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GREEN CHEMISTRY AND BIOREMEDIATION: INVESTIGATION OF METAL INFLUENCE FROM CATALYSTS ON MICROORGANISM CONSORTIA WHICH IS USED IN BIOREMEDATION

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The object of our study was to investigate whether there is an influence of metal catalysts (waste material obtained by desulfurization of oil) in various consortia of microorganisms isolated from a variety of waste materials, which can be used in the process of bioremediation.

Expected results should expand knowledge in the field of microbial ecology, such as the structure of microbial communities studied, the interconnection of abiotic and biotic factors, and at the same time to answer the questions, whether isolated consortia can be used in bioremediation processes of oil contaminated soil where there is a higher concentration of metals as well as for bioremediation of legacy waste in oil, that is a mixture of a catalyst and hydrocarbon waste, as such a threat to the environment.

Rapid industrialization generates different industrial waste, which has toxic elements such as heavy metals. Elevated concentrations of heavy metals can affect almost every index of microbial metabolic activities.

For bioremediation of heavy metals on an industrial scale we used waste oil from Belgrade heating power plant and waste motor oil as materials from which they were isolated microbial consortia, which will be used in the process of bioremediation of soil contaminated with hydrocarbon contaminants.

Catalysts used in the experimental work were by-products of oil desulfurizer and treated as waste material. Metals to which we were directed attention in this study was molybdenum and cobalt.

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Introduction. Bioremediation can be defined as any process that uses microorganisms or their enzymes to return the disturbed environment to its original condition. It has the potential of complete degradation or transformation of hazardous organic pollutants into harmless products. The use of microorganisms in bioremediation is not limited to detoxification of organic compounds. Some microorganisms can reduce the cations of heavy metals into less toxic and harder soluble forms [1].

Bioremediation pile

Rapid industrialization generates different industrial waste, often mixed with heavy metals. Elevated concentrations of heavy metals can affect almost every index of microbial metabolic activities [2].

For bioremediation of heavy metals on an industrial scale, it is important to use materials such as by-product or waste material [3].

The subject of our study was to investigate if there is an influence of metal catalysts on microbial consortia isolated from a variety of waste materials, which can be used in the process of bioremediation.

Catalysts used in the experimental work were by-products of oil desulfurizer and treated as waste material. Metals to which we were directed attention in this study were molybdenum and cobalt.

Material and Methods. For the preparation of microbial consortium the following materials were used: waste motor oil and soil contaminated with waste fuel oil originated from Belgrade Power Plant.

For toxicity testing 5 different waste catalysts from the process of hydrodesulfurization were used.

Investigation of chemical composition of catalysts included: determination of moisture, pH, ash, n-hexane extractable substances (HES) [4], total petroleum hydrocarbons (TPH) [5], carbonates, CO_2, elemental analysis, determination of total heavy metals (As, Fe, Co, Mo).

The Inhibitory effect of tested catalysts on growth of microbial consortium in nutrient medium was studied using catalyst aqueous extract in concentration range of 250-6000 ppm for molybdenium, and 64-1540 ppm for cobalt.

Identifications of microorganisms were performed by API tests.

Results. The data from chemical analysis of investigated catalysts are shown in table 1.

Table 1. The basic chemical characteristics of studied catalysts

Characteristics		Catalyst				
		1	2	3	4	5
Basic chemical parameters	Moisture (%)	4.0	4.5	9.8	28	12.5
	pH	3.7	3.8	3.54	9.95	2.8
	Ash (%)	91.20	92.71	84.59	7.69	94.00
	HES (g/kg)	5.29	1.39	1.20	/	/
	TPH (g/kg)	2.26	0.57	0.43	/	/
	Carbonates (%)	/	/	1.16	/	/
	CO_2 (%)	/	/	0.51	/	/
Elemental analysis (%)	Total nitrogen	< 0.1	/	/	0.35	/
	Total carbon	2.27	0.32	0.64	83.38	< 0.12
	Hydrogen	0.51	0.65	0.90	2.16	0.54
	Sulfur	2.21	1.81	3.19	/	0.87
Total heavy metals (mg/g)	Arsenic	2.05	0.007	0.31	0.001	2.77
	Iron	4.58	0.932	9.12	2.26	2.56
	Cobalt	7.75	0.002	17.12	0.033	18.65
	Molybdenum	21.46	0.007	52.15	0.055	56.68

All catalysts (except number 4) has the similar basic chemical characteristics. In catalyst number 4 is evidently larger amount of organic supstance. For the further investigation of heavy metals role in the process of bioremediation the catalyst number 3 was chosen due to its higher content of molybdenum, cobalt and iron.

It was determined that toxicity of molybdenum is higher than 6000 ppm and cobalt more than 1540 ppm.

The genera of microorganisms present in consortium are *Pseudomonas, Rhodococcus, Sphingomonas, Achromobacter, Stenotrophomonas* and *Aeromonas.*

Conclusion. Aqueous extract of the catalyst number 3 doesn't have inhibitory effect on consortium at investigated concentration of metals and could be safely used in the bioremediation process.

The results of present study provide evidence that microbial consortium isolated from oil contaminated soil could also be used in the bioremediation process with the presence of wasted catalysts.

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