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October 9-13, 2016



# 低濃度 PCB 廃棄物処理

環境省 大臣認定番号 平成26年第9号

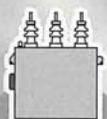
LOW CONCENTRATION PCB WASTE PROCESSING



絶縁油等  
汚染廃油処理  
23.3Kℓ/日



トランス  
(500kg相当)  
約100台/日



コンデンサ  
(100kg相当)  
約50台/日



プッシング  
(100kg相当)  
約70本/日



OFケーブル  
約200m/日



汚染物入り  
ドラム缶  
48本/日



空ドラム缶  
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### Bioremediation of polychlorinated biphenyls in river sediment: a laboratory study

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Persistent organic pollutants (POPs) are chemical substances which can persist in the environment, bioaccumulate in the food chain and cause adverse health effects in humans and wildlife. POPs include the group of industrial chemicals, polychlorinated biphenyls (Polychlorinated Biphenyls, PCBs). PCBs may be substituted with 1 - 10 chlorine atoms. These chemicals were used as heat exchangers, as insulators in transformers and capacitors, in the production of plastics and color additives because of their chemical inertness, heat resistance and high dielectric constants.

The aim of our study was to analyze the PCBs biodegradation potential of autochthonous and allochthonous microorganisms in river sediment samples in order to protect the environment and estimate future treatment of these sites. This samples collected from rivers in the territory of Belgrade, Serbia, from four locations: confluence of the Topčider river with Čukarički Rukavac (CR), Marina Dorćol (MD), the confluence of the river Sava and the Danube, Usce (U) and Zemunski Kej (ZK). Sediments were sampled from four depths: 0-1, 1-3, 3-6 and 6-10 cm. In a samples, CR sediment (169-305 ng/g) and MD (19.3-54.5 ng/g), were determined the highest level of PCB, while the sample concentration in ZK (6.2-7.1 ng/g) and U (2.1-5.3 ng/g) were relatively low.

For the study of PCBs bioremediation the composite samples (from four depths in the ratio 1: 2: 3: 4) and sand, 1: 1 (w/w) were added in Bushnell - Haas medium (modified, chloride-free). The experiment lasted 70 days with alternating anaerobic - aerobic cycles with inoculation at 21st and 56th day. Inoculation was carried using allochthonous microorganisms which were isolated from sites contaminated with petroleum products and that consortium consists of genera *Achromobacter*, *Pseudomonas*, and *Rhodococcus*. In parallel, also were monitored activity of autochthonous microbial consortium. As an abiotic control sterilized sample were used. Sterilization technique was used for stopped of biodegradation processes. Extraction was carried out with a mixture of acetone: hexane, 1: 1 (v/v), and PCB content in the obtained samples was analyzed by GC-MS/MS method.

After 70 days in both model systems (with autochthonous and allochthonous microorganisms) about 33 %, reduction in the concentration of PCBs, was observed. Tests have confirmed that both of this bacterial consortia can reduce the level of PCB under laboratory conditions. The results indicate the existence of bioremediation potential of microorganisms isolated from contaminated sites using alternating anaerobic - aerobic cycles for the treatment of environment contaminated with PCB compounds.



# BIOREMEDIATION OF POLYCHLORINATED BIPHENYLS IN RIVER SEDIMENT: A LABORATORY STUDY



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## Aim

The aim of our study was to analyze the potential of allochthonous and autochthonous microorganisms for the process of biodegradation of PCBs in sediment samples collected from rivers in the territory of Belgrade, Serbia, to protect the environment and estimate future treatment of these sites.

## Introduction

Persistent organic pollutants (POPs) are chemical substances that persist in the environment, bioaccumulate through the food chain and cause adverse effects on human health and the environment [1, 2]. They include the group of polychlorinated biphenyls (Polychlorinated Biphenyls, PCBs), industrial chemicals which may be substituted with 1 - 10 chlorine atoms (Fig 1.) [3-6].

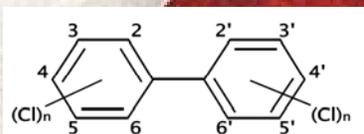


Fig 1. Chemical structure of PCBs

Due to their chemical inertness, heat resistance and high dielectric constants PCBs were used as insulators in transformers and capacitors, as heat exchangers, color additives and in the production of plastics [3-6].



Fig 2. Sampling locations in Belgrade, Serbia

CR - Čukarički rukavac

ZK - Zemunski kej

MD - Marina Dorćol

U - Ušće

## Results and Discussion

The highest level of PCB in a sample is determined in CR sediment (169-305 ng/g) and MD (19.3-54.5 ng/g), while the sample concentration in ZK (6.2-7.1 ng/g) and U (2.1-5.3 ng/g) were relatively low (Fig 3.).

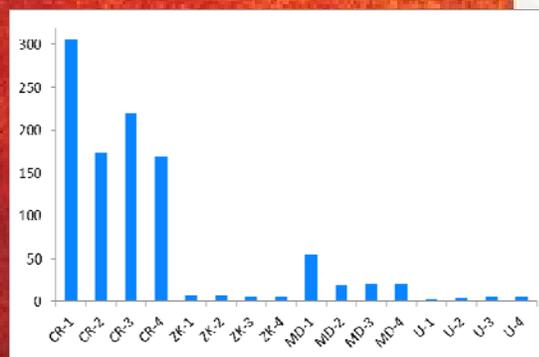


Fig 3. Concentration of PCBs in sediment samples (ng/g)

## Material and methods

The river sediment samples were collected from four locations in the territory of Belgrade (Fig 2.): confluence of the Topčider river with Čukarički Rukavac (CR), Marina Dorćol (MD), Zemunski Kej (ZK) and the confluence of the river Sava and the Danube, Ušće (U). Sediments were sampled from four depths in undisturbed condition as follows: 0-1, 1-3, 3-6 and 6-10 cm.

For the PCBs bioremediation study composite samples has been made from the samples sampled from four depths in the ratio 1: 2: 3: 4 (w/w). In Bushnell - Haas medium (modified, chloride-free) were added the sand and composite samples, 1: 1 (w/w). The experiment lasted 70 days with alternating anaerobic - aerobic cycles with inoculation of model system at 21st and 56th day. Inoculation was carried using consortium of genera *Pseudomonas* (Genbank: JF826528.1 and JQ292806.1), *Rhodococcus* (Genbank: JQ065876.1 and JX965395.1), and *Achromobacter* (Genbank: JF826529.1). These allochthonous microorganisms were isolated from sites contaminated with petroleum products. In parallel, activity of indigenous microbial consortium in the process of transforming the PCB were monitored. As an abiotic control sterilized sample were used. Biodegradation processes are interrupted by sterilization. Extraction was carried out with a mixture of acetone : hexane, 1: 1 (v/v). PCB content in the obtained samples was analyzed by GC-MS/MS method.

In Fig 4. changes in concentrations of PCBs in the sample CR during bioremediation studies, after 42 and 70 days in the inoculated and uninoculated samples are presented. The results indicate the existence of bioremediation potential of microorganisms isolated from contaminated sites for the treatment of environment contaminated with PCB compounds using alternating anaerobic - aerobic cycles.

## References

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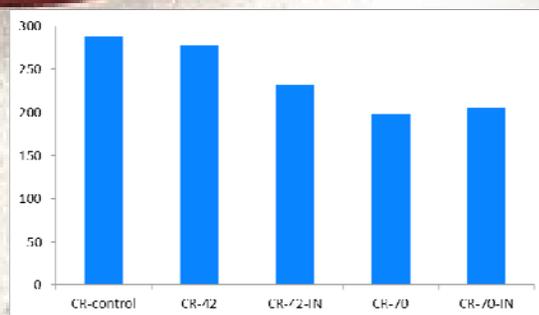


Fig 4. Reduction of PCBs in the CR (ng/g-dry)

## Conclusion

In model systems inoculated with consortium of allochthonous microorganisms as well as in model systems with indigenous microorganisms it was observed reduction in the concentration of PCBs. This fact suggests that the mentioned microorganisms can be used in bioremediation of river sediment contaminated with polychlorinated biphenyls.