

## DEMONSTRACIJA INOVATIVNE TEHNOLOGIJE PRANJA S TOKSIČNIMI KOVINAMI MOČNO ONESNAŽENIH VRTNIH TAL

## DEMONSTRATION OF INNOVATIVE SOIL WASHING TECHNOLOGY FOR REMOVAL OF TOXIC METALS FROM HIGHLY CONTAMINATED GARDEN SOIL

### Poročilo za širšo javnost Layman`s Report

Projekt / Project: LIFE 12 ENV/SI/000969 LIFE ReSoil

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**Upravičenec koordinator / Coordinating Beneficiary**  
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## GLAVNI CILJI

Glavni cilj projekta je bil predstaviti inovativno, okoljsko in stroškovno učinkovito tehnologijo za remediacijo urabanih tal, onesnaženih s toksičnimi kovinami.

Cilji projekta so bili tudi:

- Načrtovanje in postavitve pilotnega remediacijskega objekta za demonstracijo predlagane tehnologije.
- Uspešna remediacija načrtovane količine onesnažene zemlje.
- Predstavitve projekta in inovativne tehnologije strokovni in splošni javnosti na lokalni in mednarodni ravni.

## MAIN GOALS

The primary goal of the project was to introduce an innovative, environmental and cost-effective technology for remediation of urban soil contaminated with toxic metals. The goals of the project were also:

- A design and construction of a pilot remediation plant for demonstration of the proposed technology.
- Successful remediation of the planned quantity of contaminated soil.
- Introduction of the project and innovative technology on local and international level, to professional and general public.

## GLAVNI REZULTATI

- Nadgradnja postopkov procesa, ki ponuja edinstveno, stroškovno učinkovito remediacijsko tehnologijo, ki ohranja funkcijo tal in je brez emisij.
- Izgradnja pilotnega remediacijskega objekta za demonstracijo tehnologije s kapaciteto obravnave 6 ton tal na dan.

## MAIN RESULTS

- Upgrade of an unique, cost-efficient, soil preserving and emission free soil remediation technology.
- Construction of a pilot remediation plant for demonstration of the technology with remediation capacity of 6 tons of soil per day.



- Uspešna remediacija onesnaženih tal.
- Postavitve demonstracijskega zelenjavnega vrta.
- Predstavitve projekta na domačih in mednarodnih dogodkih, organizacija dogodkov, kot so dan odprtih vrat, novinarska konferenca, predstavitve za šolske skupine, slavnostna otvoritev demonstracijskega objekta in organizacija mednarodne strokovne konference ob zaključku projekta.

- Successful remediation of contaminated soil.
- Constructed demonstration vegetable garden.
- Presentations of the project at domestic and international events, organization of events such as open days, a press conference, presentations for school groups, a grand opening of the demonstration plant and organization of an international expert closure conference of the LIFE ReSoil project.

Trajanje projekta: 1. julij 2013 – 31. december 2018 / Project duration: July 1<sup>st</sup> 2013 – December 31<sup>st</sup> 2018

Vrednost projekta / Project value: 2.256.709 €

Prispevek EU: 50 % končnih upravičenih stroškov projekta / EU contribution: 50 % of final project eligible costs



Evropska Komisija Finančni inštrument LIFE  
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Tla predstavljajo ključno sestavino ekosistema za obstoj človeka in so dragocen ter omejen vir. Pogosto so onesnažena s številnimi toksičnimi kovinami, svinec (Pb) pa je WHO razglasila za eno od kemikalij z največjim tveganjem za človeško zdravje. Vsaka izpostavljenost Pb velja za potencialno škodljivo, prag za škodljivost ni določen. Najbolj ogrožena skupina so otroci.

Svetovna populacija narašča in pomanjkanje obdelovalnih površin nas bo neizogibno prisililo v uporabo onesnaženih območij. Raziskava mest je pokazala, da onesnaženost urbanih tal s Pb povzroča velik problem za zdravje ljudi in lahko postane velika ovira pri kmetijski uporabi urbanih tal.

Problem onesnaženosti tal je mogoče rešiti le z učinkovitimi, stroškovno sprejemljivimi in trajnostnimi metodami remediacije, ki ohranjajo funkcijo tal za rast rastlin. Zaradi pomanjkanja primernih tehnologij, se očisti le majhen del s Pb onesnaženih tal.

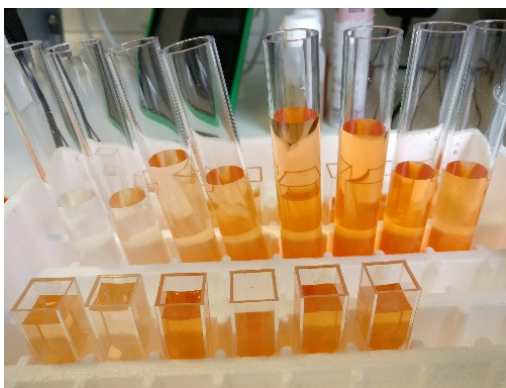
Metode odstranjevanja kovinskih ionov iz tal z uporabo učinkovitih kelatnih lingandov (kot je EDTA) so v zadnjih dveh desetletjih intenzivno razvijali po vsem svetu. Ostajala so nerešena vprašanja glede stroškovno učinkovite obdelave velikih količin procesnih raztopin, recikliranja in načina popolne odstranitve EDTA iz remediirane zemlje. Odgovore in učinkovite rešitve na ta vprašanja smo podali v okviru projekta ReSoil.

Soils are an omnipresent factor of human existence and a valuable, limited resource. They are often contaminated with a number of toxic metals, with lead (Pb) presenting the most pervasive and persistent risk to human health. Any exposure is considered to be potentially harmful, no threshold for adverse effects has been identified. Children are the most vulnerable group.

Human population is growing and the scarcity of soil resources will inevitably force us to cultivate on contaminated areas. The citywide study showed that Pb contamination of urban soils is raising a major human health concern that may become a major obstacle for the adoption of urban agriculture.

A solution for contamination problems is reclamation and re-use of metal contaminated land by effective, cost-efficient and sustainable (soil preserving) remediation methods. Only a fraction of Pb contaminated soils is treated due to the lack of efficient and environmentally sustainable technologies.

Soil washing with effective chelants (such as EDTA), was intensively studied for the last two decades by research groups worldwide. However, difficulties with cost-effective treatment of vast quantities of process solutions, absence of feasible EDTA recycling and removal of EDTA from remediated soil has been an unsolved problem. Answers and effective solutions to these questions are provided within the framework of ReSoil project.



## Obstoječe stanje

Izkop in odlaganje onesnaženih tal na odlagališča je najpogosteje uporabljena tehnologija (82-84% primerov), saj ponuja hiter način odstranjevanja vira onesnaženja. Evropske države čedalje bolj uveljavljajo zakonodajne omejitve za odlaganje onesnaženih tal na odlagališčih, saj le to ne predstavlja trajnostne rešitve.

V odgovor so raziskovalci pričeli z razvojem tako imenovanih nežnih remediacijskih metod, ki ohranjajo funkcionalnost tal in ne predstavljajo tveganja za okolje. Ena od možnosti je imobilizacija kovin z različnimi dodatki (fosfati, zeoliti, železo in železovi oksidi itd.), ki učinkovito zmanjšajo rastlinski privzem kovin, a ne odstranijo strupenih kovin in polkovin iz tal. Druga možnost je fitoekstrakcija ali odzvem kovin iz tal s pomočjo rastlin. Žal pa hiperakumulacija Pb, Cu, Co in Tl v rastline obstaja v veliki meri nepotrjena.

Soočamo se s pomanjkanjem ustreznih tehnologij remediacije tal, ki bi ustrezale okoljskim, ekonomskim in socialnim vidikom. Z zviševanjem cen za odlaganje onesnaženih tal na odlagališča, pa v zadnjem desetletju nove tehnologije remediacije tal postajajo konkurenčne.

## State of the Art

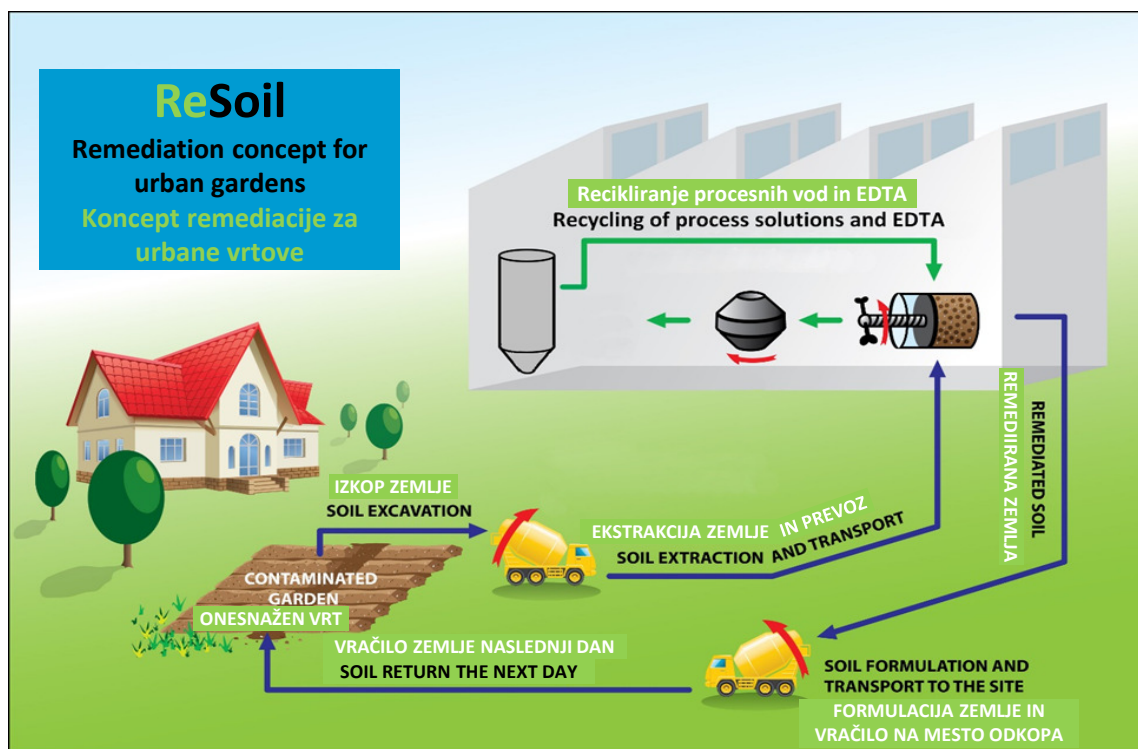
Historically, excavation to landfill has been the solution (82-84% of cases), offering a quick removal mechanism of a pollution source in the soil. Ever more the industrialized countries are implementing the legislature with heavy restrictions on landfill, because excavation with landfilling cannot be classified as a remediation technology.

In response, the concept of Gentle Remediation Options (GRO) has emerged. These are techniques that result in no gross reduction of soil functionality as well as risk management. For metal contaminated soils GRO comprises immobilization and phytoextraction. Up-to-date plant hyperaccumulation of Pb, Cu, Co and Tl remained largely unconfirmed. Immobilization by various additives (phosphates, zeolites, iron and iron oxides etc.) efficiently reduces metal plant uptake but does not remove toxic metals and metalloids from the soil.

Therefore, we are still facing a lack of appropriate technologies that would meet environmental, economic and social aspects of remediation. Landfill tax for contaminated soil has increased dramatically in the past decade and so made other technologies competitive.

ReSoil je *ex-situ* tehnologija pranja tal z EDTA.

ReSoil is an *ex-situ* EDTA-based soil-washing technology.



Tehnologija ReSoil je predstavljena v filmu:

ReSoil technology is presented in a movie:

**You Tube** „ENVIT Innovative soil washing technology“: <https://www.youtube.com/watch?v=r50LNFog-Hc>

## Procesni koraki

ReSoil je tehnologija s šaržnim procesom, ki vključuje izkop tal, transport do remediacijskega objekta, čiščenje tal in obdelavo procesnih raztopin po inovativnem postopku ter odlaganje očiščenih tal nazaj na mesto izkopa.

## Process steps

ReSoil is a batch-process technology where: soil is excavated and transported to remediation plant for remediation, treatment of process waters with an innovative process and remediated soil is returned to the excavation site.



### Pranje tal

Onesnažena tla se tretira z raztopino EDTA v mešalnem bobnu 12-18 ur.

### Soil Washing

Contaminated soil is washed with EDTA solution in a mixing vessel for 12-18 h.

### Ločevanje velikih delcev in spiranje

Večje talne delce se loči iz gošče tal z mokrim sejanjem.

### Oversized Material Separation

Oversized soil material is separated from the soil slurry by wet screening.

### Spiranje

Trdna faza tal se od pralne raztopine loči v filtrski stiskalnici. Oprana zemlja v filtrski stiskalnici se zaporedoma spira z recikriranimi procesnimi raztopinami iz predhodnih šarž in v končnem koraku s svežo vodo za izravnavo izgub vode. (patentirano)

### Rinsing

Solid phase is separated from the washing solution using a filter press. The washed soil is rinsed within a filter press with process waters generated & recycled from the previous batch and then with fresh water to compensate for water losses. (patented)

### Obdelava in recikliranje uporabljenih raztopin za pranje in spiranje (patentirano)

### Treatment and Recycling of the used Washing and Rinsing Solutions (patented)

### Oblikovanje talnih agregatov

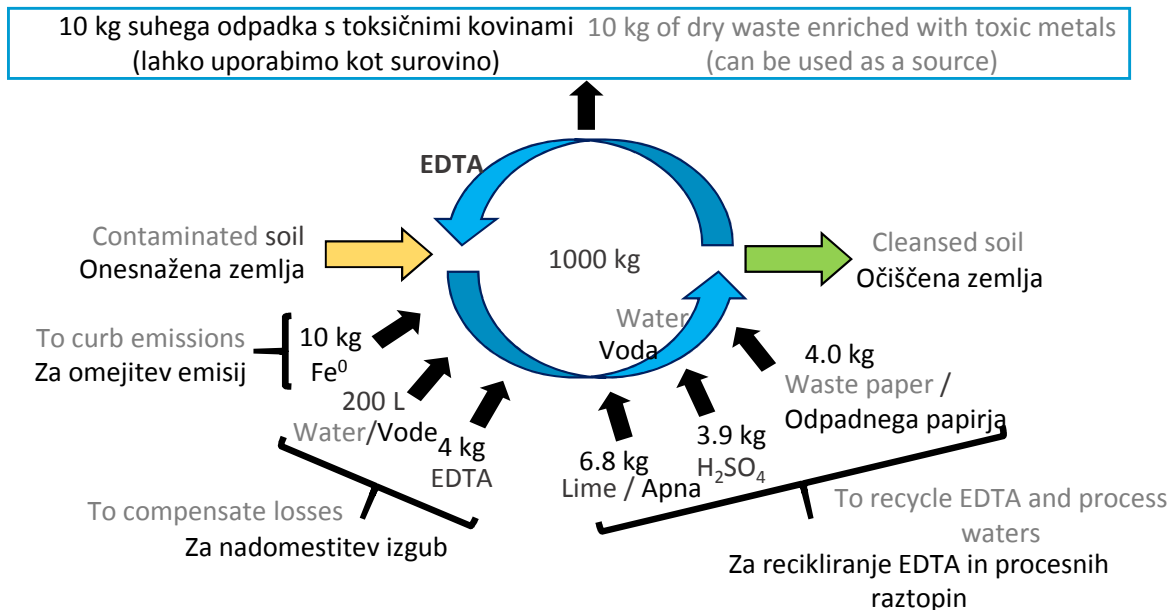
Trdna faza iz filtrske stiskalnice se zmelje do zrnate oblike talnih agregatov, ki se zmešajo z očiščeno in predhodno ločeno veliko frakcijo tal. Očiščena tla lahko obogatimo z dodatki.

### Formulation of soil aggregates

Solid phase from the filter press is milled to obtain artificial soil aggregate grains and mixed with the cleansed oversized soil fraction. The remediated soil can be amended with additives.

Za recikliranje procesnih raztopin in EDTA se uporablja cenovno dostopne in odpadne materiale: apno, odpadni polisaharidi, žveplena kislina. Večina materialov in EDTA se v procesu reciklirajo oz. večkrat uporabijo. Odstranjena onesnažila in uporabljeni materiali predstavljajo suhi odpadki (1 % teže remediirane zemlje), ki se lahko uporabi kot surovino.

For recycling of process waters and EDTA, inexpensive and waste materials as auxiliary agents are used: lime, waste polysaccharides, sulfuric acid. Most materials and EDTA are recycled or reused in the process. Removed pollutants and used materials present dry waste (1% weight of remediated soil) and can be used as a resource.



## ReSoil DEMONSTRACIJSKI OBJEKT

Objekt velikosti 580 m<sup>2</sup> se nahaja na Prevaljah, Mežiška dolina, Slovenija.

Pred začetkom delovanja demonstracijskega objekta so bila pridobljena naslednja uradna dovoljenja:

- Gradbeno dovoljenje,
- Okoljevarstveno dovoljenje za obdelavo odpadkov,
- Uporabno dovoljenje (2018).

Zmogljivost demonstracijskega objekta je 6 ton zemlje na dan, kar predstavlja količino, ki se odkoplje z 10 m<sup>2</sup> površine vrtnih tal.

## ReSoil DEMONSTRATION PLANT

A demonstration plant for the ReSoil technology in the size of 580 m<sup>2</sup> was constructed in Prevalje, Meža valley, Slovenia.

Before the beginning of operation of the demonstration plant, the following official authorizations were obtained:

- Construction permit,
- Environmental Protection permit for waste treatment,
- Operating permit (in 2018).

Capacity of the demonstration plant is 6 tons of soil per day, which represents an amount that is excavated from 10 m<sup>2</sup> of garden surface.



Procesno linijo za remediacijo tal sestavljajo kosi splošno uporabljene industrijske opreme, kot so filtrske stiskalnice, mešalni bobni, različni zalogovniki in transportni sistemi. Upravljanje procesa je avtomatizirano s sistemom SCADA.

The soil remediation process line consists commonly used industrial equipment, such as filter presses, mixing vessels, various storage units and transport systems. The process is automated through the SCADA program.

**Namen** postavitve demonstracijskega objekta je poleg predstavitve inovativne tehnologije tudi testiranje različnih vrst tal, nadaljnji razvoj tehnologije ter remediacija manjših akutnih območij.

**The aim** of the demonstration plant is in addition to presenting innovative technology also testing different types of soil, further development of technology and remediation of smaller acute areas.

# ReSoil DEMONSTRACIJSKI VRT

Demonstracijski vrt je namenjen predstavitvi vpliva ReSoil tehnologije na kakovost tal. Poskusi na demonstracijske vrtu so zasnovani tako, da se primerja rast rastlin na izvornih in remediiranih tleh. Demonstracijski vrt se nahaja v neposredni bližini demonstracijskega objekta in je vsem interesentom dostopen za ogled.

## Zasnova vrta

Vrt sestavlja 9 visokih gred, ki so napolnjene z onesnaženimi tlemi iz neposredne okolice in tlemi remediiranimi po postopku ReSoil. Obravnavana tla izhajajo iz neposredne okolice vrta in so zaradi poplavljanja reke Meže, ki je za seboj odlagala onesnažene rečne sedimente, onesnažena v povprečju z 1.734 mg/kg Pb, 3.313 mg/kg Zn in 24 mg/kg Cd.



# ReSoil DEMONSTRATION GARDEN

A demonstration garden was designed in order to demonstrate the impact of ReSoil technology on soil quality. Experiments at the demonstration garden were designed to compare plant growth on original and remediated soil. The demonstration garden is located in the immediate vicinity of the Demonstration plant and is accessible to interested visitors.

## Design of the Garden

The garden consists of 9 raised beds filled with originally contaminated soil and ReSoil remediated soil. The soil was from the immediate surroundings of the garden and, due to the flooding of the Meža river, which deposited contaminated river sediments, it was contaminated with an average of 1734 mg/kg Pb, 3313 mg/kg Zn and 24 mg/kg Cd.

## ReSoil ohranja tla kot substrat za rastline

S tehnologijo ReSoil remediirana tla v celoti ohranjajo kakovost tal in zagotavljajo ekosistemske storitve vključno z varno pridelavo hrane.

Testiranje kakovosti tal po remediaciji je bilo izvedeno v sodelovanju z Univerzo v Ljubljani v okviru raziskovalnega projekta (ARRS J4 – 8219):

- ✓ Nezkatne spremembe kemijskih lastnosti (pH, organska snov, vsebnost N, P, Fe, Ca) remediiranih tal.
- ✓ Manjše spremembe v teksturi tal in talno-vodnih lastnostih (predvsem zaradi izgube strukture tal in razpada agregatov melja v glinene frakcije).
- ✓ Prehodne spremembe bioloških lastnosti tal (encimska aktivnost v tleh, številčnost in struktura mikrobnih populacij).
- ✓ Ni vpliva na stopnjo mineralizacije organskega materiala.
- ✓ Odsotni ali manjši (prehodni) vplivi remediacije na vidno rast rastlin, biomaso in fiziološke procese (fotosinteza, prevodnost in evapotranspiracija).
- ✓ Koncentracija Pb v užitnih delih rastlin se je znatno zmanjšala, pod zakonodajno mejno vrednostjo.



## ReSoil preserves soil as a plant substrate

ReSoil remediated soil possess fully restored soil quality and provide ecosystem services including safe food production.

Quality of the soil after remediation was intensively observed in cooperation with University of Ljubljana within a research project (ARRS J4 – 8219):

- ✓ Insignificant changes in chemical properties (pH, soil organic matter, soil N, P, Fe, Ca content) of remediated soil.
- ✓ Minor changes in soil texture and soil-water properties (mainly due to loss of soil structure and disaggregation of soil silt into clayish fractions).
- ✓ Transitional changes in soil biological properties (soil enzyme activities, microbial abundance and structure of population).
- ✓ No effect on the rate of mineralization of organic material.
- ✓ No or minor (and transitional) effects of remediation on visual plant growth, biomass, and physiological processes (photosynthesis, stomatal conductance and evapotranspiration of water).
- ✓ Concentration of Pb in edible parts of vegetables cultivated on remediated soil was significantly reduced, below the threshold value of legislation.

## Uporaba demonstracijskega vrta

Demonstracijski vrt redno obiskujejo skupine izobraževalnih ustanov (šole, fakultete,...) in drugi zainteresirani obiskovalci.

Univerza v Ljubljani demonstracijski vrt uporablja za raziskave in na njem izvaja znanstvene poskuse.



## The use of demonstration garden

The demonstration garden is regularly visited by groups from educational institutions (schools, faculties ...) and other interested visitors.

Demonstration garden is used for research and scientific experiments by University of Ljubljana.

# UČINKOVITOST REMEDIACIJE

# REMIATION EFFICIENCY

Testiranja učinkovitosti uporabe tehnologije ReSoil, na različnih s Pb in ostalimi potencialno toksičnimi elementi močno onesnaženih tleh, so potrdila primernost ReSoil tehnologije za različne vrste tal.

Testing the efficiency of ReSoil technology on different soils, heavily contaminated with Pb and other potentially toxic elements, confirmed that the ReSoil technology is suitable for different soil types.

Lokacija <i>Location</i>	Vrsta tal <i>Soil type</i>	Učinkovitost metode ReSoil <i>ReSoil efficiency</i>		
		Originalna tla <i>Original Soil</i>	Odstranjen Pb (%) <i>Pb removal (%)</i>	Manjša biodosegljivost Pb <i>Less bioaccessible Pb</i>
Pribram, CZ	Kisla / <i>Acidic</i>	930	71	8,1 krat / <i>8.1 times</i>
Arnoldstein, AT	Kisla / <i>Acidic</i>	870	78	7,7 krat / <i>7.7 times</i>
Meza Valley, SL	Karbonatna / <i>Calcerous</i>	1030	68	5,0 krat / <i>5.0 times</i>

Rastline, ki so uspevale na remediiranih tleh, so vsebovale 5 do 14-krat manj Pb in 4 do 8-krat manj Cd kot rastline na onesnaženih tleh. Glede na zakonodajo\* je bila izmerjena koncentracija Pb in Cd v proučevanih rastlinah, ki so zrastle na očiščenih tleh, pod mejno vrednostjo. Vsebnost Pb in Cd v rastlinah, ki so rastle na onesnaženih tleh, so imele preseženo mejno vrednost za obe kovini. Zaključki raziskav so potrdili, da je pridelava zelenjave na očiščenih tleh, za razliko od zelenjave pridelane na onesnaženih tleh, varna. Te rezultate so potrdile tudi ekstrakcijske metode določanja dosegljivosti onesnažil.



**Povzetek rezultatov poskusov na demonstracijskem vrtu.**  
*Summary of experiments on demonstration garden.*

*\*Uredba Komisije 1881/2006/ES, 2015/1005, 488/2014 o določitvi mejnih vrednosti nekaterih onesnaževal v živilih*

*\*\*Commission Regulation 1881/2006/EC, 2015/1005, 488/2014, setting maximum levels for certain contaminants in foodstuffs*

Uptake of heavy metals in plants grown on remediated soil was 5 to 14-times and 4 to 8-times lower for Pb and Cd, respectively. According to the legislation\*\*, the concentration of Pb and Cd in plants grown on remediated soil, were below the limit values. The concentration of Pb and Cd in plants grown on contaminated soil exceeded the limit value for both metals. The results of the research have confirmed safe vegetable production on remediated soil. Results were also confirmed by laboratory extraction methods for determination of bioavailability of pollutants in soil.

## UPORABNOST TEHNOLOGIJE ReSoil

## USABILITY OF ReSoil TECHNOLOGY

Uporabniki tehnologije ali lastniki remediacijskih objektov lahko remediirajo onesnažena tla:

- Strelišč in drugih vojaških aktivnosti,
- urbanih območij (otroška igrišča, parkovne površine, urbani vrtovi...),
- industrijskih in drugih degradiranih površin.



Users of the technology and/or owners of remediation facilities can remediate soil for:

- The military (shooting-grounds),
- Urban areas (kindergartens, school, children playgrounds, urban gardens,..),
- Industrial and other brownfields.

Prepričani smo, da je ReSoil tehnologija najboljša razpoložljiva tehnologija za tla:

- Z visoko onesnaženostjo s svincem in drugimi kovinami,
- Onesnaženimi s kovinami in polkovinami in/ali organskimi snovmi,
- visoke vrednosti (urbana tla, tla s potencialom za pridelavo hrane).

Trenutno ne obstaja nobena druga učinkovita in trajnostna (ohranjanje tal) tehnologija za tla, onesnažena predvsem s Pb. Tehnologija ReSoil kaže velik tržni potencial za reševanje tehnološko trenutno nerešljivih problemov na globalnem in rastočem trgu remediacije tal.

We believe ReSoil technology is Best Available Technology for soils with:

- high contamination of lead and other metals,
- dual contamination of metals and metalloids and/or organics,
- high-value (urban soil, food growth potential).

There is no other effective and sustainable (soil preserving) remediation technology for soils contaminated primarily with Pb. ReSoil technology shows great market potential for solving technologically currently insoluble problems on global and growing soil remediation market.

Tehnologija ReSoil je:

- tehnologija pranja tal na osnovi EDTA z inovativno tehnologijo recikliranja EDTA in procesnih raztopin v zaprti zanki, kar preprečuje nastajanje tekočih odpadkov;
- učinkovita, okolju prijazna, stroškovno učinkovita in hitra (čas za dokončanje remediacije) tehnologija, ki ohranja tla;
- edina razpoložljiva možnost remediacije, ki učinkovito odstranjuje Pb in druge toksične kovine iz onesnaženih tal in ohranja zemljo kot naravni vir.



Inovativni vidiki in edinstvenost:

- ✓ Do 95 % Pb in drugih kovin (t.j. Zn, Cd, Cu) se odstrani iz karbonatnih in kislih tal.
- ✓ Recikliranje EDTA in procesnih raztopin s poceni in odpadnimi materiali kot reagenti: apno, odpadni polisaharidi,  $H_2SO_4$  (**patentirano**). EDTA se reciklira pretežno v zemlji prijazni obliki Ca-EDTA.
- ✓ Obratovanje v zaprti zanki omogoča učinkovito pranje in spiranje tal brez nastajanja odpadnih tekočin (**patentirano**).
- ✓ Nastaja le trdni odpadki: do 1.1%.
- ✓ Brez emisij.
- ✓ Uporablja nič-valentno Fe ( $Fe^0$ ) za preprečevanje izpiranja EDTA and EDTA kelatov s toksičnimi kovinami iz remediiranih tal (**patentirano**) ter za učinkovito imobilizacijo sočasnih, na EDTA odpornih onesnaževal, kot je As.
- ✓ Trajnostna tehnologija, saj ohranja tla kot funkcionalni naravni vir. Remediirana tla imajo v celoti obnovljeno kakovost in zagotavljajo ekosistemske storitve, vključno z varno proizvodnjo hrane.
- ✓ Nizki stroški obratovanja in remediacije.

ReSoil technology is:

- EDTA-based soil-washing technology with innovative technology for EDTA and process waters recycling in closed-loop and thus ensuring generation of no liquid wastes;
- effective, environmentally safe, cost-effective, soil preserving and fast (time to complete remediation) technology;
- the single available remediation option which efficiently removes Pb and other toxic metals from contaminated soils and preserves soil as a natural resource.



Innovative aspects and uniqueness:

- ✓ Up to 95 % of Pb and co-contaminating metals (i.e. Zn, Cd, Cu) are removed from contaminated calcareous and acidic soils.
- ✓ Recycles EDTA and process waters using inexpensive and waste materials as auxiliary reagents: lime, waste polysaccharides,  $H_2SO_4$  (**patented**). EDTA is recycled mainly in soil-friendly Ca-EDTA form.
- ✓ Closed-loop operation ensures for effective soil washing and rinsing, no liquid wastes are generated (**patented**).
- ✓ Produces only solid wastes: up to 1.1%.
- ✓ Produces no emissions.
- ✓ Uses zero-valent Fe ( $Fe^0$ ) to prevent leaching of EDTA and EDTA chelates with toxic metals from remediated soil (**patented**) and for effective immobilization of EDTA-resistant co-contaminants, such as Aa.
- ✓ Sustainable technology. Preserves remediated soil as a functional natural resource. Remediated soil possess fully restored soil quality and provides ecosystem services including safe food production.
- ✓ Low operation and remediation cost.

Koordinator projekta

Project coordinator

**ENVIT d.o.o.**

okoljske tehnologije in inženiring

Spopadanje s problematiko onesnaženosti tal z ekološkega, socialnega in ekonomskega vidika.

- Najboljše start up podjetje v Sloveniji 2010.
- Več kot 20 let raziskav v sodelovanju s tujimi raziskovalnim skupinami.
- "Spin out" podjetje Univerze v Ljubljani, Slovenija.
- Svetovanje, ocena tveganja, študija izvedljivosti, izdelava načrta in izvedba remediacije.

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[www.envit.si](http://www.envit.si); [www.liferesoil.envit.si](http://www.liferesoil.envit.si)

Tackling the problem of soil contamination from an ecological, social and economic point of view.

- The best start up company in Slovenia 2010.
- More than 20-years of research by many groups worldwide.
- A "spin out" company from University of Ljubljana, Slovenia.
- Consulting, risk assessment, feasibility study, preparation of the plan and implementation of remediation.

Kolofon/Colophon:

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