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Comparison between passive remediation and bioremediation for the hydrocarbons contaminated soil clean up

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Abstract

This paper provides some information about mathematical modelling that was prepared for natural attenuation of petroleum hydrocarbons contaminated soil. Concentration of initial contamination with hydrocarbons and time that is needed to degrade it was compared with the results that were received from experimental research of the bioremediation of hydrocarbons in soil by the use of silica nanocomposite. The aim of the mathematical modelling was to check if microorganism that was used in previous research was effective enough when their effectiveness is compared with natural attention effectiveness. The results of natural attenuation shows that in some cases in-situ remediation might be more effective than ex-situ bioremediation, however the effectiveness of natural attenuation depends on many factors and due that the results might vary in different areas.

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1. Introduction

Oil spillage has turned out to be worldwide problem since decades ago when people started to use petroleum more and more. Pollution from spilled oil affects not only soil, marina life and environment but it also has additional influence on worldwide economic [1]. Soil contaminated with petroleum has a serious hazard to human health, causes

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organic pollution of ground water which limits its use and decreases the agricultural productivity of the soil [2]. Petroleum products by being denser than water has ability to diminish and limit the throughput: water and air which are needed for plants are subtracting by natural hydrocarbons, which fill the soil pores and send out water and air [3]. Toxic components from oil products, ultimately gets into the human food chain and starts negatively affect our health. Environment contamination with oil products causes huge problems not only to environment but also to human health. That is why it is so important to remove pollution as quickly as possible [4].

Environment purification from pollution with oil products is still a huge challenge for environmental researchers and technicians. Due to the fact that all pollution cases are different it is essential to create and develop innovative technologies for petroleum elimination from the spilled sites [5]. According to a new technology needs, experimental research using nanocomposites was carried out. Today nanoparticles and its composites broadly used material. Nanocomposites (where one of the phases has nanoscale additives) exhibit unique physical, chemical properties: they can be easy developed, processed and modified [6]. Depending on their ability to attract and retain water was raised thesis that nanoparticles may intensify microorganism activity which mainly depends on humidity.

Unfortunately, after research was carried out it was found that nanocomposites do not activate microorganism activity. For this reason was decided to carry our mathematical modelling, which would help to determine if used microorganisms for research was effective enough. Expedient to determine the effectiveness of the research results, is to compare it with the results that will be got from natural attenuation mathematical modelling.

2. Experimental research and results

The study was done for a period of fourteen (14) weeks. Polluted diesel soil samples were placed into six (6) different containers, of similar size and geometry, where 1 kg of soil was placed in each of the containers, all of them were polluted with 10 g of diesel and all were exposed to the same atmosphere and environmental conditions. Two containers were used for the control experiment (CT), where pollutants were cleaned with the help of microorganism (without nanocomposites), while in other containers cleaning were done with microorganism and different proportions of nanosilica. Nanosilica was used in the form of white powder.

The research was done in cooperation with “Grunto valymo technologijos” company. All processes were investigated under optimal conditions for diesel biodegradation in laboratory which belongs to “Grunto valymo technologijos” company.

Biopreparation GVT-1 that was used in the experimental research was offered and prepared by “Grunto valymo technologijos” company.

Results of biodegradation of hydrocarbons in soil contaminated with petroleum products with the use of silica nanocomposites showed in Table 1.

Table 1. Petroleum degradation in different samples.

Data/Parameters	16.12.12	16.12.19	17.01.04	17.01.19	17.02.02	17.02.15	17.003.01	17.03.01
Control sample No. 1, g/kg	9.9	8.1	7.67	6.55	6.15	5.2	4.68	4.37
Control sample No. 2, g/kg	10.7	8.3	7.24	6.91	6.55	5.9	4.62	4.35
Sample No. 1 + 10 g silica nanocomposite, g/kg	10.5	7.92	6.97	6.9	6.54	5.6	4.94	4.59
Sample No. 2 + 20 g silica nanocomposite, g/kg	10.1	7.63	7.02	6.98	6.83	5.3	4.44	4.43
Sample No. 3 + 30 g silica nanocomposite, g/kg	10.7	8.12	7.24	6.94	6.87	5.2	4.74	4.50
Sample No. 4 + 40 g silica nanocomposite, g/kg	10.3	8.7	8.24	6.47	6.74	5.6	4.92	4.66

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