take place in closed system which permits control of ambient environmental conditions, it has extensive applications for different types of wastes, the process can result in a significant volume reduction of contaminant mass, cost of soil washing is low relatively compared with other multi contaminants technologies.

II. METHODS FOR REMEDIATION OF HEAVY METALS IN SOIL

- Physical Remediation: Physical remediation basically include thermal desorption and soil replacement. Thermal desorption is an environmental remediation technology that utilizes heat to increase the volatility of contaminants such that they can be separated from solid matrix. It is not incineration .The volatilized contaminants either collected or thermally destroyed. Heating is done by using numerous desorbers are available today. Some are more common like Indirect Fired Rotary, infrared, microwave, heated screw, direct fired rotary.
- It can be classified into high temperature desorption (320-560°c) and low temperature desorption (90-320 °c). Soil replacement: it is a process of removing contaminated soil and adding into new soil. It is beneficial method for small area.
- Chemical Remediation: In chemical leaching, washing of contaminated soil using water, reagents and other fluids or gas that can be leach the pollutant from the soil.
- The washing of contaminated soil mainly include inorganic eluent, chelating agents and surfactants etc.

It was found that sulfuric acid and phosphoric acid proved to be most promising extractant. Electro kinetic Remediation: is a technique of using current to remove organic, inorganic and heavy metals from soil by electric potential. It is a technology in which voltage is applying at the two sides of soil and then electric field is generate.

III. BIOLOGICAL REMEDIATION

- 1) Phytoremediation: is the direct use of living green plants for removal or degradation of contaminants in soil or sludge, sediments and ground water. The uptake of contaminants in plants occurs primarily through the root system. Root system has enormous surface area that absorbs and accumulates the water and nutrients essential for growth.
- 2) Biological Remediation: Micro organisms can affect the heavy metals present in soil by migration and transformation through changing their physical and chemical characterizations. The remediation mechanism includes intracellular accumulation, extracellular

A. Contaminants

various hazardous substances presence in sludge pesticides, herbicides, insecticides, halogenated compounds, metals and volatile organic compounds. Metals in sludge like cadmium, chromium, silver, copper and zinc.

VI. ATOMIC ADSORPTION SPECTROPHOTOMETER

Cadmium 2.5 PPM

Zinc 1090 PPM

Chromium 32.5 PPM

A. Properties of Sludge

Characteristics	Test Method	Value
MDD (%)	I.S:2720 (Part10):1991	1.088
Silt size	I.S:2720 (Part 4):1985	0.006 – 0.1 mm
Atterberg Limits	I.S:2720 (Part5):1985	Non-plastic

Table 1: Properties of Sludge

B. Bench Scale Model



Fig. 3: Bench scale model

Bench scale model was developed at University of Illinois at Chicago. This model is used to study the Efficiency of Bench scale model set up for soil washing. Up to 5Kg of contaminated soil is process at a time. The model is very simple, cost efficient and easy to operate.

Model consist of a tumbler which is placed on an inclined stand for operation. Tumbler was roatated 20 revolutions per minute. Place 5 Kg of contaminated soil with wash solution. At the end of operation, soil was filtered and effluent was separated. And then soil was dried to determine the concentration of chemical composition.

VII. CONCLUSIONS

soil washing is very simple, cost effective and easy method. Soil used in this process is contaminated with mixed pollutants like zinc, chromium, cadmium, copper and silver. Soil washing depends upon types contaminants it contains, type of soil, used wash solution and desired remediation efficiencies. Removal of heavy metals increases with increasing chelating agent concentration in wash solution.

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