PILOT PROJECT ON PCB REMEDIATION FROM SOIL IN CHEMKO STRÁŽSKE, SLOVAKIA

REPORT

REPORTING PERIOD: APRIL – SEPTEMBER, 2021

NATIONAL AGRICULTURAL AND FOOD CENTRE

green ARSENAL

About GREEN ARSENAL

Axalton Group is dedicated to identifying and developing notable innovations that promote sustainability globally. Since their passion is green tech, they gather the green products they truly believe in under the Green Arsenal umbrella brand. Their approach always includes the responsible use of resources, harmonized ecological processes, and effectively combating pollution.

For more information, please visit: www.greenarsenal.com

About NPPC (National Agriculture and Food Center)

The National Agricultural and Food Centre focuses on comprehensive research and gathering of knowledge in the sustainable use and protection of natural resources, especially soil and water resources for crop production and animal husbandry, quality and safety, innovation and competitiveness of food and non-food products of agricultural origin, productive and non-productive impact of agriculture on the environment and rural development and the transfer of knowledge from agricultural and food research to end users.

For more information, please visit: http://www.nppc.sk/index.php/en/

TABLE OF CONTENTS

Executive summary

GREEN ARSENAL conducted a pilot project together with the National Agricultural and Food Centre in Slovakia. The pilot has started in April 2021, when BIORESQ™ was sprayed on 1 hectare of PCB contaminated land in Strážske.

The contamination of the treated area resulted from the activity of Chemko, a chemical plant which produced polychlorinated biphenyls (until 1984) and contaminated a large part of East Slovakia, especially sediments of Laborec river and reservoir Zemplínska šírava.

The objective of the project is to test the biodegradation abilities of BIORESQ™ introduced in PCB contaminated soil and to find an effective solution to eliminate the contamination.

The pilot project is in line with the statement of the Slovak Government's program in which the reduction of environmental pollution, specifically in the area of Chemko Strážske is explicitly mentioned.

The pilot project is still ongoing as alfalfa and soybeans have been sown in the contaminated experimental area so that the level of contamination of the plants can also be tested and compared on treated and untreated parts of the area after the harvest.

Based on the results so far, the pilot project has been a successful first step towards the bioremediation of the area of Chemko Strážske with BIORESQ™ as the ex-situ test of the product showed a total PCB degradation rate of 48% only in 72 days.

An evaluation of the ongoing experiments is expected by the end of October, 2021.

A. Introduction

PCBs is in viscous liquid form at normal temperature and has a poor solubility in water. The aromatic hydrocarbon structure gives PCBs relatively high molecular stability. The chlorine substitution further reinforces its insolubility and chemical stability. Hence, the degradation of PCBs in the natural environment is very slow, which can range from 3 to 37 years depending on the number of chloride substitutions and their positions.

Production of PCBs have been banned for over forty years but their very nature allows them cycle through our environment until they're consumed or otherwise absorbed by living organisms.

It is more than 40 years since the environmental contamination of polychlorinated biphenyls (PCBs) was first reported in wildlife samples. Since then, a huge number of papers on PCBs have been published, which include the biodegradation of PCBs and toxicology of PCBs.

Bioremediation of PCBs is the use of microorganisms to degrade PCBs from contaminated sites, relying on multiple microorganisms' co-metabolism. Anaerobic microorganisms dechlorinate PCBs first, and other microorganisms that are capable of doing BH pathway can break down the dechlorinated PCBs to usable intermediates like acyl-CoA or carbon dioxide.

B. Objectives and participants of the project

The objective of the project was to test the biodegradation abilities of BIORESQ™ introduced in PCB contaminated soil.

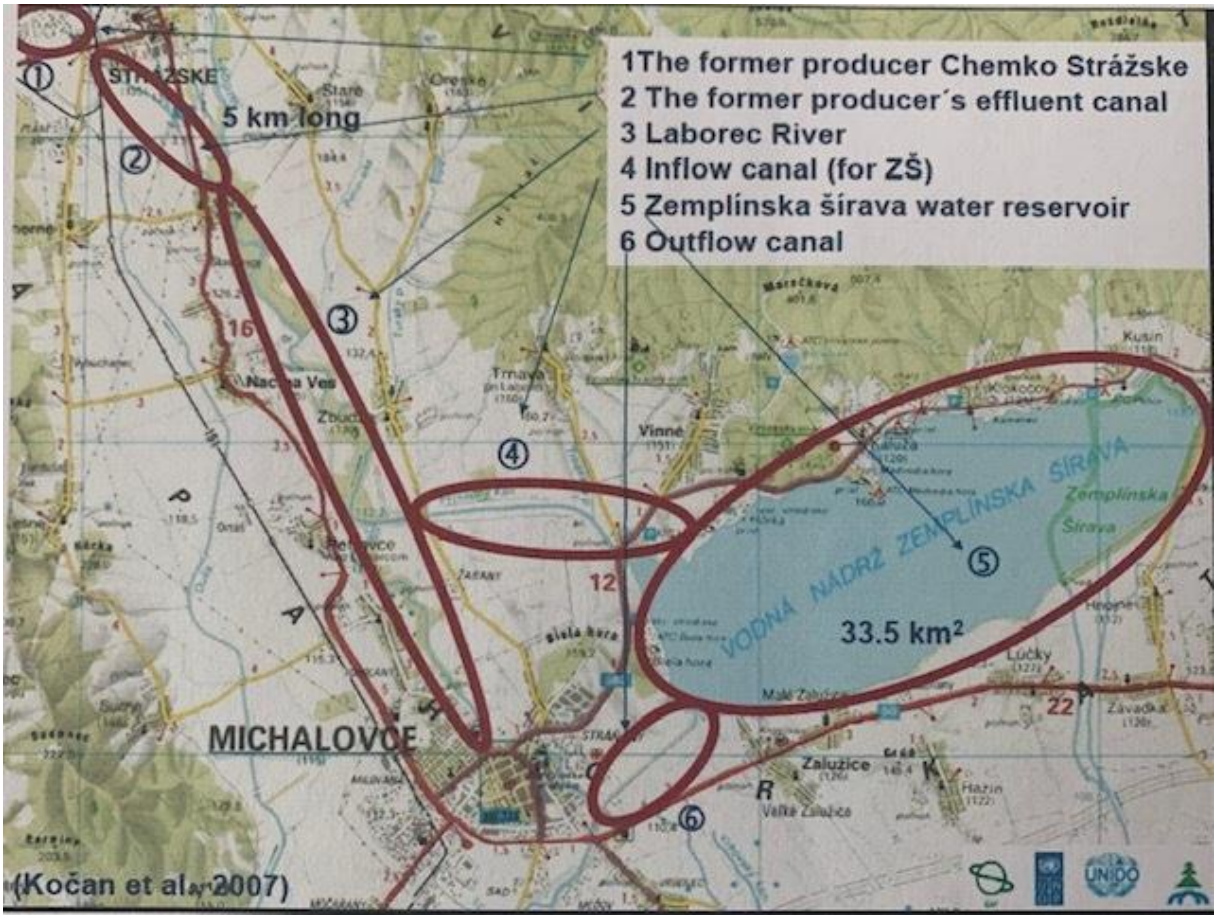
NPPC (Slovakia) and Green Arsenal Hungary Kft. were participating in the project that has been conducted from 2021 April around the contaminated of the former Chemko chemical factory and an additional ex-situ test was performed by EL spol. s.r.o. accredited testing laboratory to remediate soil with extremely high PCB contamination by the product of BIORESQ™.

C. Background information

1. PCB contamination in East Slovakia

Chemko chemical facility (East Slovakia) produced 21 500 tonnes of PCB in Czechoslovakia between 1959 and 1984. Today, this location is considered as one of the most polluted territories in Central Europe. Content of PCBs was detected in all the environment. Elements of the production were not stored properly and the wastewater was discharged into the Strážske channel and Laborec river without any purification or control. This activity polluted the soil, the surface- and groundwater.

The PCB concentration in that area is higher than anywhere else in the region. The contamination in many cases exceeds 1000 times the limit allowed in Slovak Republic for these matrices. An estimated quarter of a million people are exposed to PCB in Slovakia as a result of this contamination.



2. About PCB (Polychlorinated biphenyls)

PCBs were used heavily since the 1930s dielectric fluids in capacitors and transformers and for other applications such as flame retardants, ink solvents and plasticisers. An estimated 1,325,810 tons of PCBs were produced between 1929 and 1993 in total. In the 1970s, their toxic effects on the immune system, liver, skin, reproductive system, gastrointestinal tract and thyroid gland became prominent and their use was phased out as it was listed in the Stockholm convention.

The Stockholm Convention on persistent organic pollutants (POPs) is a multilateral environmental agreement aimed at eliminating the intentional production and use and unintentional releases of POPs. POPs are chemicals characterised by their persistence, bioaccumulation, potential for long-range environmental transport and adverse effects on humans and wildlife. To protect human health and the environment from such chemicals, the Convention was adopted by the international community, the Slovak Republic ratified the Stockholm Convention on Persistent Organic Pollutants in 2002, and has committed to gradually eliminating them.

PCBs (Polychlorinated biphenyls) are a class of chemical compounds in which 2-10 chlorine atoms are attached to a biphenyl molecule. The structure of the molecule allows the formation of a large number of chlorinated compounds, therefore there are several hundred different PCBs.

An important property of PCBs is that they are stable. They resist both acids, alkalis and heat. That is why they were useful in many applications, such as dielectric fluids in transformers and capacitors, heat transfer fluids, and lubricants. They are relatively insoluble in water and freely soluble in apolar organic solvents and biological lipids. They are highly able to bioaccumulate and biomagnify in organisms, that is why they pose danger and the process of liquidation of persistent organic pollutants, such as PCBs, is very difficult and time-consuming.

Due to their hydrophobic trait, polychlorinated biphenyls are stored in body fat, as mentioned earlier, and may be excreted in the fat of breast milk. PCBs have been shown to cause cancer in animals. They also have effects on their immune system, reproductive system, nervous system and endocrine system. Studies in humans provide supportive evidence for potential carcinogenic and noncarcinogenic effects of PCBs. They are very dangerous for pregnant mothers, since they have teratogenic effects and harm the fetus.

3. The Slovakian Government's commitment to reduce the environmental pollution, specifically in the area of Chemko Strážske

"The Government of the Slovak Republic will make every effort to eliminate environmental burdens, especially those with the highest priority of the solution:

- stopping further groundwater pollution of Žitný ostrov (Vrakunská landfill and other sources of pollution from Bratislava),
- disposal of PCBs, heavy metals and remediation of the adjacent area in eastern Slovakia, in the vicinity of Strážské and the Poša and gudron tailings pond in the Predajná complex,

The plan for remediation of other environmental burdens will be guided by the principle of value for money."*

** Program Statement of the Government of the Slovak Republic for the period 2020 - 2024, page 98*

4. Bioremediation with BIORESQ™ as a possible way to reduce PCB contamination level

Bioremediation is the process of removing or neutralizing pollutants from a contaminated site. In this process different kind of microbes biodegrade a contaminant. They use it as nutrient source and the process results in smaller, less toxic, more bioavailable molecules. While bioremediation can be achieved with indigenous microorganisms, the rate of biodegradation is usually very slow. In order to increase the rate of the remediation process, new microbe cultures can be introduced to the contaminated site. This method is called bioaugmentation. Bioaugmentation is one of the most widely used „tool" to achieve bioremediation.

BIORESQ™ is a bioremediation product containing thousands of different microbes and enzymes to achieve a high efficiency bioremediation in a contaminated area. Some of the microorganisms in the product have the ability to utilize PCBs as nutrient source, thereby eliminating them.

The elimination/degradation process occurs in two steps. Anaerobic reductive and an aerobic oxidative process. Anaerobic microbes (bacteria) attack more highly chlorinated PCB congeners. This biochemical pathway is the reductive dechlorination, which results in the transformation of highly chlorinated PCB congeners into lower chlorinated, chlorine atom – substituted PCB congeners. The aerobic biodegradation of PCBs is widely known and has been well studied for a while now. Aerobic microbes (bacteria) preferably degrade more lightly chlorinated PCB congeners, so basically the final products of the reductive anaerobic degradation. The aerobic oxidation transforms PCBs into chlorobenzoic acids. These molecules can be further biodegraded with the contribution of other bacteria. They produce carbon-dioxide, water, chloride and biomass as final products. BIORESQ™ as a microorganism and enzyme complex is able to increase efficiency over the full spectrum of biochemical processes, initiating or enhancing both the aerobic and anaerobic degradation.

In order to test the efficiency of BIORESQ™, PCB contaminated soil from the Chemko Strážske polluted area was treated with BIORESQ™.

5. Product description of BIORESQ™

BIORESQ™ provides an environmentally sustainable treatment technology for the reduction of PCB contamination.
BIORESQ™ is a mixture of microorganisms and enzymes in which the 16S rDNA sequences of 2680 different bacteria can be isolated.

Species of degrading microorganism:

i. *Anaerobic microorganisms: these operate in an oxygen-free environment of the basin, pre-decomposing organic matter*
ii. *Facultative microorganisms: can live in the presence and absence of oxygen. They digest organic matter and gases pre-decomposed by anaerobes and make organic compounds easily digestible. They live in the central regions of the basin and perform most of the biological processes.*
iii. *Aerobic microorganisms: the final stage of degradation. It takes place in the upper layers of the pool in an oxygen-rich environment, the aerobes decompose the remaining organic matter and the bad-smelling gases (for example ammonia).*

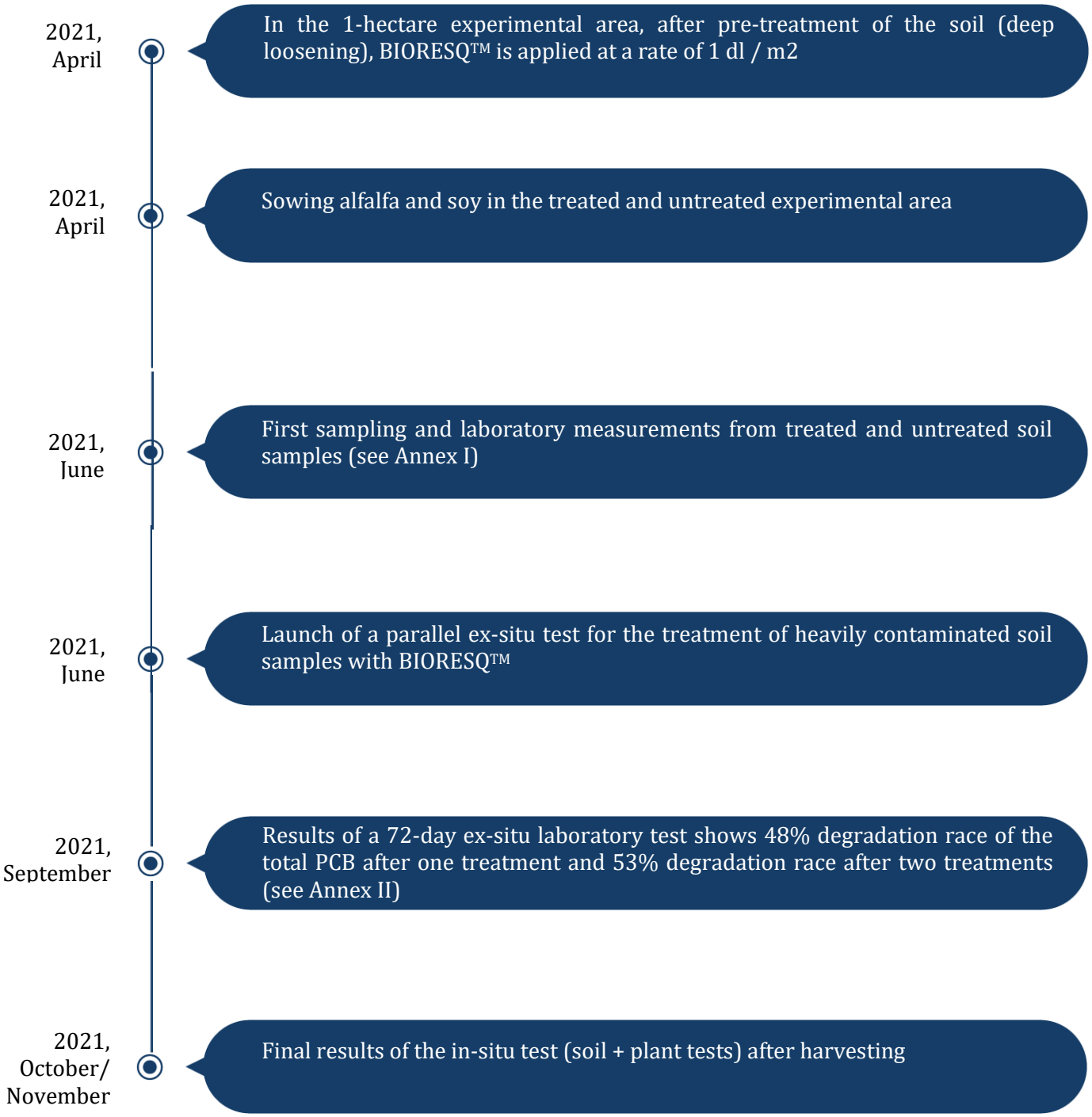
Bacteria discharge exoenzymes to break down and separate organic molecular chains and perform intracellular cleavage of simpler molecules with endoenzymes.

WHY BIORESQ™?

- highly viable bacterial strains enter the system, which triggers biological processes
- the method is both efficient and economical because it does not require expertise and investment of assets
- accelerates the decomposition of organic matter
- biological balance is restored
- adhesions are eliminated
- environmentally friendly solution contains natural active ingredients that are harmless to humans, animals, and the environment

1) contains nutrients in a more easily accessible, explored form for the vegetation
2) they provide macro-and micronutrients to plants, increase the organic matter content and adsorption capacity of soils, improve their physical properties, and also favourably modify the water management of soils.

D. Timeline and description of the pilot project

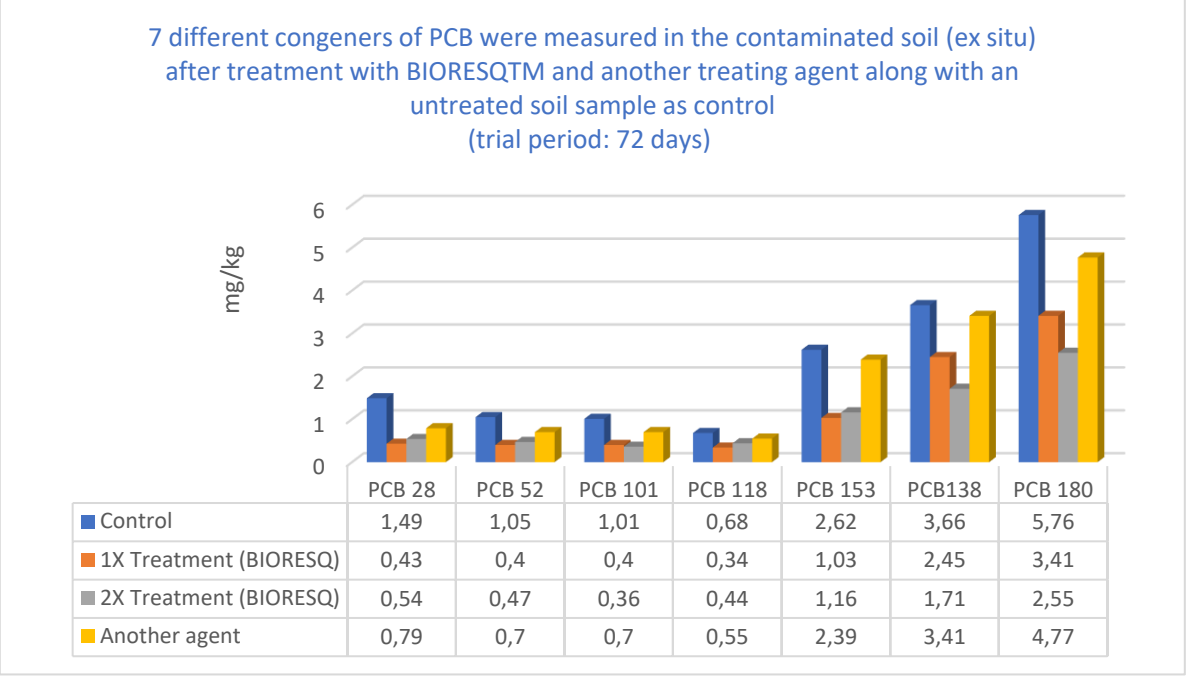


E. Results and conclusions

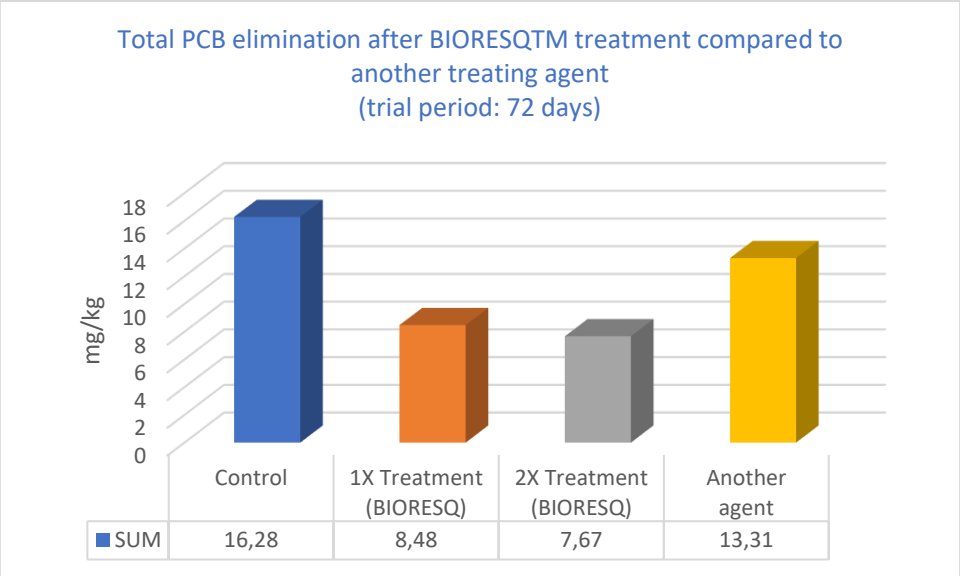
Contaminated soil treated with BIORESQ™ showed an increased loss of PCB due to bioremediation at every congener, compared to the other treating agent. It can be seen, that the PCB concentrations were halved most of the cases in only 72 days. The total PCB degradation rate was 48% after one treatment and 53% after two treatments with BIORESQ™, while it was only 18% in the case of the other treating agent.

The experiment was done in a controlled environment (ex situ), the more than 50% decrease of total PCB content is favourable for further "on site" (in situ) experiments and treatments.

The valid total PCB contamination limit in Slovak Republic is 0,05 mg/kg. After one treatment with BIORESQ™, the contamination decreased from 16,28 mg/kg to 8,48 mg/kg and to 7,67 mg/kg after two treatments. While this value is still almost 170 times larger than the allowed limit, the rate of the decrease in such a short amount of time, after one treatment is promising.



	PCB 28	PCB 52	PCB 101	PCB 118	PCB 153	PCB138	PCB 180
Control	1,49	1,05	1,01	0,68	2,62	3,66	5,76
1X Treatment (BIORESQ)	0,43	0,4	0,4	0,34	1,03	2,45	3,41
2X Treatment (BIORESQ)	0,54	0,47	0,36	0,44	1,16	1,71	2,55
Another agent	0,79	0,7	0,7	0,55	2,39	3,41	4,77


Total PCB elimination after BIORESQTM treatment compared to another treating agent
(trial period: 72 days)
mg/kg
18
16
14
12
10
8
6
4
2
0
Control
1X Treatment (BIORESQ)
2X Treatment (BIORESQ)
Another agent
SUM
16,28
8,48
7,67
13,31

ANNEX I.

EL spol. s r.o.
Radlinského 17A, 052 01 Spišská Nová Ves
Akreditované skúšobné laboratóriá podľa ISO/IEC 17025: 2017

SNAS Reg. No. 038/S-025

Akreditácia sa nevzťahuje na skúšky typu N

Protokol o skúške č.: 21/12659

Zákazník - objednávateľ skúšok

Objednávateľ: (meno a adresa)	CE Invest s.r.o. Záhradnícka 36, 82108 Bratislava	**Dátum prevzatia vzorky:**	15.06.2021
Odosielateľ:	CE Invest Bratislava	**Dátum vykonania skúšok od:**	15.06.2021
Zmluva / objednávka:	z 10.6.2021	**do:**	30.06.2021
Zákazka:	21-05317	**Dátum vydania protokolu:**	30.06.2021
Vzorku odobral:	Objednávateľ	**Počet vzoriek:**	4

Výsledky skúšok

P.č.: 1	Číslo vzorky: 21-012404	Typ vzorky: Tuhé materiály - poľnohospodárska pôda	Chemický rozbor

Označenie vzorky: vzorka č.1

Parameter	Jednotka	Výsledok skúšky	Neistota merania	Skúšobná metóda	Medza stanovenia	Metodický predpis	Typ skúšky
PCB suma	mg/kg	**0.0237**	20 %	GC/ECD	0.0100	IP 4.8	A
PCB -28 (2,4,4´-trichlórbifenyl)	mg/kg	**0.0042**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -52 (2,2´,5,5´-tetrachlórbifenyl)	mg/kg	**0.0021**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -101 (2,2´,4,5,5´-pentachlórbifenyl)	mg/kg	**0.0025**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -118 (2,3´,4,4´,5-pentachlórbifenyl)	mg/kg	**0.0015**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -153 (2,2´,4,4´,5,5´-hexachlórbifenyl)	mg/kg	**0.0037**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -138 (2,2´,3,4,4´,5´-hexachlórbifenyl)	mg/kg	**0.0055**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -180 (2,2´,3,4,4´,5,5´-heptachlórbifenyl)	mg/kg	**0.0042**	20 %	GC/ECD	0.0012	IP 4.8	A

P.č.: 2	Číslo vzorky: 21-012405	Typ vzorky: Tuhé materiály - poľnohospodárska pôda	Chemický rozbor

Označenie vzorky: vzorka č.2

Parameter	Jednotka	Výsledok skúšky	Neistota merania	Skúšobná metóda	Medza stanovenia	Metodický predpis	Typ skúšky
PCB suma	mg/kg	**0.0119**	20 %	GC/ECD	0.0100	IP 4.8	A
PCB -28 (2,4,4´-trichlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -52 (2,2´,5,5´-tetrachlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -101 (2,2´,4,5,5´-pentachlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -118 (2,3´,4,4´,5-pentachlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -153 (2,2´,4,4´,5,5´-hexachlórbifenyl)	mg/kg	**0.0021**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -138 (2,2´,3,4,4´,5´-hexachlórbifenyl)	mg/kg	**0.0028**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -180 (2,2´,3,4,4´,5,5´-heptachlórbifenyl)	mg/kg	**0.0022**	20 %	GC/ECD	0.0012	IP 4.8	A

P.č.: 3	Číslo vzorky: 21-012406	Typ vzorky: Tuhé materiály - poľnohospodárska pôda	Chemický rozbor

Označenie vzorky: vzorka č.3

Parameter	Jednotka	Výsledok skúšky	Neistota merania	Skúšobná metóda	Medza stanovenia	Metodický predpis	Typ skúšky
PCB suma	mg/kg	**0.0128**	20 %	GC/ECD	0.0100	IP 4.8	A
PCB -28 (2,4,4´-trichlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -52 (2,2´,5,5´-tetrachlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -101 (2,2´,4,5,5´-pentachlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -118 (2,3´,4,4´,5-pentachlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -153 (2,2´,4,4´,5,5´-hexachlórbifenyl)	mg/kg	**0.0023**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -138 (2,2´,3,4,4´,5´-hexachlórbifenyl)	mg/kg	**0.0033**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -180 (2,2´,3,4,4´,5,5´-heptachlórbifenyl)	mg/kg	**0.0024**	20 %	GC/ECD	0.0012	IP 4.8	A

Tel.: + 421 53 4424740, + 421 53 4192322 e-mail: elsro@elsro.sk www.elsro.sk

EL spol. s r.o.
Radlinského 17A, 052 01 Spišská Nová Ves
Akreditované skúšobné laboratóriá podľa ISO/IEC 17025: 2017

SNAS Reg. No. 038/S-025

Akreditácia sa nevzťahuje na skúšky typu N

Strana: 2 z 2
Výtlačok: 3 z 3

Protokol o skúške č.: 21/12659

P.č.: 4	Číslo vzorky: 21-012407	Typ vzorky: Tuhé materiály - poľnohospodárska pôda	Chemický rozbor

Označenie vzorky: vzorka č.4

Parameter	Jednotka	Výsledok skúšky	Neistota merania	Skúšobná metóda	Medza stanovenia	Metodický predpis	Typ skúšky
PCB suma	mg/kg	**0.0123**	20 %	GC/ECD	0.0100	IP 4.8	A
PCB -28 (2,4,4´-trichlórbifenyl)	mg/kg	**0.0018**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -52 (2,2´,5,5´-tetrachlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -101 (2,2´,4,5,5´-pentachlórbifenyl)	mg/kg	**<0.0012**	-	GC/ECD	0.0012	IP 4.8	A
PCB -118 (2,3´,4,4´,5-pentachlórbifenyl)	mg/kg	**0.0012**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -153 (2,2´,4,4´,5,5´-hexachlórbifenyl)	mg/kg	**0.0019**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -138 (2,2´,3,4,4´,5´-hexachlórbifenyl)	mg/kg	**0.0026**	20 %	GC/ECD	0.0012	IP 4.8	A
PCB -180 (2,2´,3,4,4´,5,5´-heptachlórbifenyl)	mg/kg	**0.0024**	20 %	GC/ECD	0.0012	IP 4.8	A

Skúšobné metódy

Skratka	Názov metódy
GC/ECD	Plynová chromatografia s detektorom elektrónového záchytu

Použité skratky: **IP** – Interný predpis
Typ skúšky: **A** - akreditovaná, **N** - neakreditovaná, **T** - terénna, **S** - subdodávka (externá služba)
Neistota merania predstavuje relatívnu rozšírenú neistotu z výsledku skúšky, koeficient rozšírenia k=2.

Vyhlásenia a upozornenia:
Tento protokol môže byť reprodukovaný iba ako celok, časť protokolu len so súhlasom laboratória.
Uvedené výsledky sa týkajú len testovanej vzorky a nenahrádzajú schválenie skúšaného predmetu príslušným orgánom.
Ak vzorku dodal zákazník, laboratórium nie je zodpovedné za odber a stav prijatej vzorky - výsledky sa vzťahujú na vzorku, ako bola prijatá.
Laboratórium nezodpovedá za informácie poskytnuté zákazníkom, ktoré môžu mať vplyv na platnosť výsledkov.
Miesto výkonu skúšok (okrem terénnych a subdodávok) je totožné s adresou uvedenou v záhlaví.
Skúšobné zariadenia a meradlá boli kalibrované a overené v zmysle platných metrologických predpisov.
Reklamovať výsledky skúšok možno do 30 dní od dátumu ich odoslania zákazníkovi. Akceptované a vybavované sú iba písomne podané reklamácie.

Protokol dostane: CE Invest s.r.o.

Protokol o skúške vyhotovil: Mgr. Monika Dobošová, Vedúca LPMS

Schválil: Mgr. Monika Dobošová, Vedúca LPMS

Tel.: + 421 53 4424740, + 421 53 4192322 e-mail: elsro@elsro.sk www.elsro.sk

ANNEX II.

EL spol. s r.o.
Radlinského 17A, 052 01 Spišská Nová Ves
Akreditované skúšobné laboratóriá podľa ISO/IEC 17025: 2017

SNAS Reg. No. 038/S-025

Akreditácia sa nevzťahuje na skúšky typu N

Strana: 1 z 2
Výtlačok: 1 z 3

Protokol o skúške č.: 21/20894

Oprava k protokolu o skúške č.: 21/18654
Dôvod opravy: výpočtová chyba pri stanovení PCB vo vzorke 21-019921

Zákazník - objednávateľ skúšok

Objednávateľ: (meno a adresa)	CE Invest s.r.o. Záhradnícka 36, 82108 Bratislava	**Dátum prevzatia vzorky:**	10.09.2021
Odosielateľ:	CE Invest Bratislava	**Dátum vykonania skúšok od:**	10.09.2021
Zmluva / objednávka:	09/2021	**do:**	29.09.2021
Zákazka:	21-08418	**Dátum vydania protokolu:**	29.09.2021
Vzorku odobral:	Objednávateľ	**Počet vzoriek:**	4

Výsledky skúšok

P.č.: 1	Číslo vzorky: 21-019919	Typ vzorky: Tuhé materiály - poľnohospodárska pôda	Chemický rozbor

Označenie vzorky: **vzorka č.1**

Parameter	Jednotka	Výsledok skúšky	Neistota merania	Skúšobná metóda	Medza stanovenia	Metodický predpis	Typ skúšky
PCB suma kongenerov	mg/kg sušiny	**13.31**	18 %	GC/ECD	0.01	IP 4.8	A
PCB -28 (2,4,4´-trichlórbifenyl)	mg/kg sušiny	**0.7931**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -52 (2,2´,5,5´-tetrachlórbifenyl)	mg/kg sušiny	**0.7004**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -101 (2,2´,4,5,5´-pentachlórbifenyl)	mg/kg sušiny	**0.7004**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -118 (2,3´,4,4´,5-pentachlórbifenyl)	mg/kg sušiny	**0.5459**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -153 (2,2´,4,4´,5,5´-hexachlórbifenyl)	mg/kg sušiny	**2.3895**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -138 (2,2´,3,4,4´,5´-hexachlórbifenyl)	mg/kg sušiny	**3.4092**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -180 (2,2´,3,4,4´,5,5´-heptachlórbifenyl)	mg/kg sušiny	**4.7688**	18 %	GC/ECD	0.0012	IP 4.8	A

P.č.: 2	Číslo vzorky: 21-019920	Typ vzorky: Tuhé materiály - poľnohospodárska pôda	Chemický rozbor

Označenie vzorky: **vzorka č.2**

Parameter	Jednotka	Výsledok skúšky	Neistota merania	Skúšobná metóda	Medza stanovenia	Metodický predpis	Typ skúšky
PCB suma kongenerov	mg/kg sušiny	**8.48**	18 %	GC/ECD	0.01	IP 4.8	A
PCB -28 (2,4,4´-trichlórbifenyl)	mg/kg sušiny	**0.4316**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -52 (2,2´,5,5´-tetrachlórbifenyl)	mg/kg sušiny	**0.4007**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -101 (2,2´,4,5,5´-pentachlórbifenyl)	mg/kg sušiny	**0.4007**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -118 (2,3´,4,4´,5-pentachlórbifenyl)	mg/kg sušiny	**0.3391**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -153 (2,2´,4,4´,5,5´-hexachlórbifenyl)	mg/kg sušiny	**1.0275**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -138 (2,2´,3,4,4´,5´-hexachlórbifenyl)	mg/kg sušiny	**2.4661**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -180 (2,2´,3,4,4´,5,5´-heptachlórbifenyl)	mg/kg sušiny	**3.4114**	18 %	GC/ECD	0.0012	IP 4.8	A

Tel.: + 421 53 4424740, + 421 53 4192322 e-mail: elsro@elsro.sk www.elsro.sk

EL spol. s r.o.
Radlinského 17A, 052 01 Spišská Nová Ves
Akreditované skúšobné laboratóriá podľa ISO/IEC 17025: 2017

SNAS Reg. No. 038/S-025

Akreditácia sa nevzťahuje na skúšky typu N

Strana: 2 z 2
Výtlačok: 1 z 3

Protokol o skúške č.: 21/20894

P.č.: 3	Číslo vzorky: 21-019921	Typ vzorky: Tuhé materiály - poľnohospodárska pôda	Chemický rozbor

Označenie vzorky: vzorka č.3

Parameter	Jednotka	Výsledok skúšky	Neistota merania	Skúšobná metóda	Medza stanovenia	Metodický predpis	Typ skúšky
PCB suma kongenerov	mg/kg sušiny	**7.67**	18 %	GC/ECD	0.01	IP 4.8	A
PCB -28 (2,4,4´-trichlórbifenyl)	mg/kg sušiny	**0.5400**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -52 (2,2´,5,5´-tetrachlórbifenyl)	mg/kg sušiny	**0.4700**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -101 (2,2´,4,5,5´-pentachlórbifenyl)	mg/kg sušiny	**0.3600**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -118 (2,3´,4,4´,5-pentachlórbifenyl)	mg/kg sušiny	**0.4400**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -153 (2,2´,4,4´,5,5´-hexachlórbifenyl)	mg/kg sušiny	**1.1600**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -138 (2,2´,3,4,4´,5´-hexachlórbifenyl)	mg/kg sušiny	**1.7100**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -180 (2,2´,3,4,4´,5,5´-heptachlórbifenyl)	mg/kg sušiny	**2.9900**	18 %	GC/ECD	0.0012	IP 4.8	A

P.č.: 4	Číslo vzorky: 21-019922	Typ vzorky: Tuhé materiály - poľnohospodárska pôda	Chemický rozbor

Označenie vzorky: vzorka č.4

Parameter	Jednotka	Výsledok skúšky	Neistota merania	Skúšobná metóda	Medza stanovenia	Metodický predpis	Typ skúšky
PCB suma kongenerov	mg/kg sušiny	**16.28**	18 %	GC/ECD	0.01	IP 4.8	A
PCB -28 (2,4,4´-trichlórbifenyl)	mg/kg sušiny	**1.4924**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -52 (2,2´,5,5´-tetrachlórbifenyl)	mg/kg sušiny	**1.0498**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -101 (2,2´,4,5,5´-pentachlórbifenyl)	mg/kg sušiny	**1.0087**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -118 (2,3´,4,4´,5-pentachlórbifenyl)	mg/kg sušiny	**0.6793**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -153 (2,2´,4,4´,5,5´-hexachlórbifenyl)	mg/kg sušiny	**2.6245**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -138 (2,2´,3,4,4´,5´-hexachlórbifenyl)	mg/kg sušiny	**3.6641**	18 %	GC/ECD	0.0012	IP 4.8	A
PCB -180 (2,2´,3,4,4´,5,5´-heptachlórbifenyl)	mg/kg sušiny	**5.7637**	18 %	GC/ECD	0.0012	IP 4.8	A

Skúšobné metódy

Skratka	Názov metódy
GC/ECD	Plynová chromatografia s detektorom elektrónového záchytu

Použité skratky: **IP** – Interný predpis
Typ skúšky: **A** - akreditovaná, **N** - neakreditovaná, **T** - terénna, **S** - subdodávka (externá služba)
Neistota merania predstavuje relatívnu rozšírenú neistotu z výsledku skúšky, koeficient rozšírenia k=2.
Vyhlásenia a upozornenia:
Tento protokol môže byť reprodukovaný iba ako celok, časť protokolu len so súhlasom laboratória.
Uvedené výsledky sa týkajú len testovanej vzorky a nenahrádzajú schválenie skúšaného predmetu príslušným orgánom.
Ak vzorku dodal zákazník, laboratórium nie je zodpovedné za odber a stav prijatej vzorky - výsledky sa vzťahujú na vzorku, ako bola prijatá.
Laboratórium nezodpovedá za informácie poskytnuté zákazníkom, ktoré môžu mať vplyv na platnosť výsledkov.
Miesto výkonu skúšok (okrem terénnych a subdodávok) je totožné s adresou uvedenou v záhlaví.
Skúšobné zariadenia a meradlá boli kalibrované a overené v zmysle platných metrologických predpisov.
Reklamovať výsledky skúšok možno do 30 dní od dátumu ich odoslania zákazníkovi. Akceptované a vybavované sú iba písomne podané reklamácie.

Protokol dostane: CE Invest s.r.o.
Protokol o skúške vyhotovil: Ing. Juraj Hanuščin, Zástupca ved. LPMS
Schválil: Ing. Juraj Hanuščin, Zástupca ved. LPMS

Tel.: + 421 53 4424740, + 421 53 4192322 e-mail: elsro@elsro.sk www.elsro.sk