



# ENVIT

environmental technologies and engineering

## ENVIT's advanced **soil washing technology**

Have you heard of cost effective soil remediation technology that can remove inorganic, including lead, and organic pollutants and enables full soil functioning as a natural plant substrate after soil washing?



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

## How?

### How does soil washing work?

Soil washing is a treatment process where contaminants are removed from the soil by aqueous chemicals and recovered from solution. ENVIT developed cost effective and environmentally friendly soil washing technology that enables the use of chelating agent ethylenediamine tetraacetate (EDTA) for extraction of pollutants with no negative environmental impact.

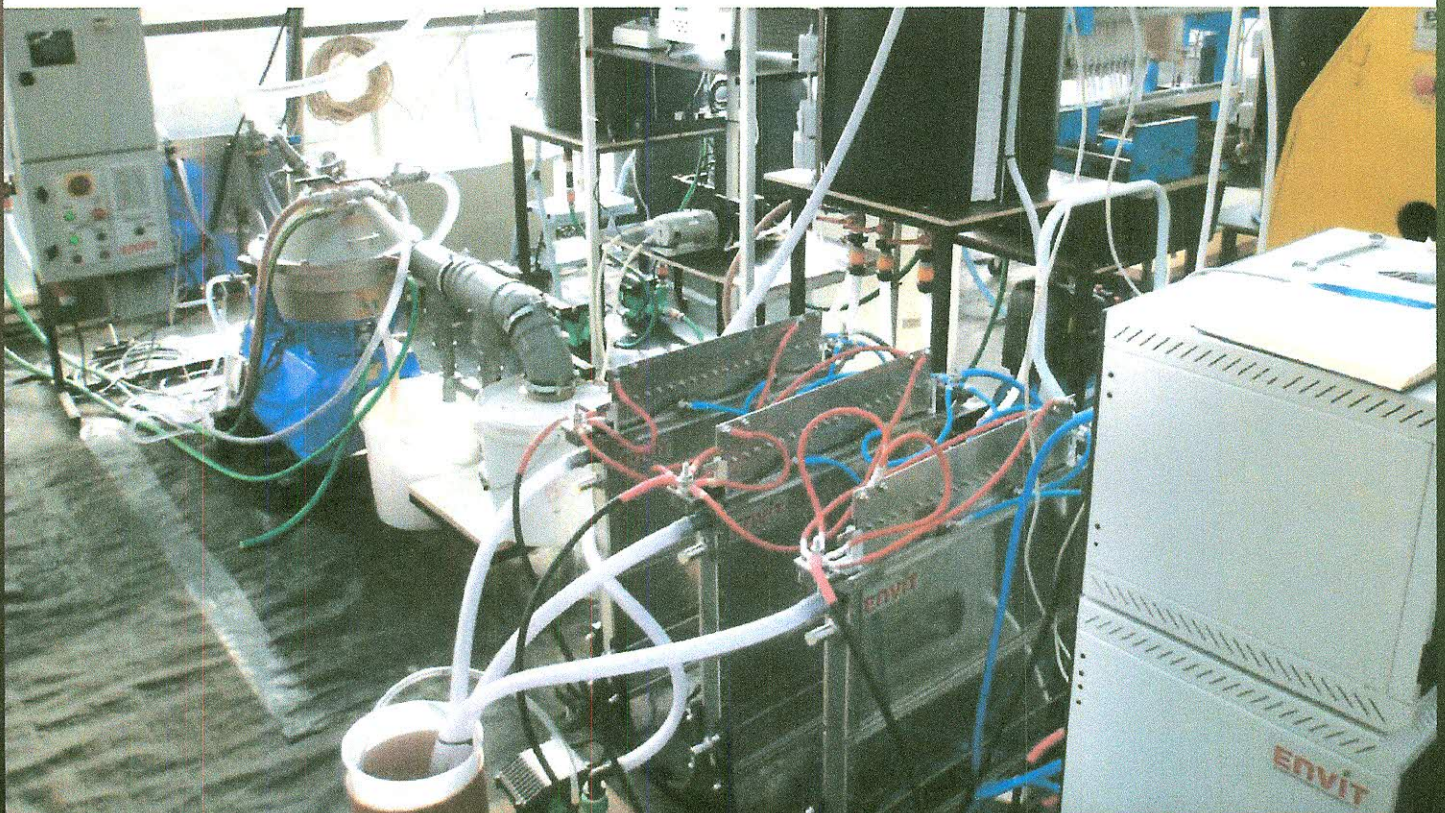
Extraction with EDTA is for most types of contaminated soils and sediments the most efficient remediation technique for toxic metal removal. EDTA desorbs toxic metals from soil solid phases by forming strong and water soluble metal-chelant complexes. Following an initial screening of the excavated soil to remove the surface debris, the soil is extracted or leached with the EDTA solution, separated by filtration and then returned to the site. Used washing solution is innovatively treated with along pH gradient and using electrochemical methods, to remove contaminants and recycle EDTA and process water in a closed process loop.

Remediated soil is used on site as a substrate for plant growth. The pollutants containing sludge (less than 5 % of income soil) is stabilized and transformed to non-hazardous waste and removed to landfill. Alternative treatment options for this material are also available.

## Facts!

### Facts about ENVIT's soil washing technology

- Removes lead and other metals from fertile and organically rich garden soils.
- Environmentally friendly.
- Cost effective.
- Enables remediation of dually (metals and organic pollutants) contaminated soils.
- Remediated soils can be used for vegetable production.
- Especially effective for soils with high organic content and developed on carbonate parent material.
- Recycles EDTA.
- The innovation aspects of our technology relate to the treatment of a large volume of waste solutions which are generated during soil washing.
- Socially acceptable.
- Available for demonstration – field tested.
- Patented.



# Advantages

## Advantages of ENVIT's soil washing technology

### Removes inorganic and organic pollutants from soil

ENVIT's soil washing technology can remove a wide variety of chemical contaminants from soils. Technology can also be used for washing of dually contaminated soils using EDTA and organic solvents or surfactants.



### Cost effective

Cost of the technology is reduced due to EDTA recycling and low energy consumption due chemical removal of metals from washing solution before electrochemical treatment. Also, money is saved due to low transport needs for substitute material (compared to disposal on landfills).

### Environmental benefits

The volume of contaminated material that needs transport to landfill is greatly reduced, saving valuable landfill space and heavy traffic emissions. Remediated soils can be used on site as a plant substrate, which leads to a significant saving in imported materials to replace the normally landfilled material. ENVIT's soil washing technology is especially suitable for use in sensitive developed areas (such as residential areas) and can often reduce the overall impact associated with remediation of a site (such as noise and dust issues).

### Extensively tested

Electrochemical recovery and reuse of EDTA and process water from the spent solutions, as novelities in soil remediation technology, were extensively tested for process robustness. Once again electrochemical methods were proven as a simple and efficient, characterized by a compact size of the equipment, simplicity of operation, and low capital and operating costs. Other parts of our remediation technology use conventional equipment.

### Permanent and sustainable remediation effect

Soil washing permanently removes pollutants from the soil. Further mobilization of pollutants to environment is thus limited.

The functioning of remediated soil can be improved during the process by amending the soil with nutrients, stabilizers, water retainers, microbial inocula or other beneficial additives.

The capacity of remediation plant can be adjusted to specific sites. For remediation of large areas longer periods are also foreseen. Remediation plant is positioned in community in similar ways like water treatment plants.



## Case study

### INNOVATIVE EDTA BASED SOIL WASHING TECHNOLOGY developed by ENVIT Ltd.

#### Technology and pilot scale treatment plant

A novel remediation technology based on soil washing with ethylenediamine tetraacetic acid (EDTA) was tested in pilot scale. Lead, zinc and cadmium contaminated soil was extracted with EDTA solution (ratio 1:1-2) in a drum washer. Gravel sized particles were separated and process solution removed from soil in filter press. Generated waste solution was treated with along pH gradient and using electro-chemical methods, to remove contaminants and recycle EDTA and process water. The innovative technology was tested in a treatment plant with capacity of 150 kg per day and the trial was carried out on 2 tonnes of soil.

#### Results

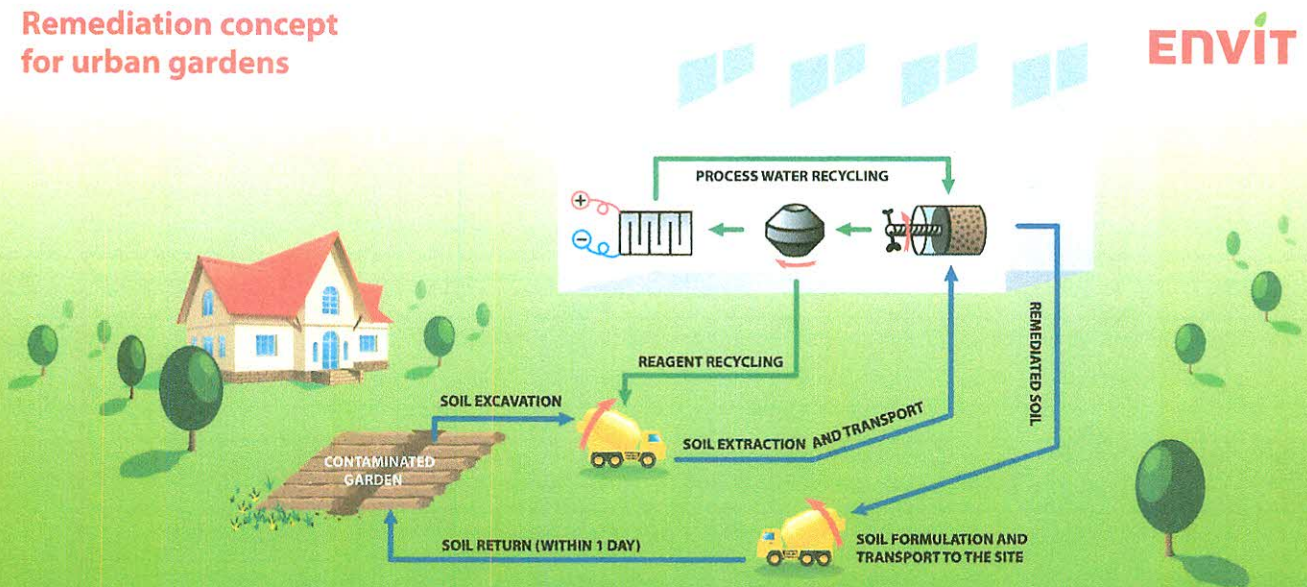
Technology was tested on urban garden soils from industrial area polluted due to air deposition from lead and zinc smelter. Soils were rich on organic matter and were developed on carbonate parent material. Table 1 provides the data for chemical analyses for total metal content in soil and reduction of metal leachability and bio-accessibility/availability assessed with different methods before and after remediation.

Table 1: Chemical analyses of soil before and after remediation.

Parameter	Contaminant removal		Leachability and bio-accessibility/availability assessment			
	Original soil (mg/kg)	Remediated soil (mg/kg)	Reduction in H2O extraction (%)	Reduction in TCLP extraction (%)	Reduction in DTPA extraction (%)	Reduction in PBET (intestine) reduction (%)
Pb	2133	320	36	29	79	54
Zn	869	378	34	18	80	46
Cd	14	2.1	70	41	64	56

Only 15% of lead and cadmium remained in the soil after soil washing with 60 mol of EDTA per tonn of soil. The pollutants containing sludge presents 2-5 % of income soil mass and was stabilized and deposited as a non-hazardous material. Efficiency of recycled EDTA for potential toxic elements removal is 100 % of original used.

#### Remediation concept for urban gardens



## Case study

ENVIT

### Costs

The fixed costs for a full-scale soil washing treatment of these soils were estimated at 20-25 EUR/tonne and include reagents, electricity and cost for stabilization and disposal of pollutants containing sludge. These costs exclude costs such as mobilization, amortization of treatment plant and cost of personnel.

### Environmental impact

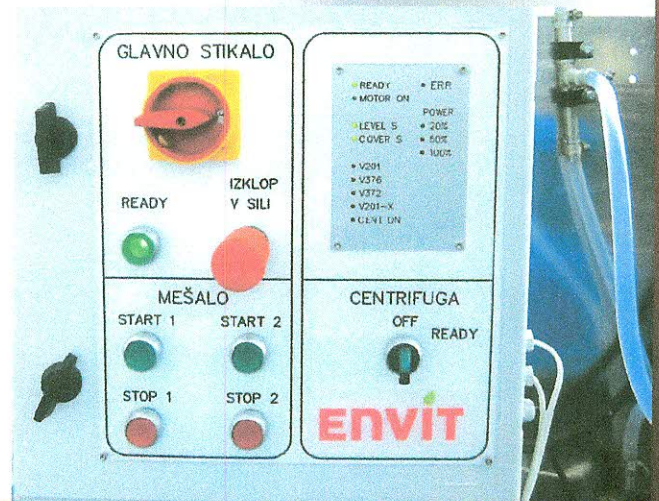
In the contrast with known soil washing technologies, ENVIT's technology does not require large volumes of water. All the water used in the process is recycled and used in the next batch. Only small amounts of water needs to be added and are mainly lost by evaporation. All the process is held in a closed process loop and enables emission and any negative impact on the environment.

Leachability and bio-availability of pollutants residuals in soil were assessed by various laboratory methods and resulted in significant lower values compared to non-treated soil. Results are present in Table 1. Uptakes into different vegetable species were also assessed.

ENVIT's technology is "soil gentle" and enables full soil functioning as a natural plant substrate.

### State of the art

Technology has been successfully tested in pilot scale for its feasibility and is ready to be applied on large scale. Contaminated soils are sought to undergo laboratory tests to assess effectiveness of ENVIT's technology.



### SOIL POLLUTION IS OUR CONCERN

Incorporated in January 2010, ENVIT was formed to develop and commercialize new soil washing technology. For our research and development, chemical engineers, biologists, agronomists and electro engineers cooperate closely with universities to ensure we have access to all the relevant techniques and expertise. The commercial potential and the environmental benefits for ENVIT's revolutionary process call for rapid growth. ENVIT is always on the lookout for strategic partners who are prepared to invest in innovative soil washing technology.

ENVIT has become a successful developer of innovative and sustainable environmental technologies, with final aim to lower negative impacts of pollution on environment. For our clients we develop cost effective soil, sediment and water remediation technologies.

The company ENVIT uses a holistic approach by integrating engineering, ecology, social awareness and economy in the pursue to find the most suitable solution for each polluted site or medium.

**We are the only company offering sustainable chelating agent (EDTA) based soil washing.**

### OUR COMPETENCE

#### Remediation technologies for metal contaminated soils and sediments:

- Laboratory and pilot scale feasibility tests for soil and sediment remediation technologies.
- Ex situ washing (leaching, extraction) of soils or sediments using EDTA and organic solvents or surfactants as pollutants chelating agents.
- Immobilization of contaminants within the soil or sediments using inorganic amendments.
- Soil or sediment solidification/stabilization (S/S) using hydraulic binders.
- Metal phytoextraction.

#### Risk assessment and metal availability assays:

- On site monitoring for metal and organic contamination.
- In vivo assays of metal bio-accessibility in soils and sediment using animal and plant bio-indicators.
- Chemical extraction tests for metal fractionation, phyto- and bio-accessibility in soils and sediments.

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