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COMPARATIVE STUDIES ON REMEDIATION TECHNIQUES IN LABORATORY OF SOILS CONTAMINATED WITH OIL PRODUCTS

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Abstract

In developed countries, as well as in Romania, were produced numerous technical incidents that lead to changes in soil quality. An enumeration of the types of incidents may include:
- discharge of crude oil, salt water and drilling fluids in oil exploitation in the area of extraction and probes scaffold-extraction, drilling.
- contamination of the soil, subsoil and groundwater in the area of transport pipe of crude oil and fuels due to breakage of pipes for various reasons;
- traffic accidents and the railway involving specific means of transport (tanker);
- technical incidents in technological installations and tanks of oil refineries and petrochemical enterprises.
In this paper we propose a review of the particularities of soil pollution with oil products and remediation opportunities currently. Process analysis remediation of soils contaminated by oil products highlights the advantages and disadvantages of each method.

Key words*: oil products, contaminated soil, depollution..*

INTRODUCTION

The remediation issue of soils contaminated with liquid oil products is one of the most complex environmental activities in both the theoretical, economic, and organizational. Soil pollution and negative effects involve extending the subsoil to groundwater (Neag, 1997).
In Romania, it was only in recent years has managed the implementation of pollution control technologies based on thermal methods, thus removing and treating of petroleum products from refineries located near battle of petroleum products, soil decontaminated being played in such a circuit. There were also decontaminated applying biological methods of decontamination Biological methods of decontamination efficiency depends on numerous factors, which must be taken into account, because there is no standard process in place to ensure success in any conditions and proved that some pollutants are resistant to biodegradation under aerobic conditions, and are biodegradable under anaerobic conditions.
Choosing the right technology for the remediation of a contaminated soil with liquid petroleum products is a very important and difficult decision because of the very large number of variables and interactions which depend on the final results.
Composition and structure of the soil in correlation with physic-chemical characteristics of pollutant specific systems that form certain approaches in the choice of pollution control technologies. The coordinator of an action of a compliant ground contaminated with petroleum products must bear in mind when choosing and implementing a remediation technologies four determinants:
a. The final remediation degree desired or required;
b. Duration of the remediation actions;
c. The total cost required to conduct routine cleaning;
d. Side effects produced during the implementation of pollution control technologies and their application.
Remediation technologies of soil contaminated with petroleum products do not respond optimally while the four factors listed This leads to the necessity of ordering it priorities in the choice of pollution control technologies in the specific conditions of each case.
Choosing the most appropriate decontamination is very difficult because you

have to consider a lot of factors technical, technological and economic development
Pollutant composition together with the type of contaminated soil is a very complex system, which requires certain conditions for routine cleaning. If you take that as a determining factor in the choice of variables of decontamination time of execution of the cleaning and the cost necessary to achieve them, in the event that none of the remediation technologies available does not satisfy in full the conditions imposed. There is a concern of researchers around the world to these issues (Lemaire at all, 2013, Taok at all 2010, Baek at all 2004, Banks at all 2005, Patrascu at all 2005, Popa 2013).

MATERIALS AND METHODS

The present paper aims to compare remediation methods applied in the laboratory for soil samples from different areas of impact. Remediation methods applied are: thermal depollution by combustion method and chemical depollution by extraction method with solvents.
We selected two samples of soil contaminated with petroleum products: test 1 soil polluted by spills from rail transport and test 2 soil polluted in the near of the battle of petroleum product.
For both variants were analyzed control samples, unpolluted close of the sampling area.
Depollution by combustion method was applied in the laboratory (Figure 1).

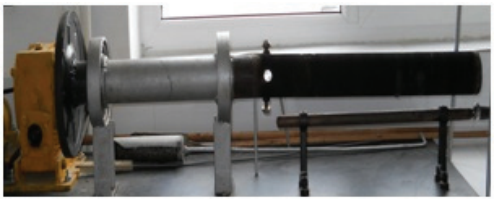

Figure 1. Installation diagram for combustion

Depollution of soils contaminated with petroleum products by combustion method consists of burning oxygen derived from air
The mixture of Ground combustion of petroleum products is performed so complete removal of pollutant organic material and soil structure. During the combustion of hydrocarbon molecules combine with the oxygen in the air, turning into carbon dioxide and water in vapour phase, both of them being disposed in the waste gas flow.
The introduction of the polluted soil in the test tube can be carried out before or after the start of heating the initial heating.
The sample is introduced inside the combustion tube, in the area corresponding to the heating with the help of a special cup which allows delivery of the sample by rotation. Burning occurs inside the tube until the complete consumption of the oil product as well as the structure of the organic portion of soil.
Mass loss produced by combustion for unpolluted soil sample P1 is calculated as:

$$P1 = [(m_1-m_2)/m_1]\cdot 100, \% \quad (1)$$

$$m_0 = m_1 - m_2, g \quad (2)$$

where,
m_1 - mass of the original sample of unpolluted soil, g;
m_2 - mass of the sample remaining after combustion of unpolluted soil, g;
m_0 – mass of sample burned (initial organic material), g.
The sample of soil contaminated by petroleum products is also subjected to the combustion process.

$$P2 = [(m_3-m_4)/m_3]\cdot 100, \% \quad (3)$$

$$m = m_3 - m_4, g \quad (4)$$

where,
m_3 - initial sample mass polluted soil, g;
m_4 - mass remaining after combustion of polluted soil sample, g;
m - burned sample mass (initial organic material + oil products), g.
Considering that by the method of combustion, burning oil product entirely, we can determine the concentration of oil in the sample analyzed.

$$c_0 = P2 - P1, \% \quad (5)$$

Remediation by extraction method was performed in Soxhlet extraction apparatus (Figure 2).

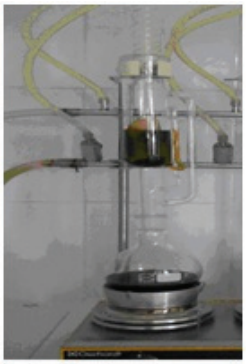

Figure 2. Installation diagram for extraction method

It was applied to successive solvent extraction method using petroleum ether and benzene.
To achieve the degree of depollution with successive extractions method will apply the following relation:

$$GD = \frac{m_5 - m_6}{m_7} \cdot 100, \% \quad (6)$$

where:
m_5 - polluted sample mass after extraction, g
m_6 - unpolluted sample mass after extraction, g
m_7 - mass of the sample subjected to extraction, g.

RESULTS AND DISCUSSIONS

Table 1. Results for unpolluted soil samples

Sample analyzed	m_1, g	m_2 , g	m_0, g	P1 %
Unpolluted soil for Test 1	100	98.2	1.8	1.8
Unpolluted soil for Test 2	100	98	2.0	2.0

Table 2. Results for polluted soil samples

Sample analyzed	m_3, g	m_4, g	P2, %	P1, %	m, g	c_o, %
Polluted soil Test 1	100	95.2	4.8	1.8	4.8	3
Polluted soil Test 2	100	35	65	2.0	65	63

Table 3. Results for unpolluted soil samples subjected to extraction

Sample analyzed	m_7, g	Quantity pollutant extracted with, g		m_6, g
		Petroleum ether	Benzene	
Unpolluted soil for Test 1	13.3	0.001	0.019	0.02
Unpolluted soil for Test 2	14.5	0.001	0.015	0.016

Table 4. Results for polluted soil samples subjected to extraction

Sample analyzed	m_7, g	Quantity pollutant extracted with, g		m_5, g
		Eter de petrol	Benzene	
Polluted soil Test 1	13.3	0.3	0.85	1.15
Polluted soil Test 2	14.5	5.4	1.8	7.2

Remediation of polluted soils with petroleum liquid products is generally for agricultural use playing surfaces affected. By disappearance of the organic part where remediation by combustion is applied reduces total germination potential of soil.
Ecological reconstruction of such land has to firstly restore its germination potential by the appearance of organic parts in composition, optimal in terms of quantity and quality.
Among numerous methods of soil organic reconstruction decontaminated by thermal methods to accomplish the simplest of technical and cheapest in economically de-polluted soil is mixed with unpolluted soil, usually the same or higher quality in terms of agro.

CONCLUSIONS

Technologies for remediation of soils polluted with petroleum-based liquid thermal methods are less applicable in Romania, although in other countries have taken a competitive position on the market for remediation.
Decontamination procedures subjecting samples contaminated with petroleum liquids whose composition is not known it can be concluded that it is easily combusted contaminated soil. This method involves burning completely to the pollutant.
Applying successive extraction is observed that is difficult to remove the entire amount of oil. Degree of depollution obtained for Test 1 was 8.5 % and for Test 2 was 49.5 %. There are various filling

solvent. In this regard were initiated studies on the use of a third solvent, a mixture of benzene and methyl alcohol.

Unfortunately, these substances are unfriendly to the environment and the economically costly. Combustion method has the following disadvantages:

-Investing achieve the necessary equipment is relatively high, even if its depreciation can be done very quickly;

-Application of thermal remediation technologies of soil contaminated with petroleum products requires fuel consumption leading to an increase in operating expenses;

- Decontamination of fixed or mobile installations can be equipped with heat recovery, making to increase the value of the investment and operating costs, even if the recovered energy can be harnessed.

After mixing unpolluted soil with thermal de-polluted soil, germination potential of the soil can be recovered, so can play agricultural circuit.

Any remediation method should be applied, are important both soil nature and the nature of the oil product.

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