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A REVIEW ON PHYTOREMEDIATION OF OIL CONTAMINATED SOIL

[1]Kokni Vicky G., [2]Shukla Vishwa H

[1]PG Student, Environment Departmet, LDCE, Ahmedabad, India.

[2]Assistant Professor, Environment Department, LDCE, Ahmedabad, India.

ABSTRACT

Soil contamination by crude oil is a serious problem in the field of environmental science or engineering. Oil spillage often causes negative effects on the ecosystem of the soil. The phytoremediation system is used for this polluted soil. Phytoremediation is an actively developing biotechnology that uses plants to rehabilitate environment contaminated by inorganic and organic pollutants using their associated microorganism and agricultural techniques. The germination and development of cultivated plants varied depending on the chemical structure of the oil. Rhizodegradation by plant roots and associated bacteria is one of the major mechanisms that contribute to the removal of petroleum hydrocarbons (PHCs) during phytoremediation. This review paper focuses on crude oil phytoremediation and its application in the soil- polluted ecosystem.

Keywords: phytoremediation; rhizodegradation; oil; cultivation; specie.

I. INTRODUCTION

Contamination of the soils has become a global issue. This problem arises through various human activities, such as industrial and farming. Crude oil processing is one of the major role plays for contaminated of land by oil. Crude oil refining obtains marketable petroleum products, such as diesel, kerosene, petrol, gasoline etc, this all products transport for used at industrial and community level. The instrument used supply of crude oil or midstream operation which includes the structures used to transport crude oil and petroleum products [17]. During all this operation, several of the quantity of oil material may be contaminated with the surrounding environment by accident or by intentional seepage and may regulate the discharge into the land ecosystem. Oil contaminates in the soil environment, resulting in harmful effects on humans, animal husbandry, plant species and soil microorganisms that allow species of plants and other creatures to survive. The techniques for oil spill cleanup and recovery are challenging and usually involve complex mechanical, chemical and biological methods. Phytoremediation is plant utilization to reduce contaminant volume, mobility, or toxicity in soil, groundwater, or other contaminated media [20]. Phytoremediation provides a cost-effective alternative to soil remediation by accelerating the removal of contaminants from the soil through plant.

Physiological processes and microbial activity at the plant roots [9]. Phytoremediation has now emerged as a promising strategy to eliminate many contaminants, in land ecosystem. Microbe-assisted phytoremediation,

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including rhizoremediation, appears to be particularly effective for the removal or degradation of organic contaminants from contaminated soil. Root exudates from plants help to degrade toxic organic chemicals and act as substrates for soil microorganisms in the soil which directly result in an increased rate of biodegradation of organic contaminants [8].

II. PHYTOREMEDIATION

Phytoremediation is described as the use of plants species to reduce the mobility, volume and toxicity of organic contaminants in soil, groundwater, air or other contaminated medium [20]. Plant has ability to reduce concentration of organic chemicals, harmful metals, from contaminated soil. Phytoremediation has become a cost-effective alternative to physicochemical soil remediation method. In the case of remediating crude oil contaminated soil, phytoremediation technology is very inexpensive. Petroleum hydrocarbons (PHCs) degrade with associated bacteria, micro-organisms, in the plant roots zone. In phytoremediation, different types of plant mechanics such as Phytoextraction, Phytovolatilization, Phytodegradation and Rhizodegradation help to soil remediation.

III. TYPES OF PHYTOREMEDIATION

There are two types of phytoremediation based on site: In-situ and Ex-situ. In the in-situ phytoremediation, the contaminated soil is not transferred anywhere but, treated on the site i.e. plant is grown on the site. In the ex-situ phytoremediation, the contaminated soil is transferred from the site for the further treatment.

IV. MECHANISM OF PHYTOREMEDIATION

Different types of plant mechanisms, researchers have identified which is help in remediating of contaminated soil. The phytoremediation mechanism observe in plants are Phytoextraction, phytovolatilization, phytodegradation and rhizodegradation. Each mechanism is detailed in below.

Phytoextraction: Phytoextraction define to the ability of plants to remove metals and other inorganic or organic compounds from the soil and translocated them to the leaves and plant tissues. The plants may then need to be harvested and removed from the site. The plants can then need to be harvested and taken off the field.

Phytovolatilization: phytovolatilization refer contaminants taken up into the body of the plant, but then the contaminant, a volatile from thereof, or a volatile degradation product is transpired with water vapor from leaves.

Phytodegradation: In this type of mechanism work, taken organic contaminant through phytoexraction to degrade by plant, which harmful for land ecosystem.

Rhizodegradation: Contaminate soil remediate by microbal activity in plant roots zone, here associated *rhizobium* bacteria. Plants root has ability absorb the pollutant from contaminated soil; thereafter its helps *rhizobium* bacteria to degrade petroleum hydrocarbons or other harmful organic compounds from soil.

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V. DIFFERENT SPECIES USED FOR PHYTOREMEDIATION OF OIL CONTAMINATED SOIL

Table 1 Accumulation rate in species

No.	Species	Name of pollutants	Efficiency	Duration	Ref.
1	*Helianthus annuus*	Cobalt	57.7 mg/kg	-	17
2	*Mirabilis Jalapa*	TPH (Total petroleum hydrocarbons)	21%	127 days	6
3	*Medicago falcate*	TPH	80%	21 days	11
4	*Zea mays*	Atrazine (pesticide)	97%	-	17
5	*Epipremmumaureum*	TPH	54.4%	5 weeks	10
6	*Jatropha curcas*	Lubricating oil	89.6%	180 days	14
7	*Canna lily*	Benzene, toluene, ethylbenzene and xylenes (BTEX)	80%	80 days	17
8	*Red clover*	TPH	98%	72 days	1
9	*Leguminous*	TPH	86	72 days	1
10	*Iris pseudacorus*	Triazophos (pesticide)	42.2 µg/g	-	17
11	*Millet*	TPH	97%	72days	1

Abrasive: TPH (Total petroleum hydrocarbons), BTEX (Benzene, toluene, ethylbenzene & xylenes.

VI. DISCUSSION

The different types of species, which can be used for phytoremediation based on their effective removal efficiencies, are shown in table1.the plants remediated of different pollutant from oil contaminated soil such as cobalt, Total petroleum hydrocarbons(TPH), Benzene, toluene, ethylbenzene & xylene(BTEX), Atrazine

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(pesticide) From table1, it is shown that plant species can be applied in phytoremediation at different location for some limit of time period and it provide good pollutant reduction or removal efficiency.

VII. CONCLUSION

The review leads to a conclusion that oil contamination using various types of plants spices is one of the most promising methods for removal of oil from the soil. Various plant spices have different capacity for the remediate oil content from the soil with different mechanisms. Phytoremediation can be carried out on site or off site. Majority of the research up till now has done the pot based ex situ experiments using different plant species in laboratory set up. Moreover based on review it is concluded that *Medicago falcate* found best plant spice that has capable enough to reduce TPH content from the soil within 21 days with 80 % efficiency. Other plant has higher efficiency but take more time to reduce TPH from the soil.

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