BULETINUL Universităţii Petrol – Gaze din Ploieşti	Vol. LXII No. 3A/2010	70 - 74	Seria Tehnică

Techniques for Remediation of Soils Contaminated with Liquid Petroleum Products for Ecological Reconstruction

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Abstract

The interest for soil pollution has increased for the whole population of the world, after producing several aimed contamination of environmental accidents. Soil is the third environmental factor that must be protected, like water and air. This paper presents a study on the decontamination of soil polluted with liquid petroleum products where applied thermal methods of remediation, combustion and desorption are. Also, it was reviewing the ecological reconstruction.

Key words: *soil pollution, thermal methods, reconstruction*

Introduction

Given the fact that interest has grown lately methods remediation of soil with oil products, the paper aims to present their studies on decontamination by thermal methods. She was selected a forest soil sample considered "blank" that has been contaminated in the laboratory control. They were chosen both heating methods remediation, combustion and desorption.

Experimental Part

Selected soil samples, contaminated blank and the sample were subjected to thermal decontamination methods using existing equipment in the laboratory of "soil science and ecological restoration" of the Department of Chemical Engineering and Environmental UPG Ploiesti.

Using the method of combustion, the burning mixture of soil with oil products is done both complete removal of the pollutant and organic material in soil structure. During the combustion of hydrocarbon molecules combine with oxygen from the air, turning into carbon dioxide and water vapor phase, both being eliminated in the combustion gases [1-4]. To express the quantitative results apply cleaning combustion gravimetric method. Using the method of desorption, remediation of soils contaminated with liquid petroleum products is based on the ownership of liquid hydrocarbons to vaporize at atmospheric pressure at temperatures below 400^{o}C. For the experiments was chosen an arable soil sample was analyzed as follows: permeability and retention capacity, capillarity and granulometry. Polluted soil sample was controlled with a liquid petroleum product characterized by density and viscosity. Polluted soil

sample was then subjected to thermal decontamination methods: combustion and desorption. Degree of pollution was established for both methods and then samples were made by mixing soil with fresh soil decontaminated for ecological reconstruction.

Results and Discussion

Arable soil sample was subjected to analysis of permeability (P_m) and retention capacity (C_R) for water and petroleum and results are presented in Table 1.

Table 1. Permeability and retention capacity of soil sample

1.	Soil type	Arable soil	
2.	Liquid	Water	Petroleum
3.	m_0, g	970	560
4.	H_{layer}, cm	30	6
5.	d_{layer}, cm	4,52	4,52
6.	V_{layer}, cm^3	481,14	96,23
7.	P_m, cm^3/h	372,08	70,83
8.	C_R, kg/m^3	685,87	613,11

The values obtained for the capillarity water and soil samples for petroleum products are presented in Table 2.

Table 2. The measured values for determining capillarity of arable soil

The sample		**With water**	**With petroleum**
1.	$H_{u,10}$, cm	5	4,2
2.	$H_{u,20}$, cm	6,8	4,6
3.	$H_{u,30}$, cm	7,2	5,2
4.	$H_{u,40}$, cm	8,6	5,4
5.	$H_{u,50}$, cm	9,3	5,7
6.	$H_{u,60}$, cm	11,2	5,9

The soil particle size distribution, determined using the method with sieves [5] are presented in table 3.

Table 3. Particle size distribution of soil sample

	S 1 <0.15	**S 2 d_1=0.15**	**S 3 d_2=0.2**	**S 4 d_3=0.25**	**S 5 d_4=0.5**	**S 6 d_5=1.5**	**S 7 d_6=2**	$\sum m_i$	**The losses**
m_i,g	7	10	50	18	3	5	6	99	1
%	0,07	0,10	0,50	0,18	0,03	0,05	0,06	-	0,01

With the data in table 3 has presented the variation of soil granulometry (Fig. 1.)

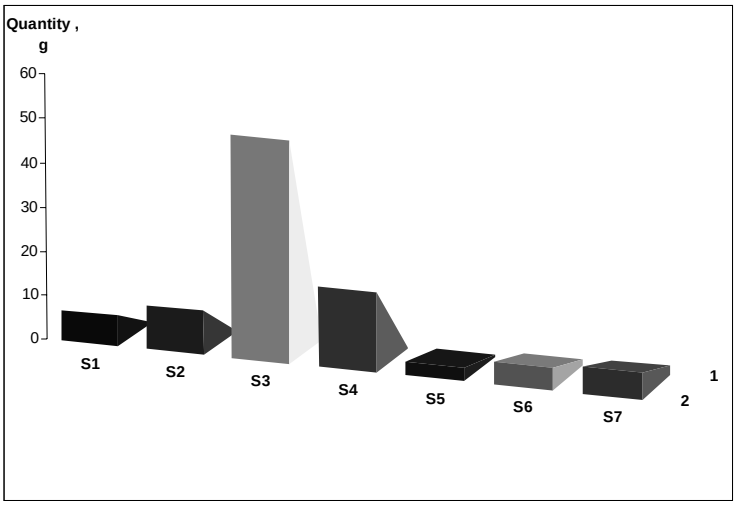

Fig. 1. The variation of unpolluted soil of granulometry

The petroleum sample was characterized by the density and viscosity and the results are presented in table 4.

Table 4. Characterization of petroleum product

Size calculated	**UM**	**PETROLEUM**		
		20 ^{0}C	**30 ^{0}C**	**40 ^{0}C**
Density	kg/m^3	801,5	794,3	789,6
Viscozity	^{0}E	1,026	1,004	0,983

Fresh arable land has undergone thermal decontamination analysis to reveal the percentage of organic matter losses. Then, the soil pollution was subjected to a process controlled by a rate of 15% oil. After homogenization, the sample was subjected to thermal decontamination methods and results are presented in Table 5.

Table 5. Results obtained from thermal decontamination methods

Size	Combustion	Desorption
	Fresh soil	
Fresh soil sample mass, g	100	100
Mass of soil sample after decontamination, g	98,1	98,4
Organic material is lost, mass%	1,9	1,6
	Contaminated soil	
Contamination soil sample mass, g	100	100
Mass of soil sample after decontamination, g	83,3	83,4
Losing weight, mass%	16,7	16,6
Depollution degree,%	98,7	100

Conclusions

The composition and the structure of soil depolluted were more affected due to high temperatures, so it appeals to ecological reconstruction. Ecological reconstruction of the soil for the present study involved a sample of polluted soil mixing with unpolluted soil sample in order to restore the potential for germination. Advantages of remediating soil contaminated with petroleum products, based on thermal methods are:

- Extremely short time in which the decontamination;
- Simple technological facilities;
- Independence from the weather and season;
- Independence from the type of pollutant, soil type and concentration pollutant in the soil.
- Efficiency in the remediation of soils contaminated with petroleum products, and costs for the method itself, and for ecological restoration are reduced.

In figure 2 are presented the soil samples after decontamination and mixed with fresh soil:

1) after decontamination by combustion (50 % the sample of soil unpolluted and 50 % the sample of soil decontaminated) and 2) after decontamination by desorption (50 % the sample of soil unpolluted and 50 % the sample of soil decontaminated).

Fig. 2. The soil samples after decontamination and mixed with fresh soil

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Tehnici de decontaminare a solurilor poluate cu produse petroliere lichide şi reconstrucție ecologică

Rezumat

Interesul şi pentru poluarea solului a crescut mult pentru întreaga populație a globului, după producerea mai multor accidente ecologice care vizează contaminarea acestuia. Solul este cel de-al treilea factor important de mediu, ce trebuie protejat, la fel ca şi apa şi aerul. Această lucrare prezintă un studiu privind decontaminarea solului poluat cu produse petroliere lichide în cazul în care sunt aplicate metode de reabilitare termică, combustie şi desorbție. Din acest motiv este studiat şi gradul de reconstrucție ecologică.