

TE Microbial uptake of diesel oil sorbed on modified peat PeatOs



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Introduction

Materials & Methods

Peat sorbent is an oil organic adsorbent produced from modified peat. Among the benefits of the use of peat sorbent are the effectivenes on land and water; it is non-toxic, non-leaching, lightweight, non-abrasive and vapour suppressive [1]. Thermally treated peat was shown to be a prospective sorbent for oil removal during spills [2-3]. The further reuse or utilization of the used peat sorbents is one of the important issues related to the efficiency and ecological safety of this approach [4]. The aim of these experiments was to determine the capacity of bacteria

Peat was modified via low temperature pyrolysis. The obtained sorbent has following characteristics: C 64.8 %, H 4.3 %, N 0.4 %, specific surface area 34 m²/g, oil sorption capacity 7 g oil/g sorbent. The modified peat (Peat based oil sorbent - PeatOS) was further used in biodegradation experiments (Fig.1). 10 g PeatOS was spiked with 200 mg of diesel oil. Bacteria consortium MDK-EKO-7 consisting of 5 strains of *Stenotrophomonas maltophilia* and 2 strains of *Pseudomonas* spp., was used. The process occurred in a slurry model system was carried out during 36 days at 28 °C and was evaluated by microbial enzymatic activity, as well as by a decrease of hydrocarbons concentration in dynamics. The standard method of gas-liquid chromatography EN ISO (9377-2) was used to determine changes of hydrocarbon concentration in samples.

consortium MDK.EKO-7 to clean up the spent peat sorbent.



Results & Discussion



Figure 1. SEM micrographs of a modified peat sorbent (PeatOS) used in the experiment. Bar 10 μ m.

In this study, the tested peat was specifically treated with the aim to enhance the oil sorption capacity. Therefore, activity of microorganisms onto a modified peat was not obvious, for example, due to an increased hydrophobicity of peat.

In this study, three groups of enzymes, i.e., fluorescein diacetate (FDA) hydrolysis, urease and dehydrogenase (DHA) were measured in a peat-slurry system inoculated with bacteria consortium MDK.EKO-7. The measured enzymes behaved differently over time. In the

Figure 2. Changes of microbial enzymatic activity and the number of colony forming units (CFU) during 36 day incubation with hydrocarbons-contaminated and non-contaminated peat. (a) – FDA hydrolysis activity; (b) – dehydrogenase activity (DHA); (c) – urease activity; (d) – CFU number. Control – non-contaminated peat. Error bars represent the standard deviation.



Period of incubation, days

Figure 3. Concentration of total petroleum hydrocarbons in a peatslurry with diesel oil during 36 days incubation. Error bars represent the standard deviation.

References

presence of diesel, FDA hydrolysis activity was increased in average from 1.06 to $3.02 \mu g/ml h$. Besides, one more peak of the FDA hydrolysis activity was shown at the beginning of the experiment, i.e., at the 7th day of incubation (Fig.2(a)). DHA activity fluctuated over time, while urease activity was constant during 36 days incubation in the both sets with a lower average activity in the presence of diesel oil (Fig.2(b,c)). The number of CFU in the sets with diesel-contaminated and non-contaminated peat remained constant during incubation (Fig.2(d)).

Assessment of microbial activity in a peat-slurry system with hydrocarbons was accompanied with the measurement of hydrocarbon concentration in dynamics. A decrease of hydrocarbons concentration from 7.54 to 0.67 mg HC/g dw peat during 36 day incubation was found (Fig.3). The ratio between (n-C₈ to n-C₂₃) and (n-C₂₄ to n-C₄₀) did not change considerabely and varied in the range from 82% to 98 %, and from 2% to 18 %, respectively. This fact indicates to the biodegradation process occurred in the presence of bacteria consortium [5].

Conclusions

Degradation of the diesel fuel sorbed onto peat sorbent (PeatOS) (diesel concentration 200mg/g dw), was shown to be possible in a slurry system (diesel oil : modified peat : nutrient amendments : bacteria consortium). A decrease of hydrocarbons concentration up to 90 % was detected after 36 days incubation.

Enzymes of bacteria in the sets with raw-oil- and diesel-oil-contaminated peat behaved differently over time. FDA hydrolysis activity in the set with diesel oil was notably increased during 36 days incubation. Conversly, DHA and urease activity did not demonstrante considerable changes during the experiment, except the initial stage of incubation, which was accompanied by DHA increase.

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Taking into consideration the effect of the diesel loading rate to biodegradation activity, the testing of higher concentrations of diesel is necessary in future.



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