Microbiological degradation and transformation of complex refinery waste caused by violent destruction of installations

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Background

In this study, we examined the model waste formed on the base of that in the NATO campaign in Serbia in 1999, where a refinery in Pančevo (RiP) city was bombed. A huge amount of material which contained crude oil and its derivatives, hydrodesulphurization catalyst (HDSc) that contained toxic metals molybdenum and cobalt was generated.

Methods

We used the model mixture of pollutants that should fit the waste derived from RiP (SoRHFO and HDSc) and it also contained wood sawdust and river sand. Quantities of components of interest (total petroleum hydrocarbons–TPH, Co, and Mo) were taken to ensure that all of them were in the hazardous waste category. The experiment was performed in polyvinyl-chloride containers (approx. 65 kg of the substrate) as pilot-plant and was treated with different conditions. The CMOs was isolated from original refinery waste. Microorganisms were identified from them. During the experiment, different parameters were analyzed.

Objectives

The aim of this research was to investigate if a consortium of the microorganisms (CMOs) used in the process of bioremediation of soil contaminated with the sludge of the residual heavy fuel oil (SoRHFO) can change the chemical form of heavy metals from waste HDSc.

Results

It is noticed that the content of different fractions (hydroxides, sulfides, etc.) of examined toxic metals is transformed during time by microbiological interaction. Through the process, we observed a level of TPH degradation. High microbial activity is expressed in the transformation of the sand to clay, and the degradation of lignocellulose material.

Fraction	Units	C-0		C-3		M-0		M-3	
		Co	Mo	Co	Mo	Co	Mo	Co	Mo
Exchangeable	%	54	88	8	20	13	13	8	8
Bound to carbonates		30	4	18	3	21	3	18	3
Bound to Fe-Mn oxides		8	3	3	2	15	4	14	22
Bound to organic matter		1	3	8	22	8	35	6	16
Residual		7	1	64	52	48	24	53	51
Melting procedure	g/kg	1.97	7.21	2.190	7.493	2.015	7.352	2.130	7.385

Sequential extraction of the cobalt and molybdenum

Results of the basic chemical, and microbiological analysis chemoorganoheterotrophs (CH), yeasts and molds spores (YM), anaerobic chemoorganoheterotrophs (AN) and hydrocarbon degraders (HD)

Parameter	Unit	C-0	C-3	M-0	M-3
HES	g/kg	38.807	38.002	37.516	35.626
TPH	g/kg	24.585	23.987	22.974	18.020
Humic acids	g/kg	2.073	2.225	2.242	2.852
Number of microorganisms					
CH	cfu**** /g	1×10^4	3×10^3	6×10^5	4×10^5
YM		6×10^3	2×10^2	5×10^4	4×10^3
AN		6×10^3	1×10^3	4×10^4	3×10^4
HD		6×10^3	2×10^3	6×10^4	2×10^5

Acknowledgments

The authors would like to thank the Ministry of Education, Science and Technological Development of Republic of Serbia (Contract number: 451-03-68/2022-14/200026) and BREM GROUP LTD for financial support.