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An Experimental Study on Soil Washing Technique for Remediation of Soil Contaminated with Pesticide

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ABSTRACT

Disposal of chemical waste from pesticide results in contamination of soil, ground water and surface water. The release or potential release of contaminant from such sites may endanger human health, welfare & the environment. Human health could be at a risk due to inhalation of air borne contaminants, direct contact with soil /sediment and ingestion of contaminated groundwater. It is, therefore, necessary to remediate contaminated soil by adopting suitable measures. The objective of study is to determine the efficiency of soil washing technology in the removal of pesticide waste adsorbed on soils. In this paper we are giving our experimental work on remediation of soil which comprises of soil washing technique.

I. INTRODUCTION

Due to limited availability of natural resources and rapid urbanization, there is a short fall of conventional building construction materials. On the other hand, energy consumed for the production of conventional building construction materials pollutes the air, water and land. Accumulation of unmanaged agro-waste, especially from the developing countries, has an increased environmental concern. Therefore, development of new technologies to recycle and convert waste materials into reusable materials is important for the protection of the environment and sustainable development of the society.

Need of the project

Land contamination is an historical practice leading to disposal substances into land. On the other hand soil contamination is also an common practice. It is the layer of organic (derive from decayed remains) and inorganic (made up of rock fragments) materials that covers earth rocky surface. Soil contamination presents of manmade chemicals with degree industrialization or other alteration in natural soil environment

Objectives

To study the properties of pesticide contaminated soil

- To reduce the land pollution
- Soil water washing technique
- Use of inorganic (Fly ash) materials
- To reduce the water pollution
- Testing of land and soil
- To remove the heavy metals
- PH test of soil

Advantages of Soil Washing Technology

The following is a brief summary of some advantages and limitations of soil washing technology.

1) Soil washing can treat both organics and in organics inthe same treatment system.
2) Generally, there are no air or waste water discharges from the system, making permit processes easier than for many treatment systems. This attribute should also make the technology attractive to local community stake holders. Soil washing is one of the few permanent treatment alternatives for soils contaminated with metals and radio nuclides.
3) Most soil washing technologies can treat a broad range of influent contaminant concentrations.
4) Depending upon soil matrix characteristics, soil washing can allow for there turn of clean coarse fractions of soils to the site at a very low cost.

ADVANTAGES

1. Reduce land pollution
2. Reduce water pollution
3. Removal of land contamination
4. Increase the yield of the crops
5. Protects the eco system
6. Protects the microorganism

II. SOIL WASHING TECHNIQUES

Insitu Treatment Technologies

Insitu remediation can be grouped into three categories: physiochemical, thermal and biological. Due to different and complex nature of many polluted soils in many situations. It is frequent to apply several remedial techniques.

Biological Treatments

In this treatment, contaminants such as soil, sediments etc., are transformed to innocuous substances as$CO2$ etc. It is economical, but it is difficult to determine whether the contaminants have completely nullified or not.

Soil washing:

It is a new method for treating excavated soil. It involves application of unit processes, and equipment that have been used for years in mining, mineral processing and ore benefaction.

Soil Washing Systems:

Soil washing systems usually consist of the following six distinct process units: pretreatment; separation; coarse- grained treatment; fine-grained treatment; process water treatment; and residuals management.

Pre treatment:

It’s main aim is to remove grossly oversized material to prepare homogeneous feed stream. Process employed are scalping; crushing and grinding. Scalping is an initial separation whereas crushing is necessary to liberate contaminated particle to successfully wash this fraction.

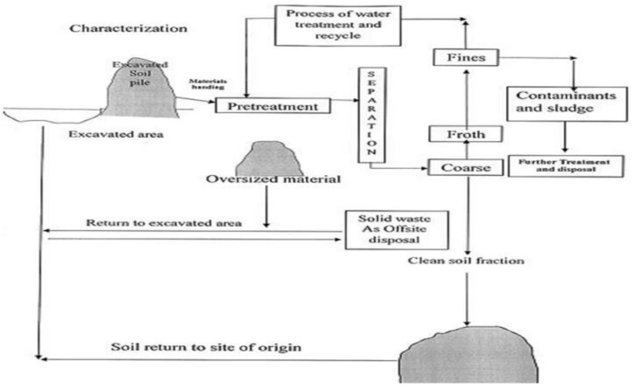
Separation

In separation method, most common cut point is usually between 63 and 74 microns. Cutting techniques generally require different treatment methods for final cleaning. Hydro- cyclones are almost always employed to make the first size separation.

III. PROPERTIES OF SOIL

Properties	Values	Units
Soil moisture content	24.47	%
Soil porosity	14.91	%
Soil pH in water	7.22	
Soil bulk density	1.54	
Soil organic matter content	8	%
Soil particle size	2.587	mm

METHODOLOGY



IV. TEST PROCEDURE

Desorption batch tests

1. Solvent obtained from soxhlet extraction was collected in
2. Evaporation flask.
3. The flask was attached to the ground glass joint of the bump trap at the end of the distillation tube.
4. It was Ensured that all glassware is held securely in place with a plastic Keck clip and/or ring cap.
5. The rotary evaporator motor (green switch) was turned on.
6. The dial was adjusted to rotate the flask at medium speed.
7. The aspirator pump was turned on.
8. The vaccum was sealed by closing the valve at the top of the diagonal rotary evaporator condenser. (i.e. turning the knob until the arrow on it points straight down towards the attached tubing)
9. When necessary, the round-bottom flask was lowered into the water heating bath. (Note: The hot water should cover the liquid level in the flask. If the RB flask is more than half- way full, the water should touch the bottom of the RB flask and as the liquid evaporates, the RB flask can be further immersed in the water.)

The rotavator was stopped when there is no more liquid dripping from the condenser coils for 30seconds. (Note: For small volumes, dripping may not occur, wait 1-2 minutes and observe if there is any change.) Batch agitation studies were performed to determine appropriate ranges of concentration and dosage of the washing solutions to extract the heavy metal pollutants from soil. Two washing reagents were selected for the decontamination studies; namely, $Na_2S_2O_5$ and disodium salt of Na_2EDTA.D I water washes were per formed to provide a base line for the removal obtained by chemical washing. The tests were accomplished by placing certain amounts of soil in 150 ml plastic bottles followed by addition of varying volumes of the washing solution. The samples were then placed on a shaker table operated at 175 rpm at room temperature. A2-hreaction time was deemed sufficient based upon batch rate desorption tests conducted overa48- hperiod. After mixing, the samples were allowed to settle for about15min and then filtered through a0.45-mm membrane filter. The pH of the washing solution before contact with the soil and the pH of the filtrate were measured and recorded.

Following filtration, the filtrate was acidified to a pH of 2.0 with 1:1HNO_3 for heavy metal analysis. Precision was established by preparing replicate total of three bottles. For each test. It was assumed that the metal concentration of the filtrate represents that released from the contaminated soil. Removal efficiencies were determined by dividing the heavy metal release quantities by the initi quantity in the soil. All heavy metal analyses were performed using a Horizon5310 inductively coupled plasma ICP.spectrometer. ICP calibration standards were prepared from stock solutions according to Method 6010 Standard concentrations bracketed the anticipated concentration range of the samples and included a calibration blank metal concentration equal.

V. TEST RESULTS &OBSERVATIONS

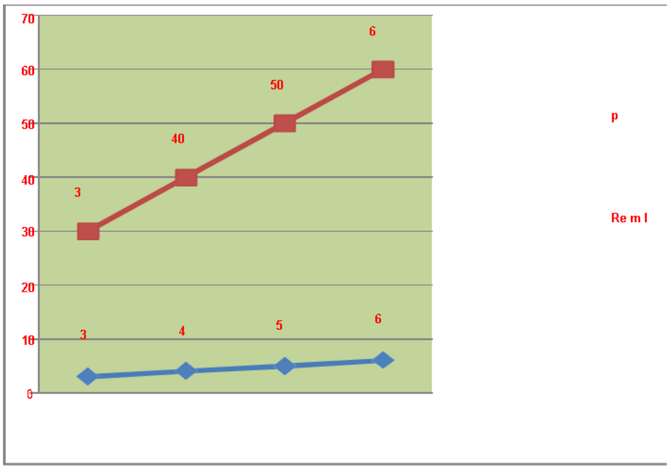
The results of analysis of black cotton soil, are presented will be presented. As can be seen from the values reported in tables, the black cotton soil contained fraction less than 0.15mm.

Factors	Level			
ph	3	4	5	6
Soil-solution ratio	1:2	1:3	1:4	1:5
Surfactant Concentration ratio	0	1	2	3
Shaking Time (hr)	3	4	5	6
Removal %	30	40	50	60

Washing studies were conducted in batches to investigate the effect of surfactant concentration, soil solution ratio and pH on the removal of heavy metals from contaminated soil samples. Details of the experimental conditions are given in Series of batch tests were conducted in 125 ml conical flask over rotary shaker at about 200-rpm for a known contact time at room temperature (240C); then samples were collected and centrifuged at 7000g for 15min. The initial pH of the surfactant solution was modified either by addition of hydrochloric acid or sodium hydroxide. The supernatants were collected after filtration using What man 41 filter paper. Percentage of heavy metal removal (%) = C1V1 /CsMS X 100 Where C1 (mg/l) and CS (mg/kg), are the concentrations of metal in supernatant and soil respectively; V1 is the volume of supernatant (litres) and MS is the dry mass of the soil (kg).

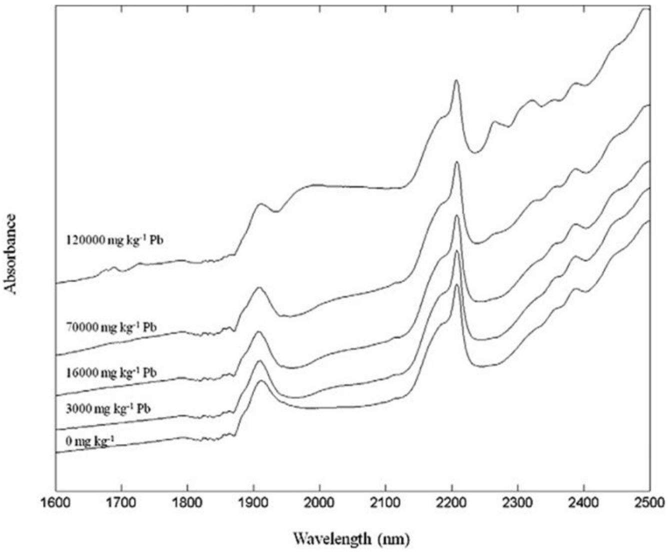
The pH values of the solutions before washing and that of supernatants after washing were recorded. To ensure precision, all the experiments were performed in three replicates and results were presented as averages.

FACTORS LEVEL



FTIR Spectroscopy analysis

Design of sampling can be aided by on-the-go proximal soil sensing; and expedited by subsequent adaptive spatially optimal sampling and prediction procedures enabled by field spectroscopic methods and advanced geo statistics. Field deployment of portable Visible &Near Infrared [wavelength 400–2500 nm] (Vis- NIR) and X-ray fluorescence (PXRF) spectroscopies will require special calibration approaches but show huge potential for synergistic use. The use of mid-infrared spectroscopy [wavelength 2500–25,000 nm, wave number 4000–400 cm–1 (MIR) for field implementation requires further adaptive research.



Infrared diffuse reflectance spectroscopy is based on the principle that molecules have specific frequencies at which they rotate or vibrate corresponding to discrete energy levels. Absorption spectra of compounds are a unique reflection of their molecular near (Vis-NIR, 400–700–2500 nm) and mid (MIR,2500–25,000 nm) infrared ranges allows rapid acquisition of soil information. Spectral signatures of soil materials are characterised by the irreflectance to particular wavelengths in the electromagnetic spectrum. Properties that are related to the surface area of the soil usually can be predicted well from Vis- NIR and MIR spectroscopy.

VI. CONCLUSION

The operating variables in soil washing with SN and SH for the removal were studied in laboratory batch processes. Removal efficiencies recorded in this study showed that the surfactants used were effective in removing Cu, Cd, Zn, and Pb from the spiked soil. In general, removal efficiency obtained using the two surfactants increased with increase in surfactant concentration, time and soil- solution ratio but decreased with increase in the pH of washing solution. The optimum concentration of the surfactants was 3%. The highest removal efficiency was observed when the pH of washing solution was 4, soil-solution ratio was 40 and washing time was 48 hr for SN. However, highest removal efficiency was obtained when the pH of washing solution was 3, soil-solution ratio was 10 and the washing time was 24 hr for SH. The removal efficiencies of heavy metals were: Cu > Cd>, Zn>Pb for both surfactants. Utilization of both surfactants showed great potential for heavy metals remediation of contaminated soil

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